MISSION INNOVATION SOLUTION FRAMEWORK



Framework for Assessing Avoided Emissions

Accelerating innovation and disruptive low- and zero-carbon solutions

Full Report

Methodology Framework for low carbon solutions











Framework for Assessing Avoided Emissions version 2018-1

Accelerating innovation and disruptive low- and zero-carbon solutions

Part 1 A three-step approach to support and assess low-carbon solutions

Introducing a three-step model for the use of avoided emissions to accelerate the uptake of disruptive solutions for tackling climate change

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Framework for Assessing Avoided Emissions

Accelerating innovation and disruptive low- and zero-carbon solutions

Part 1

A three-step approach to support and assess low-carbon solutions











Framework for Assessing Avoided Emissions

Accelerating innovation and disruptive low- and zero-carbon solutions

A three-step approach to support and assess low-carbon solutions version 2018-1

How calculating avoided greenhouse gas emissions can accelerate the transition to a low-carbon economy

Introducing a three-step model for the use of avoided emissions to accelerate the uptake of disruptive solutions for tackling climate change

The Research Institutes of Sweden (RISE), together with the Swedish Energy Authority and the Carbon Trust have – alongside other partners – developed a new framework approach and methodology for assessing avoided greenhouse gas emissions. This work forms part of the activities in the global Mission Innovation initiative's Action Plan for 2018-2020, which aims to accelerate the development of innovative solutions that can help tackle climate change.

The purpose of this work is to better identify and support solutions (including technologies, products, services and business models) that enable us to do things in a different way to today, and which result in significantly lower greenhouse gas emissions than would occur under a business-as-usual scenario. Examples include the use of teleconferencing to displace business travel, replacing a motor with a more efficient alternative, or offering an advisory service to help customers reduce emissions.

Businesses, investors, governments and legislators are today familiar with the commonly-used and generally accepted approaches and methodologies for measuring the greenhouse gas emissions associated with organisations, products, services, and other activities. Effective use of these measurement tools allows for reductions in emissions to be readily tracked from a baseline, supporting better target setting and risk management, identifying cost reduction opportunities and supporting good policymaking.

However, there has been far less consistency around measuring the impact of solutions that can help to avoid emissions. The approach and methodology outlined in this document has therefore been developed to provide a robust and coherent way to measure, assess, and compare the current and potential impact of solutions that help reduce greenhouse gas emissions. It is hoped that this will support greater levels of innovation, as well as unlocking growth and new revenue opportunities for the solutions that will be necessary in addressing the challenge of climate change and achieving the ambitions of the Paris Agreement.

1. Background

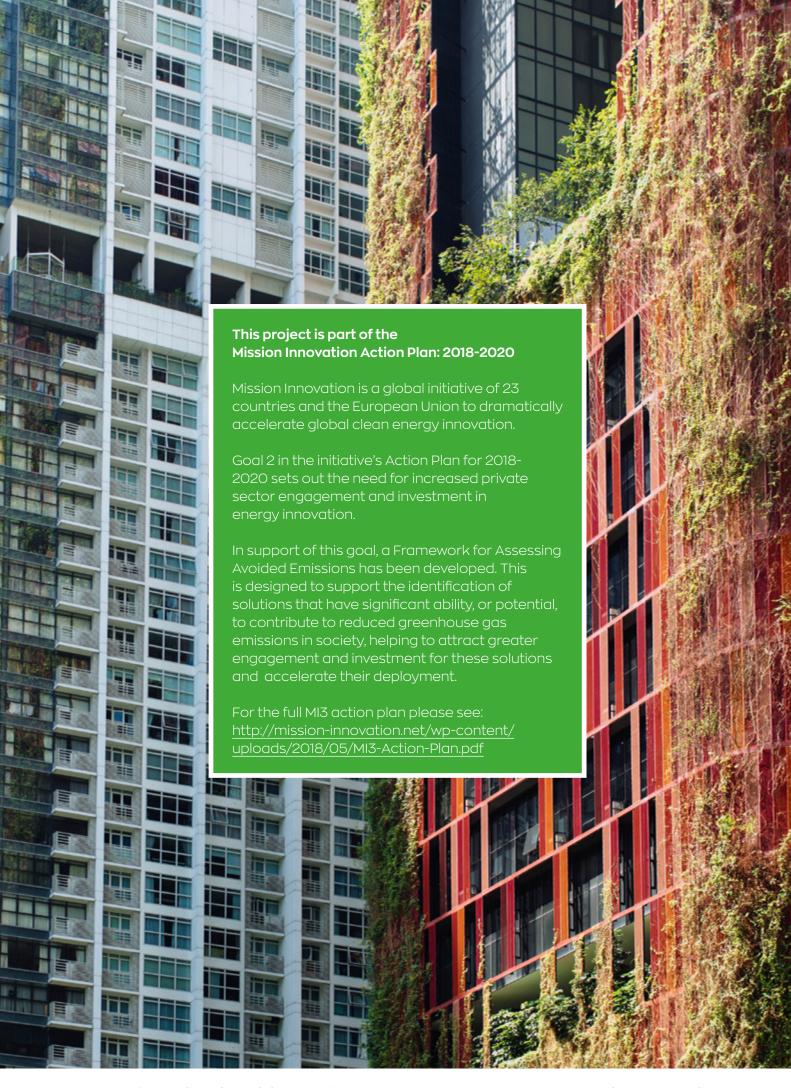
The Paris Agreement contains an internationally-agreed ambition to keep "global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius". Achieving this goal will prevent some of the most severe impacts of dangerous climate change that result in serious negative consequences for society, the economy and the natural environment.¹

However, the best available science tells us that current levels of action to reduce greenhouse gas emissions fall a long way short of what is needed. Even if fully achieved, the nationally-determined contributions put forward by countries suggest a likelihood that we will see a temperature rise of more than 3 °C this century compared with preindustrial levels, with a more than 67% probability. And perhaps even more alarming, a 8-10°C with more than 1% probability.²

To deliver the dramatic emissions reductions that are needed, will require more than a business-as-usual approach where companies only focus on reducing their existing emissions. It will require new approaches driven by companies delivering innovative and disruptive solutions that will bring about significant changes in societal behaviour and overall reductions in emissions. It is therefore important to make sure that we can deliver the necessary reductions through a low energy demand scenario.³ This is especially true if CCS will become too expensive or if it will only work in limited areas, something that even reports about CCS now begin to recognise.⁴

Many of the most significant emissions reductions today have been made possible by companies delivering solutions, not simply reducing their own emissions. Examples such as renewable energy, electric cars, dematerialisation, virtual meetings, etc. have been driven by companies providing solutions rather than by reducing their own emissions. The Fourth Industrial Revolution (connectivity, new materials, and new business models) provides ample examples of opportunities that could radically reduce the emissions by delivering much smarter solutions for mobility (including virtual mobility), building/spaces (including virtual spaces) and nutrition (especially when linked to health and wellbeing).

Given the importance of these solutions, it might come as a surprise that no generally-agreed framework or measurement methodology exists to calculate their impact on society. Current frameworks and tools for tracking emissions – such as those provided under the Global Reporting Initiative or Greenhouse Gas Protocol – use an accounting approach that allows organisations to track their own emissions. So when companies, cities and financial institutions today talk about their contributions on climate change, typically focus is put on their own reductions, rather than quantifying how their products and services lead to reductions in society.



1. Background

'We have unprecedented agreement to move towards resilient and sustainable development powered by low-emission energy. We have unprecedented consensus on the path forward. And we have unprecedented political will to move forward together.

[...]

We have a path forward

- towards sustainable
development that is good for
the planet and for the wellbeing
of every woman, man and child.
And towards a world where
average global temperature rise
is held to as close to 1.5 degrees
as possible.

This path implies a deep transformation of societies, of how we grow and develop.

[...]

In spite of the overwhelming evidence – both social and scientific – of the need to act, we will no doubt face challenges and skepticism. Deep transformation is not easy.'

Patricia Espinosc

Executive Secretary of the UN Framework
Convention on Climate Change
UN Summer Academy
August 2017
https://unfccc.int/news/internationalagreements-must-drive-deep-transformationof-societies

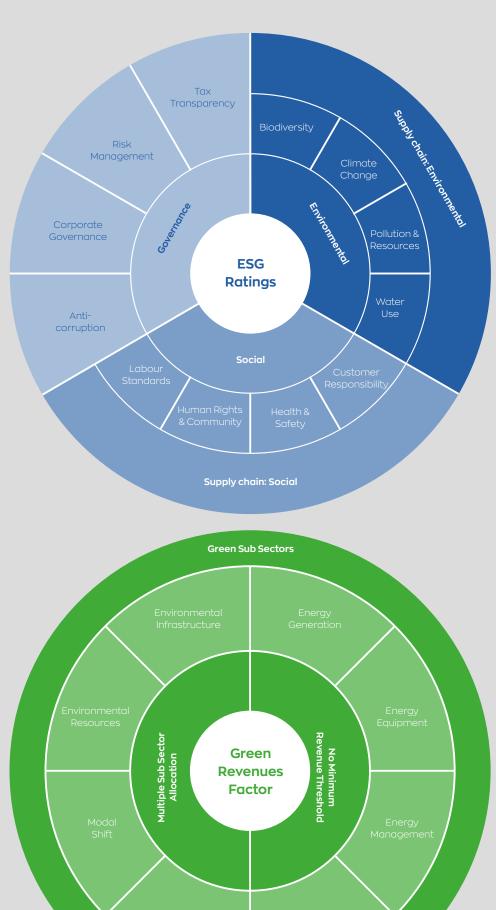
It could be argued that the mindset encouraged by this organisational-level accounting approach leads to a greater focus on efficiency, cost reduction and risk mitigation within existing systems. But these efforts come with an opportunity cost. A focus on doing less bad, rather than doing good, could potentially be holding back the development or accelerated deployment of solutions that have a greater impact on reducing emissions across society.

Understanding that many opportunities exist is not the same as saying that companies' own emissions are unimportant. We will only reach a zero-carbon society if all emissions are brought down to zero. However, rapid reductions in emissions require innovative solutions, and this requires an approach which can assess the impact of the avoided emissions from these solutions. This framework aims to provide a structure within which avoided emissions can be assessed and included into the strategies for overall emissions reductions and decarbonisation. It builds on existing practice and initiatives.

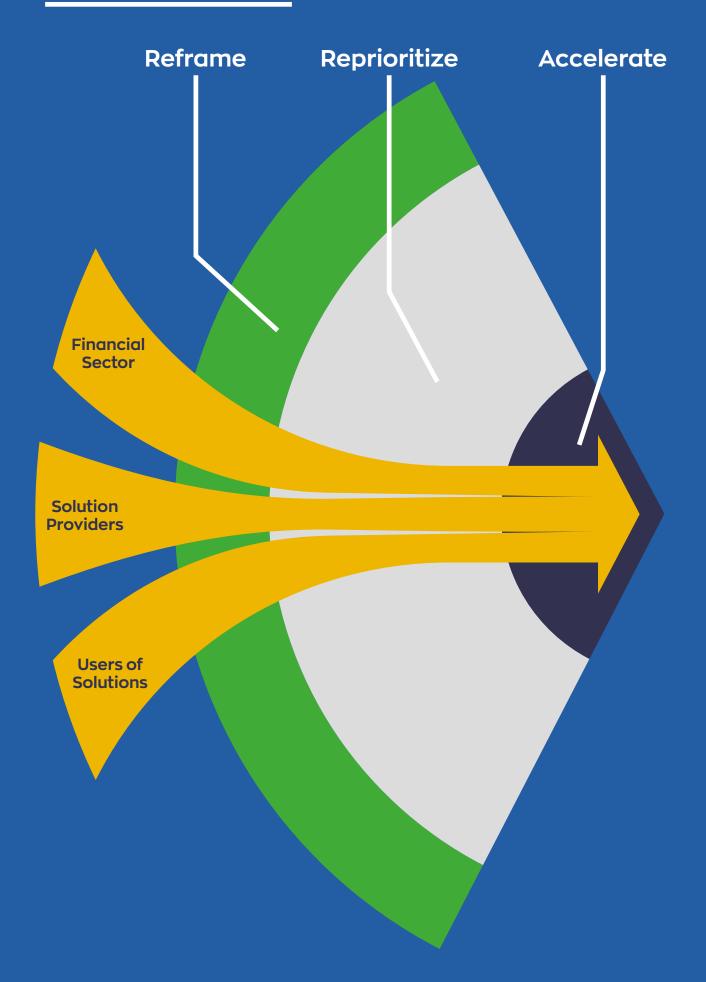
It might come as a surprise that no generally agreed framework exists to calculate the CO₂e reductions in society. Current frameworks tend to use an accounting approach where the reasons for calculating the emissions are based on a potential liability or branding problem. So, when companies, cities and financial institutions today talk about their contributions to reduced emissions, they almost never talk about reductions in society; but rather their own reductions. Sometime these two can be the same, but very often a reduction in one part of the system, results in increased emissions in others.

To accelerate emission reductions; companies, government and the financial sector cannot only be driven by cost and risk reductions in existing systems; they must also use their capacity to deliver the kind of innovation that delivers the solutions that we need. Hence, solutions providers need the tools and credibility to be able to demonstrate their positive impacts in society. It is not sufficient to just allow polluting companies to show how they reduce their emissions, governments need to be able to direct support to providers of solutions in a cost-efficient way (most GHG emissions reduction for the buck). Investors need to be able to identify winners in a low/zero-carbon economy (not just avoid the losers). This will require a shift in emphasis from "doing things less bad" to "doing good things", but will also need tools and methods to quantify and compare the impact of different solutions and potential solutions.

An illustrative example of the current dominating ESG approach (with focus on risk/cost reduction/accounting/liability) and the opportunity approach (with focus on possibilities/revenues/strategic business development and innovation) is the illustration "Two key approaches to evaluating companies" from FTSE Russel.⁵



2. A three-step approach for assessing low-carbon solutions



2. A three-step approach for assessing low-carbon solutions

There are three main stakeholder groups that have expressed the need for a framework to assess avoided emissions, each with different reasons for wanting to do so.

1

Companies and other solution providers

Organisations with solutions that can help to reduce emissions in society – whether established corporate or disruptive start-ups – want to know the level of reductions these are providing and their potential if scaled up further. This allows them to credibly communicate their impact to customers and other important stakeholders, helping then to raise capital and sell more effectively.

2

Investors and financial institutions

Investors and financial institutions want to gain a deeper understanding of the key technologies and business models that will succeed in the low-carbon economy of the future, helping them actively pick winners rather than just avoiding losers. This is especially valuable for impact investors, or institutional investors acting with an ethical purpose, who want to maximise the positive impact of their investments.

3

National and subnational governments policymakers and regulators

in national, regional and city governments want to better assess where their efforts could have the greatest effect and what further support might be required in order to scale up the solutions to climate change in the most cost-effective way.

For these different stakeholder groups there are three key benefits that can be delivered through the use of a framework that allows for the calculation of avoided emissions: to reframe their way of thinking; to reprioritize their efforts; and to accelerate the deployment of the solutions to climate change.

'Nonlinear change is needed – significant innovation in technology, financing, and business models is required on both the supply and demand side of energy systems to spark exponential progress towards the goal.'

Shaping Energy Transitions Position Paper of the Energy Transitions Commission April 2016

http://www.energy-transitions.org/sites/default/files/20160426%20ETC%20Position%20Paper%20vF%20low-res.pdf

Step 1: Reframe

Measuring avoided emissions can help to reframe an organisation's approach to tackling climate change, from a focus on the problem to the opportunity to take action.

Many companies currently take a risk-based approach to climate change. They regularly report the direct emissions from their operations (scope 1) and any purchased electricity, heat and steam (scope 2), making incremental improvements to reduce these over time. An increasing number of companies are also taking action in their supply chains, looking to reduce their indirect upstream emissions through engagement with suppliers (scope 3).

However, far fewer companies are looking as closely at the impact of what they sell. But by better understanding the impact that existing or proposed products or services might have in reducing emissions in society, this supports the introduction of net positive strategies and the growth of green revenues.

This shift in focus is supported by a number of trends, including the increasing preference for purpose-driven and sustainable companies. This is especially the case for millennials, who express a strong interest in working for and buying from companies that go beyond just minimising the harm they do.

Another significant trend is a shift in buying habits from products to services, which has been unlocked by new technologies and can offer significant reduction in emissions. For example, car companies are now looking at moving beyond just selling cars, instead exploring how to offer mobility as a service and using a variety of transport modes in a more efficient manner. Or – in cases like Tesla – a company can be something even more complex, something many investors and journalists have a hard time understanding. Even more disruptive companies are also including virtual mobility and integrated solutions for buildings as part of a broader mobility offering.

Similarly, in the financial sector, the focus for many investors and institutions has been on avoiding climate-related risks. Responses to this can include a preference for companies with better-than-average performance on climate issues, assessing the risk of high carbon assets becoming stranded, or actively divesting from dirtier industries.

By instead looking at avoided emissions and green revenue streams, this can help open up climate-related opportunities by driving investment and growth for the companies providing the sorts of solutions needed to tackle climate change. This is a shift from how companies should approach how they are producing their products today, to a focus on what they should deliver on the market. A shift from how to what. Different approaches exist: from using green revenues, via specific areas identified by the IEA, to patents.⁸

2. A three-step approach for assessing low-carbon solutions

For national and subnational governments, an understanding of avoided emissions helps them to develop the structural support needed to succeed in the transition towards a low or zero carbon economy. This can be seen in certain cities in China, which are now well-positioned for export success with booming industries manufacturing renewable energy technologies, LED lighting and electric vehicles.

Some of the leading groups doing city work have begun to approach cities as providers of solutions, not only as a geographical area that should reduce their own emissions. For example, The Innovate4Cities initiative by The Global Covenant of Mayors for Climate & Energy focus on the need to create solutions for cities of all scales and enhance access to technology globally, not just for well-resourced cities. In a similar way, the Global Climate City Challenge, a joint pilot initiative of the EIB and the Global Covenant of Mayors for Climate and Energy (GCoM) to help prepare and finance urban climate action projects, is a collaboration to turn climate commitments into investments.

A number of innovative ICLEI projects could also provide valuable contributions to an "avoided emissions" agenda including the Transition Academy and Urban Transitions Alliance. 11 C40 has a project called the "Climate Positive Development Program" where they define climate positive as "when the actions of a Development Partner lead to avoided or abated emissions in the surrounding community". 12 This is very much in line with the avoided emissions approach, even if "surrounding community" could perhaps be substituted with "the rest of the world" to make it clear that the focus is on reducing emissions in society, not just from a specific geographical area.

For all the three groups above, the opportunity in reframing is to unlock a step change in ambition. By moving away from trying to just focus on a company's own emissions, to instead unleash solutions, this could lead to savings across society as a whole that are orders of magnitude greater.

'Incremental innovation alone will not achieve a decoupling of economic growth from environmental impacts. Increasing the development and uptake of more radical and systemic eco-innovations, including new business models, is therefore important for the long-term transformation towards a greener economy.'

OECD Why New Business Models Matter for Green Growth February 2013

Step 2: Reprioritise

Following the process of reframing, organisations need to act on the knowledge they have gained from recognising the potential to avoid emissions. The next step, reprioritisation, is about making concrete changes to take advantage of these opportunities.

The changes that occur in a reprioritisation process can be very different depending on the type of organisation. On the one hand, tensions can arise as disruption can lead some people to feel threatened, which may necessitate a good change management process and teaching new skills.

On the other hand, when a company can begin to recognise that its core business is part of the solution to climate change, this can be very engaging for senior management and boards. With this buy-in from the top, an organisation can rapidly refocus its activities and grow its impact. For example, businesses might set combined sales and carbon emissions avoidance targets.

Under a reprioritisation process, when the focus shifts to solutions that help society reduce emissions, it is often necessary to engage with the customers to ensure that the solutions are used in the best way and get data, so the savings can be calculated. The reprioritisation process also tends to challenge the company to think about the service being provided. So not only try to sell more of the product; but to provide it as a service where carbon reductions in society is part of the package.

Some organisations might want to move beyond exploring individual cases of avoided emissions, to get an overall understanding of their entire organisation. Others might want to drill deeper into one particular element and see what kind of further changes might be needed.

For financial stakeholders the reprioritisation process might include new offerings where they assess how much they have helped reduce emissions by supporting companies that deliver solutions that reduce emissions in society. This could be companies that calculate their own contributions to reduced emissions, or companies that are providing certain key solutions that the investors have identified as important based on key studies such as those by IPCC's work on the 1.5 C special report and the Sustainable Development Scenario by IEA.¹³

For cities and governmental agencies, the reprioritisation tends to result in focus in strategic areas and targets for export, or other ways of making solutions available outside the city.

Regardless of focus in reframing, there is a greater need for quality data that is specific to the context of the organisation. It is here that questions about rebound effects become important to address. For example, as well as avoiding travel emissions, video conferencing technology can actually cause an increase in international travel by making cross-continental working more commonplace.

Step 3: Accelerate

To avoid dangerous climate change we will need to rapidly accelerate the uptake of disruptive solutions that can deliver fast and deep reductions in emissions.

For companies to significantly accelerate their contribution to the avoidance of emissions, it is helpful if this becomes a part of their core purpose as a business. This can come from introducing a focus on the sustainability needs in society, rather than just considering what the company currently provides, sometimes called a sustainability 3.0 approach. Using this lens can change the perspective across all parts of a business, from R&D and product development, through to sales and marketing.

For some start-ups, the need for reduced emissions in society is factored in from the very beginning. Examples can be seen in the WWF Climate Solvers initiative and the New Energy Nexus. ¹⁵ But is important that mainstream accelerators adopt this to incubate the next generation of fast-growing companies. ¹⁶

At this stage the framework can be integrated to the data that the stakeholders collect through their existing systems: such as Customer relationship management (CRM) and Data Collection Systems (DCS). The framework can also be used to identify potential new areas that can help guide the development if the company becomes 'challenge' driven rather than 'product' driven. Key barriers that must be removed in order for the accelerated uptake of zero-carbon solutions to take place, can also be identified and used to informed policy makers and other stakeholders.

Financial stakeholders that set targets based on avoided emissions in society are also beginning to emerge. Such assessment requires more data and a methodology that includes assumptions about baselines and different scenarios with different probabilities.

Frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD), while having a string focus on traditional risks, also acknowledge the need for an opportunity approach as well.¹⁷

Cities and government agencies have so far seldom focused on accelerated uptake of solutions, often because they tend to have a strong national focus. Hopefully we will see leading cities start to collaborate to deliver the solutions at the accelerated phase they are needed.

The framework is meant as a strategic decision-making tool, not a PR tool, but all tools can be used in different ways. However, those that focus on PR are more likely to focus on offsetting, or even overcompensating as this is the best a company can do from a pure risk perspective ,where business innovation and companies as solution providers are excluded.¹⁸

'Accelerating clean energy innovation is essential to limiting the rise in global temperatures to well below 2°C. While significant progress has been made in cost reduction and deployment of many clean energy technologies, the pace of innovation and the scale of transformation and dissemination remains significantly short of what is required.'

Mission Innovation
December 2015
http://mission-innovation.net/the-goal/

	1992		2018	
Rank	Name	Category	Name	Category
1	General Motors	Fossil cars + GCC	Walmart	Retail
2	Exxon Mobil	Fossil fuel + GCC	Exxon Mobil	Fossil fuel
3	Ford Motor	Fossil cars	Berkshire Hathaway	Holding company
4	IBM	Technology	Apple	Technology
5	General Electric	Fossil power generation	UnitedHealth	Health care
6	Mobil	Fossil fuel	McKesson	Health care
7	Altria Group	Tobacco	CVS Health	Health care
8	DuPont	Fossil chemicals + GCC	Amazon.com	Technology
9	Техасо	Fossil fuel + GCC	AT&T	Technology
10	ChevronTexaco	Fossil fuel + GCC	General Motors	All electric future with fossil still dominating today
11	Chrysler	Fossil fuel + GCC	Ford Motor	Electric and autonomous vehicles as well as fossil
12	Boeing	Fossil airplanes	AmerisourceBergen	Health care
13	Procter & Gamble	Consumer goods	Chevron	Fossil fuel
14	Amoco	Fossil fuel + GCC	Cardinal Health	Health care
15	Shell Oil	Fossil fuel + GCC	Costco	Retail
16	United Technologies	Fossil airplanes	Verizon	Smart green Technology
17	PepsiCo	Carbonated soft drinks	Kroger	Retail
18	Eastman Kodak	Imaging products	General Electric	Mixed power generation
19	ConAgra Foods	Packaged foods	Walgreens Boots	Health care
20	Dow Chemical	Fossil chemicals + GCC	JPMorgan Chase	Green financial services
	new	fossil fuel	solutions	

This section illustrates the case for change by looking at where a framework for avoided emissions through products and services could be effectively employed, to meet the needs of a changing society, changing organisations and future generations.

3.1 Many of the structures, incentives and organisations working on climate change were created when the world looked different. Structures, initiatives and organisations are needed that are based on today's situation

When the international framework for climate change was established back in 1992,s the world was a very different place. ¹⁹ In 1992, at the time of the Earth Summit, ²⁰ 14 of the 20 largest companies, 70%, on Fortune 500 focused almost exclusively on delivering fossil-based products. ²¹ At the time of the Kyoto protocol many of the world's largest companies, nine of 20, were part of the Global Climate Coalition (GCC): an industry group known for its hard-line scepticism on global warming and intense lobbying efforts against legislated controls. ²² The GCC dissolved in 2001, 17 years ago, after membership declined in the face of improved understanding of the role of greenhouse gases in climate change and of public criticism. ²³

Today, 26 years after the Rio conference, a lot has changed. Only two of the 20 largest companies, or 10%, on Fortune 500 focus almost exclusively on delivering fossil-based products. Further, even though companies acknowledge climate change and support action to reduce emissions publicly, there are reports about continued lobbying among some companies continuing to undermine actions to reduce GHG emissions through support of different lobby groups.²⁴

Today there are five companies on the top 20 list that actively pursue opportunities to deliver smart low-carbon solutions (green highlight). An additional five tech, retail and financial companies talk about their work to reduce their own emissions (scope 1-3) but could easily become important solution providers if they embraced a solution approach on top of their existing risk approach.

A legacy from the 90's is that many of the tools still used today are built on the assumption that the focus should be on the biggest polluters; and create transparency around the risks related to emissions and ownership of high carbon assets. Most frameworks for reporting climate impact assume that the most important thing companies can do is to reduce their own emissions. Much of this was true 1992 but, as the illustrative example of the shift among the top 20 companies on Fortune 500 indicates, a dramatic shift has taken place over the last 26 years. There are many reasons for the dramatic shift, but three changes are of particular importance.

1 Companies move towards a service perspective

Many of the companies that used to focus almost exclusively on fossil-based products now have a broader perspective where they have diversified into renewable and electric cars for example. Many are also moving into a more service-based perspective where they focus on what the customers want (heat lighting, mobility, etc) not the old ways of providing these. Companies like General Motors, Ford and General Electric that used to focus almost exclusively on fossil-based solutions have now shifted focus and think more about how they can provide the service needed in smarter ways. Many, but not all, of the earlier big polluters now have plans for a fossil free future and include zero-carbon solutions in their portfolios.

2 Solution providers are emerging

Solutions to climate change are no longer a matter of reducing the emissions from the fossil fuel companies. Two of the companies with focus on low-carbon solutions, on the 2018 top 20 list are illustrative examples.

First, Verizon a company with a new goal that by 2022, Verizon's networks and connected solutions will save more than twice the amount of global emissions that their operations create. They are among a new generation of ICT companies that focus on how they can help reduce emissions in society. Back in 1992 there was one technology company, IBM, and at that time they did not provide any low carbon solutions.

Today IBM has a high profile when it comes to smart low-carbon solutions, but from place 34 on the Fortune 500 list. At the same time, it is important to note that neither of the two largest technology companies on the list, Apple and Amazon.com, have any strategy or goals for helping reduce emissions in society through their products and services. Even though they are two of the most influential companies on the planet when it comes to influencing the lifestyles and consumption habits, they only focus on emissions from their own operations. ²⁸

Second, JPMorgan Chase have a goal to facilitate \$200 billion in clean financing by 2025. They still have a strong focus on the supply side, renewables in society but also mention technology innovations. ²⁹ Obviously they also have targets for the traditional emissions, but they are a good example of a company where the potential impact of their core business on emissions in society is magnitudes more important than their own emissions. It is worth noting that the third company on the list, Berkshire Hathaway, is weak when it comes to addressing their impact through their core business. Warren Buffet has indicated the he thinks climate change is important and has made investments both in renewables and electric cars. However, Berkshire Hathaway has also been accused of undermining solar companies to protect their interest in old fossil companies. ³⁰

One of the strengths with a framework that can assess how much companies can help reduce emissions in society is that it will be easier to compare different companies, both with regards to how much they have saved and what potential they have to provide solutions.

3 The market is changing

The fourth industrial revolution is changing the very foundations for how society operates.³¹ New opportunities are emerging at an increasing pace and many of these are based on sharing, dematerialisation, and renewable energy. The willingness to pay for fossil-fuel based solutions is decreasing in relation to other areas such as health and technology. This is even more true if we look at the stock market and how investors value companies. In 2017 Tesla passed Ford in market capitalization.³² In 2018 Apple became the first company ever with a trillion dollars in market capitalization.³³ While some of the valuation is likely due to speculation, there is a growing consensus that the world is moving towards more resource efficient and fossil free solutions. This is not just due to the urge to avoid dangerous climate change, but that many areas now have the capacity to deliver services in much smarter ways, ways that do not depend on the use of fossil fuel.

Current frameworks with focus only on companies as providers of products and their own emissions are good in times when companies are not changing much and where only incremental improvements are needed. Such frameworks can however also push companies in a direction where the focus on only their own reductions, makes more significant changes more difficult. The relative widespread use of carbon offset is one indication of that: the fact that many rankings focus on those reducing their own emissions rather than those providing solutions. Combining the traditional approach and reporting with a strategy to help deliver reductions in society can help make the necessary carbon reductions in society a driver for innovation and increased revenues.

If we go back to 1992, or even before 1972, to the thinking that shaped the structures, incentives and organisations created during the 90's, but shaped during the decades before; we find a situation where companies existed in a situation where the main challenge was to produce as much as possible in a society that wanted more of almost everything.

The idea that the social responsibility of business is to increase its profit, often referred to as "the business of business is business", or "the Friedman doctrine" dominated during this time. This, together with a strong focus on products and a lack of solutions, resulted in a situation where only a brave few dared to challenge current structures and ask large companies to radically reduce their emissions, and even fewer challenged companies to become part of the solutions and provide what society needs.

'Fighting climate change is one of our greatest opportunities for improving lives especially in the world's cities. Parks and trees make cities more beautiful. and they also suck carbon and soot out of the air. **Energy efficiency reduces** emissions while cleaning the air and saving money. Bike lanes and mass transit make it easier to aet around town while also shrinking city carbon footprints. These are just a few of the steps that help cities attract new residents and businesses while also strengthening the economy.'

OECD Why New Business Models Matter for Green Growth February 2013

Without relevant solution providers and with strong focus on products, a framework that can assess how much companies can help reduce emissions in society makes little sense. Remember that modern renewables were almost non-existent only a decade ago and most smart solutions would not emerge until the digital revolution. Most experts and scientific studies in the area of climate mitigation assumed incremental improvements and an industry that would look almost identical to how it had done for many decades, sometime over a century.

In this world, an exclusive focus on companies' own emissions and to approach climate change as a risk, made perfect sense. Companies in focus were coal companies selling coal, (fossil) car companies selling fossil cars, steel companies selling steel, etc.

3.2. Companies are changing very fast and use new technologies and business models

Today the world looks very different We have an increasing group of companies with focus on providing the solutions society needs. Three trends are contributing to the shift:

1 New technologies

In the last decade prices have been falling dramatically on renewable energy, storage and energy efficient solutions. Solar, often combined with batteries and LED, has become a symbol for the transition that has started. All are technologies, together with other technologies like wind and electric cars, that have fallen between 60-90% in less than 10 years.³⁶

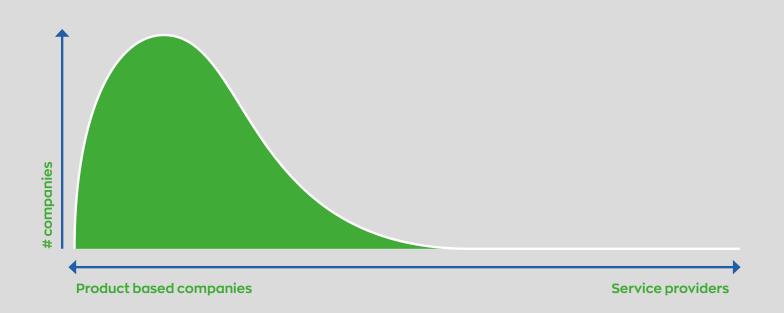
Underlying these individual technologies is a much broader shift driven by digitalisation, new materials and biotech breakthroughs that are fundamentally changing all key sectors in society from energy, transport and agriculture to health, education and entertainment. The shift is so significant that many talk of a new industrial revolution. Companies can now do what the polluting companies did but with different products, such as renewable energy and electric cars. But even more disruption is due to a shift in business models and ways to provide services.

2 New business models

Equally important, or perhaps even more important, is the shift in business models. Car companies are not only shifting to electric and hydrogen technologies in order to make better cars, they want to sell physical mobility as a service (MaaS), or even provide mobility (digital and physical). It is not a coincidence that it was a car company, Honda, that was one of the first companies in the US to build a home that is a net-provider of renewable energy.³⁸ The smart home by Honda was built so it could charge an electric car. New companies have been making headlines with new ways of providing services, from car sharing and room sharing to services



19-20th century industrial structure: Doing more things in a time of scarcity



where customers now are used to subscribing to e-books and music. We are likely to see similar shifts among all industrial companies, as we have seen in the music industry and printing industry, where old business models become obsolete and new are taking over. However, much of the development is happening locally and therefor often outside traditional mass media and conferences where traditional stakeholders often pay for participation and visibility.

Almost none of the disruptive solutions, including totally new ways of providing services, have been driven by sustainability concerns. One reason for this is probably the focus for sustainability stakeholders has been on reducing emissions in existing systems, rather than supporting the next generation of solutions.

3 Increased urgency to address climate change

A trend that should not be underestimated is the understanding that climate change as an existential risk has grown stronger. Today, the question is not if climate change is an issue, but how urgent it is and what risk understanding people have. The fact that scientists highlight uncertainty and that we already are in unchartered territory makes the issue difficult to discuss. We are now in a situation where there is a probability that we will not be able to stop feedback systems and find ourselves way beyond 2 °C. Every greenhouse gas molecule that is released into the atmosphere increases the probability for catastrophic climate change. This urgency is not only bad, it helps us move beyond incremental thinking and shortterm self-interest and focus on what society really needs. For many companies that has meant to look at what they can do to deliver the solutions needed. Leading architects, lawyers, bankers, chefs, providers of gardening equipment, steel companies, etc. have all begun to look at what they can do to provide the services needed in society in a sustainable way.

Combined, these three trends are transforming the corporate sector. While it is hard to make an exact estimation, the general direction is clear. Product based companies with big emissions used to be the most important group by a wide margin, back when only incremental improvements were seen as possible and business models focused on providing slightly better versions of the same products. Today, we are in a transition phase where still almost all attention is on the big polluters and addressing them as product providers. At the same time, there are an increased understanding that a solution perspective is needed. Looking ahead, most trends indicate that the shift in focus will continue and we will see more service-based companies, using new business models. We are moving in the right direction, but too slowly. One reason is that structures, knowledge and tools are based on yesterday's world.

Establishing new structures, knowledge and tools that support the move towards a service-based circular economy, where companies can assess their positive contributions can help accelerate a sustainable transition.

'As a business leader who has been bitten by the sustainability bug, it's clear that radical transformation is required. It's not good enough to do CSR from a philanthropic point of view; it must be really integrated into the core of your business.'

Peter Bakker President of WBCSD, 2013

Business Sustainability

0.0

- Purely economic view of the firm and the business processes
- Typical economic concerns are pursued to produce economic value
- Inside-out

Business as usual

1.0

- Shift from purely economic concerns to include social and environmental concerns
- · Refined shareholder value
- Inside-out

Refined shareholder management

2.0

- Shifts from shareholder value to a broadened value proposition including people, planet, and profit
- Management of the triple bottom line
- Inside-out

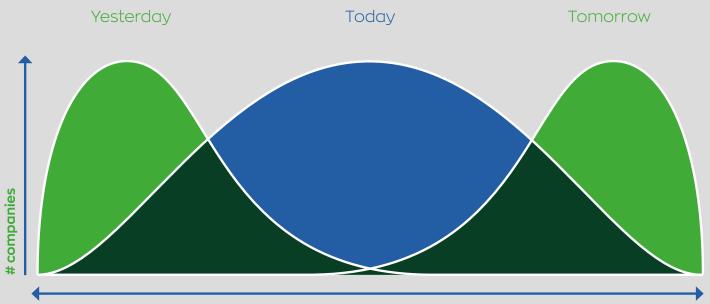
Management of the triple bottom-line

3.0

- Shifts from an inside-out perspective, with a focus on the business, to an outside-in perspective, with a focus on society and the sustainability challenges it is facing
- Reframing the business concerns and business models
- Outside-in

True business sustainability

Industrial structure in the 21st century: Transitioning to providing smart solutions



Product focus

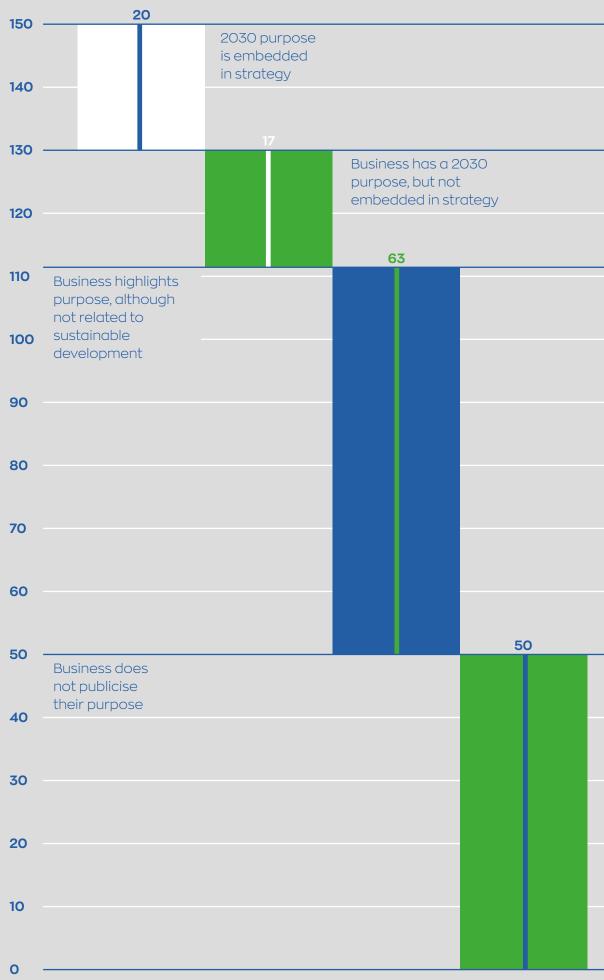
No plans to think beyond the current business model

Need focus

Constantly revising the company based on needs in society

Business, purpose and global sustainability

Number of top 150 of FTSE350



 $source: \underline{https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/gx-2030-purpose-report.pdf}$

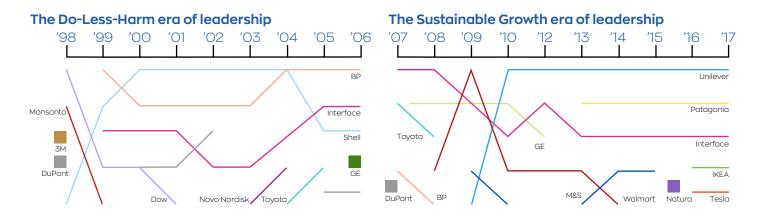
Most companies still address climate change as a cost/risk, sometimes with an added element of PR opportunities. Those in charge of climate change in companies are often in the environment, health and safety department, making sure that no accidents happen and that the company is not breaking any laws. Surprisingly often they are also linked, or even housed in the PR/communication department. Perhaps a little surprising as this increases the likelihood of different measures driven by communication objectives, rather than core business, or the climate.

However, there are indications that this might change fast. It will still be important for companies to ensure that their own emissions are reduced to zero as soon as possible. But for many it will become a sub-set of the goal of delivering what society needs. The more companies that start by asking what society needs and what they can they can do to deliver it, the more likely we are to have a growing group of companies that take for granted that they must make sure how they provide those.

We see an increasing number of models and tools that are meant to help companies move from reactive to proactive. One example is the typology below developed by Katrin Muff that shows how companies can move from business-as-usual to true sustainability in three steps.³⁹

It is the last stage, the out-side in, when companies look at what is needed in society that tends to be the most difficult one. It is likely that very successful work with reductions from a risk and PR perspective could make it harder to take the third step. This because structures and incentives as well as knowledge has been built around the old era. Over the coming years, we should expect unexpected companies to emerge as leaders in the new era. In particular as more companies becomes purpose driven companies.

There are still only a few companies that are purpose driven and link that to a strategy for sustainability. Of those, it is likely that the majority are creative PR people that like the idea of purpose driven companies, but where the real work is about reducing internal emissions. In a study by Deloitte the group that embedded a purpose into their strategy was only 13 percent. Still if we see these companies as market leaders, others will follow, even if they do not adopt an out-side in drive.



There are also a number of studies indicating that sustainability experts now see real leadership among companies that try to deliver what society needs. In the 2017 "Sustainability Leaders" GlobeScan / SustainAbility Survey, they identified a two separate eras. The first era of leadership, "Do-less-harm", lasted until 2006. The second era, "Sustainable growth", begun in 2007. The first era was dominated by big polluters and they showed leadership by reporting and focusing on their own pollution, using the traditional tools for how to measure carbon emissions. The framework for avoided emissions is very much for the new era of leadership.

The framework for assessing avoided emissions is meant to be used by companies at all stages, from those who just want to explore what a reframing would imply, to those who are ready and want tools to help them accelerate their positive contributions to society.

'Four-fifths of the total energy-related CO₂ emissions permitted to 2035 in the 450 Scenario [presented in IEA's World Energy Outlook] are already locked-in by existing capital stock, including power stations, buildings and factories. Without further action by 2017, the energy-related infrastructure then in place would generate all the CO₂ emissions allowed in the 450 Scenario up to 2035.'

International Energy Agency (IEA)
November 20115
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- https://www.fsb-tcfd.org/
- 18 Some will probably even go so far as calling the unsustainable products they have, carbon neutral or in the case of over compensation carbon positive, once they have bought the carbon offsets.
- 19 https://unfccc.int/
- 20 https://en.wikipedia.org/wiki/Earth Summit
- This is an approximate estimation based on the revenues from companies, public strategies and reports about lobbying $such as \ https://www.ucsusa.org/using-astroturf-front-groups-hide-fossil-fuel-lobbying-efforts. The important is not the account of the properties of the$ exact number but the overall trend.
- 23 https://en.wikipedia.org/wiki/Global Climate Coalition
 - The situation was quite dramatic in the years after Kyoto with Shell being one of the first to leave GCC. Shell as a company backed the emissions-reductions targets, yet Shell Oil remained a member of GCC, which rejected the agreement). Mark Moody-Stuart, chairman of Shell Transport & Trading, revealed that the company had spoken to other GCC members about emissions targets before the Kyoto conference. "Since Kyoto," said Moody-Stuart, "divisions within GCC have become marked. After the conference Shell wrote to the GCC saying that, while GCC was opposed to the Kyoto targets, that was not Shell's position. "We told GCC there was a fundamental difference of opinion and that it had become so extreme that Shell would have to terminate its membership. We concluded last week that our differences with GCC are irreconcilable.
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MISSION INNOVATION SOLUTION FRAMEWORK



Framework for Assessing Avoided Emissions

Accelerating innovation and disruptive low- and zero-carbon solutions

Part 2

Draft methodology for calculating avoided emissions













Framework for Assessing Avoided Emissions

Accelerating innovation and disruptive low- and zero-carbon solutions

Draft methodology for calculating avoided emissions version 2018-1

Introducing a draft methodology for measuring avoided emissions

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Structure of the Document

This document has the following structure:

1. Introduction

introduction and background to the framework

2. Guidance

this section provides an overview of the framework and approach; the general steps for applying the framework

3. Methodology

provides details of the methodology and discussion of some of the aspects of the methodology

4. Worked examples

three examples are presented for applying the framework

Appendix 1

Examples and references

Appendix 2

Glossary

1. Introduction

The Paris Agreement set an ambitious aim to hold the increase in global temperature to well below 2°C and pursue efforts to limit the temperature increase to 1.5°C. Achieving this aim is vital to avoid major disruption to human life on the planet. However, projections based on current NDCs predict a temperature rise of over 3°C.1 To deliver the dramatic emissions reductions that are needed, will require more than a business-as-usual approach to companies reducing their existing emissions. It will require new approaches driven by companies delivering innovative and disruptive solutions that will bring about significant changes in societal behaviour and overall reductions in emissions. Many of the most significant emissions reductions today have been delivered by companies delivering solutions, not simply reducing their own emissions. Examples such as renewable energy, electric cars, dematerialisation, virtual meetings, etc. have been driven by companies providing solutions rather than by reducing their own emissions. The Fourth Industrial Revolution² (connectivity, new materials, and new business models) also provides ample examples of opportunities. This is not to say that companies own emissions are unimportant, we will only reach a zero-carbon society if all emissions are brought down to zero. However, rapid reductions in emissions require innovative solutions, and this requires an approach which can assess the impact of the avoided emissions from these solutions. This framework aims to provide a structure within which avoided emissions can be assessed and included into the strategies for overall emissions reductions and decarbonisation. It builds on existing practice and initiatives.

To accelerate emission reductions companies cannot only be driven by cost and risk reductions, but must also use their capacity for innovation to deliver the solutions that we need. Hence, solutions providers need the tools and credibility to be able to demonstrate their positive impacts in society. It is not sufficient to just allow polluting companies to show how they reduce their emissions, governments need to be able to direct support to providers of solutions in a cost-efficient way (most GHG emissions reduction for the buck). Investors need to be able to identify winners in a low/zero-carbon economy (not just avoid the losers). This will require a shift in emphasis from 'doing less bad' to 'doing more good', but will also need tools and methods to quantify and compare the impact of different solutions and potential solutions.

1.1 Introduction to framework

The Research Institutes of Sweden (RISE) is leading an initiative together with the Swedish Energy Authority, the Carbon Trust, and other partners, to provide an assessment framework that is able to identify companies, system solutions and technologies that have significant ability, or potential, to contribute to reduce greenhouse gas (GHG) emissions in society, so called avoided emissions. The initiative has been adopted as one of the activities in the Mission Innovation Action Plan for 2018-2020.³

The objective of the initiative is to develop a draft framework that is capable of classifying and then ranking companies/solutions, based on their positive climate impact, through their supply of low carbon products and services. The methodology framework will be applicable to: 1) Products/solutions; 2) System solutions; and 3) Companies.

This document is an initial step in the development of the methodology framework. It has been developed by starting with existing published methodologies that relate to avoided emissions.

1.2 Concept of avoided emissions

The overall concept of avoided emissions is that a solution (product or service) enables the same function to be performed with significantly less GHG emissions. The method of measuring avoided emissions is to compare a baseline scenario without the enabling solution with a scenario using the enabling solution, where the baseline represents the 'business as usual' (BAU) scenario.

1.3 GHG accounting, reporting and ranking frameworks

A short history of GHG accounting and reporting

Arguably, the formation of the United Nations Framework Conventions on Climate Change (UNFCCC) in 1992 and the Kyoto Protocol of 1997 focussed attention on the measurement of GHG emissions at a national scale. And this then looked at industrial sectors that contribute significant emissions. Hence the first generation of companies that measured their emissions were those companies directly responsible for significant emissions such as power plants, steel, chemical and cement plants (those with significant scope 1 emissions).

Over time, other companies also began to measure and report their emissions, including the emissions of their value chain which could also be significant – for example, automotive companies (due to the emissions from the cars) and food companies (due to the emissions from farming). However, the focus remained on the companies

1. Introduction

responsible for large emissions. This was due to a combination of factors, from NGOs and environmental authorities focus on companies as a problem, to the financial investment approach of only considering climate change as a risk where companies with high carbon exposure should be avoided.

Reporting of GHG emissions by companies is now well established, with most large corporations reporting their annual emissions as a matter of routine. However, commonly agreed approaches and standards for GHG accounting have only been established in the last 20 years, which is a mere flicker in time compared to the history of financial accounting.⁴

Frameworks for reporting of GHG emissions, and frameworks for ranking of companies on sustainability criteria, are also relatively recent, with the GRI formed in 1997 and the CDP being founded in 2000.

While over the last 10 years there have been a number of initiatives related to avoided emissions and net-positive approaches, there are currently no agreed standards for the assessment and reporting of avoided emissions, although the GHG Protocol Product Standard refers to avoided emissions.⁵

For a more detailed perspective on the history and evolution of the net-positive approach see the Cybercom report: 6 'Digital Sustainability – Global sustainability as a driver of innovation and growth'.

Summary of key GHG reporting standards and frameworks

The GHG Protocol supplies the world's most widely used greenhouse gas accounting standards. Three key GHG Protocol standards (and initial publication dates) are: the Corporate Standard (2001, revised 2004), the Product Standard (2011), and the Scope 3 Standard (2011).

The GRI Sustainability Reporting Standards are used by businesses and governments worldwide to understand and communicate their impact on critical sustainability issues such as climate change, human rights, governance and social well-being. In 2000 the GRI launched the first version of its reporting guidelines, representing the first global framework for comprehensive sustainability reporting. The guidelines have been continually updated with new releases, G4 was launched in 2013.

CDP was formed in 2000 to support companies to disclose their environmental impact primarily in terms of GHG emissions. It has become the global repository for corporates to report their GHG emissions, with over 5,600 companies reporting in 2017. CDP uses the responses from companies to create a ranking by scoring company responses from A to D.

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Other sustainability ranking systems exist, most notably the Dow Jones Sustainability Index (DJSI), and the FTSE4Good Index, (which is based on the FTSE Russell ESG rating system). The FTSE Russell Green Revenues model takes this further by measuring the proportion of a company's revenue that is linked to a green product or service, and providing a 'Green Revenue Factor' for different green revenue sectors.

However, all existing major measurement and ranking systems related to climate change impact still focus on companies' and cities' GHG emissions and emission reductions. The purpose of this document is to shift the focus to the potential positive impact that a company can have in reducing its customers' emissions through the use of its products and services, so called avoided emissions.

1.4 Avoided emissions - Maturity of approach and future ambition

There are today a number of examples of net-positive initiatives, approaches for assessing avoided emissions, and companies that are looking to change focus from 'doing less harm' to 'doing more good'. Appendix 1 lists some of these examples. One of the earliest documents to present an approach for assessing avoided emissions was GeSI's 'Methodology for evaluating the carbon-reducing impacts of ICT', published in 2010. A number of ICT companies and other initiatives have since published work in the same direction, also using some of the earlier company led net-positive strategies from 2007-2010.

Thus the current examples and practice of net-positive approaches are developing and reasonably mature, although there remain a number of methodological challenges.

Current examples broadly fall into the following categories:

Companies that are reporting avoided emissions and having netpositive targets

These include a number of international ICT companies, and other multi-national companies such as IKEA and Kingfisher.

New initiatives are also emerging. The Net Positive Project is a cross sector collaborative initiative to develop principles, methodologies and promote the net positive concept (which extends beyond just GHG emissions to include other sustainability aspects).

2. Financial investment and disclosure initiatives.

The finance and investor sector have historically had some ethical and socially responsible investment approaches that do not invest in certain sectors, and for a climate perspective do not invest in fossil fuel companies. More recent approaches are now looking at climate-positive investment decisions by actively

1. Introduction

selecting more sustainable companies, based on ranking criteria. Examples include: the FTSE Russell Green Revenues ranking model; the Transition Pathway Initiative; Carbon Delta's 'green patent' assessment methodology; and WHEB's sustainability fund.

Mark Carney, the Governor of the Bank of England, and Laurence Fink, CEO of Blackrock are two prominent leaders in the finance sector encouraging companies to fully disclose their climate change risks. The TCFD published its recommendations for financial disclosures in 2016.

3. Identification and acceleration of new solutions

WWF have for over 15 years been active in researching, promoting and publishing reports in relation to avoided emissions, and have developed the Climate Solver Tool – an on-line calculator for assessing the carbon reduction potential from technologies. The Swedish energy agency have used a version of the WWF framework to assess its portfolio of low-carbon entrepreneurs. The possibilities to assess Mission Innovation initiatives is most closely related to these initiatives. An increasing number of cities are also increasingly focusing on supporting solution providers, not only supporting emissions reductions from big polluters.

As mentioned above, existing reporting frameworks and methodology initiatives have focused on companies as sources of emissions, not sources of solutions. Their offer to the financial sector and other stakeholders has been mainly about avoiding risks associated with significant dependence on fossil fuels, or to identify the worst in existing sectors. In later years there has been a growing understanding about the need to also identify those companies with solutions.

The WRI produced a draft white paper on avoided emissions in 2016. Sector specific methodologies have been published for the chemicals and cement industries.

(See Appendix 1, for more details of these examples).

Challenges

One of the key challenges of current approaches is providing a consistent method for reliably quantifying avoided emissions. The process often has a higher uncertainty compared to measurement of emissions within a company's direct control such as Scope 1 & 2 emissions. This is because it often relies on estimates and assumptions, and is inherently considering hypothetical cases when comparing to the base case (i.e. what would have happened if this did not happen). This means that the assessment may be resource intensive, and therefore costly. As data and routines are established the costs will fall. It is therefore important to apply the appropriate level of detail to data gathering and calculation relevant to the purpose for which the results will be used, so that efforts and resources are directed to those areas which have the most significant impact on the overall result.

1. Introduction

What is important is to initially establish an understanding of the order of magnitude of the potential avoided emissions opportunities, so that companies with significant opportunities to reduce emissions though their products and services are encouraged to increase those contributions.

In the future, as even more reliable data and studies become available and easier to process due to factors like digitalisation, increased transparency, inexpensive sensors, process power, etc., the process to estimate positive contributions should become easier and more accurate.

Future Ambition

A future scenario would be where relevant companies routinely publish their avoided emissions (for all relevant products, and for the company as a whole). This would sit alongside their financial reporting, and the reporting of their GHG emissions. This information would then be used by investors and analysts to help understand a company's exposure to climate change related risks as well as their potential to make money and be successful under different reduction scenarios.

This future scenario could also include a situation where avoided emissions would be verified and traded.

1.5 Different motivations for assessing avoided emissions

Different stakeholders will have many different needs and motivations for assessing avoided emissions. These could vary from very initial, high-level estimates to detailed and verified assessments. The required assessment process will change as tools and data develop for doing the analysis, and as organisations travel through the different stages on their 'avoided emissions journey'.

These different stages will therefore require different levels of rigour, which should be borne in mind as this framework is applied.

For example, the following three stages could be envisaged on the 'avoided emissions journey' for a company:

1. Introduction

- A company is starting to think about its potential role as a solution provider: It needs to get a general and approximate overview of the current situation, using current sales data and multiplying this by average sector estimations of carbon abatement factors. This assessment will be very rough, but will help the company to understand its potential role as a solution provider and what parts of the company are delivering reductions in society and what parts are resulting in increased emissions.
- **B** Providing guidance for the development of a strategic plan for avoided emissions: This could drill into more details in quantifying the actual amount of avoided emissions and allow for calculations of how the market and income could change over different scenarios. This, in turn, would help the company to prioritise the development of certain products, where to invest, and identify potential new markets and revenue streams.
- **C** Get actual reduction measures that can be traded/sold on a market. At this stage, it is envisaged that there would exist established markets for trading of avoided emissions credits. In this case, the numbers need to be verified and allocated in ways that are not important in stages A and B. This stage therefore requires a much more rigorous approach to the calculations, traceability of the data and justification of the assumptions, and an independent audit of the process. (Note: C might never happen).

2. Guidance

2.1 Overview of Approach/Framework

A short note on terminology 2.1.1

'Avoided emissions' - definition

Avoided emissions can be defined as 'reductions in emissions caused indirectly by a product. This is where a product provides the same or similar function as existing products in the marketplace, but with significantly less GHG emissions'. This definition being derived from the GHG Protocol Product Standard - see chapter 11, sections 11.2 and 11.3.2. (Note that the Product Standard uses the term 'products' to mean either 'goods or services').

'Avoided emissions' is the terminology used by the GHG Protocol. This is elsewhere also referred to as 'carbon abatement' and is often referred to as being caused by 'the enabling effect' of a technology or solution.

Solutions

In this document the term 'solutions' is used to refer to either products or services that have an enabling effect to avoid emissions.

See the glossary in Appendix 2 for terminology used in this document.

2.1.2 **Summary of Methodology**

In summary, the methodology provides a comparison of the greenhouse gas (GHG) emissions from a business-as-usual (BAU) baseline scenario with those from a solution-enabled scenario to demonstrate the benefit of the solution to reduce overall systemlevel GHG emissions. This involves calculating the emissions in the following categories:

2.1.2.1 **BAU system**

The emissions from the BAU baseline, without the introduction of the enabling solution.

2.1.2.2 Enabling Effects

The avoided emissions due to the activities avoided as a result of using the solution. These are further subdivided into primaru (or immediate) enabling effects and secondary (or longer-term) enabling effects.

2.1.2.3 Direct Solution Emissions

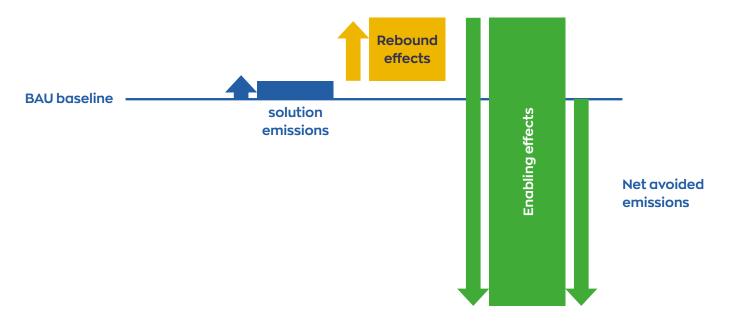
The life cycle emissions of the solution that is causing the enabling effect.

2.1.2.4 Rebound Effects

The increase in BAU emissions occurring as result of the enabling solution implementation. Rebound effects may be caused by related consequential effects or by unrelated (and sometimes unintended) effects and are often related to human behavioural changes in demand for carbon-intensive goods or activities. These effects are further subdivided into *immediate* rebound effects and *longer-term* rebound effects. Because of the nature of rebound effects, they are extremely hard to quantify and predict, and assessing them is inherently uncertain as it is difficult to accurately estimate the effects.

The net avoided emissions are then calculated as follows:

Net avoided emissions = Enabling avoided emissions - Direct solution emissions - Rebound emissions



The net avoided emissions can alternatively be defined in relation to the BAU emissions as follows:

Net avoided emissions = BAU baseline emissions - emissions of the solution enabled scenario

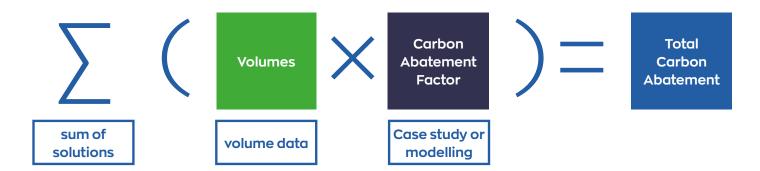
2.1.3 Calculation Method

Each individual enabling solution is assessed by determining a carbon abatement factor that reflects the net avoided emissions per unit of the solution implemented. (Thus for video conferencing this would be the avoided emissions per video conference, and would be measured in kgCO₂e per video conference).

The advantage of using a carbon abatement factor is that it provides a normalised factor that can be compared between different assessments and studies, thus helping significantly with consistency and comparability. It can be thought of as analogous to the use of the 'emission factor' in product footprinting, which is multiplied by the activity data to calculate the product emissions.

2. Guidance

The carbon abatement factor is based on existing academic or industry studies where available, or otherwise based on data or supported assumptions that demonstrate the carbon abatement. In order to calculate the total carbon abatement for a solution over a specific time period, the carbon abatement factor is multiplied by the volume of the solution deployed (this can be either an actual figure or a projected figure, depending on what analysis is being performed). And for multiple solutions, the total carbon abatement is the sum for the individual solutions:



In practice, the calculation is more complex than the simplified formula above suggests. Firstly, the 'carbon abatement factor' may require significant research and then additional analysis to appropriately apply it to the scenario being considered. Also, the carbon abatement factor may itself be multiple factors - for example where a solution that reduces electricity consumption is applied globally, the carbon abatement factor will vary regionally to reflect the local electricity grid emission factor. Further, a single solution may have multiple applications, and when used in different contexts can deliver very different outcomes. In this case, either multiple usecases should be considered, or the analysis should be constrained only to those use-cases that are appropriate and relevant. In summary, it is important that the studies used to provide the carbon abatement factor are appropriate to the assessment, are scalable (i.e. do not only apply to an idealised test case), and the data and quality underlying the studies are relevant and transparent.

Also the calculation needs to acknowledge the uncertainty in the data and measurements. Ultimately the approach is an estimation, including some assumptions. An uncertainty analysis can be applied to each of the factors to derive an uncertainty figure for the total result. Or, alternatively, a qualitative discussion on uncertainty sources and their implications, combined with sensitivity analysis may be more useful.

Applying the calculation to assess future potential scenarios

Additionally, when applying this approach to future scenarios (which will often be the case for new technologies and solutions) then the probability of the solution delivering the expected benefits should be included (probability of successful development of the solution), as well as the probability of the solution being adopted at scale (probability of adoption).

Thus a more complex version of the calculation can be expressed as follows:



Thus if we want to assess the possible impact of a new technology, let us assume that the technology can reduce a person's annual emissions by $400 \, \mathrm{kgCO}_2\mathrm{e}$. As this is a new technology we are not certain that it will be successfully developed due to technical challenges, and we assess the probability of success at 70%. The technology is applicable for all of the population, however not everyone will adopt the solution, and there may be alternative solutions that also take a share of the market, thus we assess the probability of adoption at 40%. Then for a country with a population of 50 million the avoided emissions would be:

Avoided emissions of solution = $70\% \times 40\% \times 50,000,000 \times 400$ [kgCO₂e]

'Flags' for potential lock-in threats

The solution should be analysed for potential long term lock-in' threats. This is particularly relevant for long-life high capital investments, where there might be short term benefits, but in the future either the technology may become obsolete, or may lock-in carbon emissions that could have been avoided by different investment. For example replacing a coal-fired power station with a gas-fired power station reduces emissions, but also locks in fossil fuel emissions for a further 30 years.

The solution should be reviewed with regards to its potential impact on society's ability to move in a decarbonisation direction. Any identified risks should be transparently considered and described.

2.2 General steps for quantifying avoided emissions

1 Identify solutions to be assessed

Identify the solutions that are to be assessed. This step may involve a rough calculation of the avoided emissions enabled by the solution in order to determine its significance, and therefore whether it would be useful to do a full detailed assessment, and if so to focus the data collection on the areas that will have the most significant contribution to the total avoided emissions.

2 Establish system boundary, carbon saving mechanism, and BAU

For the chosen solutions, establish what the mechanism is that is causing the enabling effect - e.g. is it travel/fuel saving, or energy saving; and is the enabling effect directly attributable to the solution? Establish the system boundary, BAU baseline and functional unit

3 Document methodology and identify data requirements

Document the carbon saving mechanism and the calculation methodology. This will help to formalise the process, allow the methodology to be reviewed, and identify what data is required for the calculation. The documentation will be further refined when the calculation process has been completed.

4 Test mechanism & methodology

It may be useful to review the methodology at this stage. This may involve independent (internal or external) reviewers, and product specialists to test that the assumptions and proposed methodology are valid and reasonable.

5 Identify studies and determine the carbon abatement factor

Conduct research to collect data and studies that provide a auantitative basis for the calculation of the carbon abatement factor. These may be academic studies, other published reports, or internal project studies. The calculation of the carbon abatement factor should include the reference to the BAU baseline, the direct solution emissions, and rebound effects (where these can be quantified).

6 Collect data (for volumes and carbon abatement factor)

Complete the data collection related to the carbon abatement factor, and collect the data required to determine the volumes of the solution. (See discussion of data sources in section 3.7.4).

7 Calculate carbon abatement

The total carbon abatement can now be calculated by multiplying the carbon abatement factor by the volume for each solution, and then summing the results for all the products being assessed.

At this stage, where considering a portfolio of solutions, it is important to check for overlap between solutions, so that there is not double counting of the same avoided emissions being delivered by different solutions.

8 Final documentation and validation of the process

Fully document the methodology and calculation process, including the assumptions and data sources. Ideally, the documentation would be sufficient for someone to independently calculate the avoided emissions, and produce the same results. It is best practice to have the process independently validated. This provides for scrutiny of the assumptions, methodology and data sources; adds credibility to the process; and may identify any errors in the assumptions or calculations. This validation can be performed by either an external expert, an internal expert, or by a panel of reviewers.

2.3 Application of framework at solution, company and portfolio level

This methodology has been developed as a 'bottom-up' approach for individual products and services, and can then be applied to companies by totalling up the avoided emissions from the separate products for all of the company's relevant products.

For investors with a portfolio of companies then the approach is to sum up the avoided emissions from each company.

At each stage of aggregation it is necessary to check for overlap, as the same avoided emissions may be being delivered by different products and by different companies.

In the future, it could be imagined that all companies will report their avoided emissions as routine all to a consistent agreed standard (similar to current reporting of Scope 1&2 GHG emissions to CDP). Then it cwould be a relatively simple exercise to aggregate avoided emissions from all the companies in an investment portfolio. The reality is that only a handful of companies currently report avoided emissions, and there are no officially recognised agreed standards for measurement and reporting.

2.4 Reporting of avoided emissions

When reporting avoided emissions at a company level, companies should take care to include this in context with other actions that the company is doing on climate change, and particularly to report its efforts in reducing its own emissions. Thus there should be a 'dual approach' of reporting the Scope 1, 2 and 3 emissions and actions to reduce these (including setting science-based reduction targets), as well as reporting on the avoided emissions enabled by the company. If this is not done then companies will be criticised for not taking responsibility for their own emissions, while claiming credit for reducing emissions elsewhere. Note that different companies will validly have different priorities and emphasis between own emissions and avoided emissions - for example a heavily emitting company (such as a steel or cement manufacturer) should focus on reducing their own emissions, while a service company with significant potential to enable avoided emissions can validly focus on their avoided emissions (such as an architecture company that can reduce the emissions of buildings that it designs). In any case, reporting of avoided emissions should not be used to focus attention only on positive examples while ignoring significant emissions elsewhere.

Avoided emissions should be clearly reported as separate from a company's own Scope 1, 2 and 3 emissions, and should not be subtracted from its own emissions.

2. Guidance

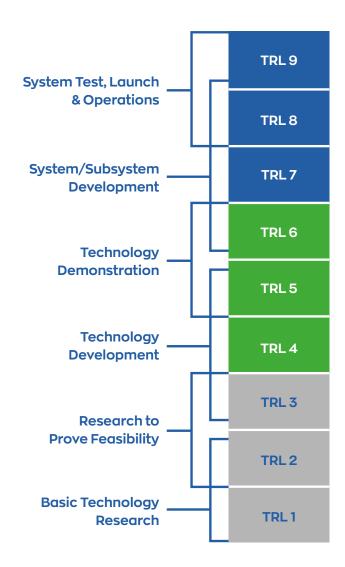
The reporting of avoided emissions should be transparent, clearly stating assumptions, and referencing sources of data. Ideally, the reporting would be sufficiently transparent that someone could independently calculate the avoided emissions, and produce the same results.

2.5 Assessing solutions at different TRI levels

In the calculation method (section 2.1.3) the concept of a 'probability of success' was introduced. This reflects the probability that the solution will be successfully developed, which relates closely to the concept of the 'Technology Readiness Level' (TRL). The greater the TRL, the greater probability that the solution will be successful. Thus if comparing two solutions that are at different TRLs, then all other things being equal, the solution with the higher TRL is likely to deliver greater avoided emissions.

This framework can be used to understand the impact of different development options for new technologies and what to focus on in the development process to deliver more significant avoided emissions. Depending at what stage of the TRL a technology is at, this analysis could fundamentally change the direction of the development (if at the lower end of the TRL scale), or might provide minor but significant changes in configuration and deployment of the technology (if at the higher end of the TRL scale).

The framework can also help with assessing different scenarios, in terms of the uncertainty of the solution, and how this might impact the magnitude and timing of the potential emissions reductions.



This section expands and discusses further some specific aspects and considerations of the methodology, and explores challenges and opportunities presented by the methodology. It is expected that as this and other related methodologies and approaches are used more widely, then the methodology will further develop and mature.

3.1 General principles

It is expected that the assessment of avoided emissions follows the GHG Protocol accounting and reporting principles of relevance, accuracy, completeness, consistency, and transparency. These are reproduced here from the GHG Protocol Corporate Standard:

Relevance Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.

Completeness Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.

Consistency Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

Transparency Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

Accuracy Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

Additionally, as the avoided emissions typically relate to a product or solution, it is recommended that where practical a life-cycle approach is taken to the assessment of the avoided emissions.

3.2 Materiality and refining of estimates

Another important principle is that of materiality – that is, the calculations and estimations should reflect the order of magnitude of carbon reductions and carbon emissions. Generally, more detail and better quality data is relevant for the most significant reduction potentials, while less detail is necessary for less significant areas. To understand the materiality, it is often useful to perform an initial high-level scoping assessment, which will identify the largest contributors to the carbon reductions.

This same principle should also be applied in relation to the scope and context of the assessment. For example, the same methodology can be used at a number of different levels:

- · Assessing an individual product
- Assessing a company's net-positive product portfolio
- Assessing an investment portfolio including a number of companies
- Assessing future potential avoided emissions from an existing solution in a specific country
- Assessing future potential avoided emissions from a solution under development in a variety of countries

For each of these different scenarios, different levels of data quality and estimation techniques would be appropriate. This can be imagined as a funnel of assessments, and as the scope and context is refined and becomes more precise, then so do the data and estimation methods needed also become more precise.

A further future scenario, is where avoided emissions can be verified and traded. This would have an additional level of rigour and independent validation required, and more detailed protocol to specify the calculation methodology, which could be sector or product specific.

3.3 Identification of solutions

When selecting solutions to be assessed, it is natural to focus on those that are going to have the most significant reduction potential. However, it is important to not only look at those solutions and ignore other related solutions that may have a negative impact. To use an extreme example, a company has an advisory service for energy efficiency that is 5% of the total company operations. It would be disingenuous to discuss the positive impacts, by only looking at the impact from the energy efficiency portfolio and ignoring the negative impact if the other 95% of the company is advising on exploration of tar sand and coal.

It is important to consider all of a company's product portfolio to avoid the accusation of cherry-picking. Although there may be situations where a company assesses only one product or a few products, this should only be the case if the ambition is to eventually use it across the complete portfolio of the company's products.

A related issue is where multiple products have similar impacts, and there is the risk of double counting the avoided emissions where different products enable carbon reductions that overlap.

3.4 Disruptive solutions

Disruptive solutions are ones that render existing technologies obsolete and create new markets. Truly disruptive solutions are rare and difficult to predict, and often have multiple and unexpected consequences that may be both positive and negative from a

climate change perspective. The nature of disruptive solutions means that they have the potential to enable significant avoided emissions, but there is also inherent uncertainty in their impact.

Assessing the future avoided emissions of disruptive technologies, requires some major assumptions about future market, adoption of the technology, behaviour changes, and success of the technology. Due to the potential scale of the impact, changes in assumptions will lead to significant range of results. Therefore, it is important to clearly state the assumptions used, and to perform some sensitivity analysis on the results. It can be useful to present different scenarios, to demonstrate the possible range of outcomes, as it is unlikely that there is only one valid scenario. It is always a brave and ambitious task to predict the future.

An example of a disruptive solution was the introduction and uptake of the mobile smartphone. This enabled new ways of working and interactions such as collaborative and mobile working, and has led to significant behaviour change. It has led to the ubiquitous rise of social media, and has been adopted at a massive scale world-wide.

3.5 Boundary

3.5.1 System boundary (Functional unit, direct emissions, LCA approach)

3.5.1.1 System boundary

The system boundary that is being considered should be clearly documented. The key principle of completeness should be followed – i.e. nothing should be deliberately left out, and also checks should be made for overlaps between different solutions which may deliver the same benefits and thus could result in double counting of the avoided emissions (see also section 3.11 on double counting).

The system boundary should clearly define what is included and what is excluded from the assessment. The following are examples of where there should be clarity over the inclusion or exclusion of specific items: embodied emissions of products; transportation of equipment and people; environmental control (e.g. cooling) of equipment; capital goods; and buildings.

In particular, a consistent approach and boundary definition should be adopted for both the BAU scenario and the enabling solution scenario.

It is also important to state clearly what secondary enabling effects are included (if any), and similarly what rebound effects are included in the system boundary. For example, longer term secondary enabling effects are often excluded due to the greater uncertainty relating to these, and that these typically relate to infrastructure changes such as reductions in building infrastructure or transport infrastructure. (This is also further discussed in sections 3.5.3 and 3.5.4).

3.5.1.2 Functional Unit

The functional unit defines the system boundaries in which the BAU scenario is compared to the enabling solution. This means that the functional unit should be applicable to both the BAU scenario and the scenario where the enabling solution is used. The functional unit should be clearly defined and measurable.

The functional unit will typically define the following three parameters:

- The quantity of the solution
- The time period for the solution
- The quality of the solution

For comparison purposes, it is useful to express the avoided emissions for an annual period, even if the study period is different. The avoided emissions may be expressed in terms of more than one functional unit, where that is useful – for example the avoided emissions for a year and also for a five year period. (Although if doing this, then it is important to check that the results do simply scale over a longer timeframe, or if other considerations need to be made.

It is also recommended to estimate the life-time avoided emissions for a product, as the impacts for infrastructure that may be around for decades is very different from product with a life time of just a few years. (See also section 3.5.2 for further discussion of timeframe).

Example - Functional Unit:

Video-conferencing: Different functional unit could be used to calculate the avoided emissions.

- Per video-conference for one year.
- Per video-conference room for one year.
- Per video-conference room for life-time of equipment.

3.5.1.3 LCA approach - Direct emissions from the solution

The direct emissions from the enabling solution relate to any emissions directly or indirectly due to the introduction of the solution. This can include embodied carbon emissions of the solution itself (e.g. carbon emitted during its manufacture) or energy consumption resulting from the use of the solution. Direct emissions, particularly the embodied emissions of the enabling solution, may be difficult to quantify and can, depending on the solution, be small in magnitude when compared to the primary enabling effects. ^{9 10 11}

The impact of the direct emissions should be acknowledged and documented, and where likely to be materially significant should be included in the calculation of the net avoided emissions.

Example - Direct emissions:

Video-conferencing: the direct emissions of the enabling solution are the embodied emissions of the video conferencing equipment, the energy use of the video conferencing equipment, and the emissions associated with the telecommunications networks used to transmit the video data.

Typically for video-conferencing, (as for most other solutions based on digitalisation), the direct emissions of the solution are relatively small compared to the enabling emissions. When this is the case, appropriate approximations can be used to estimate the direct solution emissions, ideally based on relevant previously published studies or using a screening assessment.

To assess the emissions of the solution a life-cycle approach should be followed covering all the life-cycle stages: raw materials, manufacturing, transport, use, and end-of-life. A pragmatic approach should be taken, so for example where the embodied emissions are likely to be small compared to the use stage emissions, then appropriate estimations can be used. If an existing LCA is available and appropriate, then it can be used, or alternatively a proxy may be used for a similar product. The approach taken will depend on the materiality and data availability.

3.5.2 Timeframe

Avoided emissions are often reported for a one year period. This allows for simple comparison between solutions, and takes account of any season variability. However, there are a number of cases where it is important to also look over different time periods.

For new solutions the adoption rate can change rapidly over months or years – thus both historic and predictive assessments should acknowledge this.

It may be useful to include a life-time emission reduction estimation. This makes it easier to highlight different important estimations and identify potential lock-ins. This would also be helpful to illustrate the benefit of solutions that have a short-lifetime compared to those with long term impacts. For example, there are other factors that should be included if you deliver a building or bridge that might be around for 100 years, compared to a mobile charger that might be around for 2-3 years.

3.5.3 Rebound Effects

Rebound effects occur when carbon emissions increase due to often unintended or ancillary use of the enabling solution. These may be excluded from the calculation of the avoided emissions, where it is difficult to quantify rebound effects due to data limitations. As is the case with secondary enabling effects, any identified rebound effects should be acknowledged and documented.

Rebound effects relate to an increase in emissions caused by consequential or unrelated effects of the solution avoiding the emissions. These effects are often unintended and often relate to difficult to predict behavioural changes that are either a direct or longer-term effect of the newly introduced solution.

Rebound effects are difficult to estimate as a number of different variables will impact the magnitude of the rebound effect. As a result, despite being widely acknowledged in theory, rebound effects are often not accounted for when calculating the avoided emissions of solutions.

Example - rebound effects:

Video-conferencing: Due to the availability and ease of video-conferencing, this is likely to lead to an increase in the number of meetings. This will be reflected in an increase in the use of video-conferencing facilities and equipment, which consequently leads to an increase in the electricity used for videoconferencing equipment, and other emissions associated with the facilities.

Most calculations simply acknowledge the possibility of rebound effects, without further quantification. This highlights a very important gap between the theoretical and practical approach of estimating avoided emissions. Many documents on the topic of avoided emissions highlight the importance of taking all effects, including rebound effects, into account when calculating the avoided emissions of a solution. Forum for the Future for example encourage the estimation of rebound effects by conducting 'new research or by making an allowance based on existing complementary research'.

Acknowledging and assessing rebound effects are particularly important when their impact has the potential to outweigh the positive impact of the avoided emissions. In these circumstances, the failure to quantify rebound effects could lead to wrong conclusions about the net carbon impact of a solution. In these situations the likelihood of the rebound effect outweighing the positive carbon impact should be assessed by conducting a sensitivity analysis, which tests the impact of changes in different variables. Furthermore, it is recommended to investigate, over time, the uncertainty around individual variables allowing for a more accurate calculation of the rebound effect.

If the rebound effect is assumed to be relatively small compared to the impact of the avoided emissions, the most practical solution is to simply acknowledge the likely impact of the rebound effect on the total avoided emissions estimated.

Where it is not practical to quantify the rebound effects, a useful step is to identify the potential rebound sources and to identify ways to counteract them.

One particular kind of rebound effect is where the financial savings related to the enabling solution are used for other activities that

cause additional carbon emissions. For example, a new domestic heating system saves energy and also saves money. This money is used for additional weekend holidays resulting in increased flight emissions. However, the counter-point to this is that as society decarbonises the alternatives for spending additional disposable income will also become lower carbon.

3.5.4 Primary and secondary enabling effects

Enabling effects, directly or indirectly attributable to the use of the enabling solution, should be identified and assessed in order to calculate the avoided emissions. The enabling effects are subdivided into two types:

1. Primary Enabling Effects:

Immediate reduction of BAU emissions occurring as result of the solution implementation.

All primary enabling effects should be included in the calculation of the avoided emissions.

2. Secondary Enabling Effects:

Secondary enabling effects are those expected to reduce emissions relative to the BAU system, but which occur over a longer timeframe or as a result of increased scale of adoption.

Secondary enabling effects (sometimes called indirect effects) tend to have an impact over a longer time period. As a result it becomes difficult to establish a direct correlation between the enabling solution and the enabling effect. There is uncertainty both regarding the likelihood of these effects occurring, as well as the scale of adoption. This makes it even more difficult to quantify secondary enabling effects. In addition, secondary enabling effects may lead to unintentional rebound effects.

Secondary enabling effects, therefore, are often excluded from the calculation of the avoided emissions. However, any identified secondary effects should be acknowledged and documented.

Example - enabling effects (video conferencing):

Primary Enabling Effects: the reduction in business travel enabled by video-conferencing reduces distance travelled and associated emissions.

Secondary Enabling Effects: As the number of business trips is reduced, the use and need for company cars diminishes, and as a result the total number of vehicles owned by a company may also decrease resulting in a long-term reduction in emissions from the manufacture of new vehicles. Similarly this could lead to a reduced number of new aircraft manufactured.

3.6 Baseline

A reasonable and reliable baseline or BAU scenario needs to be defined in order to measure the avoided emissions of the solution. The baseline represents the 'before' scenario of a specific process, i.e. what is the most likely alternative solution to be used to achieve a certain outcome in the absence of the enabling solution. The BAU baseline reflects the situation in the absence of the enabling solution. Defining the baseline is a crucial step of the methodology, as the baseline is used to compare the enabling solution against, and will impact the scale of the avoided emissions.

One of the most important decisions to make when calculating the avoided emissions of a solution is to decide what to compare it to, i.e. what should the baseline or the Business-As-Usual scenario be. The baseline represents the situation as it would be without the enabling solution in place. The chosen baseline should represent the most widely used alternative to achieving the same outcome. The question that needs to be asked is: 'What would have happened without the solution?' As the baseline emissions will directly determine the magnitude of avoided emissions, it is important to choose an accurate and reliable baseline.

One challenge in choosing the baseline from which to measure the avoided emissions is determining the most widely used alternative. For example, the alternative to speaking to friends on the phone is visiting them in person. But what is the most widely used transport method to do so? It is obvious that today cars are preferred to horse carriages, which would have been the main form of transport more than a hundred years ago (before the telephone was widely available).

The emissions of the



Replace the emissions of the



However, in other cases, where technology has only recently been replaced, the decision may not be so obvious. The issue is that if a baseline is chosen, which no longer represents the most widely used alternative, avoided emissions might be over or understated. Furthermore, even at a single point in time, there may be more than one possible alternative. For example, the most widely used alternative to using a phone to call your friends today may be visiting them by car, airplane or even bicycle. This case highlights that location is another important factor that will influence what is considered to be the most appropriate baseline.

Furthermore, one could also argue that the most widely used alternative to using a phone to call friends is now using Skype to call

your family over the internet. This highlights that the baseline might be rapidly changing due to changing technologies or because of a change in human behaviour. As a result, the baseline needs to be continuously reviewed and updated if necessary.

Recognising the challenges of choosing the most appropriate baseline, it may be sensible to develop a scenario based on a combination of different alternatives.

3.7 Data quality

3.7.1 Uncertainty

Uncertainty describes how accurate results are or how close to the 'true' value a result is. Typically the uncertainty will relate to a statistical or probability assessment of the results. The calculation of avoided emissions typically uses various data sources including volume data and other factors to calculate the carbon savings. Often, the result is highly dependent on saving factors and assumptions, which have few data points and therefore cannot be analysed statistically. In this case it is not practical to perform a statistical uncertainty analysis. In other cases, where it is possible to perform an uncertainty analysis, the resource and time required may be excessive. An alternative, and a complementary approach, is to carry out a sensitivity analysis by varying some of the key parameters and assumptions to understand the impact on the result.

3.7.2 Assumptions

Where possible, avoided emissions calculations should be based on available primary or secondary data. In the absence of required data, appropriate assumptions may be made. Assumptions should be clearly documented along with a justification and evidence supporting the assumption. Ideally, assumptions should be based on surveys, reports or other credible published data. If conflicting information is available for one assumption, the most conservative assumption should be used in order to not overstate the avoided emissions.

3.7.3 Types of Data

Different types of data can be used to calculate the avoided emissions. The different types of data include: primary, secondary and modelled data. Primary data relates specifically to the solution being assessed, secondary data is derived from other sources, and modelled data is derived from modelling based on sampling, proxies and assumptions. Primary data will always be the preferred option, although primary data may be substituted with secondary data in the absence of available primary data. Modelled data derived from a number of assumptions may also be used, but only if no other primary or secondary data is available. The level of data quality, including any uncertainties, should be documented.

3.7.4 Sources

In order to prevent the use of assumptions and data from biased sources, multiple sources should be considered for a single parameter and compared against each other wherever feasible. The source that offers the most relevant information for the calculation should be identified during the comparison of multiple sources. For example, a study providing a specific piece of data might be geographic-specific and therefore not appropriate to use. In order to avoid using dubious sources, all sources should be checked for unreliable data or inappropriate assumptions. All sources should be documented and clearly referenced.

Company sources may often be considered as biased - but in many cases companies are the only ones that have access to actual measured data and are preferred for that reason. This perhaps demands more validation, but not to use company sources may lead to lower data quality in many cases.

It is important to consider both the quality and original source of the data used in the calculation of the avoided emissions from any solution. First, it is important to ensure the highest quality data is used with primary data being applied where possible. If primary data is not available, secondary data from published sources can be applied. Finally, in the absence of secondary and primary data, estimations can be made based on validated assumptions. Any assumptions should be clearly stated and substituted with more accurate data if this becomes available.

The source of data is also important and considerations should be taken with regards to location and date of the data source. Where there are multiple sources for data points, the most recent data should be used and it is also important to consider the context and background of the study from which the data came. This will indicate whether the data point is appropriate for the calculation.

To avoid using biased data or data based on inappropriate assumptions, all data points used in the calculation of avoided emissions should be, if possible, cross-checked against multiple other data sources to validate that the data point is feasible. Furthermore, it is best practice to document and reference all data sources used for the calculation of avoided emissions of specific solutions based on digitalisation opportunities.

3.8 Transparency

Transparency is crucial to the process of calculating the avoided solutions from a solution. It helps to provide confidence to stakeholders that the avoided emissions calculations are as robust and accurate as possible. Being transparent includes clearly documenting all assumptions, data sources, gaps and issues, provided that this will not compromise any commercially sensitive information.

3.9 Emission factors

Emission factors should reflect full life cycle emissions – for example emission factors for electricity should include generation, transmission and distribution, and upstream 'well-to-tank' (i.e. emissions associated with extraction and transportation of fuel used for electricity generation).

Future projections should use emission factors that reflect projected decarbonisation of the electricity grid, and decarbonisation of transport. Thus future reductions in electricity use and reduction in transport will result in less avoided emissions than the same reductions today.

Emission factors should be appropriate to the assessment and the purpose. However, there may be a conflict, for example, between using a locally relevant emission factor compared to using one which is appropriate to the technology being considered. There may be a trade-off necessary to address such conflicts.

3.10 Attribution (Allocation)

Often avoided emissions are the result of multiple products or services working together. Therefore one solution alone is not responsible for all the avoided emissions. There is currently no consistent way to allocate avoided emissions, thus it is common practice to attribute all of the avoided emissions to a solution where that solution has a fundamental role in enabling the avoided emissions. The test of a fundamental role may be determined by whether the avoided emissions would only be realised with the existing of the solution (i.e. if the solution did not exist would the avoided emissions still take place?).

Example - attribution:

Video-conferencing: videoconferencing has an enabling effect through avoiding the requirement to travel for a business meeting. For the video-conference to take place we can assume that the following is necessary: the video-conference equipment, software running on the equipment, and the telecommunication network. Without any one of these technologies the video-conference would not be able to happen, thus they all have a fundamental role in enabling the avoided emissions.

Thus, in this example, all 3 companies (the equipment provider, the software provider and the telecommunications provider) could claim the total avoided emissions.

There are some challenges with this approach, including:

- 1. There is 'double counting' (with multiple companies claiming the same avoided emissions)
- 2. The avoided emissions claimed by each participant does not necessarily fairly represent their role in the overall solution (e.g. one participant may only have a minor role, but is still claiming credit for the total avoided emissions)

Companies have so-far not attempted to allocate avoided emissions because:

- 1. It adds an extra layer of complexity to an already expensive, complex and uncertain process.
- 2. Scope 3 carbon accounting allows for double counting. As an extension of an organisation's impact outside of their organisation, avoided emissions can be seen as analogous to an organisation's scope 3 impact (i.e. the positive side of their scope 3 impact) and therefore there is not a problem with double-counting of avoided emissions, so long as this is clear and transparent.
- 3. No obvious solution exists and no standards exist for assessment of avoided emissions.

An organisation may wish to allocate avoided emissions to different elements of the solution in order to communicate a 'fairer' picture of the positive impact they are playing. This may help drive organisations to innovate further and deliver solutions with a positive carbon impact.

A successful attribution methodology would meet the following criteria:

- Practicable (i.e. data exists that could be used for calculations, or could be easily measured)
- Objective (i.e. reduces how arbitrary an attribution is)
- Accessible (i.e. easy to understand)
- Fair
- Affordable
- Transferrable (i.e. can be consistently applied across different products / companies / sectors)

Possible attribution approaches to consider:

- · Allocate equally between all different elements
- Financial cost attribution
- Financial value attribution
- Stakeholder consensus

3.11Double-counting

Double counting of avoided emissions should be avoided where possible, although there are some cases where it may be valid to have double-counting. If this is the case, then this should be clearly

stated and explained. Some possible situations involving doublecounting of avoided emissions have been mentioned previously and are discussed further below:

- Accounted for in multiple contributors to the same solution
- Accounted for in other GHG scope of the company
- Accounted for by overlapping product of the same company

Accounted for in multiple contributors to the same solution

This situation has been discussed earlier in the section on 'Attribution' (see 3.10), and reflects the case where multiple products or services contribute to the overall enabling solution, and all claim credit for the avoided emissions. This may be valid, where this relates to products from different companies, as it is analogous to Scope 3 accounting, which by definition involves double-counting of emissions.

Accounted for in other GHG scope of the company

This situation is where a company is reporting its avoided emissions in comparison to its own Scope 1, 2 or 3 emissions and some of the avoided emissions are the same as a reduction in the company's Scope 1, 2 or 3 emissions. For example, if a company reports its avoided emissions in comparison to its own operational emissions, and it provides a solution that reduces the number of truck rolls required, and the trucks are owned by the company, then the emission reductions associated with the trucks would already be accounted for in company's scope 1 and 2 carbon footprint, and should not be included in the carbon abatement.

Accounted for by overlapping product of the same company

In the case where the avoided emissions of two products from the same company overlap, then the overlapping avoided emissions should only be counted once. For example, a company might provide vehicle telematics solutions, and also provide a mobile app to improve driver behaviour to its customers. Both these solutions enable carbon savings by improving driving behaviour. Where a customer has both the mobile app and the telematics solution, then the overlapping avoided emissions should only be accounted for once.

3.12 Best practices

These are some of the learnings from calculating avoided emissions by the companies. It is not intended as an exhaustive list, but aims to highlight some the key issues together with a discussion of how to address these, and how they impact the avoided emissions.

The following points highlight best practice when calculating avoided emissions:

- Where possible, avoid using arbitrary assumptions (e.g. 'we assumed 50% adoption'). Preferably, base all assumptions on data and studies, or undertake sample surveys to have a more factual basis.
- If there is high uncertainty about the assumptions then be cautious with the assumptions i.e. understate the benefits and use conservative assumptions. And preferably present the results for different scenarios, and perform a sensitivity analysis.

- Documentation of assumptions and methodology should be sufficiently detailed that someone else could independently calculate the avoided emissions, and produce the same results. This adds credibility and may identify errors in the assumptions or calculations.
- It is best practice to carry out an Independent Review of the assumptions and calculations. This may be undertaken internally or externally. Guidance on carrying out independent reviews is provided in the GHG Protocol Product Standard,¹² Chapter 12: Assurance.
- Carry out sense checks on the assumptions, data and results:
 - Do the assumptions, data and results seem reasonable?
 Do they match with experience, are they credible? Often, expressing the savings in percentage terms helps to provide the context to do a reasonableness check.
 - Cross check against other data compare with national statistics, other sources of data, and other studies. And where there are discrepancies discuss how the results differ, and the motivation for using specific data.
 - Carrying out both top-down and bottom-up assessments is another method to check how reasonable the results are. How close are the results from a top-down approach compared to a bottom-up approach? Do the two methods 'meet in the middle'?
 - Avoid using single source of data some data and studies may not be representative, either because of the scope of the study, or because it was a trial under idealised conditions. Where possible get two or three sources for data and take a judgement as to which is the most representative, or take an average, or take the most conservative. Often an expert opinion may be more reliable than simply taking data at its face value, particularly where there is conflicting data, or the underlying assumptions behind the data are not clear.
 - Check the results against total sector emissions expressing
 the avoided emissions results as a percentage of the total
 carbon emissions of the related sector (or of the total
 deployment of the original solution) will provide a very useful
 sense check. Is it reasonable that the scale of the enablement
 being considered is able to achieve this impact? For example,
 if the avoided emissions are more than 100% of the relevant
 emissions, then there is something wildly incorrect.
 - If reusing data from previous studies, check that the assumptions in the original study are relevant to the assessment being carried out. Are the same conditions applicable? Are the geographical and technological scopes the same?
 - Do the results pass the 'blush test'? That is, would you be comfortable to stand on a public platform and explain the results and the assumptions without fear of embarrassment and awkward questions that cannot be convincingly answered?



4. Worked Examples of Framework Application at a Solution Level

These three worked examples will help to illustrate how the methodology could be applied, and also include a discussion of the opportunities and challenges presented by these examples. These worked examples are currently being developed. A short description of each is included at present.

4.1 Mobility - Car club sharing

Car club membership is a low-carbon alternative to owning a private car, as it has been shown to reduce greenhouse gas (GHG) emissions whilst providing other benefits such as improved air quality and safety.

The car club model offers user private mobility without the commitment to car ownership, by allowing members to conveniently book vehicles on an hourly, daily or longer basis. Car club vehicles service a greater number of users and many members can either dispose of an owned vehicle or avoid purchasing one, resulting in avoided embodied emissions through reduced demand for vehicles.

At the same time, the per-use pricing of car clubs vs. the significant capital ownership of an owned car encourages the use of more sustainable modes of transport for shorter journeys or where good public transport links exist. Finally, car club vehicles are, on average, newer and have lower emissions than the private car fleet.

4.2 Buildings - Domestic heat pumps

This worked example considers replacing existing domestic heating by heat-pumps. The base case is the existing domestic heating systems, which may be gas, oil or conventional electricity-powered heating systems. The worked example is used to illustrate the calculation of the avoided emissions, and also considers the impact of different factors such as comparing different countries, different adoption rates, and different electricity grid decarbonisation rates.

4.3 Nutrition - reducing emissions intensity of food

This worked example looks at two ways that the emissions intensity of food could be reduced.

- 1. replacing animal protein based food with plant based protein
- 2. public information campaigns that provide information on lowcarbon recipes and health related information, encouraging behavioural change to lower-carbon diets

The worked example illustrates the calculation of the avoided emissions, and also considers the impact of different factors such as comparing different countries, different adoption rates, and different options for the carbon intensity of the foods or diets.

Appendix 1 - Examples and References

Introduction

This includes a selection of related initiatives that are relevant for the concept of avoided emissions. These include related methodologies, standards, calculation tools, and examples of use by investors, companies and other organisations.

The list is purely meant to provide examples and references, and does not claim to be exhaustive or complete. Any omissions or errors are the responsibility of the authors of this document and do not reflect the organisations themselves.

It is intended that this list may be extended and added to in future.

Examples

The following table summarises examples of related initiatives. (Note: table to be completed).

Initiative	Category	Brief Description	Reference
FTSE Russell Green Revenues data model and Green Revenues Classification System	Classification Framework	The Green Revenues Classification System defines the 60 industry subsectors which are supporting the transition to a green economy within eight broad sectors: energy generation, energy equipment, energy management, energy efficiency, environmental infrastructure, environmental resources, modal shift and operational shift. The data model then measures how much of a company's revenue is linked to a green good, product or service.	https://www.ftserussell.com/financial-data/ sustainability-and-esg-data/green-revenues- data-model
WWF Climate Solver Tool and methodology	Tool and Methodology	The Climate Solver Tool is an online platform that estimates the avoided greenhouse gas emissions and energy use from an innovative product. The calculations are based on the potential market for an innovation, the climate impact of the innovation, the climate impact of a baseline scenario and the estimated market share for the innovation. The tool was launched in 2012.	http://www.climatesolver.org/
Climate Impact Forecast (CIF) assessment tool	Assessment tool	The Climate Impact Forecast tool was developed by Climate-KIC, which is a public-private partnership that works on innovative ways to adapt to climate change. The tool allows a business to assess whether a product or idea has a negative or positive carbon footprint compared to the product or idea it is replacing. The user can input data about their product and analyse if it reduces, prevents or replaces fossil fuels within different areas of production.	Tool to be launched shortly.
Carbon Delta 'green patent' approach	Methodology	Carbon Delta's 'Climate Value-at-Risk (VaR)' methodology analyses the amount of patents a company has and categorises these into which are green as a predictor for low carbon profits. Patents are evaluated on their market potential, cost and monetisation strategy and are combined with other patents to determine how much a company's portfolio is green.	https://www.carbon-delta.com/

Appendix 1 - Examples and References

Initiative	Category	Brief Description	Reference
Business Sustainability 3.0 - Lausanne	Methodology	The Business School Lausanne (BSL) in Switzerland has developed a methodology called True Business Sustainability/Business Sustainability 3.0. This approach evaluates the level that sustainability is integrated into a business and helps them take advantage of the benefits of aligning actions to the Sustainable Development Goals.	https://www.bsl-lausanne.ch/business- sustainability-typology/
WHEB Sustainability Fund and Impact Report	Investment assessment	WHEB's strategy is to invest in companies that benefit from, and enable, the shift to a more sustainable economy. The WHEB Sustainability Fund groups different environmental investment themes that are then used to calculate the green credentials of the fund. WHEB assesses the companies in the fund and measures the total ability to save energy, generate clean energy and avoid emissions to calculate an avoided emissions figure.	http://www.whebgroup.com/media/2017/05/ WHEB-Impact-Report-2016-1.pdf
Blackrock - Laurence Fink open letter Jan 2018	Open letter	Blackrock is the world's largest investment management company with over \$6.3 trillion in assets. Blackrock have published reports on adapting investment portfolios to climate change, detailing the risks and opportunities going forward. On 26 January 2018, Blackrock's CEO Laurence Fink sent an open letter about companies needing to think more about their long-term future and put purpose at the heart of their business, which has sent a clear environmental message to investors around the world.	http://www.ethicalcorp.com/comment-how-laurence-finks-letter-ceos-has-raised-bar-business
Transition Pathway Initiative (TPI) Methodology	Methodology and investment analysis	The TPI was set up between the investment bodies of the Church of England and the Environment Agency Pension Fund. It is supported by asset managers and owners with over £5 trillion under their control. The TPI assesses high-impact sectors, such as oil, gas and mining, to understand what the transition to a low carbon looks like and how businesses can adapt their business models. The analysis is also used to direct investment decisions and engagements with companies in an investment portfolio.	http://www.lse.ac.uk/GranthamInstitute/tpi/methodology/
Buildings EDGE tool for World Bank -	Standard and certification	The Excellence in Design for Greater Efficiencies (EDGE) is a sustainable building standard and a free online software that gives specific building stakeholders an insight into the most cost-effective options for resource-efficient design. The EDGE software and standard directs investments towards sustainable solutions that reduce water, resource and energy use, thus avoiding CO ₂ .	https://www.edgebuildings.com
IRENA avoided emissions calculator	Assessment tool	The International Renewable Energy Association, IRENA, has developed a tool to estimate the greenhouse gas emissions avoided each year as a result of renewable energy deployment in a country.	http://www.irena.org/climatechange/Avoided- Emissions-Calculator
Climate KIC Mitigation assessment	Methodology guidance	Climate-KIC invest in projects and solutions that help address climate change. All projects develop and implement products, processes, technologies, services and tools that can significantly reduce greenhouse gas emissions. Climate-KIC has developed a technical guidance that helps estimate the projects in terms of mitigating greenhouse gas emissions.	http://www.climate-kic.org/wp-content/ uploads/2016/07/Guidance-Mitigation-Climate- Impact-Assessment.docx
Caring for Climate Initiative	Methodology	Caring for Climate is organised by the UN Global Compact, UN Environment and UNFCCC, and brings together businesses to tackle climate change. They published a paper in 2009 to provide an overview of the possibilities for calculating and reporting a company's positive contributions to societal emissions reductions.	http://caringforclimate.org/forum/wp-content/uploads/LCLP_Calculations.pdf
IFC GHG reduction accounting guidance	GHG reduction accounting guidance	The World Bank's International Finance Corporation (IFC) have published the 'IFC greenhouse gas reduction accounting guidance for climate-related projects' (May 2017). This is a technical guidance for IFC investment and advisory staff assessing the GHG emissions reductions for climate related projects.	https://www.ifc.org/wps/wcm/connect/21d21b80423bdbf19f39bf0dc33b630b/IFC+GHG+Reduction+Accounting+Guidance.pdf?MOD=AJPERES

Appendix 1 - Examples and References

Initiative	Category	Brief Description	Reference
ICCA and WBCSD avoided emissions guidelines for chemicals	Methodology guidelines	The International Council of Chemical Associations (ICCA) and the World Business Council for Sustainable Development (WBCSD) have developed guidelines for reporting avoided greenhouse gas emissions along the value chain of different chemical products.	https://www.wbcsd.org/contentwbc/ download/1888/24018
LafargeHolcim avoided emissions protocol for cement-based products	Methodology	Protocol for quantifying avoided GHG emissions along the value chains of cement and concrete products.	https://www.lafargeholcim.com/sites/ lafargeholcim.com/files/atoms/files/ lafargeholcim-avoided-emissions-protocol.pdf
GEF Guidelines on GHG Accounting and Reporting for GEF Projects	Methodology	The Global Environment Facility (GEF) has developed guidelines for greenhouse gas emissions accounting and reporting for assessing GEF projects. It identifies the impact of a policy, action or project and then estimates a baseline scenario and compares it against a policy scenario and alternative solution in order to estimate the GHG reduction effect.	http://www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.C.48. Inf09_Guideline_on_GHG_Accounting_and_Reporting_for_GEF_Projects_4.pdf
GHG reductions enabled by solar PV systems	Academic paper	Academic paper describing a simple methodology for estimating the climate change mitigation of solar photovoltaic (PV) systems by calculating the avoided GHG emissions for specific PV applications in respective regions. Christian Breyer, Otto Koskinen, Philipp Blechinger.	http://www.sciencedirect.com/science/article/ pii/\$1364032115003317
ING	Investment fund example	In January 2018, Dutch Bank ING launched a €100m Sustainable Investments fund that will provide capital support targeted at companies with proven concepts that can deliver positive environmental impacts.	https://www.edie.net/news/6/ING-announces- EUR100m-Sustainable-Investments-fund/
Net Positive Project	Coalition and methodology guidance	The Net Positive Project is a coalition of organisations committed to developing a net positive approach for businesses. It has published frameworks and guidance principles for measuring and communicating an organisation's net positive approach. The Net Positive Project was launched in 2016 by Forum for the Future, BSR and SHINE, and had developed from the previous Net Positive Group (convened in 2013 by FFF, TCG and WWF).	https://www.forumforthefuture.org/project/net-positive-project/overview

Appendix 2 - Glossary

Avoided emissions

Reductions in emissions caused indirectly by a product. This is where a product provides the same or similar function as existing products in the marketplace, but with significantly less GHG emissions'.

BAU baseline

The Business-as-Usual (BAU) baseline reflects the situation in the absence of the enabling solution.

The baseline represents the 'before' scenario of a specific process, i.e. what is the most likely alternative solution to be used to achieve a certain outcome in the absence of the enabling solution.

Enabling solution

The product, service, or technology that enables the avoided emissions.

Rebound effects

Rebound effects negate some portion of the enabling-effect avoided emissions due to additional changes in human behaviour within the system boundary caused by or related to the availability of the enabling solution.

Endnotes

- 1 https://climateactiontracker.org/
- 2 https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab
- 3 http://mission-innovation.net/wp-content/uploads/2018/05/MI3-Action-Plan.pdf (see under Goal 02).
- It can be argued that financial accounting has existed for more than 7,000 years, with ancient accounting records having been found in Mesopotamia. The Roman Empire kept detailed financial records. Luca Pacioli, recognized as The Father of accounting and bookkeeping was the first person to publish a work on double-entry bookkeeping in 1494. The first international standard on GHG accounting was the ISO 14040 on life cycle assessment first published in 1997.
- 5 See the GHG Protocol Product Standard, chapter 11, sections 11.2 and 11.3.2. The Product Standard defines avoided emissions, but classifies them as outside the boundary of a product's life cycle, and as such must be reported separately from the product's life cycle emissions.
- 6 https://www.pamlin.net/s/Cybercom-Digital-Sustianability-full-report.pdf
- 7 http://www.ghgprotocol.org/standards
- $8 \quad \overline{\text{http://gesi.org/report/detail/evaluating}} \text{the-carbon-reducing-impacts-of-ict-an-assessment-methodology}$
- 9 Malmodin, J and Bermark, P. 2015. Exploring the effect of ICT solutions on GHG emissions in 2030. Ericsson. http://www.atlantis-press.com/php/pub.
 php?publication=ict4s-env-15
- 10 Ericsson.2011. Case study: Mobile Money Kenya: Life Cycle Assessment of ICT enablement potential. https://www.ericsson.com/res/thecompany/docs/success_stories/case_mobile_money_final.pdf
- 11 Ericsson.2009. E-health Croatia: Life Cycle Assessment of ICT enablement potential https://www.ericsson.com/res/thecompany/docs/success_stories/2009/e-health_croatia.pdf
- 12 GHG Protocol (2011), Product Life Cycle Accounting and Reporting Standard, World Resources Institute and World Business Council for Sustainable Development.

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