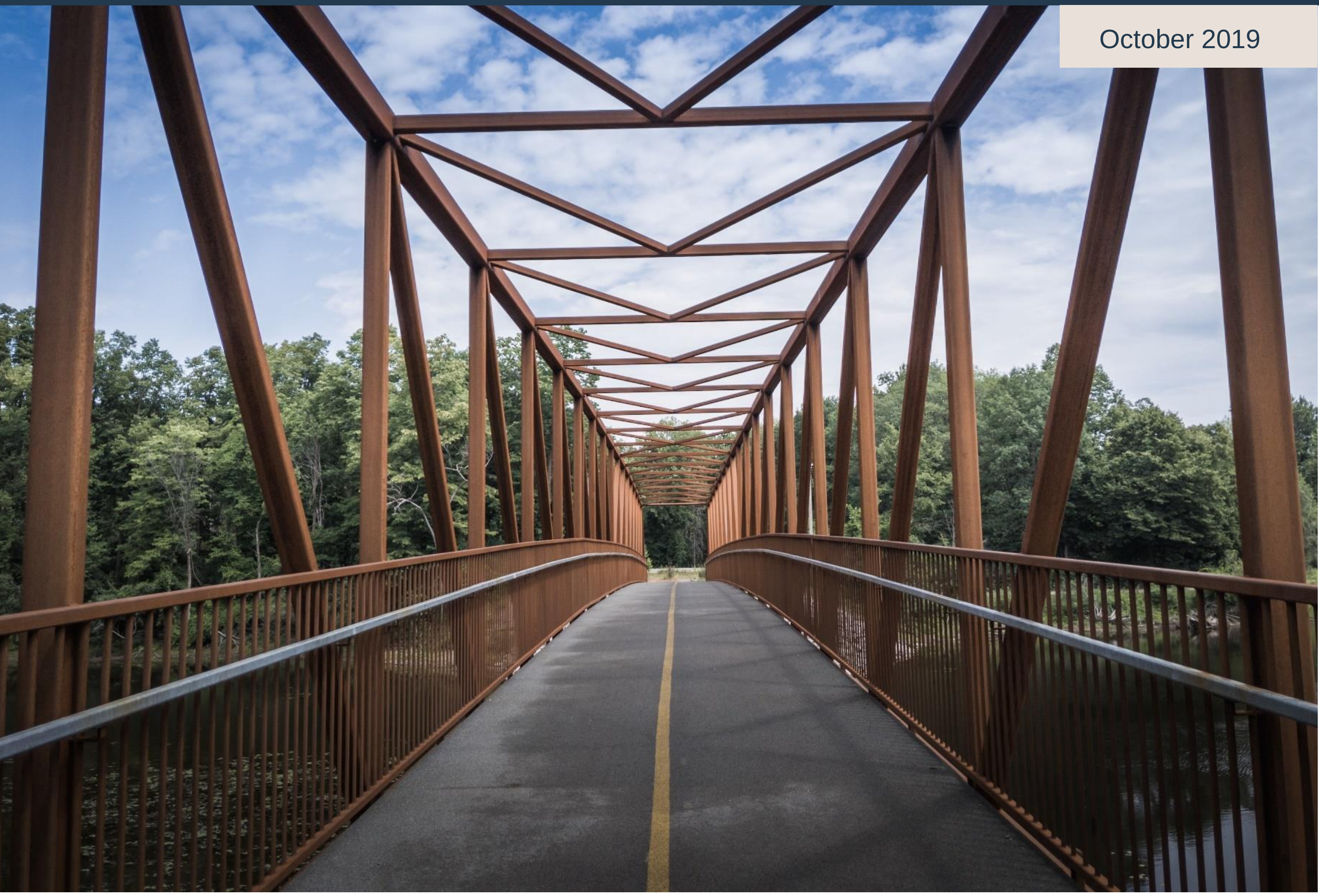
Aligning Portfolios with the Paris Agreement

October 2019



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Summary

Whether voluntarily or in response to regulation, investors are increasingly looking at the links between their portfolios and climate change. So far, there is no clear consensus as to how to perform such evaluations.

Among the existing approaches based on carbon emissions, most exclude lifecycle emissions of a company’s products and do not take into account their potential to reduce emissions. The results, often in absolute units (i.e. tons of CO_2), are not necessarily suited to straightforward interpretation.

Other methods seek to evaluate portfolios relative to a breakdown of investments by energy subsector needed to attain a certain climate scenario. These approaches avoid the complexity introduced by carbon emissions and offer a simple result: compatible or not compatible. But, measuring a portfolio against an allocation of investments has its limits. Not all portfolios are intended to be representative of the economy as a whole and, more importantly, there is no single, agreed-upon investment scenario for achieving climate objectives.

So, we have developed a new method to evaluate the coherence of a portfolio with climate scenarios using:

- A carbon emissions database, including both induced and avoided emissions over the lifecycle of a company’s products. This database was created through a multiyear collaboration between Mirova and Carbon4finance.
- Climate scenarios and investment projections from the Intergovernmental Panel on Climate Change.
- Investment projections from the International Energy Agency.

Combining these sources allows us to produce an evaluation in degrees Celsius corresponding to the climate trajectory implied by investment in a portfolio. The results are in line with qualitative analysis.

Example of Index Evaluations

	CAC40	MSCI Europe	S&P 500	MSCI World
Climate Trajectory	**5.0°C**	**4.2°C**	**4.3°C**	**4.1°C**
Induced (tCO2/m€)	*227*	*223*	*91*	*129*
Avoided (tCO2/m€)	*14*	*18*	*7*	*11*

Source: Mirova / (Carbon4finance, 2015), carbon data as of October 2019

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I. Introduction to Carbon Accounting

We are convinced that a comprehensive carbon footprinting method – counting the emissions created and avoided over the full lifecycle of a company's activities – forms the most effective basis for building investment portfolios that effectively reduce risks and capture opportunities related to climate change.

Lifecycle Impacts

Consuming less fossil fuel to combat climate change would not only affect those who burn the fuel. It would also affect those who extract and sell the fuel and those who sell machines that use the fuel. Along the same lines, the carbon impacts of a company are clearly not limited to its direct activities, but also the activities of its suppliers and its customers. Assessing impact on a lifecycle basis means considering both the direct and indirect climate impacts of a company.

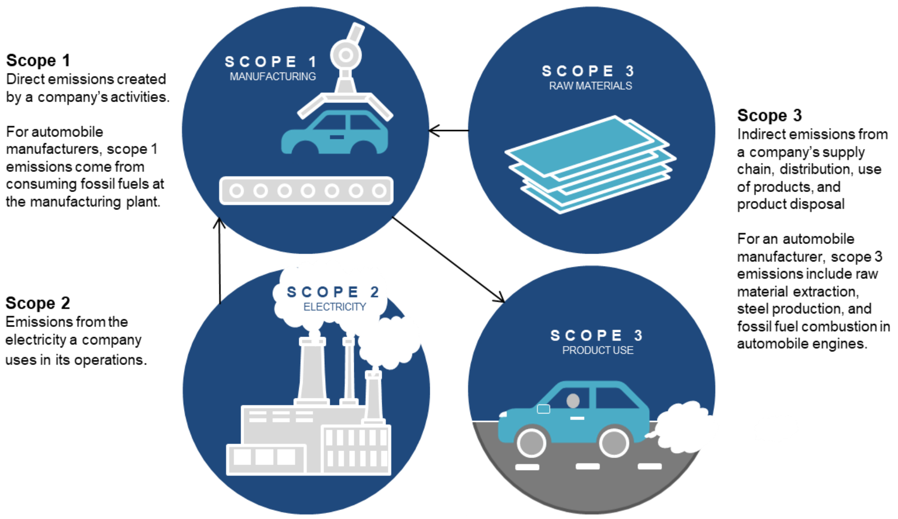
A company's lifecycle carbon emissions are typically divided into three "scopes".

- **Scope 1:** direct emissions created by a company's activities.
- **Scope 2:** indirect emissions from a company's electricity and heat use.
- **Scope 3:** indirect emissions from a company's supply chain, distribution, use of products, and product disposal.

Induced emissions refer to the greenhouse gases a company physically discharges into the atmosphere. Most companies report on their induced emissions through scopes 1 and 2. These scopes are relatively easy to measure and track by looking at purchase and combustion of energy commodities (scope 1) or by using an electricity or gas bill (scope 2). Scope 3 emissions, on the other hand, are difficult to measure. Tracking and allocating scope 3 emissions can be more complicated in the context of complex supply chains and product use.

Nevertheless, in most "high-stakes" sectors (e.g. fossil fuel extraction and production, industrials, automobile and airplane manufacturing, agriculture), scope 3 emissions are far greater than scopes 1 and 2 combined. In these sectors, scope 3 emissions can represent the bulk of the company's emissions. As a result, all three scopes must systematically be assessed, especially in these critical "high-stakes" sectors, to understand a company's climate impacts. (Please see Figure 3 for examples, and (Carbon4finance, 2015) / (EU Technical Expert Group on Sustainable Finance, 2019) for more information about "high-stakes" versus "low-stakes" sectors.)

Figure 1: Schematic of Emissions Scopes for an Automobile Manufacturer



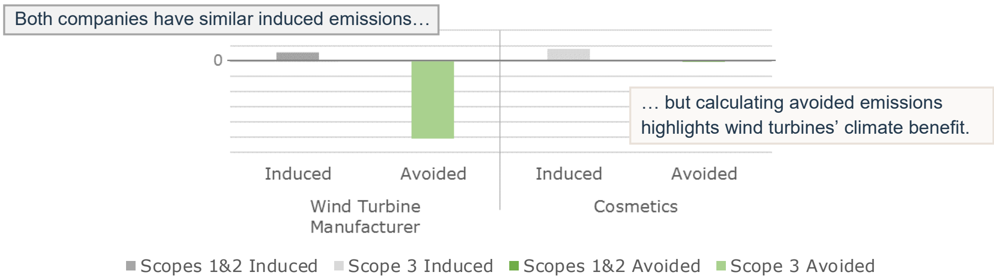
Source: Mirova

Identifying Solutions Providers

Even when all three scopes are considered, induced emissions do not necessarily paint a complete picture of company's climate impacts. A company that manufactures cosmetics, for example, might have the same total induced emissions over all three scopes as a company that manufactures wind turbines. Should we only look at induced emissions, the cosmetics company and the turbine manufacturer would appear comparable in terms of climate impacts. But this is counterintuitive: a turbine manufacturer clearly contributes far more to decarbonization objectives and the energy transition. Furthermore, it would benefit from a global transition to a low-carbon economy while the cosmetics company would not.

To better appreciate a company's positive climate contributions, **avoided emissions** relative to an adaptable, baseline scenario should be estimated alongside induced emissions. Avoided emissions are hypothetical. They represent the greenhouse gases that were not emitted thanks to a company's products or processes, across all three scopes.

Figure 2: Emissions Comparison for Cosmetics Company and Wind Turbine Manufacturer



Source: Mirova / (Carbon4finance, 2015), carbon data as of October 2019

Climate Scenarios

Carbon dioxide is the most prevalent of the **greenhouse gases**, all of which trap heat in the atmosphere, increasing global average surface temperature. As the degree of warming increases, the impacts of climate change become more severe.

For reference, the Intergovernmental Panel on Climate Change has modeled several long-term climate trajectories. Based on carbon emissions, the IPCC's models are typically described in terms of the temperature differential between 2100 and pre-industrial times (1850-1890, before humans began large-scale combustion of fossil fuels).

As such, a "+2.5°C scenario" suggests that the global average surface temperature will have increased by 2.5°C in 2100 compared to the temperature in 1850.

- **+1.5-2°C Scenario**: the Paris Agreement indicates that temperature rise should remain limited to less than 2°C (ideally less than 1.5°C) in 2100 and beyond to limit the effects of climate change. This is a very ambitious objective that would require large cuts in greenhouse gas emissions over the coming decades.
- **+2.5-3.5°C Scenario**: the likely outcome if the new climate regulations and commitments in place today (like the Paris Agreement) are respected. Climate change would have a severe, global impact.
- **+4-6°C Scenario**: the likely outcome in 2100+ if old policies are maintained. This scenario would lead to catastrophic, global consequences.

Estimating the extent to which a portfolio or index aligns with these scenarios allows us to produce a simple-to-interpret indicator (+2°C = good climate performance, +4°C = in line with the status quo, +6°C = very poor climate performance).

Figure 3: Emissions Comparison between Sectors

Type	Induced Emissions (sector average intensity, tCO_2e/M€ EV)		Avoided Emissions (sector average intensity, tCO_2e/M€ EV)	
	Scope 1&2	Scope 3	Scope 1&2	Scope 3
Automobile Manufacturer	40	300	-1	-80
Since automobiles burn oil directly, and throughout relatively long lifetime, most of the induced emissions allocated to an automobile manufacturer come from the use of its products (i.e. cars) and their supply chain (especially steel). Producing cars emits far less carbon than the cars do when they are used. Energy efficiency measures in the manufacturing plant can lead to avoided emissions in scope 1 and 2. But, there is even greater potential for improvement in scope 3 avoided emissions when fossil-fuel powered automobiles are replaced by electric vehicles where electricity has relatively low carbon intensity.				
Wind Turbine Manufacturer	70	0	0	-400
Wind turbines emit no carbon directly when they are used, and emissions related to maintenance are marginal. Emissions induced via production and disposal of the turbines are also very low. Almost all emissions avoided by a wind turbine manufacturer are in scope 3 since it is the downstream use of their products (generating electricity from a wind turbine instead of a coal power plant, for example) that leads to climate benefit.				
Electric Utility	300	90	-100	0
Most of this electric utility's induced emissions come from scope 1 since it burns fossil fuels directly to generate power. For utilities, scope 3 emissions represent the supply chains of the fuels it relies on, like coal mining or natural gas extraction. Unlike the wind turbine manufacturer, avoided emissions by a utility would be in scope 1. Generation from low-carbon sources leads to lower carbon emissions compared to the baseline (fossil fuels) because of the utility's direct activities.				
Integrated Oil & Gas	70	600	-1	-10
Extraction and production of hydrocarbons consumes energy and emits CO_2 but burning the fossil fuels extracted emits much more. So, like an automobile manufacturer, most of an integrated oil & gas company's induced emissions will be caused by the final use of its products (scope 3). In scope 1, an integrated oil & gas company can avoid emissions by reducing flaring. In scope 2, it can improve efficiency, and it can avoid emissions in scope 3 by either encouraging demand-side efficiency or reducing the carbon intensity of its energy portfolio relative to peers.				
Cosmetics	1	60	0	0
Cosmetics companies have very low emissions overall. Within these, production processes (scopes 1 and 2) contribute less than scope 3 emissions. Scope 3 induced emissions come mainly from upstream production of chemicals in the supply chain, downstream distribution of products, packaging, and recycling. A cosmetics company does not have many options for reducing emissions in its supply chain, with the potential exception of reducing packaging. However, it can avoid emissions in scope 1 and 2 through greater efficiency in the production process.				

Source: Mirova / (Carbon4finance, 2015), carbon data as of October 2019

II. Rationale

Emissions-Based Assessments

We believe that induced emissions and emissions savings, measured across all three scopes, are essential for a complete understanding of a company's climate impacts. As a result, we believe that methods excluding scope 3 and the notion of emissions savings are based on inadequate - and even potentially misleading - information. Again, excluding scope 3 and emissions savings can lead to data biased in favor of heavy indirect emitters, like mining, oil and gas, or automotive companies.

Approaches based on carbon emissions tend to produce results in absolute terms and varying units, which can complicate interpretation. How do we compare figures when different units are used for normalization (i.e. market cap, revenues, enterprise value)? When scope 3 is included to varying extents?

In absolute terms, at what point do we consider a company, investment portfolio, or index to have good climate performance? Going further, when do we consider it aligned or misaligned with international climate objectives? These thresholds are complex to define for absolute emissions, and the results can therefore be difficult to communicate.

Top-Down Assessments

The International Energy Agency (IEA) and Intergovernmental Panel on Climate Change (IPCC) have created sets of macro-level investment and demand projections compatible with limiting negative climate impacts (Intergovernmental Panel on Climate Change, 2018) (International Energy Agency, 2018). These projections are especially useful for guiding policymaking and regulation with regards to the climate.

Some methods for assessing a company, portfolio, or index's climate performance take a top-down approach based on these projections. They may seek to align the sector allocation of a portfolio or index with the sector allocation suggested by the investment projections. They may also compare an individual company's decarbonization objectives with the suggested decarbonization target for the sector. As a result, these methods tend to be forward-looking.

However, they cannot be applied to thematic portfolios with specific sectorial focuses as the investment breakdown would no longer be comparable with the projection, which comprise the entire global economy. Then, even for a portfolio diversified over the entire economy, these approaches are too reliant on a single forecast; in our view, there are numerous potential pathways for achieving today's energy transition objectives.

III. Mirova's Approach

Seeking to contextualize carbon emissions data, comprising both induced and avoided emissions over all three scopes, for any portfolio or index, without reliance on a single pathway, we have developed a method to evaluate the climate change trajectory of investment portfolios and indexes.

The data inputs are:

- A **carbon emissions database** that includes induced and avoided emissions over all three scopes
- **Energy investment projections** developed by the IEA and the IPCC.

The output is the portfolio or index's climate change trajectory alignment, in degrees Celsius.

Emissions Database

Since no existing emissions databases considered both induced and avoided emissions using a lifecycle approach, Mirova created a partnership with Carbon4finance (Carbon4finance, 2015). Carbon4finance calculates and creates a database of induced and avoided emissions at asset-level over scopes 1, 2 and 3.

These figures are then divided by the company's enterprise value, which includes both market capitalization and debt. This attributes the emissions figures to both equity and debt investors, in line with their respective share in the company's financing and irrespective of the capital structure or leverage level. The normalized data is not necessarily an indicator of climate performance; instead, it indicates to what extent an investment leads to induced or avoided emissions. To find a portfolio or index's carbon intensity, we take a weighted average of asset-level data and portfolio or index weights.

Figure 4: Example of Induced and Avoided Emissions

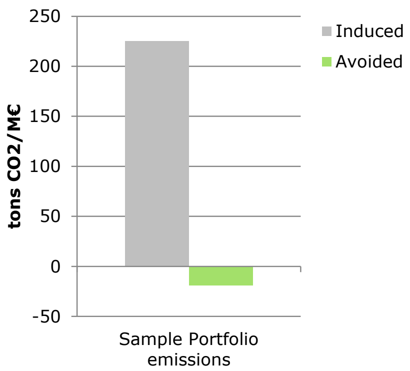
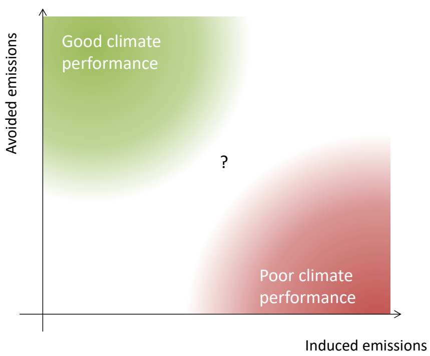


Figure 5 : Climate Performance Schematic



Source: Mirova / (Carbon4finance, 2015)

Although they have the same unit (tons CO_2 per million € of enterprise value), these indicators represent different concepts. Induced emissions are "real"; they represent a physical discharge of carbon dioxide (or equivalent greenhouse gases) into the air. Avoided emissions, on the other hand, are "virtual", i.e. hypothetical emissions avoided compared to a reference scenario. As a result, induced and avoided emissions cannot simply be added to create a single indicator representing net climate performance (Carbon4finance, 2015).

Sometimes, analyzing carbon performance is straightforward: high induced with low avoided emissions indicates negative climate impact. High avoided with low induced emissions indicates climate benefit. But when both indicators are of comparable value, no matter whether high or low, interpretation is more challenging.

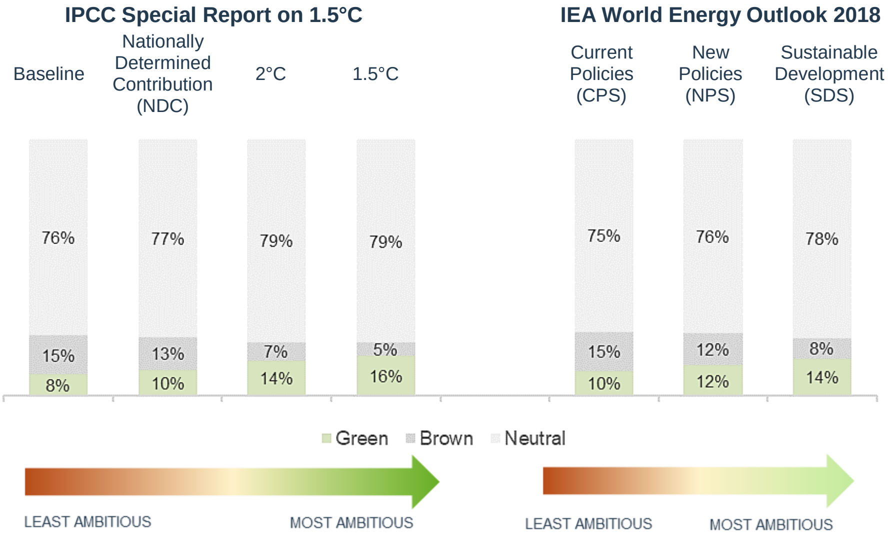
Energy Investment Projections

To link CO_2 emissions and the climate scenarios, we rely on global investment scenarios provided by the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC).

The IEA's World Energy Outlook provides figures on annual investments by energy subsector, as well as projections for investment amounts under the Sustainable Development, New Policies, and Current Policies scenarios (International Energy Agency, 2018).

The IPCC's Special Report on 1.5°C provides annual investment figures by energy subsectors as well (though categorized differently than the IEA), for a Baseline, Nationally Determined Contribution, 2°C, and 1.5°C scenario (Intergovernmental Panel on Climate Change, 2018).

Figure 6: Green/Brown/Neutral Categorization of Investment Projections



Source: Mirova / (Carbon4finance, 2015) / (Intergovernmental Panel on Climate Change, 2018)/ (International Energy Agency, 2018)

We categorized each energy subsector as "brown", "green", or "neutral", corresponding to their climate impact. "Brown" includes all fossil fuels, both in electricity and extraction. "Green" represents renewable and low-carbon energy, energy efficiency, and utility-scale batteries. "Neutral" is primarily made up of transmission and distribution networks.[1]

The categorized ("green", "brown", or "neutral") investment projections serve as our basic assumption of how capital will need to be allocated under each scenario, without choosing any specific technologies or companies within each category.

Alignment Method

Our carbon emissions database allows us to aggregate companies' emissions into carbon intensities at the portfolio and index-level, comprising two figures: induced emissions (over all three scopes) and avoided emissions (over all three scopes). Our objective is to use these two figures to calculate the climate trajectory alignment of the portfolio or index.

To connect emissions data to the investment projections, we assume that all induced emissions come from assets falling into the "brown" projection category. We also assume that all avoided emissions come from "green" assets. "Neutral" assets have no effect, positive or negative, on emissions.

We further assume that the MSCI World[2] is representative of the global economy. Based on its carbon footprint and distribution of green/brown/neutral investment categories within the projections, we estimate:

- **Investments in fossil energy** contribute, on average, to induced emissions of approximately 800 $tCO_2e/M€$ (equation 1, appendix).
- **Investments in renewable energy and energy efficiency** lead to, on average, approximately 130 $tCO_2e/M€$ in avoided emissions (equation 2, appendix).

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[1] *While agriculture represents substantial carbon emissions, it is not included in investment projections, its carbon impacts are difficult to quantify, and integrating agriculture into investment strategies remains challenging. As a result, it is not currently part of this estimation.*

[2] *Ideally, we would use the MSCI World All Countries (AC) index as a proxy for the global economy, especially since companies in emerging economies may be more carbon intensive than those in developed economies. However, given that current data quality and completeness is substantially better for the MSCI World, and that the MSCI world comprises the majority of the MSCI World AC, we currently use the MSCI World.*

We consider the most pertinent indicator of climate performance to be the ratio of green:brown investments, and consequently, of avoided:induced emissions. Using the conversion factors above, we convert the ratio of green:brown investments to a ratio of avoided:induced emissions using equation 3 (appendix). The climate trajectory of each projection is known; this information is provided by the IPCC and IEA. (Ratio and trajectory data are summarized in the appendix, table 1).

Plotting the ratio of avoided:induced emissions versus the climate change trajectory produces a plot that resembles the form $y = ax^b$, where x=the ratio of avoided:induced emissions and a and b are constants. Using a least squares regression to find the values of a and b yields an equation that **represents the climate change trajectory in terms of induced and avoided emissions.**

$$\boldsymbol{trajectory, in\,°C} = \mathbf{t} = \mathbf{1.0162}\left|\frac{\boldsymbol{avoided\ emissions}}{\boldsymbol{induced\ emissions}}\right|^{-\mathbf{0.571}} \quad \text{(appendix: equation 4)}$$

Graphically, this can be represented in two equivalent ways. Both characterize the relationship between portfolio or index emissions and climate trajectory.

Figure 7: Climate Trajectory
as a function of avoided:induced emissions ratio, with emissions scenarios (figure 6)

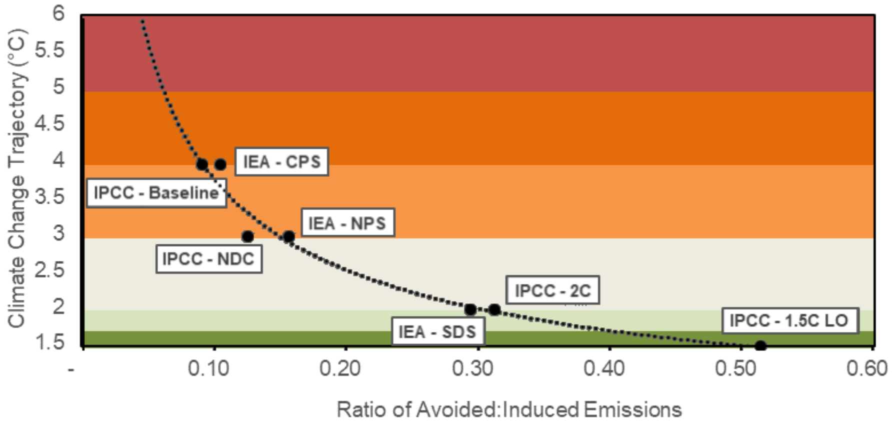
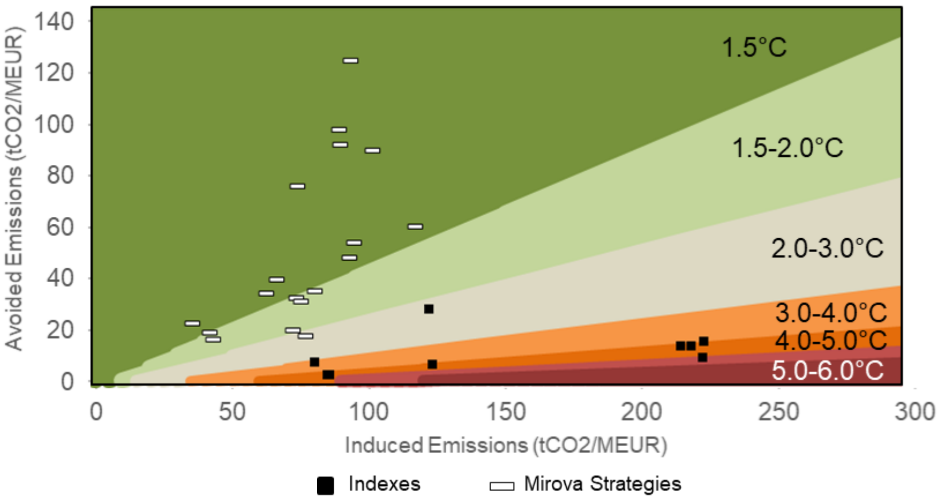


Figure 8: Climate Trajectory
as a function of induced and avoided emissions, with indexes and Mirova's strategies



Source: Mirova / (Carbon4finance, 2015) / (Intergovernmental Panel on Climate Change, 2018)/ (International Energy Agency, 2018), carbon data as of October 2019

This model leads to results consistent with qualitative analysis.

- Indexes are generally in line with 3-5°C, consistent with our understanding of the climate trajectory of the global economy, approximately +4°C (see figure 9).
- Fossil-heavy strategies tend towards 4-5°C.
- Environmentally-conscious strategies are in line with 1.5-2°C.

Figure 9: Index Evaluations

	CAC40	MSCI Europe	S&P 500	MSCI World	Barclays Euro Ag Cp
Climate Trajectory	**5.0°C**	**4.2°C**	**4.3°C**	**4.1°C**	**3.1°C**
Induced (tCO2/m€)	*227*	*223*	*91*	*129*	*85*
Avoided (tCO2/m€)	*14*	*18*	*7*	*11*	*12*

Source: Mirova / (Carbon4finance, 2015), carbon data as of October 2019

We also account for cases where the magnitude of emissions is small overall, or where portfolios/indexes have relatively low exposure to "high-stakes" sectors. A portfolio exclusively invested in healthcare and media, for example, is neither contributing to nor obstructing the fight against climate change, so we consider it in line with the status quo: +4°C. Portfolios and indexes with very little investment in "high-stakes" sectors are pulled linearly toward +4°C, in proportion to the difference between its "high-stakes" exposure and the "high-stakes" exposure of the MSCI World (typically about 30%). This adjustment is reflected in equation 5.

Lastly, the model is adjusted to account for physical constraints, also reflected in equation 5. Equation 3 approaches infinity as the ratio of avoided:induced emissions approaches zero. And while emissions, left unchecked, would lead to drastic warming, very few models predict temperature rise above +6°C in 2100. The output is capped at +6°C to reflect this. Similarly, the Earth has already warmed by more than 1°C, so achieving anything less than +1.5°C is not considered physically realistic. The model is thus floored at +1.5°C as well.

IV. Conclusion

The way investors allocate capital can and will make a difference in meeting global sustainability challenges and succeeding in the energy transition. We encourage investors to avoid overreliance on a single scenario or emissions pathway, so our method emphasizes and supports the multitude of potential pathways to 2°C, free from pre-defined sectoral allocations. It is applicable across all asset classes, versatile, and scalable, with many potential applications within the investment process. The outcome is a simple-to-interpret indicator – climate change trajectory in °C – consistent with qualitative analysis.

The approach still has several limits:

- The reliance on several levels of estimates, from the scope 3 emissions data to definition of the reference scenarios, considering the MSCI World as a proxy for the global economy, assumptions inherently present in the IEA/IPCC investment projections, and extrapolation of the IEA/IPCC investment projections data.
- The emissions data is not forward-looking. The result of the model (trajectory in °C) therefore does not consider company decarbonization objectives or planned strategic evolutions. The data is re-assessed each year, so the data and the calculated trajectory will only reflect strategic changes the year after they occur.

Nevertheless, we believe that it can serve as a useful tool for investors, no matter whether they are looking to create impact, respond to regulatory requirements, or better consider climate risks and opportunities in their investment portfolios.

Appendix

Equations

(Eq. 1) $$c_{induced} = \frac{induced\ emissions\ of\ MSCI\ World\ (\frac{tCO2}{M€})}{baseline\ \text{"brown" investment (as portion of total)}} = \frac{121.2}{0.15} = 808\ tCO_2/M€$$

(Eq. 2) $$c_{avoided} = \frac{avoided\ emissions\ of\ MSCI\ World\ (\frac{tCO2}{M€})}{baseline\ \text{"green" investment (as portion of total)}} = \frac{10.6}{0.08} = 132\ tCO_2/M€$$

(Eq. 3) $$\frac{avoided\ emissions}{induced\ emissions} = \frac{green\ investment}{brown\ investment} \times \frac{c_{avoided}}{c_{induced}}$$

Avoided emissions and induced emissions must have the same unit
Green investment and brown investment must have the same unit

(Eq. 4) $$trajectory, in\ °C\ = \text{t} = 1.0162 \left|\frac{avoided\ emissions}{induced\ emissions}\right|^{-0.571}$$

(Eq. 5) $$t_{adjusted} = \begin{cases} 1.5 & t < 1.5 \\ 4\left(\frac{s-p}{s}\right) + t\left(1 - \frac{s-p}{s}\right) & 1.5 \leq t \leq 6, if\ p < s \\ t & 1.5 \leq t \leq 6, if\ p \geq s \\ 6 & t > 6 \end{cases}$$

$t_{adjusted} = final\ climate\ trajectory\ in\ °C$
$t = climate\ trajectory\ calculated\ in\ eq.4$
$s = portion\ (by\ weight)\ of$ *high-stakes issuers in the MSCI World* (typically ~ 30%)
$p =$ *fraction of portfolio/index investments in "high-stakes" assets*

Tables

Table 1: Ratios and Trajectory, by Scenario

	IPCC SR 1.5°C				IEA WEO 2018		
	Base-line	**NDC**	**2°C**	**1.5°C**	**CPS**	**NPS**	**SDS**
Ratio (green:brown, investments)	0.55	0.76	1.91	3.14	0.64	0.96	1.80
Ratio (avoided:induced, emissions) *calculated from eq. 1 and eq. 2*	0.09	0.12	0.31	0.51	0.10	0.16	0.29
Trajectory (2100)	+4°C	+3°C	+2°C	+1.5°C	+4°C	+3°C	+2°C

Source: Mirova / (Carbon4finance, 2015) / (Intergovernmental Panel on Climate Change, 2018)/ (International Energy Agency, 2018), carbon data as of October 2019

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