Carbon Impact Analytics

Designing low carbon indices based on Carbon Impact Analytics indicators

carbone 4

carbon 4 finance

mirova
Responsible Investing

EXECUTIVE SUMMARY

BEYOND CARBON FOOTPRINTING AND TOWARDS LOW-CARBON INVESTMENT STRATEGY

Investors are increasingly exposed to carbon risks and now face the challenge of managing these risks and developing climate-resilient investment strategies. Carbon Impact Analytics (CIA), an innovative methodology for analyzing the full carbon impact of a portfolio or index, equips investors and asset managers with the tools necessary to reduce their climate-related risks but also to seize the opportunities offered by the ongoing energy transition.

Investors, asset managers and other financial institutions may use CIA results to:

- measure and manage risks,
- optimize their contribution to the energy transition,
- seize opportunities associated with climate change mitigation,
- report on GHG emissions and savings (for regulatory purposes or voluntarily),
- engage in dialogue with companies,
- reallocate investment portfolios,
- and build new low-carbon indices.

METHODS FOR DESIGNING LOW CARBON INDICES

In this report, Carbone 4 offers a detailed look into how CIA indicators can be used to either 1) reallocate an existing portfolio or index to achieve maximal carbon performance or 2) build new low carbon indices from the ground up, drawn from Carbone 4's ever-growing database of CIA-analyzed firms.

Two main levers were used to optimize CIA output:

1. **Sectorial reallocation: exclusion of fossil fuel-related sectors or insertion of low carbon pure players**

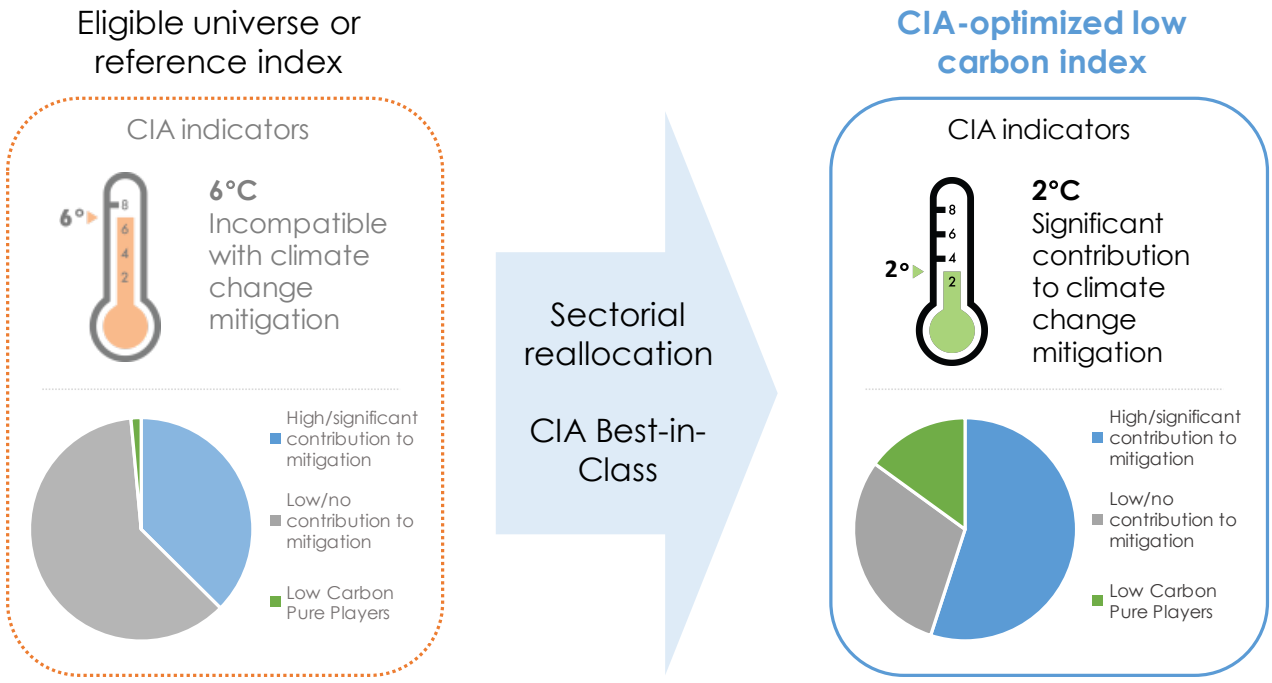
   This method either consists of excluding or reducing the share of companies in the fossil fuel sector or adding or increasing the share of companies in a carbon-friendly sector. For example, we may remove all firms involved in coal, oil and gas extraction and production. Once this sector is removed, the relative weights of the remaining sectors are increased. Inversely, we may choose to increase the share of "low carbon pure players" in the index and proportionately decrease the share of other firms. Low carbon pure players are those companies whose emission savings are higher than their induced emissions, leading to a carbon impact ratio greater than 1.

2. **Intra-sectorial reallocation: best-in-class approach within a sector**

Several criteria exist for evaluating the best companies within a sector. While Scope 1 and 2 emissions may be the most convenient indicator, Carbone 4 believes the best way to judge climate performance is by examining a wide range of performance criteria, including Scope 3 emissions, emission savings, sector-specific indicators, and forward-looking indicators. That is why the CIA best-in-class approach relies on the CIA overall rating as a comprehensive performance measure. Only those companies having obtained the highest CIA overall rating are retained, while those with the lowest overall rating are excluded. The relative weight of each sector represented in the index remains constant as compared to the reference universe.

Combination of levers:

Sectorial and intrasectorial methods may be applied in conjunction with one another to maximize results. For example, a best-in-class + fossil fuel-free index may be constructed by first excluding the fossil fuel sector and then applying a CIA best-in-class approach to all remaining sectors.



These methods are applied in two preliminary examples of indices designed by Carbone 4: the reallocated Stoxx 600 (a fictive index) and the recast of Euronext's Low Carbon 100 Europe (published in December 2015).

REALLOCATION OF THE STOXX 600: FROM 4°C TO 2.5°C

Sponsored by the University of Cambridge's *Investment Leaders' Group*, Carbone 4 carried out an analysis of the Stoxx 600 and proposed four theoretical low-carbon indices for comparison. All indices were built from the same universe, the 600 companies in the Stoxx 600, using the different optimization levers described below.

- **Low Carbon Index 1:** best-in-class approach based on Scope 1+2 intensity
- **Low Carbon Index 2:** exclusion of fossil fuel producers (sectorial reallocation)
- **Low Carbon Index 3**: CIA best-in-class (companies selected based on CIA rating) + exclusion of fossil fuel producers
- **Low Carbon Index 4:** CIA best in class + exclusion of fossil fuel producers and fossil fuel equipment manufacturers

	STOXX 600	*LCI 1*	*LCI 2*	*LCI 3*	***LCI 4***
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)	250	210	160	90	**80**
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)	-14	-14	-15	-15	**-15**
Trajectory alignment (°C)	4°	4.1°	3.5°	2.6°	**2.5°**
Share of companies with "high" and "significant" positive contribution[1]	11%	9%	12%	14%	**14%**
Share of top "forward-looking" indicators	24%	11%	29%	36%	**37%**

Low-carbon indices 3 and 4, which adopt a CIA best-in-class approach, provide the best results. They have the lowest induced emissions and the highest shares of companies with the best overall and forward-looking ratings. Nevertheless, the best optimized index (LCI 4) is not on a 2°C trajectory alignment, as it lacks reinforcement of low-carbon sectors. As demonstrated in the recast of Euronext's Low Carbon 100 Europe®, going one step further and adding low carbon pure players to the initial universe of firms further boosts carbon performance.

[1] « High contribution » and « Significant contribution » correspond to the two best CIA overall ratings. Overall ratings rank from A (« High contribution to climate change mitigation ») to E (« Incompatible with climate change mitigation »).

RECAST OF EURONEXT'S LOW CARBON 100 EUROPE®: ATTAINING 2°C ALIGNMENT

CIA methodology was used to develop Euronext's Low Carbon 100 Europe® to attain 2°C alignment. This index consists of 100 low-carbon firms drawn from a universe of approximately 300 European companies: 12 low carbon pure players and around 288 European companies with the highest free float market capitalization. Unlike the optimized Stoxx 600 described above, Euronext's Low Carbon 100 Europe® allows for an increased share of low carbon pure players, all while maintaining a sectorial diversification close to that of the reference index. The introduction and overweighting of low carbon pure players, combined with the exclusion of fossil fuel producers and a CIA best-in-class approach, allows for a 100% optimized index aligned with a 2°C trajectory. The Low Carbon 100 Europe® generates 51% less emissions and saves 100% more emissions as compared to the reference index, as presented in the results below.

	Reference Universe	**Euronext's Low Carbon 100 Europe®**	
Induced emissions (Scope 1, 2, 3) (tCO_2e/yr/M€)	222	**109**	↓51%
Emission savings (Scope 1, 2, 3) (tCO_2e/yr/M€)	-12	**-24**	↑100%
Climate trajectory / alignment	4°C	**2°C**	↓50%
Share of companies with "high" and "significant" positive contribution	11%	**30%**	↑172%
Share of top "forward-looking" indicators	29%	**55%**	↑89%

A CIA-BASED APPROACH FOR OPTIMAL CARBON PERFORMANCE

The results of these two preliminary case studies highlight the advantages of using CIA indicators to construct low carbon indices.

First, results show that traditional indicators (Scope 1 and 2 induced emissions) are inadequate for building low-carbon investment strategies: investors must set objectives not only to reduce their carbon footprint but to optimize their carbon impact. An investor whose strategy is only to reduce its Scope 1 and 2 emissions might have a significant Scope 3 intensity, which, when unaccounted for, will lead the investor to invest only in the service industry, or sectors that contribute marginally to curbing global GHG emissions.

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Second, the low-carbon indices with the highest contribution to the energy transition are those based on a dual approach of sectorial reallocation and a best-in-class selection process based on the CIA rating of portfolio constituents. The CIA rating is attained via a bottom-up approach and relies on a mix of sector-specific quantitative and qualitative information, thus providing the most robust indicator on which a low carbon index can be built. The application of a bottom-up methodology for analyzing portfolio constituents is necessary to enable selection of the assets that are most likely to thrive, and to exclude those that introduce carbon risks in the context of a low-carbon transition.

Lastly, although a combined CIA best-in-class and fossil fuel exclusion approach can significantly reduce the carbon risk of a portfolio or index, the addition of low carbon pure players appears necessary in order to achieve 2°C alignment. This is clear when comparing the results of the Low Carbon Index 4, based strictly on an index lacking a sufficient number of low carbon pure players (2.5°C alignment), and the Low Carbon 100 Europe®, which incorporates a higher proportion of low carbon pure players.

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A methodology and a tool developed by Carbone 4

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Main sponsor and co-developer: Mirova

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INTRODUCTION

The global finance community has officially taken notice- climate risks are real and the time to manage them is now. Events leading up to 2016, from FSB Chairman Mark Carney's warning cry over climate risks like stranded assets to the World Economic Forum's decision to name climate change as the number one global risk to business in terms of impact, climate change now unarguably plays a role in the world of financial risk. Investors must anticipate regulatory developments and equip themselves with tools adapted not only to disclose the carbon footprint of their portfolio but to pilot investment strategy. Regulations like Article 173 in France, one of the most ambitious laws on investor climate disclosure to date, as well as voluntary disclosure schemes such as the Montreal Carbon Pledge and the recommendations being developed by the Task Force on Climate-Related Financial Disclosures, are placing increased pressure on investors to demonstrate their contribution to limiting global temperature rise to 2 degrees or less[2].

In 2015, Carbone 4 launched Carbon Impact Analytics (CIA), an innovative methodology that responds to the need to go beyond carbon footprinting by analyzing the full carbon impact of a portfolio or index. This requires adopting whole-picture indicators which account for the emissions saved by portfolio constituents as well as forward-looking indicators like capital expenditures which gauge a portfolio's contribution to a more climate-compatible economy. Carbone 4 is of the opinion that disinvestment does not constitute a complete response to aligning financial capital with climate concerns. In fact, major emitters are key players in the shift towards a low-carbon future. Studies show that companies who make improvements in carbon intensity can achieve higher financial returns[3]. This is why CIA is designed to steer investment strategy and facilitate dialogue between investors, asset managers, and underlying firms.

Carbone 4 clients have already used CIA to measure and report their GHG emissions and savings and to steer investment decisions. Now, Carbone 4 takes its offer one step further with the construction of low-carbon indices, allowing investors to capture the financial benefits presented by demand shift and new products and markets. This report offers a detailed look into how CIA indicators can be used to rework portfolios or indices to maximize carbon performance or to build low carbon indices from the ground up. These methods are illustrated via two preliminary examples of indices designed by Carbone 4: the reallocated Stoxx 600 and the recast of Euronext's Low Carbon 100 Europe.

[2] A global average temperature rise of 2° Celsius compared to pre-industrial levels is the internationally agreed upon limit necessary to minimize the risk of "dangerous" human interference with the climate system.
[3] BlackRock (2015) "The Price of Climate Change: Global Warming's Impact on Portfolios"

PART 1. CARBON IMPACT ANALYTICS METHODOLOGICAL PRINCIPLES

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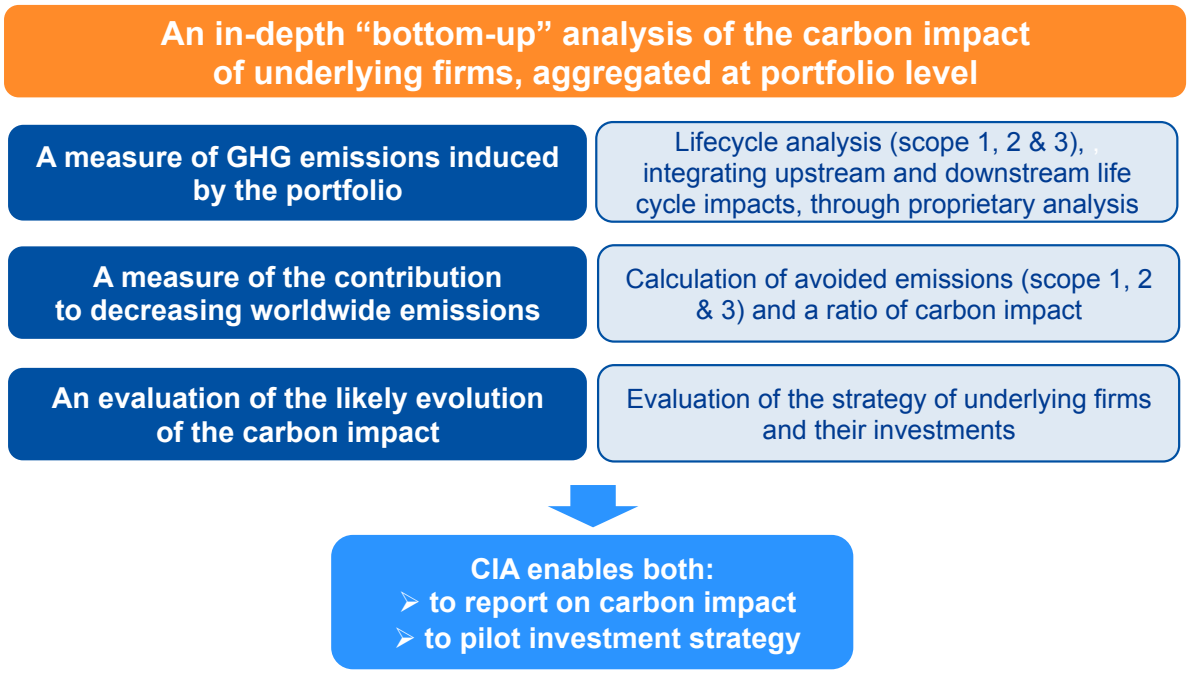
1.1. A BOTTOM-UP APPROACH TO ENSURE PRECISION AND DIFFERENTIATE COMPANY PERFORMANCES WITHIN A SECTOR

Carbon Impact Analytics (CIA) relies on a **bottom-up approach** to analyzing the carbon impact of portfolio constituents. Underlying firms are analyzed through **sectorial lifecycle analysis principles**, enabling:

- Calculation of Scope 3 emissions[4] on the basis of company data obtained in annual reports,
- Back-testing of reported Scope 1 and 2 emissions,
- Calculation of GHG savings by comparison of induced emissions with a reference situation,
- Assessment of a firm's strategy, which may either enable or inhibit the energy transition (forward-looking indicator).

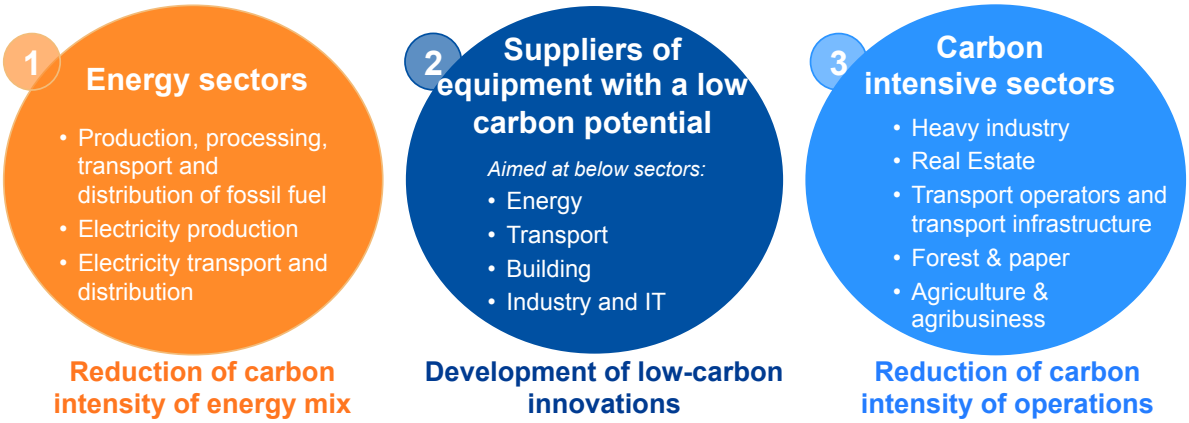


1.1.1 HIGH-STAKE SECTORS

The indicators are based upon sectorial calculation principles. Only high-stake sectors, for which reported information enables a detailed analysis, are evaluated through Carbon Impact Analytics. These sectors are most concerned by the low-carbon transition, both as

[4] Greenhouse Gas (GHG) emissions are counted following different scopes of analysis. Scope 1 emissions include direct emissions due to fossil fuel combustion, Scope 1 emissions include direct emissions due to electricity, heat and cold consumption and Scope 3 emissions correspond to indirect emissions for which an actor can be held partly responsible (e.g. energy consumption induced by use of sold products).

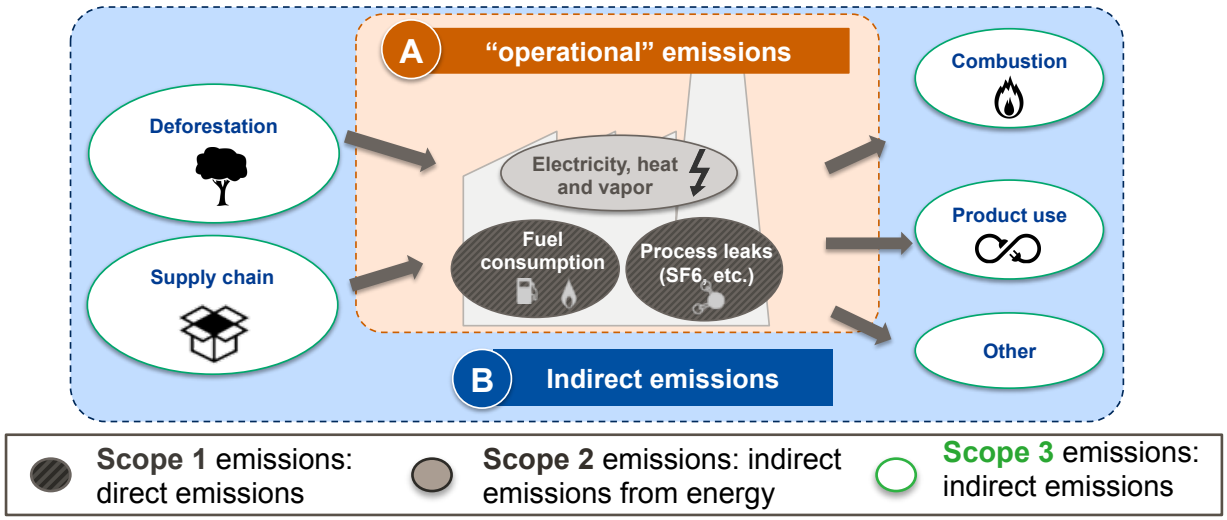
large emitters and potentially large emissions savers. High-stake sectors are listed in the figure below:



1.1.2 MAIN CIA INDICATORS

AN IN-DEPTH ANALYSIS OF INDUCED EMISSIONS

In order to have a complete and comparable picture of the emissions induced by underlying firms, it is necessary to measure both direct and indirect emissions of these firms throughout their entire supply chain, as illustrated by Scopes 1, 2 and 3 (both upstream and downstream) pictured in the figure below.



For most firms, the majority (typically 80%) of greenhouse gas emissions are indirect emissions, attributable to purchases and eventual use of products sold. As a result, limiting the assessment of carbon emissions generated by a portfolio to Scopes 1 and 2 often leads to misleading conclusions in understanding an activity's true dependence on fossil fuels. It is therefore necessary to account for induced emissions over the entire Scope of

impact of underlying firms, including Scope 1, Scope 2, and Scope 3 emissions, both downstream and upstream.

EMISSION SAVINGS

To evaluate the alignment of an investment portfolio with the low-carbon transition, an additional indicator is necessary, complementary to the carbon footprint. A firm in a highly carbon intensive sector could contribute significantly to decreasing emissions, perhaps by creating a disruptive product or process. The additional indicator should therefore generate an understanding of how an underlying firm is disrupting its sector, either through more efficient processes or through carbon-efficient products or services.

GHG savings vs. induced emissions

GHG emission savings are "virtual" emissions: they are the emissions that would exist if the company had not actively made an effort to decrease them.

A company's savings do not "erase" or "absorb" the emissions it induces. Savings are not "real" negative emissions; they are fictive and only provide information about an actor's contribution to global emissions reduction.

THE CARBON IMPACT RATIO (CIR)

In addition to the absolute figure of induced or emission savings, the extent to which a firm reduces GHG emissions relative to total GHG emitted is very important; this ratio measures the carbon performance of the firm.

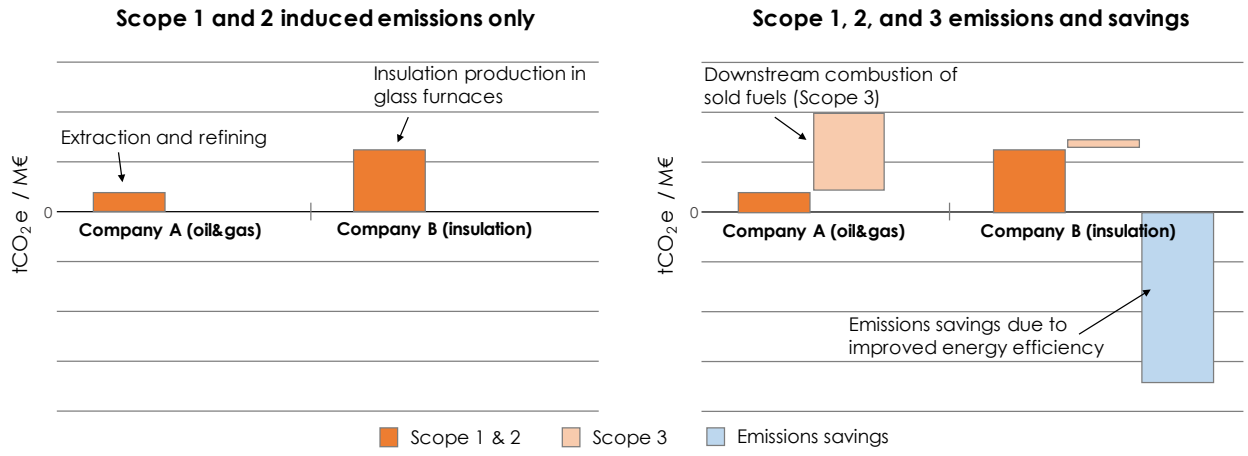
The carbon impact ratio is the ratio of emission savings to induced emissions. It is an easy-to-read indicator of the carbon impact of a company, and enables comparison between the carbon impact of a company and the impacts of its sectorial peers.

$$\text{Carbon Impact Ratio of a company} = \frac{\text{Emissions savings } (tCO_2e)}{\text{Induced emissions } (tCO_2e)}$$

In particular, the carbon impact ratio enables the identification of companies which have significantly improved the carbon-efficiency of their operations, as well as companies that sell products and solutions leading to GHG emissions reductions over their lifetime. As the CIR relies on hard data and measures a company's emissions savings relative to its own induced emissions (including Scope 3 emissions), a company's CIR may be uncorrelated with the climate change position publicly communicated by the company or with other climate-related evaluations the company has received.

The importance of considering a broad scope of emissions

It is crucial to consider Scope 3 emissions in addition to Scope 1 and 2, as well as emissions savings. Inclusion of these indicators allows for the calculation of the carbon impact ratio and can dramatically alter overall results, as demonstrated in the figure below which compares two different companies, an oil and gas producer and a manufacturer of building insulation.



When only Scope 1 & 2 emissions are considered, Company B appears more emissions intensive.

Once Scope 3 emissions are considered, Company A becomes more emissions intensive. ***Company B will have a high Carbon Impact Ratio (CIR), and Company A will have a CIR of zero.***

FORWARD-LOOKING INDICATOR AND TRANSPARENCY RATING

Two qualitative indicators were added to the Carbon Impact Analytics methodology to complete the quantitative carbon data (induced emissions and savings, Carbon Impact Ratio).

- **The qualitative forward-looking indicator is meant to reflect a company's ability to face the challenges of climate change in the 5 years to come.** It is based on the analysis of several sub-indicators:
  - CAPEX directed towards low-carbon solutions,
  - R&D expenditures,
  - Share of revenues related to low-carbon activities,
  - Company strategy regarding the low-carbon transition (CO_2 reduction objectives, etc.).
- **The transparency rating measures companies' transparency and reporting quality.** Transparency is evaluated to indicate the relative precision of the quantitative indicators and to open pathways for dialogue and engagement. This evaluation, however, is not taken into account in the overall rating of the carbon performance of the company.

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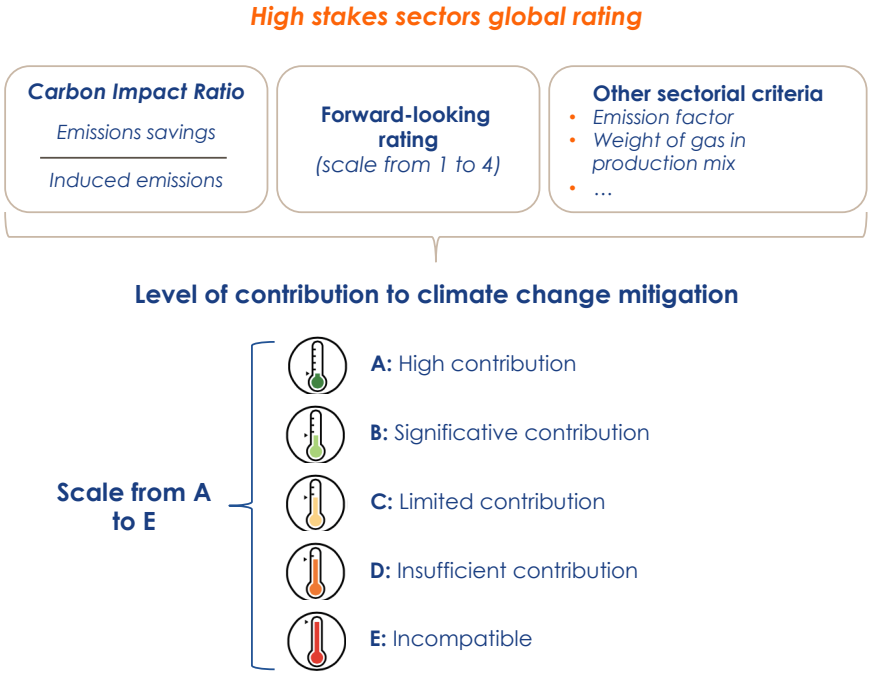
COMPANY OVERALL RATING

In addition to these indicators, **Carbon Impact Analytics provides an overall indicator for each company, based on quantitative and qualitative sub-indicators. This rating is designed to enable the management of intra and inter-sectorial stock picking.**
The overall rating is given by sectorial calculation principles. Depending on the sector, thresholds are set for several indicators: the Carbon Impact Ratio (CIR), the forward-looking qualitative assessment and sectorial indicators, e.g. tCO_2e/MWh for electricity producers. Monetary ratios (e.g. tCO_2e/€ of turnover) are never taken into account in the overall rating calculation. Indeed, all monetary values introduce a bias whereas "physical" ratios (tCO_2e/MWh, /tonne*km, etc.) are much more representative of a company's carbon efficiency.

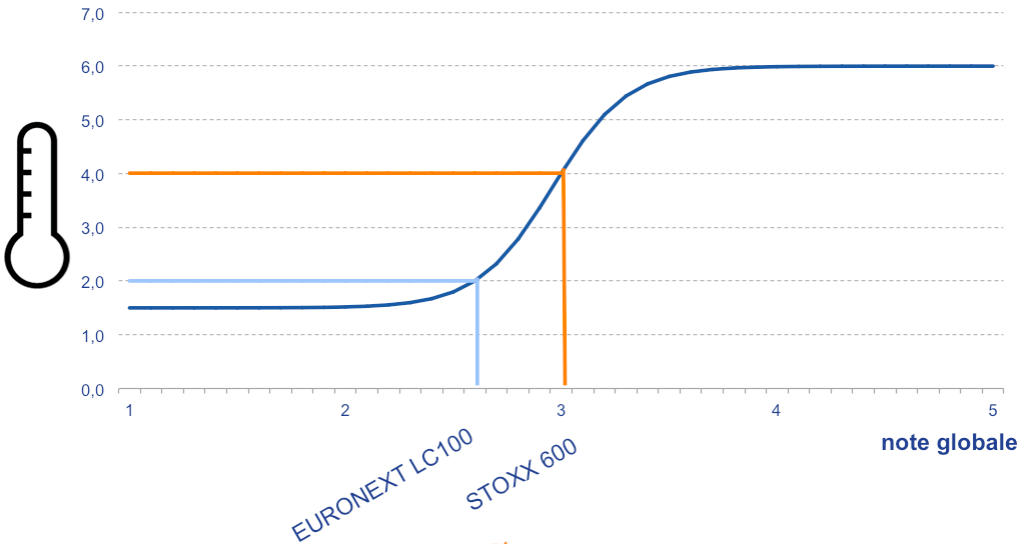


1.2 ALIGNMENT WITH A 2°C OR MORE TRAJECTORY

In the Paris Agreement of 2015, 196 countries agreed to hold the increase in global average temperature to "well below 2 degrees C above pre-industrial levels." According to the IPCC 5th Assessment Report, the risks of "severe, pervasive, and irreversible impacts" increase as temperatures rise. A business-as-usual warming of about 4°C, for example, would lead to "…severe and widespread impacts on unique and threatened systems, substantial species extinction, large risks to global and regional food security, and the combination of high temperature and humidity compromising normal human activities…".

Carbon Impact Analytics provides conclusions on the alignment of a portfolio or index with a climate change trajectory. This **alignment is a convention based on a scale of**

average overall ratings of underlying firms, calibrated as follows: for the Stoxx 600, this average corresponds to a 4°C trajectory, as it is considered that the current European listed economy, of which the Stoxx 600 is representative, is aligned with a 4°C trajectory; and for a low carbon 'CIA-optimized' portfolio (including low carbon pure players, not included in the Stoxx 600), the average overall rating corresponds to a 2°C trajectory.



Hence Carbon Impact Analytics does not enable the definition of a 2°C portfolio on a scenario basis, but through two approaches:

- Sectorial reallocation to increase "high contribution" values' share (according to 2°C scenario IEA 450ppm recommendations)
- Intra-sectorial stock picking with a « CIA best in class » logic

Other methodologies are usually based on a 2°C approach but the « 2°C-portfolio check » is only possible for a few sectors (usually power, fossil and road transport portfolios), not a fully diversified portfolio. Indeed, all 2°C scenarios (and in particular IEA's 2DS ETP scenario) are built on the idea that each sector could reach alignment with a 2°C trajectory through a few technologies. This would be the electric vehicle for the automobile industry, for example. However, this assumption is detached from the reality and practices of companies, because the process of achieving low-carbon products requires multiple technologies. Following the example of the automobile industry, levers for producing low-carbon vehicles will be the shift in energy combustion, but also the materials used, the weight of the car, the energy efficiency in manufacturing plants, etc. Moreover, companies cannot be resumed to one technology. This is why Carbon Impact Analytics' 2°C scenario approach was based on sectorial modules wherever possible (power and transport for example) but not for the portfolio's global trajectory alignment.

PART 2. METHODS FOR DESIGNING LOW CARBON INDICES

2.1 A CIA-BASED APPROACH

For an investor, measuring the climate change impact of financial assets is a necessary first step in building portfolios which contribute to the shift to a low carbon economy, both for limiting carbon risks and seizing low carbon opportunities. CIA provides specially-designed indicators which may be optimized in order to modify the overall impact of a portfolio. Optimization of the following five indicators provides the basis for creating low carbon indices:

STOXX 600
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)
Trajectory alignment (°C)
Share of companies with "high" and "significant" positive contribution
Share of top "forward-looking" indicators

Two different routes are available for building low carbon indices based on CIA indicators:

1. REALLOCATION OF AN EXISTING PORTFOLIO OR INDEX

One way of creating a low carbon index is to reallocate or adjust the weighting of an existing portfolio or index. First, the portfolio or index is analyzed using CIA methods, resulting in the key outputs figured above. The key indicators are then optimized by increasing or decreasing the weight of underlying firms, or by removing certain firms altogether.

2. CONSTRUCTION OF A NEW LOW-CARBON INDEX OR PORTFOLIO

Another option for creating a low carbon index or portfolio is to select from a broader universe of firms which can be or has already been analyzed using CIA methodology (Carbone 4 maintains an extensive, ever-growing database of analyzed firms updated on a regular basis). Firms with favorable CIA results are selected in order to construct a new portfolio or index.

2.2 OPTIMIZATION LEVERS

Two main levers can be used to optimize CIA indicators, regardless of the eligible universe of CIA-analyzed firms (reference universe or CIA database).

1. SECTORIAL REALLOCATION: EXCLUSION OF FOSSIL FUEL-RELATED SECTORS OR INSERTION OF LOW CARBON PURE PLAYERS

This method either consists of excluding or reducing the share of companies in a carbon-intense sector or adding or increasing the share of companies in a carbon-friendly sector. For example, we may remove all firms involved in coal, oil and gas extraction and production. Once this sector is removed, the relative weights of the remaining sectors are increased. Inversely, we may choose to increase the share of "low carbon pure players" in the index and proportionately decrease the share of other firms. Low carbon pure players are those companies whose emission savings are higher than their induced emissions, leading to a carbon impact ratio greater than 1. If there is an insufficient number of low carbon pure players in a reference portfolio or index, additional low carbon pure players may be added to the initial universe of constituents.

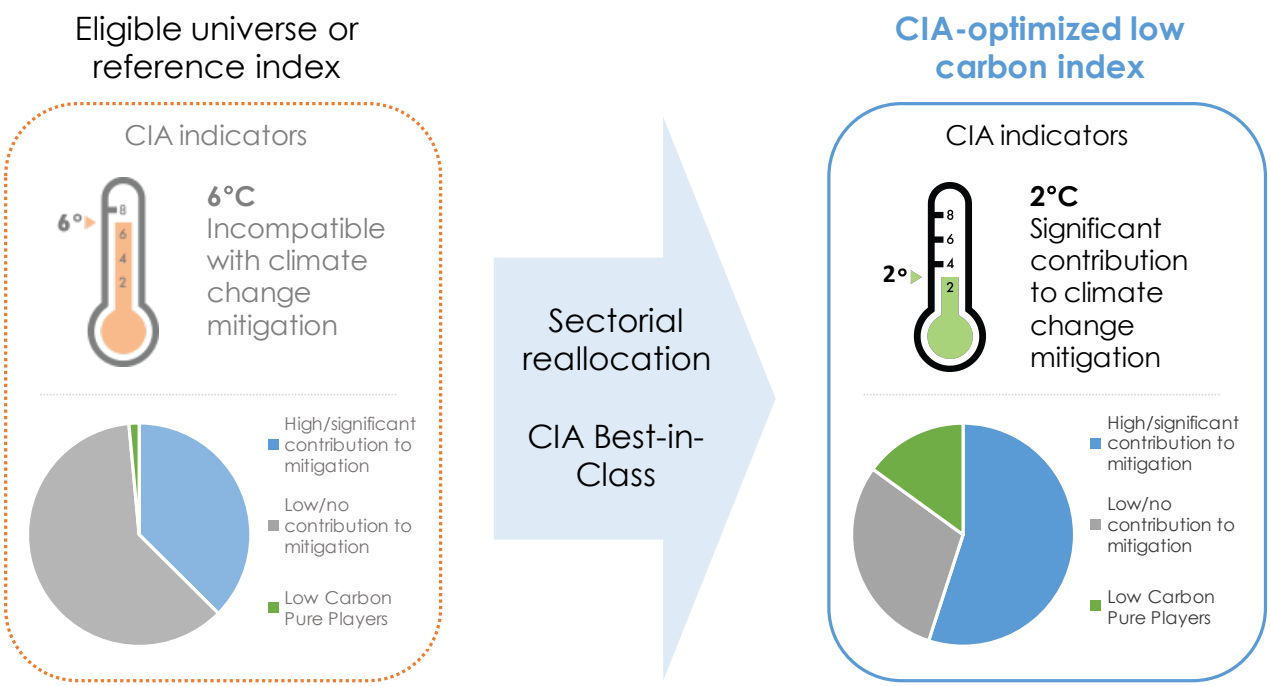
2. INTRA-SECTORIAL REALLOCATION: BEST-IN-CLASS APPROACH WITHIN A SECTOR

Several criteria exist for evaluating the best companies within a sector. While Scope 1 and 2 emissions may be the most convenient indicator, Carbone 4 believes the best way to judge performance is by examining a wide range of performance criteria, including Scope 3 emissions, emission savings, sector-specific indicators, and forward-looking indicators. That is why the CIA best-in-class approach relies on the CIA overall rating as a comprehensive performance measure. Only those companies having obtained the highest CIA overall rating are retained, while those with the lowest overall rating are excluded. The share of high-rated companies then increases proportionately. The relative weight of each ICB sector represented in the index remains constant as compared to the reference universe.

COMBINATION OF LEVERS:

The above methods may be applied in conjunction with one another to maximize results. For example, a best-in-class + fossil fuel-free index may be constructed by first excluding the fossil sector and then applying a CIA best-in-class approach to all remaining sectors.

Carbone 4's overall approach to low carbon indices is resumed in the figure below. Concrete examples of these methods are illustrated in the following section.


Eligible universe or reference index
CIA indicators
6°
8
6
4
2
6°C
Incompatible with climate change mitigation
High/significant contribution to mitigation
Low/no contribution to mitigation
Low Carbon Pure Players
Sectorial reallocation
CIA Best-in-Class
CIA-optimized low carbon index
CIA indicators
2°
8
6
4
2
2°C
Significant contribution to climate change mitigation
High/significant contribution to mitigation
Low/no contribution to mitigation
Low Carbon Pure Players

PART 3. CIA-BASED LOW CARBON INDICES

3.1 REALLOCATION OF THE STOXX 600: FROM 4°C TO 2.5°C

3.1.1 INITIAL CIA RESULTS FOR THE STOXX 600

Carbon Impact Analytics was used to analyze the Stoxx 600 index. The index has a total carbon intensity of 247 $tCO_2e/yr/M€$ and is aligned with a 4°C trajectory. The initial CIA output is presented in the figures below.

Quantitative indicators

	Stoxx 600	
Emissions - Scopes 1+2	51	$tCO_2eq/yr/M€$
Emissions - Scope 3 (indirect emissions)	196	$tCO_2eq/yr/M€$
Savings - Scopes 1+2	-2	$tCO_2eq/yr/M€$
Savings - Scope 3 (indirect emissions)	-12	$tCO_2eq/yr/M€$

	Stoxx 600
Carbon Impact Ratio (CIR)	0,03

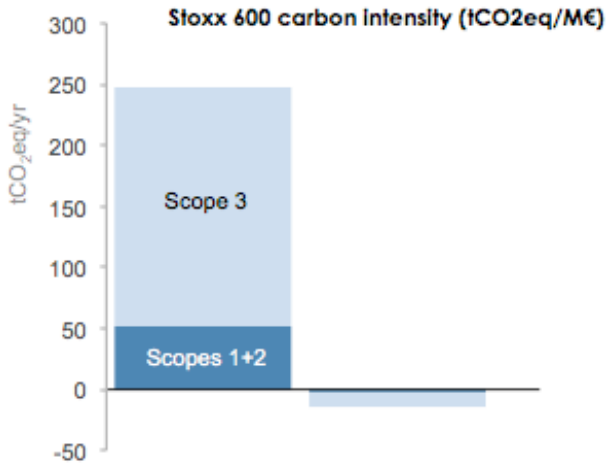


Figure 1: CIA quantitative results for the Stoxx 600

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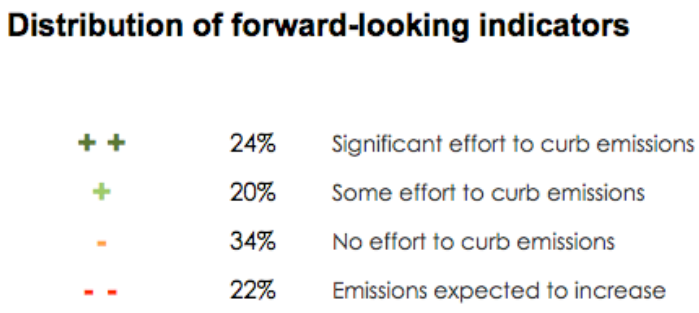


Figure 2: CIA qualitative results for the Stoxx 600

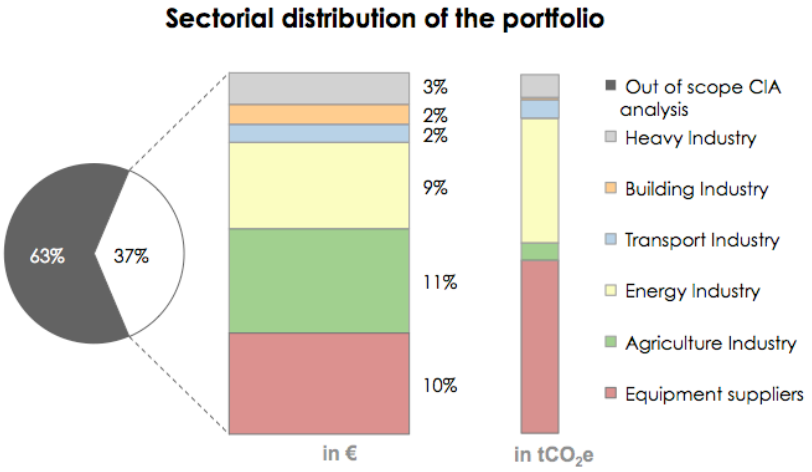


Figure 3: Sectorial distribution of the Stoxx 600 (high-stake sectors only).

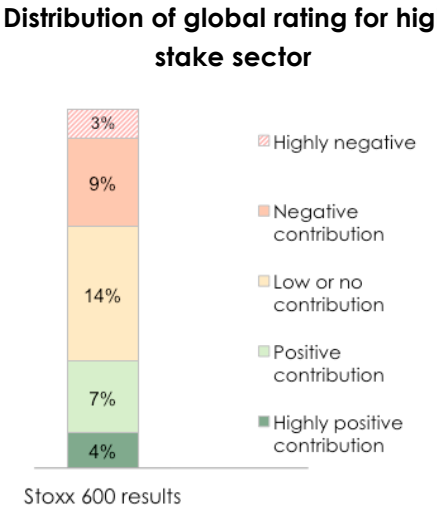


Figure 4: Distribution of overall ratings in the Stoxx 600 (high-stake sectors only)

Top 5 contributors to emissions		Top 5 best carbon impact ratio	Top 5 contributors to savings	
Company name	Weight in portfolio emissions induced		Company name	Weight in portfolio emission savings
ROYAL DUTCH SHELL	26%	**VESTAS WIND SYSTEMS**	SIEMENS AG	27%
TOTAL SA	12%	**GAMESA CORPORACION TECNOLIGICA SA**	DAIMLER AG	9%
BP PLC	11%	**ENEL GREEN POWER SPA**	ABB LTD NOM.	7%
SIEMENS AG	9%	**KINGSPAN GROUP PLC**	VOLKSWAGEN AG	7%
DAIMLER AG	2%	**EDF**	AIRBUS GROUP	6%

Figure 5: Top 5 underlying companies in terms of total induced emissions, carbon impact ratio, and emission savings.

The highest carbon impact ratios

As shown in Figure 5 above, the companies with the best Carbon Impact Ratio (CIR) are typically renewable energy producers or manufacturers who sell renewable energy or energy efficient products and systems. Although the manufacturing process may be intensive in terms of Scope 1 and 2 emissions, the downstream Scope 3 emissions saved by the products over their useful life outweigh the operational emissions of their manufacture, thus leading to a high ratio of emissions savings to induced emissions.

Companies with a CIR greater than 1 are referred to as "low carbon pure players." Only five companies from the Stoxx 600 have a CIR superior to 1:

- Vestas Wind Systems (low carbon electricity equipment manufacturer): CIR = 8
- Gamesa Corporacion (low carbon electricity equipment manufacturer): CIR = 6.9
- Enel Green Power (low carbon electricity): CIR = 5.8
- Kingspan Group (construction and building materials): CIR = 5.4
- EDF (low carbon electricity): CIR = 2

The table below summarizes the key Carbon Impact Analytics indicators for the Stoxx 600, reference index with which different Low Carbon indices are compared.

STOXX 600	
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)	250
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)	-14

Trajectory alignment (°C)	4°
Share of companies with "high" and "significant" positive contribution	11%
Share of top "forward-looking" indicators	24%

The initial results of the Stoxx 600 presented above were then optimized to create four different low carbon indices for comparison. These new indices were created using the optimization levers described in Part 2 of this report. All indices were built from the same universe: the 600 companies in the Stoxx 600.

As this index comprises too few low carbon pure players, it was not possible to go one step further and increase these companies' share in the indices built.[5]

3.1.2 LOW CARBON INDEX 1: BEST-IN-CLASS SCOPE 1+2 INTENSITY

The first low carbon index is built on a best-in-class approach based on lowest Scope 1+2 intensity, two thirds of values being excluded in number.
This method corresponds to what most existing low carbon indices are: an optimization of the Scope 1+2 carbon footprint, but not an increase in index contribution to the energy transition. Indeed, a low carbon portfolio might include essentially tertiary companies (media, financial sector, services, etc.) but no equipment manufacturers that will actually enable energy efficiency and energy mix decarbonization.

Low Carbon Index 1: best in class Scope 1+2 intensity	
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)	210
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)	-14
Trajectory alignment (°C)	4.6°
Share of companies with "high" and "significant" positive contribution	9%
Share of top "forward-looking" indicators	11%

[5] Carbone 4 has nevertheless conducted this exercise with Euronext by building the Low Carbon 100, in which smaller capitalization low carbon pure players were added to the initial universe.

The results presented above confirm this assumption:

- Scope 1, 2 and 3 intensity is indeed reduced, but GHG savings remain constant.
- The share of companies with "high" and "significant" contribution to mitigation (two best overall ratings) is lower than in the Stoxx 600 (9% vs. 11%).
- As a result, the Carbon Impact Analytics trajectory alignment is 4.6°C (even higher than the reference index).
- On top of that, the share of top "forward-looking" companies is lower than in the Stoxx 600 (11% vs. 24%).

Although this index is less carbon-intensive than the Stoxx 600, its contribution to the low-carbon transition is diminished. This is due to the fact that a significant part of companies with a "high contribution" to climate change mitigation (energy-efficient or renewable energy equipment manufacturers for instance) also happen to be intensive in terms of operational Scope 1 and 2 emissions. It is only in considering the Scope 3 emissions induced and saved by these companies (i.e. through the sale of energy-efficient products or renewable energy equipment used downstream) that their emissions reduction potential is fully exposed. **Therefore, a selection process based purely on Scope 1 and 2 emissions is inadequate in building an index with low carbon risk and the capacity to contribute to the low-carbon transition.**

N.B. The relative weight of each ICB sector represented in the index remains constant compared with the Stoxx 600.

3.1.3 LOW CARBON INDEX 2: FOSSIL-FREE

The second low carbon index is built on a sectorial reallocation approach based on the exclusion of fossil fuel producers (oil, gas, and coal). The ICB sector "oil & gas production" (12 companies) and coal mining companies (Anglo American, BHP Billiton, Glencore and Rio Tinto) were thus excluded.[6]

Low Carbon Index 2: fossil-free	
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)	160
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)	-15
Trajectory alignment (°C)	3.5°

[6] Theoretically, in order to be truly "fossil free," an index would have to exclude not only fossil fuel producers but also those companies who depend on fossil fuel inputs in their value chain. This is however difficult to accomplish in reality.

Share of companies with "high" and "significant" positive contribution	12%
Share of top "forward-looking" indicators	29%

This approach has several effects on Carbon Impact Analytics results (compared with the Stoxx 600):

- Scope 1, 2 and 3 intensity is greatly reduced (160 $tCO_2e/yr/M€$ vs. 250 $tCO_2e/yr/M€$).
- Savings are more significant (-15 $tCO_2e/yr/M€$ vs. -14 $tCO_2e/yr/M€$), although they remain very modest compared to induced emissions.
- The share of "high" and "significant" contribution companies is greater than in the Stoxx 600 (12% vs. 11% for Stoxx 600).
- As a result, the Carbon Impact Analytics trajectory alignment is 3.5C.
- On top of that, the share of companies with top "forward-looking" is higher than in the Stoxx 600 (29% vs. 24%).

This index appears to be better aligned with the challenges of the low-carbon transition. It is less intensive in terms of Scope 1, 2 and 3 induced emissions and also has a higher proportion of companies with a "high" or "significant" contribution to climate change mitigation. **However, the exclusion of fossil fuel producers, on its own, does not lead to a significantly improved climate change trajectory** (only 3.5C). Additional optimization levers, such as an increase in the share of companies with "high" and "significant" contributions, are needed in order to significantly shift alignment.

N.B. The relative weight of each ICB sector present in this index slightly increases compared with those of the Stoxx 600, since one sector and part of a second one are excluded.

3.1.4 LOW CARBON INDEX 3: BEST-IN-CLASS CIA AND FOSSIL-FREE

The third low carbon index is built on a sectorial reallocation based on fossil producers (oil, gas and coal) exclusion and a Carbon Impact Analytics best-in-class approach.
Sectorial exclusion is the same as for Low Carbon Index 2 and best-in-class logic is the following:

- The best-in-class approach is based on the best CIA overall rating for high-stake sectors (two thirds of values excluded in number), selection being applied ICB sector by ICB sector.
    - In case of equality, Carbon Impact Ratio is first used to select values, second largest market cap,
    - For companies within the sector "Gas, Water & Multiutilities," those involved in fossil fuel extraction are also excluded from this index.
- Low-stake sectors are left out of this selection process; all companies remain in the index.

Low Carbon Index 3: CIA best in class + fossil-free	
Scope 1, 2 and 3 carbon intensity (*($tCO_2e/yr/M€$)*	90
Scope 1, 2 and 3 GHG savings intensity (*$tCO_2e/yr/M€$)*	-15
Trajectory alignment (°C)	2.6°
Share of companies with "high" and "significant" positive contribution	14%
Share of top "forward-looking" indicators	36%

This approach has several effects on Carbon Impact Analytics results (compared with Stoxx 600):

- Scope 1, 2 and 3 intensity is much reduced (90 *$tCO_2e/yr/M€$* vs. 250 *$tCO_2e/yr/M€$)*.
- Savings are increased (-15 *$tCO_2e/yr/M€$* vs. -14 *$tCO_2e/yr/M€$* in the Stoxx 600).
- The share of "high" and "significant" contribution companies is much more important than in the Stoxx 600 (14% vs. 10% for Stoxx 600).
- As a result, the Carbon Impact Analytics trajectory alignment is 2.6°C.
- On top of that, the proportion of companies with the best "forward-looking" indicator is higher than in the previous indices.

The combined use of optimization levers leads to a higher contribution to the low-carbon transition, as it is aligned with a 2.6°C trajectory.

N.B. The relative weight of each ICB sector present in this index is the same than in Low Carbon Index 2.

3.1.5 LOW CARBON INDEX 4: CIA BEST IN CLASS, FOSSIL PRODUCER AND FOSSIL EQUIPMENT MANUFACTURER-FREE

The fourth low carbon index is very similar to the third one but it goes one step further in terms of sectorial exclusion. It is built on sectorial reallocation based on the exclusion of both fossil producers (oil, gas and coal) and fossil equipment manufacturers, as well as a Carbon Impact Analytics best-in-class approach.
The best-in-class logic is the same applied to Low Carbon Index 3 and sectorial exclusion is the same applied to Low Carbon Index 2, except that the ICB sector "Oil Equipment, Services & Distribution" is also excluded.

Low Carbon Index 4: CIA best in class + fossil producer and fossil equipment-free	
Scope 1, 2 and 3 carbon intensity (*$tCO_2e/yr/M€$*)	80
Scope 1, 2 and 3 GHG savings intensity (*$tCO_2e/yr/M€$*)	-15
Trajectory alignment (°C)	2.5°
Share of companies with "high" and "significant" positive contribution	14%
Share of top "forward-looking" indicators	37%

This approach has several effects on Carbon Impact Analytics results (compared to the Stoxx 600):

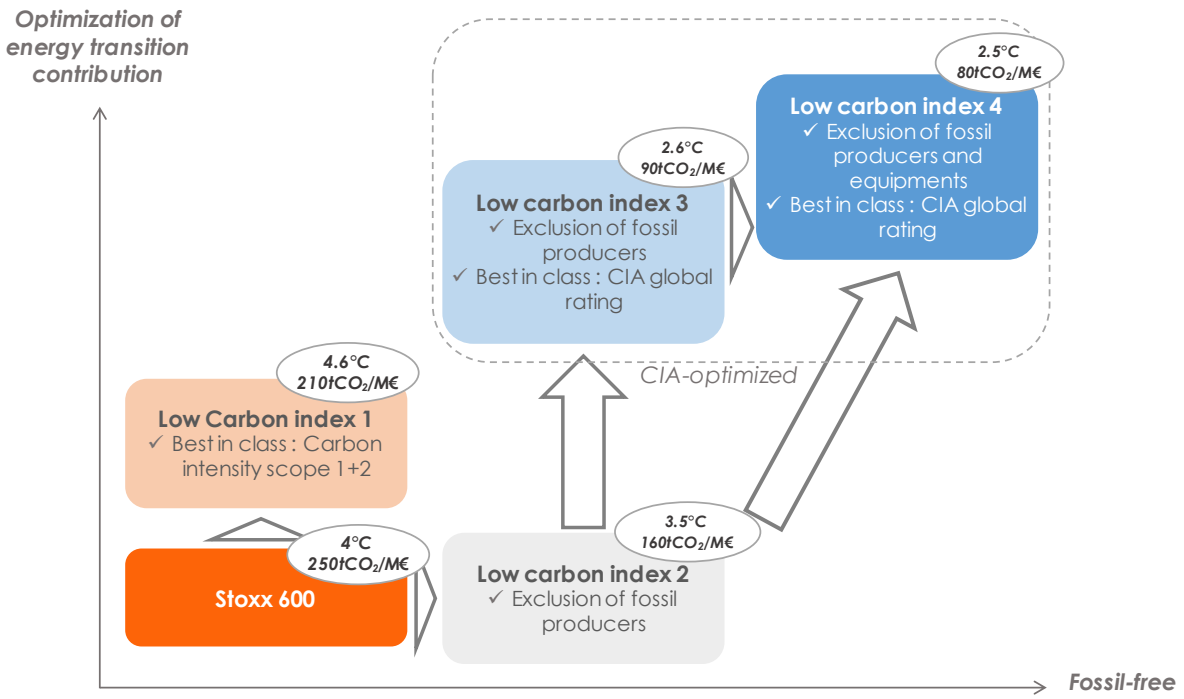
- Scope 1, 2 and 3 intensity is greatly reduced compared to the Stoxx 600 (80 *$tCO_2e/yr/M€$* vs. 250 *$tCO_2e/yr/M€$)*
- Savings are increased (-15 *$tCO_2e/yr/M€$* vs. -14 *$tCO_2e/yr/M€$* in the Stoxx 600).
- The share of "high" and "significant" contribution companies is more important than in the Stoxx 600 (14% vs. 10% for Stoxx 600).
- As a result, the Carbon Impact Analytics trajectory alignment is 2.5C.
- On top of that, the proportion of companies with the best "forward-looking" indicator is higher than in all of the other indices.

This index appears to be the "best" of the four indices described: it has the lowest induced emissions, the highest share of companies with best overall and forward-looking ratings. Nevertheless, it is not on 2°C trajectory alignment because it lacks reinforcement of low-carbon sectors.

N.B. The relative weight of each ICB sector present in this index slightly increases compared with those of the Low Carbon Index 3, since an additional sector is excluded.

3.1.6 RESULTS

Carbon Impact Analytics enables these four indices to be positioned on a scale following two criteria: optimization of energy transition contribution and exclusion of fossil sectors.



Low carbon indices 3 and 4 have the highest levels of contribution to climate change mitigation and to the energy transition, as they have a low carbon footprint, high savings, and the best rates of "high contribution" companies. However, the best-in-class methodologies applied to these two indices could be improved for low-stake sectors (no selection was applied as the only indicator available is Scope 1 and 2 GHG intensity). The results of all Low Carbon Indices (LCI) are resumed below for comparison.

	STOXX 600	LCI 1	LCI 2	LCI 3	LCI 4
Scope 1, 2 and 3 carbon intensity ($tCO_2e/yr/M€$)	250	210	160	90	**80**
Scope 1, 2 and 3 GHG savings intensity ($tCO_2e/yr/M€$)	-14	-14	-15	-15	**-15**
Trajectory alignment (°C)	4°	4.6°	3.5°	2.6°	**2.5°**
Share of companies with "high" and "significant" positive contribution	11%	9%	12%	14%	**14%**
Share of top "forward-looking" indicators	24%	11%	29%	36%	**37%**

3.2 RECAST OF EURONEXT'S LOW CARBON 100 EUROPE®

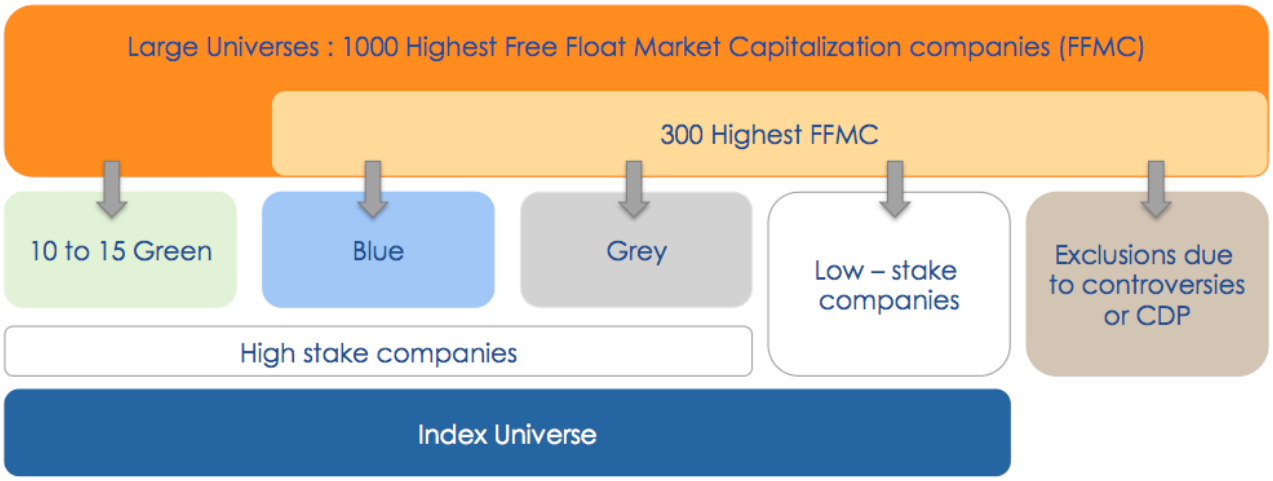
3.2.1 EURONEXT'S LOW CARBON 100 EUROPE®

SELECTION CRITERIA

Euronext's Low Carbon 100 Europe®, henceforth referred to as the Low Carbon 100, consists of 100 low-carbon firms which were selected using the two levers described in Part 2 of this report: sectorial reallocation and a best-in-class approach. The Low Carbon 100 was drawn from an initial universe of approximately 300 European companies: 12 low carbon pure players and around 288 European companies with the highest free float market capitalization. The selection criteria for the Low Carbon 100 were the following:

- Increase the proportion of low carbon pure players in the index relative to their share in the eligible universe
- Diminish the proportion of fossil-fuel pure players in the index relative to their share in the eligible universe
- Select the companies with the highest contribution to climate change mitigation within each sector (best in class approach with the CIA methodology)
- Maintain a sectorial diversification close to that of the reference universe
- Privilege low-stake companies contributing to climate change mitigation as evidenced by their CDP performance score

To accomplish these goals, the eligible universe was first divided into 2 main segments according to CIA principles: carbon high-stake and carbon low-stake (refer to CIA methodology in Part 1 for details). The high-stake segment was further divided into three categories: green, blue, and grey. The resulting four categories (low-stake, green, blue, and grey) were each assigned a target weight in the new index.



HIGH-STAKE GREEN

Low carbon pure players are those for which at least 50% of turnover is related to low carbon technology (renewables or energy efficiency) and must belong to one of the following ICB sectors: Alternative Energy (580); Construction & Materials (2350); Electricity (7530); Electronic & Electrical Equipment (2730); Industrial Engineering (2750); and Industrial Transportation (2770).

With too few low carbon pure players in the initial universe, Green companies were selected from a wider universe of European companies (1000 companies with the highest free float market capitalization) based on the above-listed criteria. For all further steps of the selection process, the initial universe thus consisted of the 14 selected low carbon pure players and the 286 largest European companies in terms of market capitalization.

HIGH-STAKE GREY

In contrast to Green companies, Grey companies are those for which at least 50% of turnover is linked to petroleum or natural gas extraction and refining, and those linked to coal extraction and/or refining (no minimum %). Electricity producers with a carbon intensity surpassing 400g CO_2 per KWh are also considered to be Grey. These companies were analyzed using CIA methodology and attributed an overall rating from 1 to 5 (1 representing a high contribution to climate change mitigation and 5 representing incompatibility with climate change mitigation). Companies with the highest CIA rating were added to the Low Carbon 100 until the Grey target weight was reached.

HIGH-STAKE BLUE

Blue companies are high-stake companies from the initial universe qualifying as neither Green nor Grey. These companies were attributed a CIA overall rating from 1 to 5. Companies with the highest CIA rating were included in the Low Carbon 100 until the target weight of the category was reached. The sectorial distribution of the original universe was maintained.

LOW-STAKE

Those companies included in the initial universe but not qualifying as high-stake form the low-stake category. These companies either have a limited impact on global warming or belong to sectors for which the current standards of disclosure are insufficient to calculate a reliable CIA score. Low-stake companies were selected based on their CDP score and added to the index until the target weight was reached. Companies declining to participate in the CDP questionnaire were automatically excluded from selection. The sectorial distribution of the original universe was maintained.

OPTIMIZATION RULE FOR GREY AND GREEN COMPANIES

Index composition was optimized by decreasing the share of Grey companies in order to make way for an increased share of Green companies. The optimization between Green and Grey companies was subject to a liquidity constraint as well as an allocation ratio. The Green/Grey allocation ratio was based on the investment needs in the horizon 2035 for the 2-degree scenario (2DS IEA), and the liquidity constraint was aimed at maintaining index investability in regards to the Green component.

ADDITIONAL CRITERIA FOR COMPANY SELECTION

If two or more companies had the same CIA overall rating, additional criteria were used. These criteria varied by sector and included a company's Carbon Impact Ratio (CIR), carbon intensity, or the share of (certain) fossil fuels in turnover.

RESULTS

The Low Carbon 100 Europe® is the first index to be constructed based on recommendations for a 2°C scenario. Alignment with a 2°C trajectory is twofold:
- The sectorial allocation includes an ambitious reallocation between "Grey" and "Green" assets. 2°C scenarios show that such a reallocation is necessary to reduce GHG emissions and limit global warming to 2°C. Notably, the International Energy Agency 2DS scenario (IEA 450ppm) estimates that cumulative investments (in billion dollars) between Grey and Green assets will need to reach a 50%/50% split over the 2014-2035 period.
- The selection of companies within each sector favors companies which are the most aligned with a 2°C trajectory, evaluated (depending on the sector) through CDP performance grade or CIA overall rating (best in class approach). For CIA "high stake" sectors, the methodology evaluates whether the operational performance and product performance are aligned with a 2°C trajectory. For "low stake" sectors, the CDP performance score reflects the level of action taken on climate change as evidenced by the company's CDP response.

As presented in the table below, the Low Carbon 100 Europe® generates 51% less emissions as compared to the European average (the initial universe being considered representative of Europe). The carbon footprint (Scope 1, 2, and 3) is cut in half from 222 tCO_2e/yr to 109 tCO_2e/yr for 1M€ invested. Emissions savings increase 100%, from 12 tCO_2e/yr to 24 tCO_2e/yr for 1M€ invested.

	Reference Universe	Euronext's Low Carbon 100 Europe®	
Induced emissions (Scope 1, 2, 3) ($tCO_2e/yr/M€$)	222	**109**	↓51%
Emission savings (Scope 1, 2, 3) ($tCO_2e/yr/M€$)	-12	**-24**	↑100%
Climate trajectory / alignment	4°C	**2°C**	↓50%
Share of companies with "high" and "significant" positive contribution	11%	**30%**	↑172%
Share of top "forward-looking" indicators	29%	**55%**	↑89%

The list of companies composing the Euronext Low Carbon 100 Europe® is available on the Euronext website.

CONCLUSION

Investors are increasingly exposed to carbon risks[7] and must take these risks into account when building investment strategies. The Scope 1, 2 and 3 carbon footprint being a good proxy to assess carbon risks, Carbon Impact Analytics can be used as a tool to measure and manage climate-related risks. More broadly, this tool may be used to:

- measure and manage risks,
- optimize an investor's contribution to the energy transition,
- seize opportunities associated with climate change mitigation,
- report on GHG emissions and savings (for regulatory purposes or voluntarily),
- engage in dialogue with companies,
- reallocate investment portfolios,
- and build new low-carbon indices.

Two preliminary case studies, based on the Stoxx 600 and the Euronext universes, highlight the advantages of using CIA indicators to construct low carbon indices. The results of the four indices presented in Part 3.1 demonstrate that the low-carbon indices with the highest contribution to the energy transition are those based on a CIA best-in-class approach, selection being based on companies' overall ratings. Moreover, the CIA best-in-class approach would substantially reduce the portfolio carbon impact. As the overall rating relies on both quantitative indicators (induced direct and indirect emissions, emission savings, and sectorial indicators, see 1.1.2) and a qualitative forward-looking indicator (see 1.1.3), Carbone 4 believes it is the most robust indicator on which a low-carbon index or portfolio can be built. The application of a bottom-up methodology is necessary to enable selection of the assets that are most likely to thrive, and to exclude those that introduce carbon risks in the context of a low-carbon transition.

Moreover, these preliminary low carbon indices show that traditional indicators (Scope 1 and 2 induced emissions) are largely inadequate for building low-carbon investment strategies: **investors must set objectives not only to reduce their carbon footprint but to optimize their carbon impact.** An investor whose strategy is only to reduce its Scope 1 and 2 emissions might have a significant Scope 3 intensity that, when unaccounted for, will lead the investor to invest in sectors with major scope 3 emissions (oil industry for example) or in sectors that contribute marginally to curbing global GHG emissions (low-stake sector in CIA methodology). But the investor can also invest in high contributive sector but with a low scope 1&2[8].

[8] Example on page 13 : The importance of considering a broad scope of emissions

Using a combined best-in-class and sectorial reallocation approach, the best low carbon index based on the Stoxx 600 (Low Carbon Index 4) attains a 2.5°C trajectory alignment. However, the Low Carbon 100 Europe® provides an example of how **the addition of low-carbon solution providers (or low carbon pure players) can further maximize carbon performance to reach a 2°C trajectory alignment**. Therefore, while sector reallocation and a CIA best-in-class can significantly improve the contribution of a given portfolio or index, Carbone 4 encourages the integration of companies dedicated to low carbon solutions in order to fully optimize the contribution of a low-carbon index.

Moving forward

Carbone 4 strives to continuously improve Carbon Impact Analytics in order to provide the most intelligent indicators by which to align portfolios and indices with the energy and climate transition. These improvements notably include broadening the coverage and treatment of low-stake sectors (Carbone 4 is currently developing a new module for the water and waste sector, for example), as well as developing its approach to the treatment of intersectorial dependence (implications of fossil fuel exclusion for various sectors).

Carbone 4 welcomes all feedback and advocates a healthy exchange with the finance community in order to further adapt its methods to investor needs.

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