2-infra challenge

Methodological guide

ASSESSING INFRASTRUCTURE PORTFOLIOS' ALIGNMENT WITH THE PARIS AGREEMENT

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carbone 4

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EXECUTIVE SUMMARY

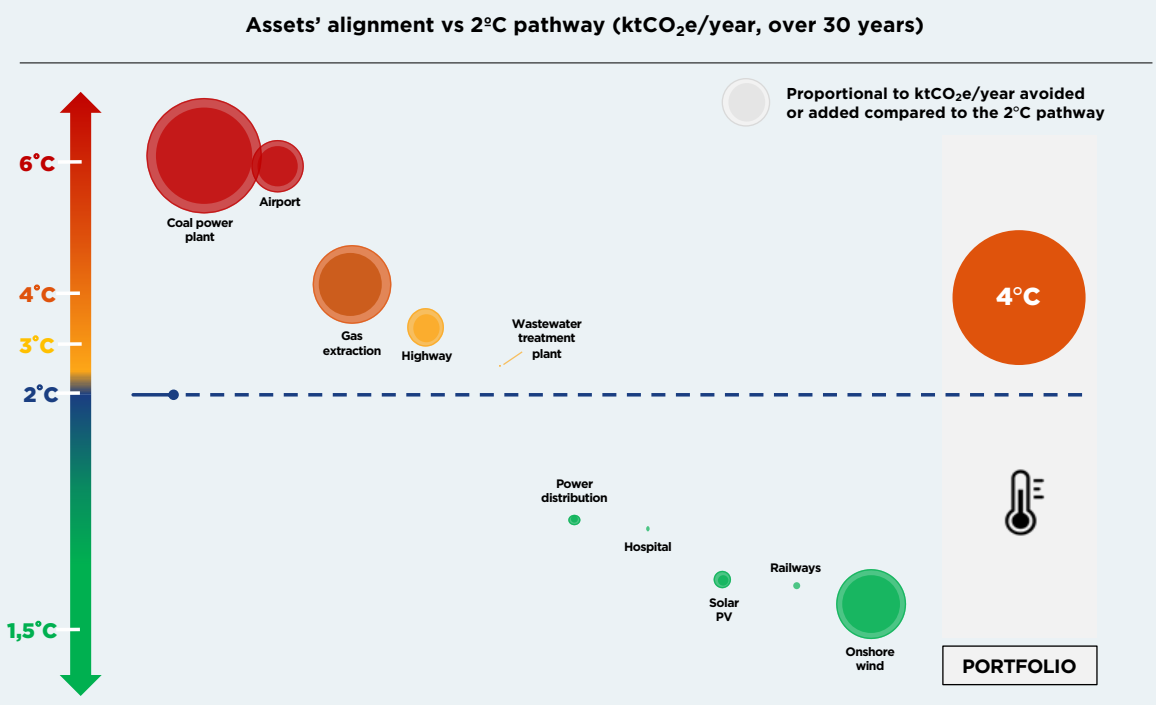
Infrastructure require special attention with regard to climate change since assets will be there for decades or even centuries, just as the greenhouse gas emissions resulting from their operations.

The choice of today's investments in infrastructure will determine the success or failure of the Paris Agreements.

Carbone 4 and long-term infrastructure investors (equity and debt) joined their forces to build a rigorous methodology aiming **to assess the alignment of infrastructure financial portfolios with the Paris Agreement** (notably with a 2°C compatible pathway). This methodology is unique in the market as it has been conceived specifically for the infrastructure asset class. It can score a portfolio's alignment from a 1,5°C compatible pathway to a 6°C compatible pathway.

With this methodology, we are now able to assess the **forward-looking carbon performance** of infrastructure portfolios. We are confident that this will become **the new best practice in the market**.

We are proud to present this methodology and key output (find an example below for an illustrative portfolio).



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TOWARDS AN INFRASTRUCTURE REVOLUTION?

A methodological framework tailored for infrastructure portfolios

The 2infrachallenge project has **two objectives:**

1. Assess infrastructure portfolios' **alignment with low carbon scenarios**
2. Assess infrastructure portfolios' **exposure to 2 climate-related risk categories: transition risks and physical risks**

This methodological guide focuses on the first goal, the assessment of compatibility with low carbon scenarios. Methodological guides for the assessment of climate-related risks (physical risks and transition risks) are also meant to be released in the coming months. In the remainder of the present report, this compatibility-check will be referred to as "alignment methodology".

This document is a first version of the methodological guide; it will be complemented as the methodology is enriched.

The alignment methodology assesses the compatibility with low carbon scenarios" which involves being able to answer the following questions:

- Is my portfolio aligned with a defined low-carbon pathway? If not, is it far from or close to being aligned?
- Does my portfolio perform better or worse than the low-carbon benchmark regarding the impact on climate change?
- What temperature increase is associated with my portfolio?
- What is the fraction of my portfolio that is composed of assets that would be stranded for a given scenario?

This assessment takes the form of a scoring expressed in tonnes of CO_2 and temperature level of the portfolio.

The need to reconcile infrastructure with climate objectives

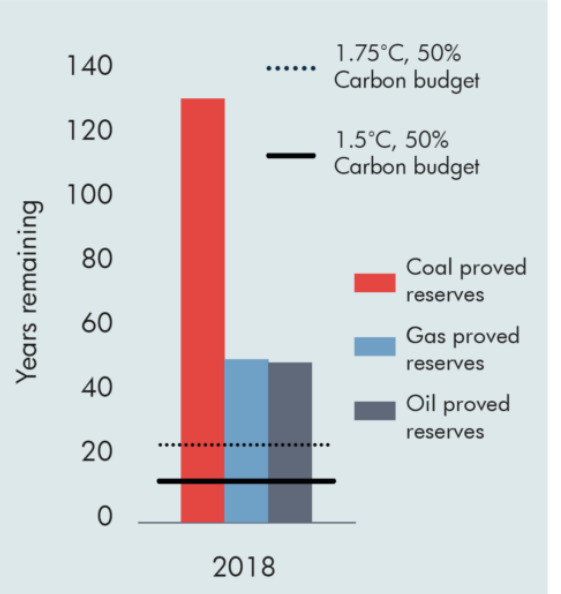
The infrastructure asset class requires special attention regarding climate change since assets will be there for decades or even centuries, just as the greenhouse gas emissions resulting from their operations. Besides, infrastructure design often structures land use, mobility and other usage patterns that are indirect drivers of climate change and environmental degradation and therefore key to their mitigation.

In its 2018 World Energy Outlook, IEA has shown that 95% of the carbon budget to keep global warming below the 2°C limit is already locked in the infrastructure existing at end 2018. There is a dire need to reconcile investments, and in particular greenfield investments, with climate objectives. In other terms, no new infrastructure build from now on should require, directly or indirectly, the use of extra fossil fuels.
International Energy Agency

TABLE 1. FOSSIL FUEL RESERVES REMAINING AT CURRENT PRODUCTION LEVELS

Fossil fuel	Remaining proved reserves, years left at current production
coal	132
gas	51
oil	50

FIGURE 1. THE 2018 CARBON BUBBLE: RESERVES LIFE OF OIL, GAS AND COAL, AND CARBON BUDGETS



Comparison between estimated Carbon reserves and the Carbon budget compatible with a +1,5°C/1,75°C global warming scenario[2]

Besides locking down long-term emissions, infrastructure corresponds to clear and specific assets. They generally serve one main use for a given geography. The story is far more complex for a company operating in many countries with many activities. When it comes to climate accounting, infrastructure can thus be more specifically assessed.

[1] Source: IPCC, Global Carbon Project, BP, CTI analysis (link:https://carbontracker.org/reports/balancing-the-budget/)

2-infra challenge addresses a methodological gap

Up until now, the standard analysis carried out for infrastructure assets is to evaluate induced emissions (ie the carbon footprint of the asset) and avoided emissions for each asset of a given portfolio. **However, that calculation does not provide a conclusion about the portfolio compatibility with a defined climate pathway:**

- The "reference situation" used to calculate the induced and avoided emissions associated to a given asset is not necessarily the same for all assets of a portfolio. It is then without relevance to add up all avoided emissions together, for example to indicate **the portfolio overall compatibility** with a defined climate pathway. A methodological work must be carried out – if possible – to **build up the results at the portfolio level using the individual assessment at asset level.**
- The way they are generally calculated, induced and avoided emissions assume a static world (i.e. emissions are evaluated at a given point in time), whereas **an alignment measurement would require a dynamic forward-looking analysis of assets' induced and avoided emissions over a significant period of ownership.**

To address these methodological caveats, Carbone 4 has launched the 2-infra challenge project with the sponsorship from first and prime sponsors the Agence Française de Développement, La Banque Postale Asset Management, EIT Climate-KIC and Meridiam and prime sponsor Generali Global Infrastructure.

AMBITION, KEY FEATURES & OUTPUTS OF THE 2-INFRA CHALLENGE METHODOLOGY

Ambition & key methodological features

The ambition of the 2-infra challenge methodology is to check the alignment of an infrastructure portfolio with a given climate scenario, considering the evolution in time of both assets' performance and scenario pathway.

The methodology is characterized by the following 7 features:

- **Bottom up**: evaluation is done at the asset level and not derived from sector averages
- **Business adaptable**: depending on data availability and on the stage of the portfolio (that can be either already complete or in a build-up process), two rating approaches can be used: either a first order of magnitude, based on easily available financial data, or an accurate and comprehensive rating, based on physical data. In the latter option, the 2-infra challenge model is able to capture assets' production profiles and mitigation actions.
- **Forward-looking**: evaluation is carried out over a given period of time, to capture the fluctuation in time of both asset performances and scenario parameters. The time period considered for the rating can be configured in the model: it may reflect assets' detention period into the portfolio, the asset overall economic life or its effective life.
- **Homogeneous**: all assets are scored by taking into account the end uses they serve. There is a defined list of end uses whose forward-looking performance is assesses in the 2°C scenario (e.g. heating, long-distance transport of passengers, specific electricity, see all end-uses in the sections below etc). Therefore, the assets are not compared simply with other similar assets (a power plant compared with another power plant for instance) but with all existing assets which serve the same end-use in the economy. The weight of end uses in the production of the asset is used to weight the final rating of the asset. This enable to homogenously compare assets in different sectors.
- **Portfolio-driven**: the model provides a consolidated vision of alignment at portfolio level, that has his own rating, obtained through the aggregation of the ratings of all underlying assets.
- **Greenfield and brownfield differentiated**: assets are rated differently depending on whether they relate to greenfield or brownfield infrastructure. Greenfield refers to newbuilt assets or existing assets that have undergone a major refurbishment whereas brownfield applies to existing infrastructure. A greenfield asset, obviously, is supposed to deliver a carbon performance superior to that of a brownfield asset, as it arises in a world of greater carbon constraint.

- **Scenario modular**: any temperature scenario, any region and any asset type can be plugged into the model. For the 2-infra challenge project specifically, Carbone 4 has developed an exclusive partnership with Enerdata in order to build realistic low-carbon scenarios with a country-level granularity.

Outputs

The output for the portfolio is "surplus" or "avoided" emissions compared to the reference low-carbon pathway. That indicator is expressed in tons of CO_2/year and corresponds to the asset-weighted average of the average annual deviations from the pathway over the cumulated period considered. The emissions avoided or in surplus relative to the pathway are actually calculated for each asset and then summed, resulting in the portfolio rating.

This indicator enables to answer the following questions:

- "Is my portfolio aligned with a defined emission pathway?"
- "Does my portfolio perform better or worse than the 2°C benchmark?"

- An indicator superior to 0 means the portfolio is adding "surplus" emissions over the reference scenario. It is not aligned with the pathway.
- An indicator inferior to 0 means the portfolio is avoiding emissions compared to the reference scenario. It means that the underlying basket of weighted assets comply with the reference pathway and could even comply with a scenario allowing a lower carbon budget.

The model can determine which assets influence positively or negatively the portfolio rating by looking at the sub-rating of each asset in the portfolio.

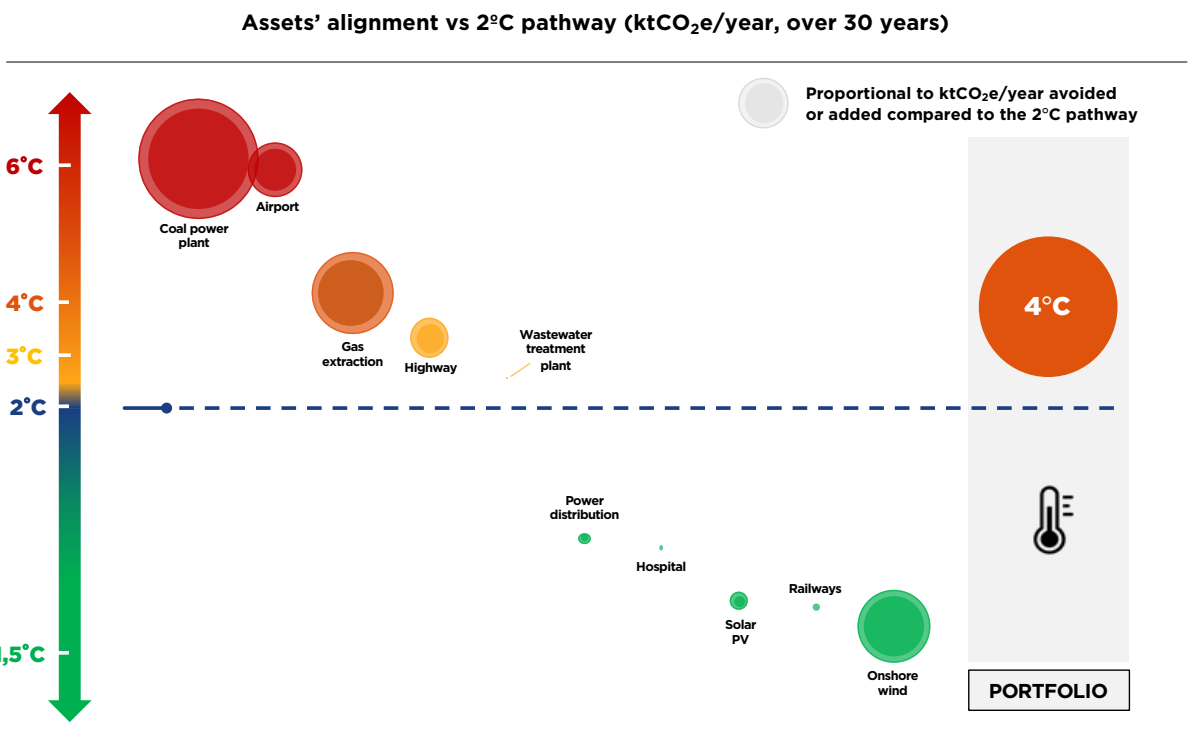
The 2-infra challenge alignment methodology also answers the two additional questions:

- "How close is my portfolio to the low-carbon pathway?"
- "What level of global warming is associated to my portfolio?"

Eventually, the output may be presented according to the graph below:

- Bubbles are proportional to the amount of CO_2 that is above or beneath the reference scenario (here a 2°C one).
- The assets are represented on a temperature scale that reflects their deviation from the target pathway (here 2°C).

Example of the methodology deliverable



The methodology provides a bottom-up portfolio rating.

Transitioning to a low-carbon economy means that investment in low carbon infrastructure needs to grow dramatically compared to current levels. However, without dedicated tools, it is impossible for an investor to say whether his mix of investment is compatible with a given low-carbon transition or not.

The portfolio approach enables any investor to measure-up the overall balance of its portfolio and to allocate its investment in a compatible manner with a low-carbon scenario (the scenario is not prescribed any the methodology allows to test the portfolio against any specific pathway).

2-infra challenge and existing standards & regulations

The new alignment methodology enables to answer key elements in existing standard framework, such as:

Reporting frameworks	Key components		Comment
Hard **Article 173**	Transition risks	Physical risks	"This information (…) concerns the level of climate-friendly investments and the contribution to meeting the international objective of limiting global warming and to achieving the objectives of energy and ecological transition"[3]
	Contribution to the energy transition	Biodiversity1	
Soft **TCFD**	Governance	**Strategy**	The alignment methodology is answering the "Strategy" part, assessing the robustness of portfolio using 2°C scenarios. It also provides performance metrics for the "Metrics & Targets" part.
	Risk Management	**Metrics & Targets**	
Soft **PRI** **Climate Risks Strategy & Governance Module**	**Policy & Coverage (SG 1[2])**	Roles & Responsabilities (SG 7)	Examples: "Indicate whether the organization carries out scenario analysis and/or modelling, and if it does, provide a description of the scenario analysis" (13.1) / "Indicate the climate scenarios your organization uses" (13.8)
	Climate in asset allocation (SG 13)	Investment risks & opportunities (SG 14)	

Notes: (1) Biodiversity was not part of the initial scope of reporting, it is being added by a bill that is in the process of being adopted. (2) Climate indicator number in PRI's = « Climate Risk Strategy & Governance » (SG) module. (3) Source: http://www.senat.fr/leg/pjl18-700.pdf

Carbone 4 full services cover **all components** for these 3 standards.

Focus: The alignment methodology and the Green share / Green taxonomy

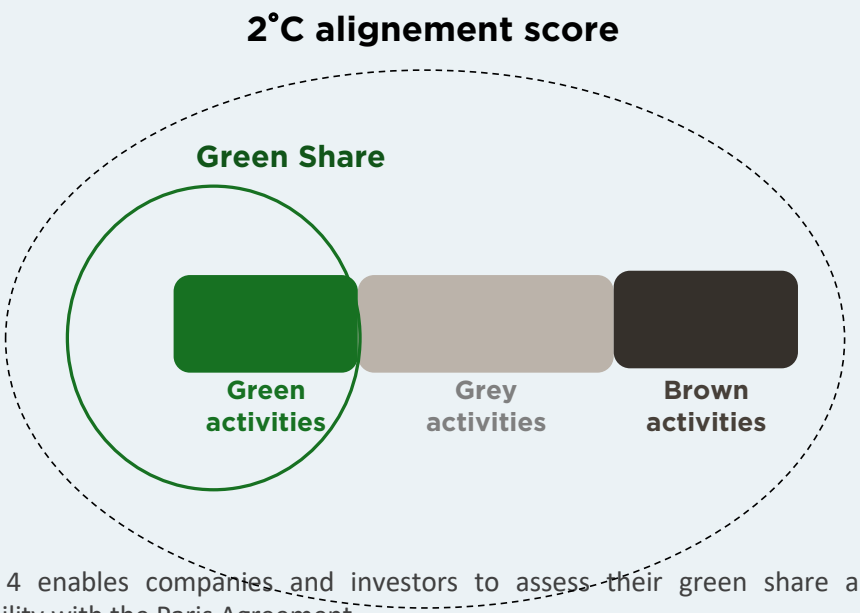
The EU Taxonomy is a tool to help investors, companies, issuers and project promoters navigate the transition to a low-carbon, resilient and resource-efficient economy. This common language enables companies and their investors to identify the activities which are already environmentally friendly. That is what we call **the green share** :

- The proportion of turnover aligned with the Taxonomy; and
- CAPEX and, if relevant, OPEX aligned with the Taxonomy [1]

[1]https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf

How does our methodology connect with the Green Taxonomy?

- A portfolio with a very significant green share (with the definition of the Green Taxonomy) will likely have a very good score on the alignment methodology. Indeed, those assets will tend to avoid a lot of emissions compared to the baseline 2°C scenario thanks to good carbon performance
- A few assets might be considered as green by the taxonomy and not be aligned with a 2°C scenario in our alignment methodology. Indeed, the threshold used by our methodology is the 2°C scenario and depend on the geography and the given carbon performance of economic end-uses served by the asset.
- Conversely, a few assets not considered as green by the taxonomy might be considered as 2°C aligned in their specific geography and taking into account the specific end-uses served.
- Overall, the 2°C or other temperature alignment methodology is **really complementary to the green share approach. Indeed, the alignment methodology no only considers the green share but the full scope of the economy, considering the allocation between green, grey and brown activities. In that perspective, the alignment methodology provides a wider perspective** on the compatibility of all real asset portfolios with tomorrow's economy.



Carbone 4 enables companies and investors to assess their green share and their compatibility with the Paris Agreement

PRINCIPLES OF THE ALIGNMENT METHODOLOGY

Working status (sectoral and geographical coverage)

As of today, the methodology:

- covers **65 asset types**, in energy, mobility, water, tertiary buildings, waste and telecoms;
- encompasses the **European Union** and the **Mediterranean rim** regions (development of the North American region – USA and Canada – for energy and transport assets is under way, and there is no theoretical limits to developing other regions and asset classes);
- Allows to test a portfolio's alignment against any scenario ranging **from 1.5°C to 6°C in 2100**.

65 assets are covered by the methodology

Energy assets				
Coal, oil & gas	Hydrogen	Heat	Power production	Power T&D&S
Coal extraction	H2 production (SMR**)	District heat T&D&S*	Coal power plant	Battery
Oil extraction	H2 production electrolysis	Heat from coal	Fuel power plant	Pumped hydro
Oil refining		Heat from oil	Coal power plant + CCS***	Power transport
Oil T&D&S*		Heat from biomass	Natural gas power plant	Power distribution
Gas extraction		Heat from waste	Biogas power plant	
Gas transport		Geothermal heat	Waste power plant	
Gas processing		Heat from power	Gas power plant + CCS	
Gas distribution			Biomass power plant	
Methanisation			Nuclear power plant	

⋮

⋮

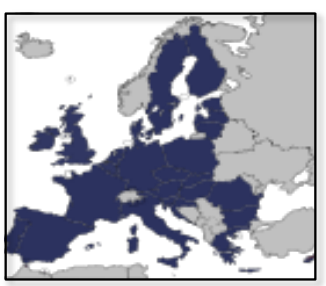
Offshore wind farm
Onshore wind farm
Solar PV farm
Solar CSP farm
Hydropower plant
Geothermal power plant
Ocean power plant

Mobility	Telecom	Waste	Water	Tertiary
Highways	Fiber network	Sort-out plant	Water treatment plant	Sports
Electric highways	Mobile network	Recycling plant	Desalination plant	Education
Parking	Data center	Landfill / storage site	Distribution network	Hospital
Charging stations		Composting plant	Wastewater treatment plant	
Bus lane		Incineration plant		
Bike lane				
Railways				
Metro				
Tram				
Train station				
Airport				
Port				

*T&D&S = Transportation & Distribution & Storage
** SMR = Steam Methane Reforming
***CCS = Carbon Capture and Storage

42 countries are covered by the methodology, in the EU and on the Mediterranean Rim regions:

European Union



Mediterranean Rim

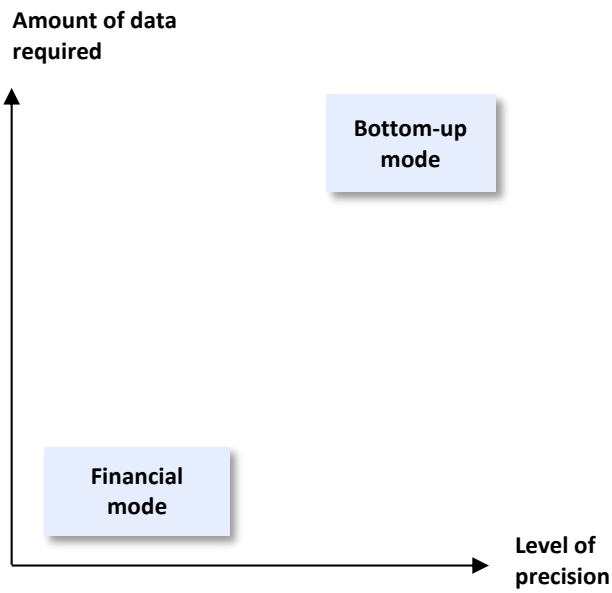
The method has been built to be modular, meaning it is possible to plug in any temperature scenario for any region (a region being a collection of countries, or a subset of a big country, that can be tailor-made).

Two ratings modes for two distinct purposes

Carbone 4 has developed **2 modes to carry out the alignment assessment**:

- A "financial" **simplified mode**: based on asset types and financial data (euros invested in the different projects).
- A "bottom-up" or **detailed mode**: based on physical metrics that are specific to each asset (e.g. MWh produced).

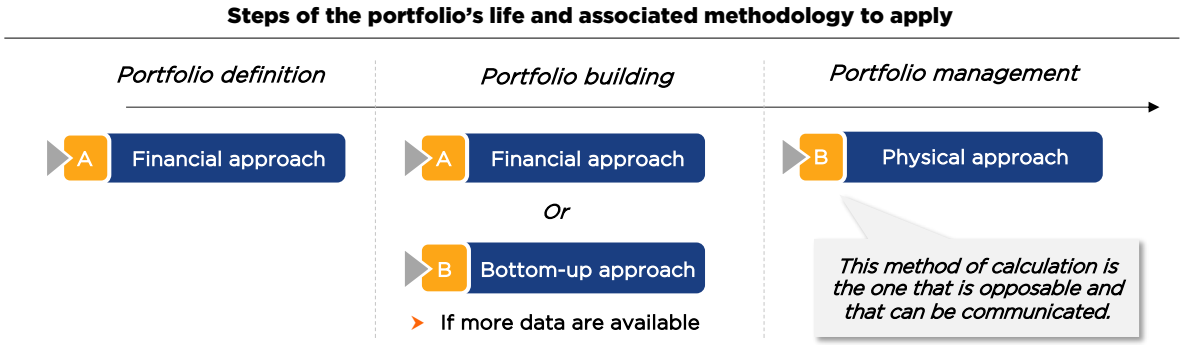
The **financial mode** requires only a limited amount of information from investors. Our model then associates physical units to monetary amounts using ratios that are derived from public data or internal expertise (e.g. euros invested per kWh produced). On the other end, the bottom-up mode requires more data from investors (or directly from the asset operators) but provides results with a lower uncertainty.



The financial – or simplified – analysis is carried out with a proprietary database of ratios built from Carbone 4's expertise. As they represent averages, though, these ratios allow only a limited accuracy for the result. This mode is relevant to give orders of magnitude while devoting a limited amount of time, and might be used to perform a first selection between eligible and non eligible asset classes beforehand defining a first set of guidelines for an investment strategy compatible with a given pathway.

The **detailed – or bottom up - mode** is conducted with the real physical data associated to each asset included into the portfolio. This approach therefore needs more time, and the access to more data, but is the only one that leads to a reliable alignment scoring, and it should therefore be used for communication to external audiences, including for certification.

The bottom-up mode is the only mode able to rigorously establish that the portfolio is compatible with a given pathway. The financial mode is useful when the portfolio is in the process of being defined or built.



Let's take an example with a fictional European portfolio

To explain the methodology, we will consider a fictive European portfolio of one billion euros. **In this example, we would like to know if this portfolio is aligned or not with a 2°C pathway.**

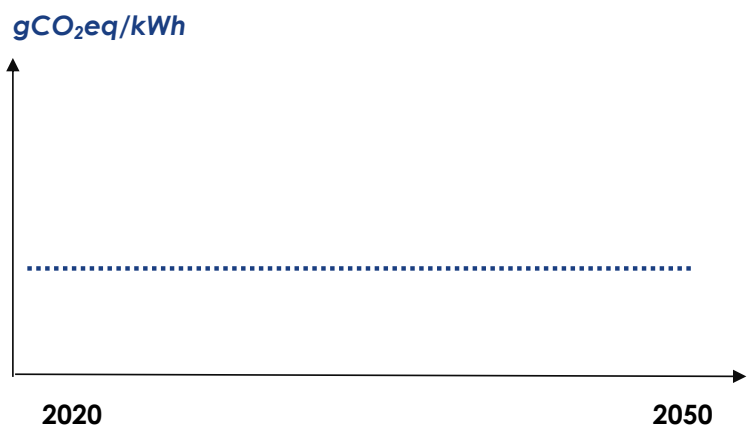
The methodology covers both greenfield and brownfield projects. In this example, we will consider that all assets are greenfield.

Asset type	Million euros	Country
Wind onshore	271	Sweden
Solar PV	213	France
Highway	145	Finland
Gas extraction	95	United Kingdom
Coal power plant	95	Poland
Power distribution	46	Denmark
Railways	35	United Kingdom
Hospitals	35	Germany
Wastewater treatment	35	United Kingdom
Airport	30	Luxembourg
Total	**1000**	

Step 0: Assessing the forward-looking of assets

Let's take the Swedish onshore wind power plant (first line of the portfolio) as an example. This asset has a specific carbon performance, expressed in gCO2e per kWh of electricity produced. The CO_2 emissions are mostly related to the manufacturing of the asset. This knowledge enables to project a forward-looking carbon performance through the asset's lifetime, which mostly depends on the electricity production per year.

Wind farm, Sweden
gCO_2/kWh



For each infrastructure sector, Carbone 4 assesses the forward-looking carbon footprint considering all infrastructure phases: construction, operation and use. For each asset, the significant emissions sources are evaluated based on Carbone 4's unique expertise[1].

Step 1: Each asset serves different final end-uses

Final end-uses represent the usefulness of the asset in our daily lives. What the asset produces allows us to heat our homes, power our devices, to move over short or long distances, etc. Once each has been defined in terms of asset type, location, brownfield or greenfield, amount invested, **the model decomposes each asset's output into final end-uses.** These final uses will end up being compared with the scenario trajectories.

[1] The choice regarding the scope of significant emissions chosen by asset is also made considering the relevance of comparison between the asset's emissions and the scenario's emissions. For some specific assets, it was relevant to take into account scopes 1 and 2 emissions only.

Here is the list of all end-uses for which we have drawn forward-looking carbon performance trajectories from the 2°C scenarios:

- Specific electricity
- Heat for buildings
- Energy for the industry
- Freight transport
- Passenger transport – Long distance
- Passenger transport – Short distance
- Water treated / distributed
- Hospital beds & slots
- Waste treated
- Data transmission
- Data stored

By the way: why an end-use-based scoring?

Consider an onshore wind farm and a biomass heat production plant. A simple (simplistic) comparison of these two assets would be to measure the delta between the carbon intensity of the kWh produced by one and the other. However, these kWh do not serve the same purposes. For instance, the electricity produced by the wind farm will be used to satisfy industrial needs, specific electricity needs (of domestic or commercial appliances), mobility needs (in trains or electric vehicles), and possibly heating needs. On the other hand, the heat produced by the biomass thermal plant will not be used for specific electricity or mobility purposes. Considering individually all end-uses of each asset separately ensures that the assets are rated on a homogeneous basis.

In the end, we focus on the changes that need to occur in the real economy to make the low-carbon transition happen. Those changes can be served by multiple types of assets (many assets can be used for one economic end-use, for instance for long distance transportation). We need to make sure that the combination of assets chosen by investors are compatible with the speed at which our economy needs to transform (ie the speed at which greenhouse gas emissions need to be reduced in the transport, building, waste-management sector, etc…).

If we take our example portfolio, we can then identify the different end-uses matching our assets.

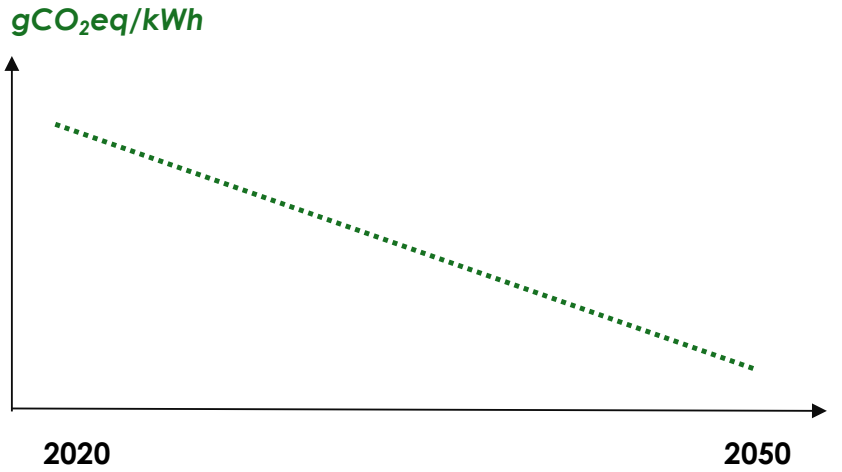
	End-use 1	End-use 2	End-use 3	End-use 4	End-use 5	End-use 6	End-use 7	End-use 8
Asset	Specific electricity	Heat for buildings	Energy for the industry	Freight transport	Passenger transport LD*	Passenger transport ST**	Water treated/ distributed	Hospital beds & slots
Wind onshore	X	X	X	X	X	X		
Solar PV	X	X	X	X	X	X		
Highway				X	X	X		
Gas extraction	X	X	X	X	X	X		
Coal power plant	X	X	X	X	X	X		
Power distribution	X	X	X	X	X	X		
Railways				X	X	X		
Hospitals								X
Wastewater treatment							X	
Airport					X			

*LD = long distance
**ST = short distance

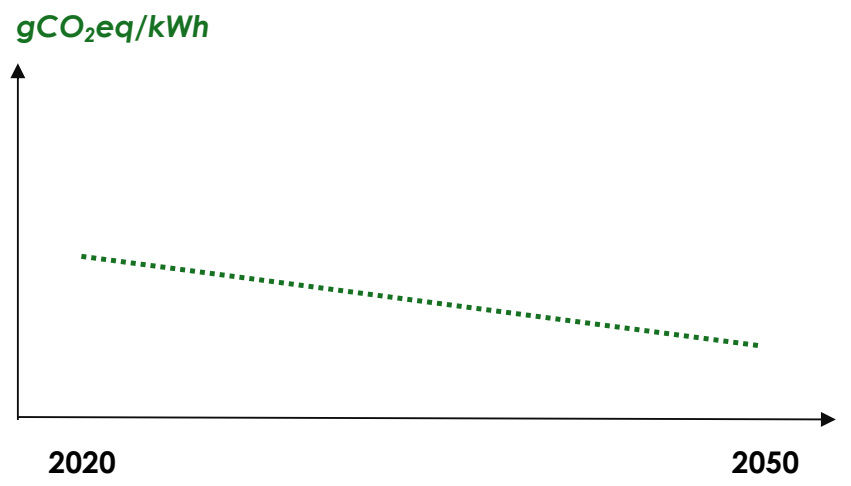
Step 2: Assets' end-uses have defined carbon performances that may be compared against that of the 2°C scenario

Let's take again the Swedish onshore wind power plant. It serves 6 main final end-uses, with for each a defined carbon performance (gCO_2/kWh). These carbon performances are compared to those of the end-uses that make up the benchmark scenario. In this example, the benchmark scenario is the 2°C scenario for the EU.

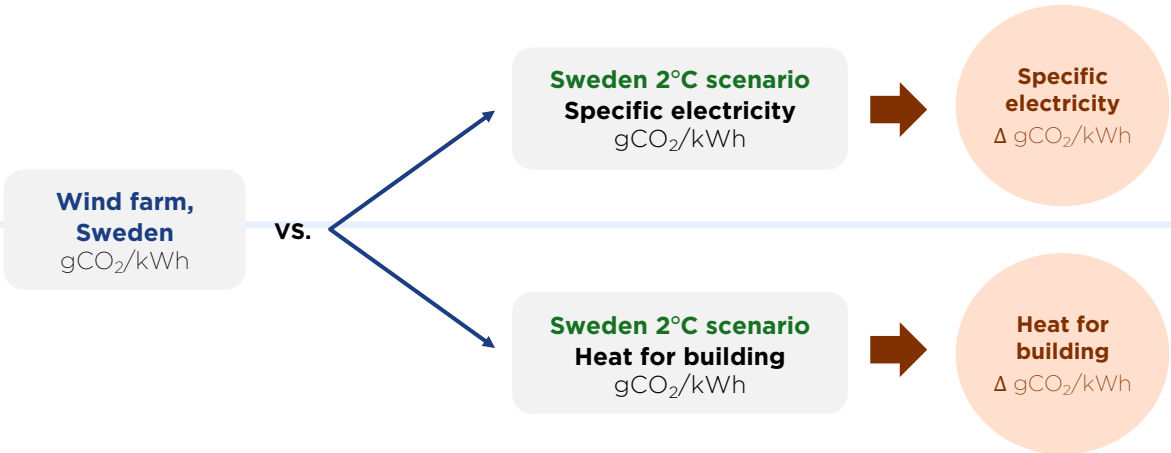
Sweden 2°C scenario
Specific electricity
gCO_2/kWh



Sweden 2°C scenario
Heat for building
gCO_2/kWh

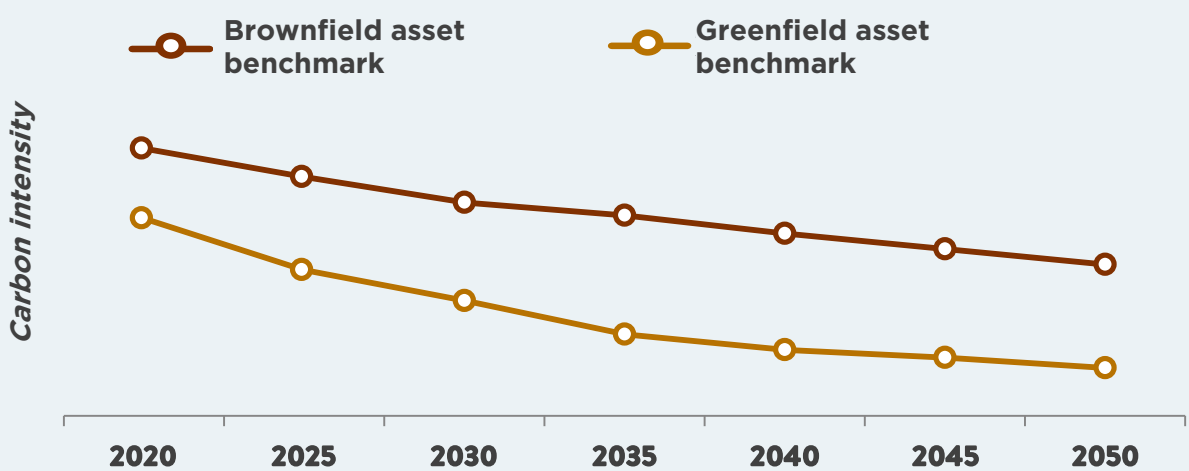


The comparison between the asset and the end uses result in a deviation from the pathway in terms of carbon intensity for each end use. Either the asset is adding emissions compared to the end uses in the 2°C scenario (therefore is it not aligned), or the asset is avoiding emissions compared to the end uses (therefore is it aligned). The general principle is shown here for two uses: the *specific electricity* end-use and the *heat for building* end-use:



Focus: Greenfield and brownfield assets are rated differently to reflect the additional constraint on greenfield assets.

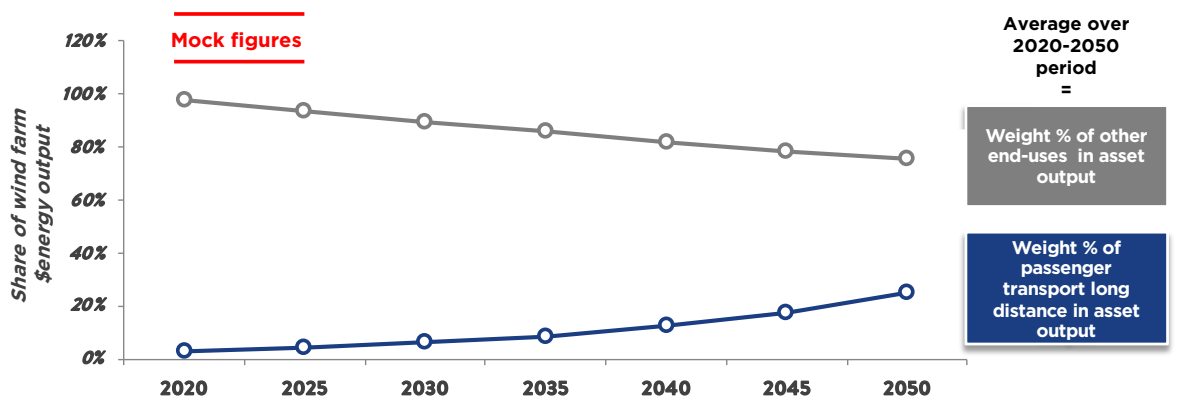
Greenfield assets have lifespans of several decades (varying from 10 to 50 years according to infrastructure and sector). And their associated emissions come on top of the carbon budget embedded into the existing brownfield infrastructure. Remaining below the 2°C limit while adding greenfield assets therefore means that the latter have a very high carbon performance, much better than that of the existing fleet. In order to reflect this requirement, differentiated scenarios for greenfield and brownfield assets have been modelled:



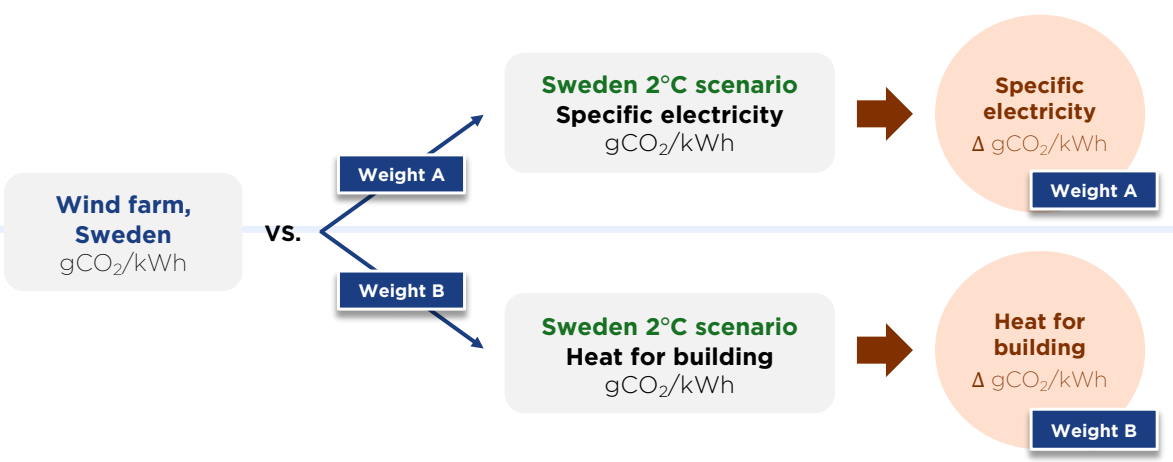
For instance, the greenfield wind power plant will be rated less favorably than the brownfield wind power plant because it is compared to a flow of new infrastructure (with better carbon performance) and not to a stock of assets.

Step 3: End-uses are projected over time in order to calculate their average weight for the asset

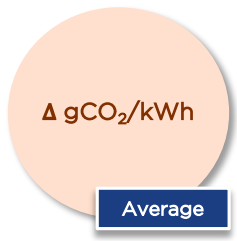
For a given asset, the share of each end-use it allows does not necessarily remain the same over time. For instance, the electricity produced by the wind farm taken in example is likely to be more and more used, in proportion, for long-distance passenger transport as electric mobility develops over time. **For each asset, Carbone 4 has projected these end-uses over time (here the rating is carried out over 30 years) in order to calculate their weight for the asset.**



The weight calculated for end-uses enables to weight end-use scorings.
For instance, for the 2 first end-uses:



Having weighted all the end-uses associated to the asset, you get a **weighted average of the delta CO_2 intensity of the wind power plant vs. the 2°C scenario for Sweden, over the 2020-2050 period.**

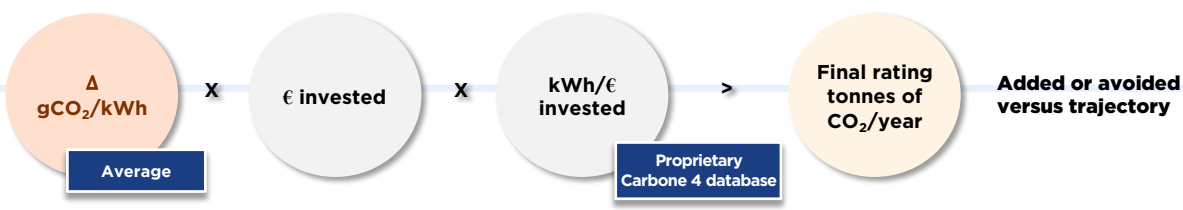


Step 4: Rating in "financial mode" (simplified mode)

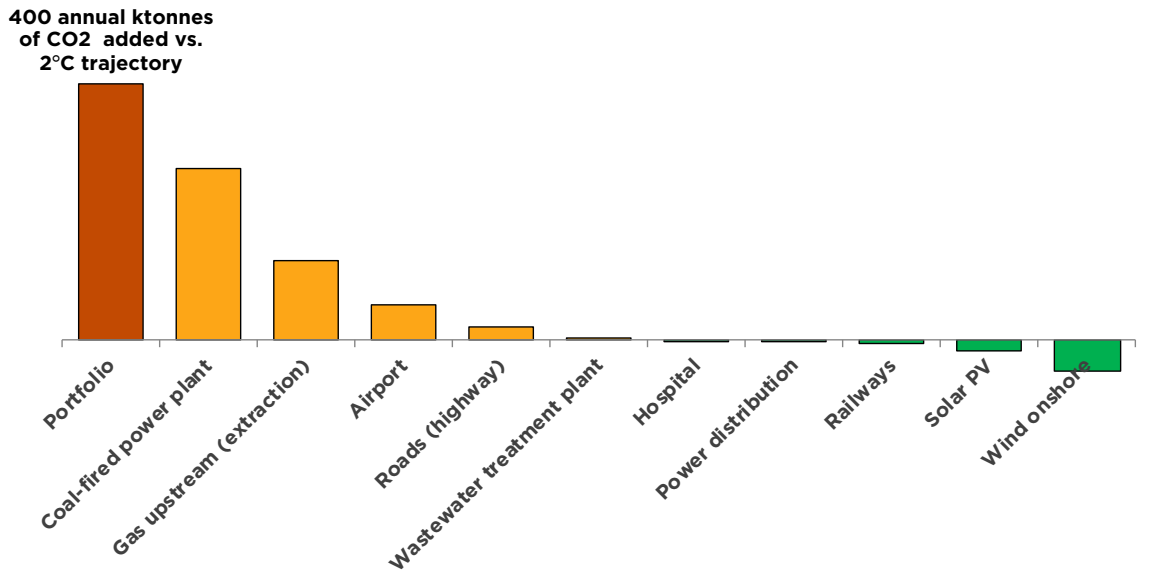
The simplified mode requires few data from users:

- **The asset type** (subsector), which determines the end-uses that must be considered for the rating and their carbon performance;
- The **country** where the asset is located, which determines the reference pathway to which the asset must be compared;
- The **amount invested**, be it debt or equity, which enables to switch from financial to physical data, thanks to Carbone 4 proprietary ratios;
- The **greenfield or brownfield** type of the investment, which determines the requirement level of the reference pathway.

Nota bene: from a liability perspective, debt and capital are treated in the same way by the 2-infra challenge method. Irrespective of its origin, any source of cash has indeed allowed the infrastructure to be suppressed, acquired or built.



For each asset, output is a rating expressed in annual tonnes of CO_2 avoided or added versus the low-carbon pathway. In the case of the fictive € 1 billion portfolio that was introduced in the beginning of this report, the results would be:



Most assets are not aligned with the 2°C benchmark and add a surplus of emissions over the 2°C reference. Overall, the portfolio exceeds the 2°C benchmark by 670 ktonnes of CO_2 every year over the 2020-2050 period. The onshore wind power plant is the asset that avoids the largest amount of emissions but not enough to counterbalance the investments in fossils, on the left part of the graph. Let us recall that the largest investments are made in onshore wind power, the results therefore highlight that the carbon intensity (gCO_2/kWh) of fossils is much higher than that of wind power.

Step 5: Rating in "physical mode" (bottom-up mode)

In the bottom-up mode, asset-specific data are required, in addition to the information provided for the simplified assessment. Let us take a look at the input data needed to carry out a detailed assessment

Asset type	Primary data
Wind onshore	MWh produced
Solar PV	MWh produced
Oil T&D&S	Bcm/tep/MWh transported or stored
Highway	Passenger-km, tonne-km (alternatively number of vehicles)
Biomass power plant	MWh produced

⋮

⋮

Gas extraction	Bcm/tep/MWh produced
Coal power plant	MWh produced
Hydro power	MWh produced
Coal extraction	Tep/MWh produced
Oil refining	Tep/MWh produced
Power distribution	MWh distributed
Railways	Passenger-km, tonne-km
Port	Tonne-km
Hospitals	Surface, construction year, energy performance
Water distribution	Cubic meters distributed
Wastewater treatment	Cubic meters treated
Airport	Number of passengers, distribution of flight hauls

Depending on asset type, **more information may be collected to capture asset specificities and to capture mitigation plans.** For instance, a solar PV farm that makes use of low-carbon panels can provide the carbon performance of the electricity it produces: obviously, that specific PV farm will be *more aligned* than a standard PV farm. Regarding mitigation plans, the model is able to capture and value emissions reduction actions that are put in place on a defined asset. For example, in the case of an airport, the average share of biofuel that is used in plane fuel mix may provide a finer scoring to that asset.

Here are some examples of secondary data that can be collected and captured by the model (non-exhaustive):

Asset type	Additional input data
Wind onshore	Specific CO_2 intensity of the electricity generated
Solar PV	Specific CO_2 intensity of the electricity generated
Oil T&D&S	
Highway	Passenger-km, tonne-km (alternatively number of vehicles)
Biomass power plant	Specific CO_2 intensity of the electricity generated
Gas extraction	
Coal power plant	Specific CO_2 intensity of the electricity generated
Hydro power	Specific CO_2 intensity of the electricity generated
Coal extraction	
Oil refining	
Power distribution	CO2 intensity of the electricity distributed, network losses
Railways	Share of diesel trains that circulate on the network

⋮

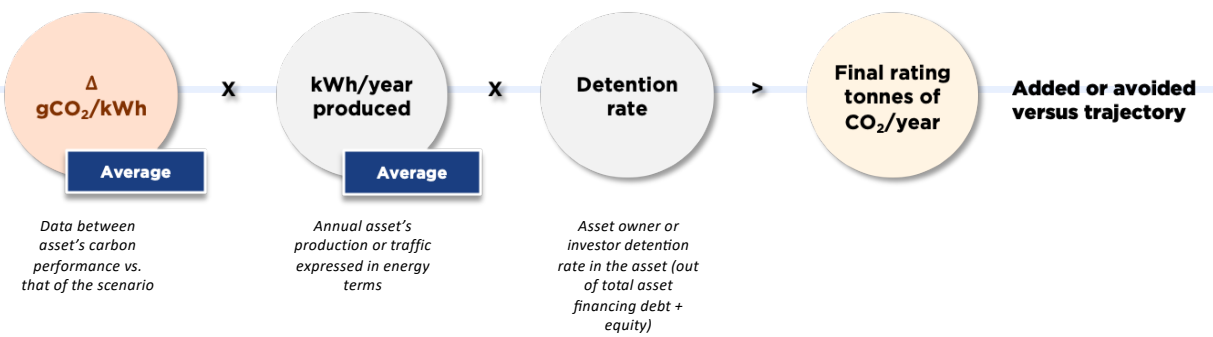
⋮

Railways	Share of diesel trains that circulate on the network
Port	Share of alternative low-carbon fuels
Hospitals	Past or scheduled retrofits, heating device
Water distribution	Water losses
Wastewater treatment	Energy performance of the plant
Airport	Share of biofuel or alternative low-carbon fuels

The model can handle dynamic input information to capture:

- changes in operations that occur over the life of the asset (e.g. a lower load factor for a coal power plant that switches its energy source to sustainable biomass);
- the implementation of a mitigation action later in time (e.g. implementation of a traffic cap for an airport in 2025);
- degradation of the asset output as it ages (e.g. a solar farm loses about 1% of output every year).

Rating follows the same principle as what has been detailed below, with Δ gCO_2/kWh and asset output (kWh/year) averaged over the rating period.



The detention rate enables to allocate the proper share of emissions to the equity sponsor and/or debt provider: when it owns only a share of a given asset, an investor will not inherit from all the emissions associated with the asset. It is important to specify that this detention rate is calculated on the basis of the *total asset financing base* (debt + equity, which corresponds to the enterprise value), the underlying assumption being that 1 € of debt comes with the same level of responsibility than 1 € of equity. This methodological choice assumes that each euro of funding is "equal".

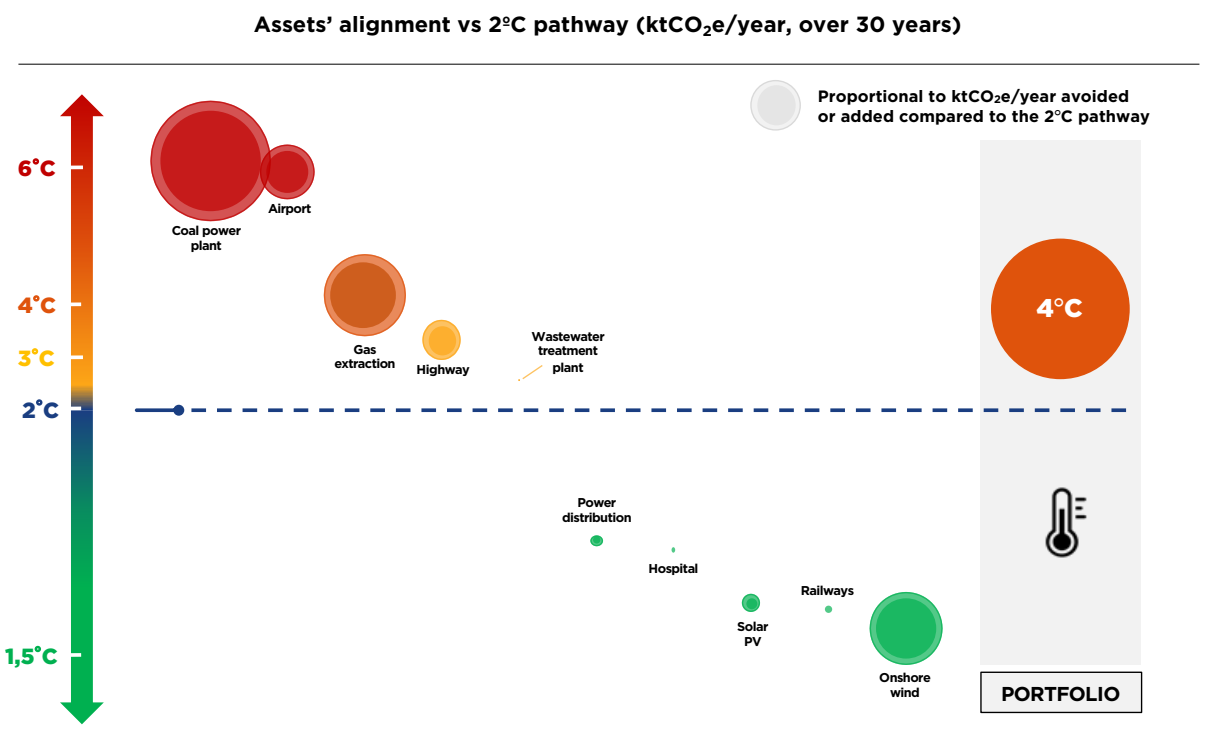
In addition, the detention rate should be calculated based on the enterprise value **at closing, in order to reflect the original responsibilities of the different providers of funds at the time of asset construction or purchase**. This original liability would not be properly represented by taking into account a discounted enterprise value, which reflects more the valuation of the asset at time t and the repayment of part of the debt.

For our fictive portfolio, a 5% detention rate has been assumed for all assets.

Step 6: Portfolio final rating

The results are shown below:

- For each asset, output is a rating expressed in **annual tons of CO_2 avoided or added versus the low-carbon pathway**. Figures are not shown here; the size of the bubbles represent this rating.
- The **deviation** from the low-carbon pathway can also be measured asset per asset. In our example, the coal-fired power plant is the most out of line with the 2°C pathway. It is compatible with a world that is 6°C warmer than the pre-industrial period.
- That deviation is associated to **a warming level** for the portfolio: 4°C in this case.



ZOOM ON 2°C SCENARIOS

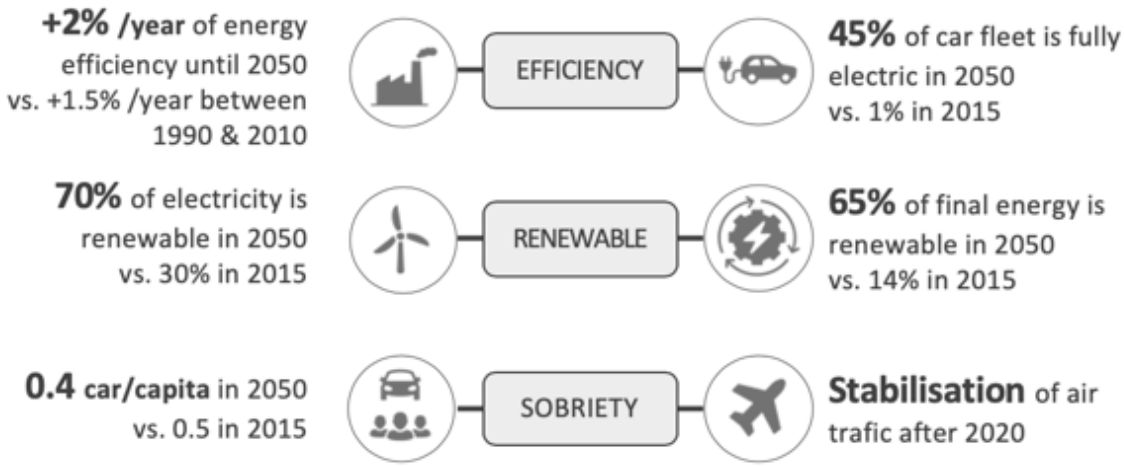
Scenarios built in cooperation with Enerdata

The 2°C scenarios that are used to carry out the alignment assessment are the result of joint work with the modelling company Enerdata. Indeed, Carbone 4's wish was not to use "standard" scenarios available on the market, based on numerous unrealistic assumptions (for instance taking into account a really optimistic energy efficiency factor out of line with past trends). On the contrary, **a work of co-construction and questioning of the underlying assumptions was carried out with Enerdata to design credible scenarios.**

The key features of 2-infra challenge's 2°C scenario for the European Union are the following:

- it assumes extremely ambitious **energy efficiency gains** over the 2020-2050 period: +2% per year, up from 1.5%/year in average over the 1990-2010 period
- it assumes that **renewable energies** account for large portions of the energy mix: 35% of the final energy mix is renewable in 2030, that value reaches 63% in 2050.
- it does not rely on technological breakthroughs, particularly in the field of carbon capture and storage
- it leverages on **sobriety to fill in the carbon budget gap**, with a rate of car per capita going downwards over the 2020-2050 period and a stabilized air traffic after 2020

Key features of the EU 2°C scenario



Scenarios updates

Scenarios will be updated by Carbone 4 and Enerdata on a regular basis, at a minimum every 3 years.

LIMITATIONS OF THE METHODOLOGY

The 2-infra challenge methodology captures the consistency of investment with respect to a climate pathway in
carbon intensity terms. However, it will not be able to say if a given portfolio goes beyond the carbon budget in absolute terms. Imagine for instance that our carbon budget for a given time period is completely exhausted and that if one more asset is built in the world, it will necessarily emit CO_2 and exceed that budget. The model will not be able to compare the absolute emissions of the asset against the remaining carbon budget.

The methodology is of course very sensitive to the reference scenario and its related parameters. If our methodology can adapt to different scenarios, we have chosen for now what we consider as a "balanced" 2°C compatible scenario, combining what some could call "optimistic" hypothesis on GDP, population and energy efficiency and some "realistic" hypothesis on sobriety (i.e. believing that CO2 mitigation could be more realistically driven by reduction of traffic as well as energy efficiency). Our scenario is one vision of a future compatible with the global carbon budget, and other scenarios could be imagined. That is why we plan to regularly update our scenarios.

Another limitation is that the 2-infra challenge methodology is restricted in terms of financial securities that can be tested: it is very specific to the infrastructure world since infrastructure embeds a clear and specific carbon performance.

Carbone 4 has developed another methodology to address corporate listed securities which is called Carbon Impacts Analytics.

carbone 4

Carbone 4 is the reference consulting and data company on the energy and climate transition. We provide metrics and expertise for the corporate and financial sectors to build business resilience. Our services cover all asset classes.

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