FONDS DE RESERVE POUR LES RETRAITES

Working document

First draft

How should the environment be factored into FRR's investment policy?

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Fonds de Réserve pour les Retraites
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Executive Summary

"Environmental concerns and, in particular, the impact of global warming on the world economy and its various sectors pose numerous questions that a long-term investor cannot afford to ignore when determining its global investment strategy. The FRR's objective between now and the end of 2009 is to specify them and analyze the various categories of possible impacts on its investment policy in order to consider possible actions." (Responsible Investment Strategy, ratified by the FRR's Supervisory Board on April 15, 2008)

This is the context within which the study whose general findings are presented in this working document was conducted, with the help of APREC (*Association for the Promotion of Research into the Economics of Cabon*) and the specialist consulting firm I Care Environnement.

How should the environment be factored into investment policy definition? In order to answer this question, it is important to begin by defining the environmental issues that are the most relevant for the long-term investor, because they have an impact on the economic context in which long-term investments are made. The first part of this document therefore describes the four key problematics – climate change, the exhaustion of fossil fuel resources, the loss of biodiversity and the aggravation of water shortages – which will make the economic environment of tomorrow more uncertain, more constrained and more unstable.

Once the critical issues have been identified, it is necessary to attempt to describe in more detailed fashion their economic and global impacts, as well as their geographic and sectoral ones. And that is what we do in the second part of this document, which offers an overview of the existing body of the most well-known work in this area, in a format that is appropriate for the decision-making process of an investor (the elaboration of economic and financial scenarios).

Finally, in the last part of the document we examine how environmental issues can be factored in at different levels of an investment policy: it can be so at the level of the long-term target allocation (strategic asset allocation), since the issues at stake have a profound impact on the entire economic framework and hence on the characteristics of the major asset classes. In most of the constructed scenarios, the integration of environmental issues at the strategic asset allocation level leads to lowering the weight of "risky" assets. Only one of the five constructed scenarios, the green growth scenario, reverses this finding.

But this integration can also occur within the major asset classes – as a function of geographic regions and economic sectors that sustain differentiated environmental impacts. Last but not least, it can occur at the level of stock- and bond-picking, to the extent that the impacts may themselves vary considerably from one business or entity to another, depending on its ability to adapt to and anticipate these impacts.

This working document lists and examines the array of relevant environmental problematics for a long-term investor, sets forth a summary of their economic and financial impacts, and provides an inventory of the resources available to investors as they attempt to factor these impacts into their investment policy. To this end, this document uses the conclusions of

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recognized work (Stern, IPCC, etc.); but it also offers an original contribution that proposes extending them with the findings of work that is specifically financial in nature. It is for this reason that we believe it is beneficial to share these first findings with the investment community as a whole, and also with anyone who is interested in these issues. Far from claiming to offer definitive answers to the core question it poses, this working document seeks merely to explore a few avenues and to encourage further work on these subjects, which are of capital importance.

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1) The main environmental challenges for a long-term investor

Under the combined effect of demographic and economic growth, human activity is exercising increasingly strong pressure on the natural milieu. The upcoming decades will be characterized by the growing scarcity of the four elements: air (which keeps temperatures stable), fire (fossil fuels), earth (the ecosystems) and water (drinkable or suitable for agricultural uses). In line with this interpretive grid, four environmental challenges are expected to profoundly modify the economic backdrop of tomorrow: climate change—which is a structural problem due to the magnitude of the changes it could possibly induce—the exhaustion of fossil fuel resources, the loss of biodiversity and water shortages.

These different environmental issues are already having real impacts. But these impacts should increase significantly in magnitude over the course of the coming decades, rendering the economic environment more uncertain over the medium term, more subject to constraints and more volatile. Accordingly, a long-term investor like the FRR simply cannot ignore these issues when defining investment strategy.

1) The big environmental issues

Climate change is a structural issue: the exhaustion of fossil fuel resources, the loss of biodiversity and the aggravation of water shortages are all different phenomena; however, they can be analyzed, at least partially, via the prism of climate change.

a) Climate change

Climate change designates the phenomenon of significant variation in core climatic characteristics (average state of the climate and variability) over an extended period (several decades at least). Since the beginning of the industrial era (mid-19th century), climate change has been occurring—more precisely, global warming, since the average temperature at the surface of the globe has increased by 0.7°C—with a clear acceleration in the last half century (+0.1°C per decade). This warming is mainly due to the so-called greenhouse gas effect: the higher concentration of greenhouse gases (six gases, including carbon dioxide and methane) in the atmosphere tends to trap infrared rays instead of releasing them into space, which leads to higher temperatures. Indeed, the concentration of GHGs has increased substantially, and this increase is accelerating. The **latest report issued by the IPCC[1] essentially attributes the phenomenon to human activities.**

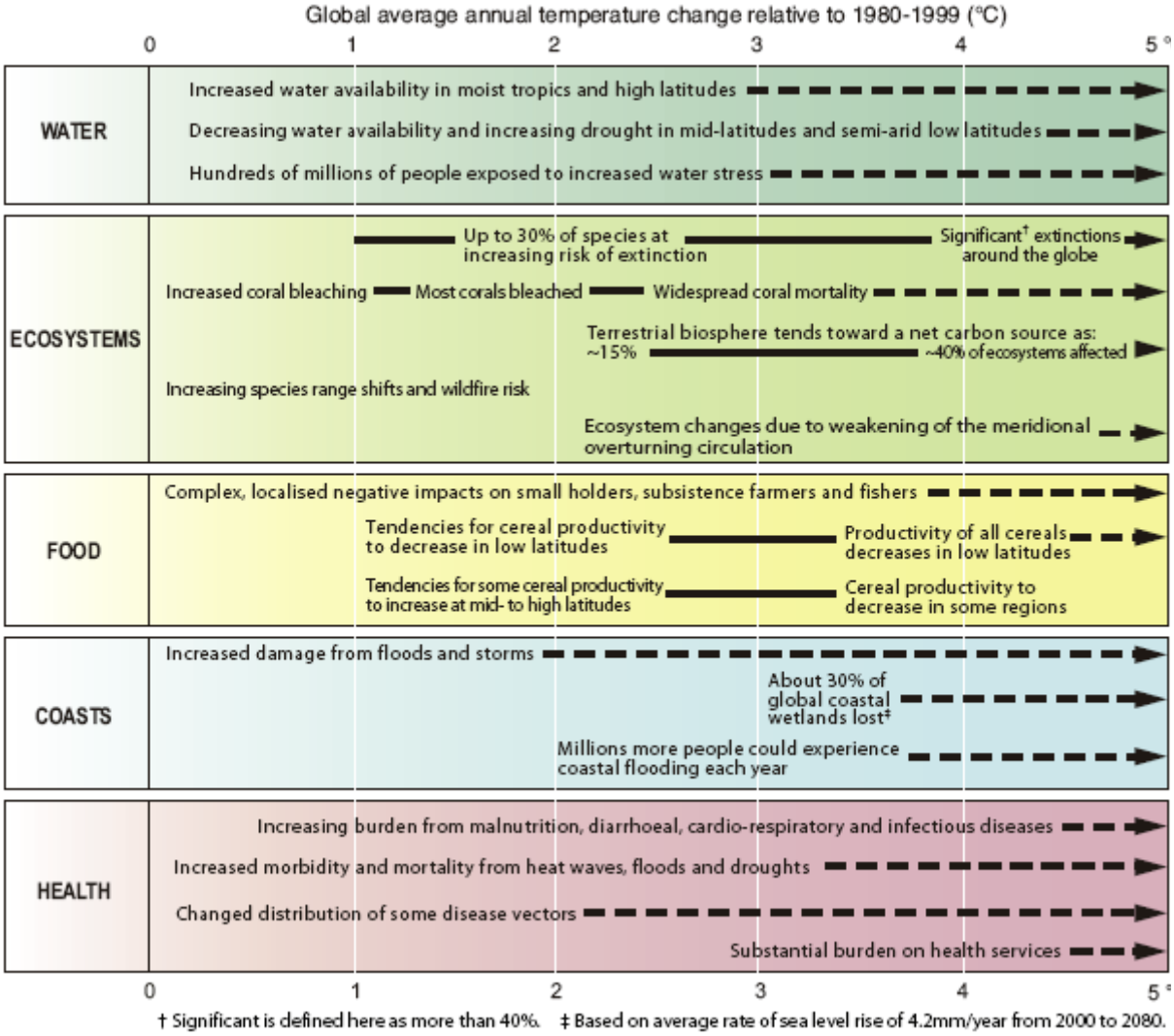
Global warming is accompanied by measurable physical impacts: rising sea level (+15 centimeters since the beginning of the 20th century), melting of the polar ice cap and glaciers (since 1978, the polar ice cap has decreased by about 3% a year on average), **modification in rain patterns and the spread of drought geographically**, increase in the frequency of

[1] Founded in 1988 under the auspices of the UNEP (United Nations Environment Programme) and the WMO (World Meteorological Organization), the group of inter-governmental experts on climate change was created to identify, analyze and publish syntheses of research on climate at the global level. Its forth report (2007) involved more than 500 key players and 2 000 specialized examiners.

heat waves, early springs, higher frequency of extreme weather events (intense tropical cyclones in the Northern Atlantic), **impacts on biodiversity and some ecosystems,** such as the coral reefs, etc.

The increase in the concentration of greenhouse gases leads to an increase in temperature about 40 years later. Because of the inertia of the weather system, and given the recent increase in the concentration of greenhouse gases, it appears ineluctable that **global warming will continue in the decades ahead (between now and 2050)**. And the **adverse effects** increase substantially as this global warming intensifies:

Table 1: Principal physical impacts of climate change
(as a function of higher temperature)



Source: IPCC, 2007.

However, while the medium-term warming appears to be mostly unavoidable, **the measures taken today could well change climatic trends over the long term (beyond 2050)**.

Since climate change is primarily linked to human activities, steps can be taken to counter it. Two major types of complementary policy initiatives are worth considering: a policy of adaptation, which consists of taking the measures needed to limit the impacts of climate

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change; and a policy of mitigation, which alludes to measures that are likely to reduce greenhouse gas emissions and thereby limit the magnitude of climate change itself.

As N. Stern[2] and others have demonstrated, the **cost of inaction is probably much higher than the cost of action**: the harms caused by global warming are believed to be 5 to 20 times higher than the sacrifices the economic system would have to make in order to fight effectively against the greenhouse effect.

Most of the existing technical solutions are affordable. According to a survey conducted by McKinsey,[3] it is possible to significantly reduce global emissions with existing techniques and for a marginal cost that is less than €40 per ton of CO2 avoided. Some of these measures will lead to cost savings (such as improving insulation, transforming lighting systems, enhancing vehicle performances, etc.), while others have a variable cost: from the least expensive (such as increasing the surface area of forests) to the most (technologies for capturing and sequestering CO2), not to mention a whole host of clean technology solutions (wind turbines, solar panels, biomass, bio-fuels, etc.).

But since climate change is an externality or spillover,[4] public policymakers must offer the right incentives to ensure that the right measures are taken – whether in the form of regulations, grants and taxes, or market instruments (emission rights trading). In every case, it is a matter of instituting – directly or indirectly – a "price" for greenhouse gases ("internalizing the externality").

b) The exhaustion of fossil fuel resources

Since the Industrial Revolution, economic development has been driven by the exploitation of fossil resources—in particular oil resources—which are finite. And while it is extremely difficult to make accurate forecasts in this area, **it is likely that we are approaching the time where the production of oil and gas should start to decline due to the exhaustion of these finite reserves** (peak oil, peak gas). Accordingly, the energy mix (combination of sources of energy) will probably undergo profound changes in the course of the next decades, which may lead to the end of the oil-driven economy.

The evolution in the energy mix will have significant impacts on the industrial tool and geographic specialization, with winners and losers. This evolution may be positive in terms of climate change (for example, if the exploitation of fossil fuels declines in favor of renewable energies) or not (increase in the burning of coal, which emits more carbon than oil or gas).

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[2] Nicholas Stern, *The Economics of Climate Change*, 2006.

[3] Mc Kinsey Global Institute, *The Carbon Productivity Challenge: Curbing Climate Change and Sustaining Economic Growth*, June 2008.

[4] In economic theory, the term externality (or spillover) describes a situation where the act of consumption or production on the part of an agent has an impact (adverse or positive) on the economic situation of another agent, without the latter being compensated/having to pay for the damages sustained/benefits accrued.

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This evolution will largely depend on the measures that are actually taken – whether under the policies aimed at combating climate change or some other framework for action (economic stimulus, energy independence, etc.).

c) Loss of biodiversity

The term biodiversity designates the quantity and variety of living organisms with regard to one and the same species (genetic diversity), different species or different ecosystems. Even if biodiversity is more difficult to measure than the concentration of greenhouse gases, we can cite a few notable evolutions which suggest that **the loss of biodiversity is already a reality today**[5]:

- In the course of the last 300 years, the world's forests have shrunk by 40% in terms of surface area.
- Since the beginning of the last century, the planet has lost around half of its wet zones.
- Around a third of the world's coral reefs have been seriously damaged by over-fishing, pollution, diseases and coral bleaching.
- 35% of the world's mangroves have disappeared in the last two decades.
- The rate of extinction of living species due to human activity is a thousand times more rapid than the rate of natural extinction over the course of the long-term history of the planet.

Biodiversity lies at the foundation of the services provided by the ecosystems[6] (foodstuffs, fresh water, wood, protection against natural risks, regulation of the climate, pharmaceutical ingredients, etc.). In the last 50 years, some 60% of the services rendered by the ecosystems of the planet have deteriorated, mainly due to human activities.[7]

This deterioration is expected to pick up speed in the decades to come, due to the effects of demographic and economic growth as well as climate change:

[5] Sukhdev Pavan, *The economics of ecosystems and biodiversity*, European Commission, 2008.

[6] An ecosystem is a dynamic whole formed by a community of plants, animals and microorganisms and its non-biological environment, the two interacting as one holistic unit.

[7] Millenium Ecosystems Assessment, *Ecosystems and human well-being,* 2005.

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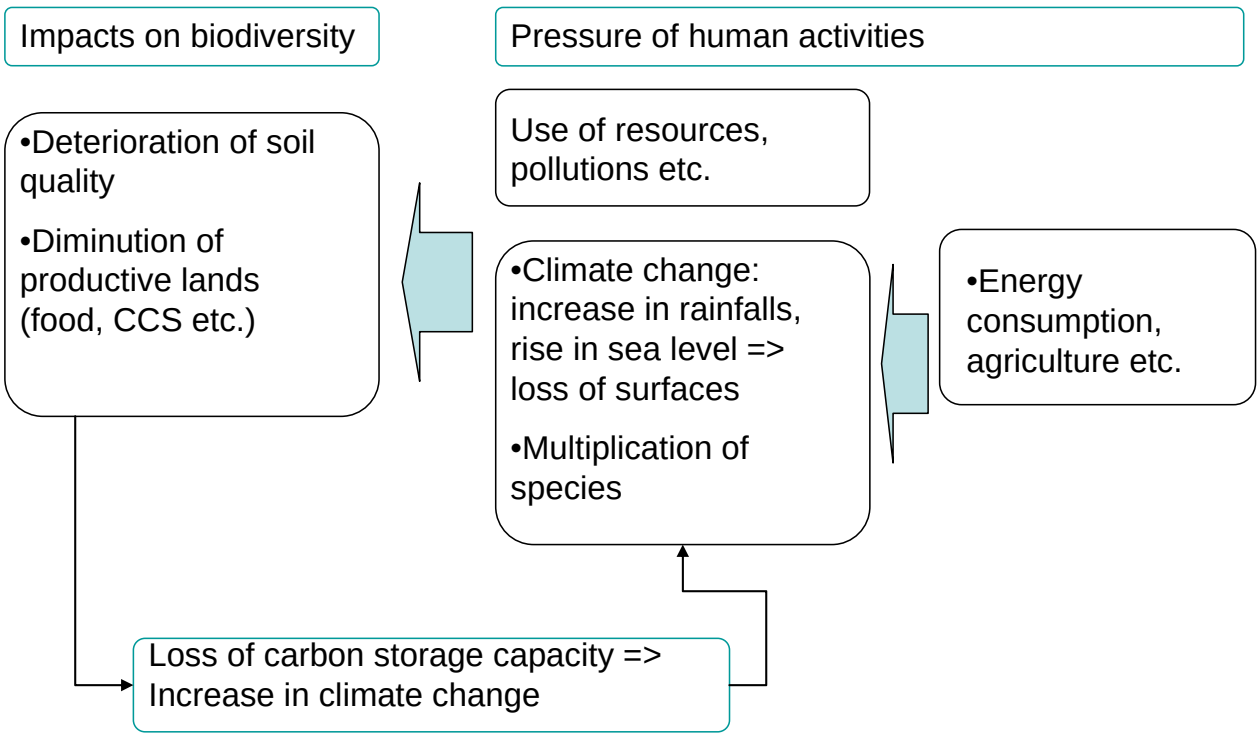
Illustration 1: Interactions between loss of biodiversity and climate change issues



Source: I Care Environnement

Growing awareness of the economic importance of biodiversity has driven attempts to measure the cost of biodiversity impairment for different milieus.[8] Various kinds of policy recommendations aimed at limiting this impairment have also been made—both regulatory (fishing quotas, the protection of natural habitats, etc.) and economic (subsidies, mechanisms for compensating the loss of biodiversity, etc.).

d) Water shortages

Water shortages, which today concern more than 20% of the world's population, have impacts on human health (illnesses) and local economies (modernization and infrastructure development).

The exhaustion of our water resources is relevant on several levels and related to many factors:

- On the supply side, fresh water, which accounts for only 2.5% of global resources (of which only 1% is accessible for consumption, since the rest is composed of glaciers, permafrost and the like), is a resource that is both directly and indirectly under threat due to human activities and their consequences, climate change in particular.

[8] Report of the *Centre d'Analyse Stratégique* under the direction of Bernard Chevassus-au-Louis, *Approche économique de la biodiversité et des services liés aux écosystèmes, Contribution à la décision publique*, April 2009.

- Demand is growing sharply as the world's population evolves and as eating habits change over time (70% of all water resources are used for farming, with production expected to double in the years ahead).

Once again, context-specific measures (fight against wasting water, water treatment, development and renovation of pipelines and delivery channels, etc.) will prove to be indispensable.

2) The impacts of environmental issues for a long-term investor

Taken together, the aforementioned environmental challenges we face tend to adversely impact the economic environment of a long-term investor like the FRR. Over the next few decades, this investor will face an economic environment that is less certain, more subject to constraints and in a fairly constant state of rapid change.

a) A more uncertain economic environment

The aforementioned environmental challenges generate uncertainty:

- Global warming is accompanied by an **increase in the frequency of extreme events** (tornados, cyclones, floods, droughts, etc.). By nature difficult to predict or foresee, the impacts of these events is also difficult to assess.
- **Climate change, but also loss of biodiversity, does not occur in linear fashion**: because of threshold effects, cumulative phenomena and retroaction loops, their economic impacts can quickly become massive or even irreversible.
- **The impacts of environmental issues are highly dependent on the actions and reactions of economic agents** (public policymakers in particular), which are another inevitable source of uncertainty.

Overall, **the decades ahead will probably see a general increase in risks, particularly economic ones, against which any long-term investor must try and find appropriate hedges**.

b) A more constrained economic environment

The growing shortage of natural resources lies at the origin of the major environmental challenges of tomorrow. This shortage will also mean a more constrained economic environment: the price of non-renewable resources will increase (or become paying, if the resource is currently no-cost), and the amount of income available for the acquisition of other goods will shrink, which could lead to both higher inflation and lower growth.

This very general reasoning can be illustrated with studies of the economic impacts of climate change. **Medium-term (before 2050), the macroeconomic impacts of climate change** (on growth and inflation trends) **should remain limited** – the harms will not become truly significant until later on (the 2050-2100 horizon). However**, the micro-economic impacts** (for certain regions, sectors or businesses) **are already with us and are expected to intensify**.

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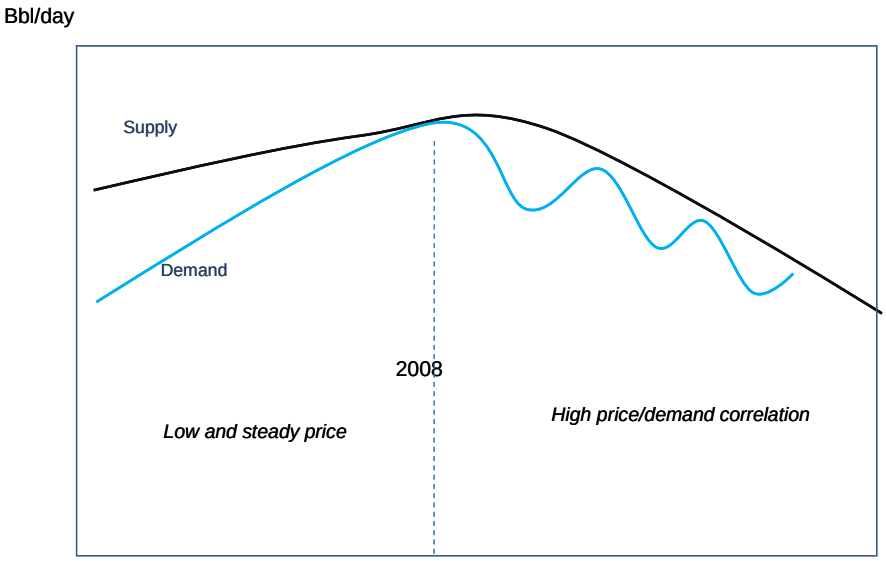
In addition, **the exhaustion of oil resources should lead to higher and more volatile oil prices, with a potential impact on inflation**: as the supply declines, price pressure will rise and changes on the demand side will become the principal factor behind price trends, bringing a higher probability of successive shocks.

Illustration 2: Possible balance between supply and demand for oil products in a peak oil context



Source: I Care Environnement.

c) An economic environment undergoing rapid change

The major environmental challenges are characterized by increasingly rapid changes whose pace is expected to increase even further in the future. **The economic environment is expected to undergo rapid changes, which in turn will create new opportunities that a long-term investor can try to catch**.

The development of clean technologies, such as renewable energies (solar, wind, biomass, etc.), the emergence of eco-friendly products (electrical cars, for example), the improvement and replacement of infrastructures (particularly in the water, transport and related sectors): all are sources of investment opportunities.

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2) The principal economic impacts of environmental problematics

The changes to the economic environment induced by environmental problematics are not precisely known or understood. However, a few broad climatic and economic scenarios can be postulated to help us describe various plausible future evolutions. This global approach needs to be completed with the incorporation of the various geographic and sectoral impacts.

1) Constructing scenarios

On the basis of three very long-term climate scenarios, we propose five major long-term economic scenarios.

a) Very long-term climate scenarios…

We prefer an approach that uses climate change as the structuring element – since it allows us to make use of available quantified evaluations. The question of exhausting fossil fuel resources, which is closely related to climate change, is also used, in particular to construct the inflation component. We consider the biodiversity and water challenges to be additional risk factors, but we don't have sufficiently reliable quantitative data to integrate them as such (beyond what climate change already covers).

On the basis of the results compiled by the IPCC in its latest report, we suggest that **three major climate scenarios be used**:

Table 2: Correspondence between IPCC scenarios and climate scenarios selected

Climate Scenarios	Concentration of greenhouse gases at the stabilization level (in parts per million)	Change in global CO2 emissions in 2050 (compared with 2000)	Difference between the average temperature at equilibrium and the pre-industrial temperature
Green Scenario	445-490	-85 to -50%	2,0-2,4°C
Median Scenario	490-535	-60 to -30%	2,4-2,8°C
	535-590	-30 to +5%	2,8-3,2°C
	590-710	+10 to +60%	3,2-4,0°C
High-Risk Scenario	710-855	+25 to +85%	4,0-4,9°C

Source: IPCC, 2007 and I Care Environnement.

As a reminder, the current concentration of greenhouse gases (in CO2 equivalent) is 470 ppm, and the difference in temperature compared with the pre-industrial period is 0.7°C.

These are very long-term scenarios (with equilibrium situated at around 2100 or thereafter depending on the case) whose occurrence will depend on the measures taken today and in the decades ahead to fight climate change:

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- In the **Median Scenario**, measures are taken to limit greenhouse gas emissions, but they are not adequate under the circumstances, because the expected rise in temperature is between 2.5°C and 4°C. This scenario is not only the most likely, it is in line with current policy ("neither-nor": neither complete inaction nor complete action).
- In the **High-Risk Scenario**, the absence of measures leads to catastrophic global warming of more than 4°C.
- Conversely, under the **Green Scenario** the measures taken are effective in limiting global warming, with the expected increase in temperature falling below 2.5°C.

A few major indicators can be used to characterize these three scenarios and serve as a **dashboard** for the investor:

Table 3: Indicators of passage from one scenario to the other (at the global level)

Scenario	Adaptive investments	Attenuating investments	Effect of greenhouse gases (GES) regulation	Remarks
Median Scenario	100 Bn$ per annum / 0.1% of global GDP in 2025	500 Bn$ per annum / 0.7% of global GDP in 2025	1/3 GHG emissions covered by regulation, at 40-50€/ton in 2040	- Strong commitment in Copenhagen from the EU and the US. - Local markets for emission rights (not interconnected) - Ambitious investment programs in new technologies: see recent statements by Obama, green stimulus packages
High-Risk Scenario	100 Bn$ per annum/ 0.1% of global GDP in 2025	100 Bn$ per annum/ 0.1% global GDP in 2025	20% of emissions covered, at 15-20€/ton	- International negotiations ended in a stalemate - Market for existing rights is in a state of stagnation - Investment efforts limited due to the economic and fiscal situation
Green Scenario	200 Bn$ per annum (= optimal level) / 0.3% of global GDP in 2025	1 000 Bn$ per annum/1.4% of global GDP in 2025	80% of GHG emissions covered, at 100€/ton in 2040	- Strong commitments in Copenhagen and later meetings, with extension to the major emerging economies - Gradual rollout of a global system of emission rights - Very ambitious investment programs in new technologies; financial cooperation with the emerging economies

Source: I Care Environnement

b) …to medium-term economic scenarios

The economic impacts that are of concern to the FRR are situated around the year 2040. Accordingly, it makes sense to build economic scenarios on a timeline of about 30 years and consistent with the major long-term climate scenarios described above in order to describe the economic environments that the FRR may actually have to deal with.

Two major types of economic impacts must be taken into account:
- The direct economic impacts: these are the harms caused by climate change. Generally, these harms vary considerably from one scenario to another over the very long term, but they generally appear to be negligible to the year 2050. However, to factor in the uncertainties

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that surround the phenomenon of climate change, we suggest an "aggravated high-risk scenario" in which the direct negative impacts on growth, equivalent to a supply-side shock, manifest themselves as of the medium term—in other words, sooner than expected.

- The indirect economic impacts: these impacts are related to measures that could be taken today to deal with climate change (adaptation and attenuation). These impacts are also generally negative because they correspond to an adjustment cost. But in some specific cases, these impacts could turn out to be positive – which one of the scenarios (green growth) takes into account.

We therefore suggest the association of five medium-term economic scenarios (around year 2040) with the three long-term climate scenarios:

Table 4: Correspondence between climate and economic scenarios

Climate Scenario	**Economic Scenario**
Median Scenario	Median Scenario
High-Risk Scenario	Extended Fossil Scenario
	More Rapid Climate Change Scenario
Green Scenario	Green Constraint Scenario
	Green Growth Scenario

More specifically, from an economic perspective:

- **Median Scenario**: defined on the basis of the Median Climate Scenario, it constitutes the point of reference from which the four other scenarios are described (central economic scenario). In this basic scenario, growth is assumed to be close to potential and inflation positive but moderate.

- **Extended Fossil Scenario**: de facto, this scenario corresponds to an **oil shock scenario**. In fact, the direct effects of climate change are negligible up to about 2040, as are the indirect effects (since it is assumed that no measures are taken). Conversely, because there are no measures taken to combat climate change, the exhaustion of fossil fuel resources is more rapid than in the Median Scenario, which provokes excessive inflation and a growth deficit attributable to the higher cost of energy-related commodities.

- **More Rapid Climate Change Scenario** is a variant of the scenario that precedes it, but allows us to factor in the uncertainties surrounding climate change. Once again, we are talking about a **negative supply side shock scenario,** due to the significant direct impacts of climate change as of the medium term (destruction of capital following the occurrence of extreme events, loss of agricultural productivity due to the higher frequency of droughts, lower labor productivity as pandemics multiply, etc.). Under this scenario, growth is weaker than under the Median Scenario – which attenuates the impact linked to the exhaustion of natural resources (slowdown in demand for oil products due to weaker economic growth). Inflation is only slightly higher than in the Median Scenario (effect of repeated negative supply-side shocks on relative prices and ultimately on the general level of prices) because oil-driven inflation is limited.

- **Green Constraint Scenario** also corresponds to a **scenario of supply-side shocks, but they are slightly negative.** However, unlike the previous scenario, the shock does not

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come from the direct harms of climate change (negligible over this horizon). Instead, it is caused by indirect impacts related to the measures taken to adapt to and fight against climate change. The investment efforts that will produce positive effects in terms of global warming after 2050 have a very slightly negative effect on growth over medium term (due to the eviction of other expenditures that are more productive in the short run). In this scenario, the change in the energy mix related to measures taken helps to resolve the problem of dwindling fossil fuel resources – which leads to oil price moderation and hence controlled inflation, as in the central scenario.

- Finally, the **green growth scenario**, a variant of the preceding scenario, allows us to integrate the fact that measures designed to combat climate change could have a positive impact on growth (savings from less waste, increased productivity following stepped-up investment, positive impact on technical progress in general thanks to an increase in research and development in the environmental area, the advent of more efficient regulation, etc.). This is a case of a **positive supply-side shock**.

Table 5: Principal economic variables in the different scenarios

Annual growth differential compared with Median Scenario (2009-2040)	**Growth**	**Inflation**	**Oil price**
Extended Fossil Scenario	-0.5%	+1.0%	+4.0%
More Rapid Climate Change Scenario	-0.5%	+0.25%	-1.0%
Green Constraint Scenario	-0.1%	0%	-2.0%
Green Growth Scenario	+0.5%	0%	-2.0%

The economic scenarios obtained allow us to describe different states of nature that could come about around the year 2040 and, in so doing, give us a simple grid for reading the major possible economic impacts of climate change. But this macro-economic analysis must not blind us to the differentiated impacts – in both geographic and sectoral terms – environmental problematics may have (see following paragraph). In addition, combined with a financial analysis, these economic scenarios can also serve to directly populate the strategic asset allocation model (see part 2-2).

2) Taking geographic and sectoral impacts into account

Above and beyond the macro-economic impacts, the environmental problematics also have impacts that differ from one geographic region and one economic sector to another.

a) Geographic impacts

In the case of unfavorable scenarios, **the developing countries** are more exposed to the environmental risk and have fewer resources for coping with it. With regard to climate change, Stern estimates that GDP loss per capita can be four times greater for these countries around the year 2050. As for biodiversity, the majority of the world's "hot spots" are found in

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developing countries, and the impact of ecosystem impairment affects the “GDP of the poor” (fishing, gathering, informal forestry, etc.) to a greater extent because it accounts for a larger share of GDP. In corollary fashion, the favorable scenarios presuppose extensive increases in investment in environmental areas, for these countries in particular.

The geographic impacts of environmental challenges are nonetheless more complex in actual practice: the exhaustion of certain natural resources favors exporting countries; water shortages and loss of biodiversity remain highly localized issues.

b) Sectoral impacts

To define the sectoral impacts, a threats and opportunities approach is deemed necessary.

Under the risk angle, KPMG for example offers a matrix for assessing business sectors – safe haven sectors (telecommunications, food and chemicals) versus at risk sectors (transport, tourism, oil and gas) – depending on their degree of exposure and their degree of preparedness for the four major perceived risks related to climate change (physical risk, regulatory risk, the risk to reputation with impact on revenues, and the legal risk). Following a slightly different logic, certain brokers assess the exposure of various sectors to a rise in the cost of carbon linked to the reinforcement of the constraint exercised on emissions.

Under the opportunity angle, it is possible to assess the distribution between the various sectors of the considerable sums invested to adapt or attenuate, or which are budgeted under government plans.

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3) Possible avenues for investment policy application

Once the possible economic impacts of the major environmental challenges are identified, the question of how they can best be incorporated into an investment and asset allocation strategy naturally arises: should these impacts modify the allocation between asset classes, and/or within them and/or the selection of stocks and bonds?

1) A typology of existing practices

The table below provides a synthetic overview of the avenues explored by the FRR's peers in other countries and helps us to arrive at a brief typology of existing practices:

Table 6: Inclusion of environmental considerations by a few major foreign funds

Fund name	Strategic asset allocation	Thematic exposure	Stock-picking	Other
APG (Netherlands)	Carbon funds Forests and Farmlands	Clean tech funds (Infrastructure, private equity funds) Thematic equity funds	Inclusion of environmental criteria in management (SRI) Possibly, carbon footprint	
Calpers (United States)	Forest funds	Clean tech funds Real estate funds		
USS (Great Britain)		Clean tech funds (Infrastructure, private equity funds)		
Environment Agency Pension Fund (Great Britain)		Unlisted thematic funds Real estate funds (rehabilitation)		Environmental overlay Pooling at manager level of environmental information (surveys, carbon performance, reporting)

Practices are varied, even though the sectoral/thematic approach appears to be preponderant, and they seem to be generally complementary. However, this apparent complementarity is undoubtedly more the result of a series of one-off decisions than of a global approach (except with respect to the UK's EAPF).

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2) Factoring the environment in at the level of the major asset classes (strategic asset allocation)

To take the environment into account at the level of the long-term allocation among the major asset classes, we can reason on the basis of types of assets given and the possible distortions of the allocation among these assets before planning to introduce environmental assets.

a) Integration within the existing portfolio structure (at given asset classes)

We can assign various financial scenarios to the different economic scenarios presented in part 2-1, which allow us to modify the return / risk hypotheses of the asset classes that feed the strategic allocation model. This working document proposes to extend existing analyses with regard to climate change by adding a bona fide financial dimension.

Simply put, the impact on asset classes can be assessed using the long-term relationships between economic variables and financial variables:

- **Equities:** over the long term, it is generally accepted that the return on equities is equal to earnings growth (which can be assimilated with economic growth) plus the dividend yield. Accordingly, equities are penalized under the three scenarios where the impact on growth is negative (Extended Fossil, More Rapid Climate Change and Green Constraint) and boosted under the Green Growth Scenario. In addition, price trends from today to tomorrow also take into account the level of uncertainty: an upward revision in this level makes risky assets less attractive (this reasoning also applies to **real estate**) and leads to a decline in their valuation and hence their return (if we assume that at the end of the period, the level of risk is higher than it was at the beginning of the period). This effect is particularly marked in the Extended Fossil Scenario – characterized by a general increase in the risk.

- **Bonds:** the yield on bonds (real long-term interest rate) depends on both economic growth (in a positive way) and the degree of macro-economic uncertainty (uncertainty increases the risk premium demanded on long-term investments). The effects of growth trump in Green Scenarios (negative impact under the Green Constraint Scenario and positive impact under the Green Growth Scenario) and in the More Rapid Climate Change Scenario (negative impact). As for the Extended Fossil Scenario, the negative effect of growth is offset by the positive impact of higher uncertainty on growth and inflation.

- **Commodities:** over the long term, it is assumed that trends in commodity prices are determined by production cost trends and by interest rates (Hotelling's Theorem: the increase in return on the scarcity of a rare resource is dictated by the prevailing interest rate and therefore equalizes the inter-temporal tradeoff between present and future consumption)[9]. Because of the specific features of investment in this asset class, it is also assumed that a

[9] Given the specific characteristics of this asset class in the FRR's allocation (predominance of fossil commodities in the benchmark index that is used).

specific risk premium exists to reward the investment via futures and that the FRR captures: the *convenience yield,* which rewards whoever, in buying a future, assures the producer of the sale of some of his production at the transaction price.

- Finally, in terms of **volatility**, in the absence of quantitative consensus and due to the need to adopt a simplified approach, a multiplier is applied to the volatilities used for the Median Scenario. The volatility is higher in unfavorable scenarios – particularly in the Extended Fossil Scenario. The More Rapid Climate Change Scenario benefits from the impact of a less volatile oil price. Conversely, in the Green Scenarios, for which trends and developments are better controlled (thanks, in particular, to the energy mix's adaptation to the new constraints), volatility is globally lower than in the Median Scenario.

Table 7: Principal financial variables in the various scenarios

Time horizon : 2040

Real return *(annual growth differential compared with Median Scenario)*	**Equities**	**Bonds**	**Commodities**
Extended Fossil Scenario	-1.75%	0%	+3.0%
More Rapid Climate Change Scenario	-0.55%	-0.5%	-1.25%
Green Constraint Scenario	-0.3%	-0.1%	-2.0%
Green Growth Scenario	+0.3%	+0.25%	-2.0%
Volatility *(multiplier applied to Median Scenario volatilities)*	**Equities**	**Bonds**	**Commodities**
Extended Fossil Scenario	1.2	1.2	1.2
More Rapid Climate Change Scenario	1.1	1.1	1.1
Green Constraint Scenario	0.9	0.9	0.9
Green Growth Scenario	0.9	0.9	0.9

Out of these financial scenarios, two types of results in terms of strategic allocation are generated. ***First of all,*** we present the efficiency frontiers[10] in cases where **each of the different scenarios are fully realized**. Therefore, each scenario is associated with an efficiency frontier built on the basis of the financial hypotheses that characterize this scenario. They may be quite different from the efficiency frontier of the central scenario. ***Secondly***, we adopt **a stress-test approach**: we build a strategic asset allocation that takes into account a certain percentage of the most unfavorable cases. For each asset we generate a composite distribution based on the median distribution, by adding the unfavorable cases. This method allows us to ultimately draw an efficient frontier that takes into account a non-zero risk that unfavorable scenarios could come to pass.

The model used is one that seeks to optimize the return-risk tradeoff over the long term for each portfolio (defined by its composition). We trace a great number of random paths, from which we estimate—at the end of the investment period—the reward (return) criterion (real final value) and the risk criterion (CVaR). Recall that from one period to the next the portfolio is governed by the following law of evolution:

[10] All portfolios that present the best return for a given level of risk.

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if $V_{t-1} > 0$, $V_t = (1+r_t)\cdot V_{t-1}$ + Endowment – Payout

if $V_{t-1} < 0$, $V_t = (1+i)\cdot V_{t-1}$ + Endowment – Payout

With r the return on the portfolio and i the risk free rate. If the value (V) of the fund becomes negative, then the FRR is presumed to go into debt to make its scheduled payouts.

As an illustration, based on a given diversified portfolio composed of equities (45%), bonds (35%), both indexed and non-indexed, real estate (10%) and commodities (10%), using the environmental impacts on the main financial variables described above into the strategic asset allocation model yields the following results:

Table 8: Variations in the resulted strategic allocation under various scenarios

	Difference against the benchmark portfolio (at a given level of risk (CVaR=0)), in percentage points (pp)			
	Equities	**Bonds (incl. indexed)**	**Commodities**	**Real estate**
Extended Fossil Scenario	-33	+38	Maximum constrained level (10%)	-6
More Rapid Climate Change Scenario	-20	+24	-2	-2
Green Constraint Scenario	+5	-3	-2	0
Green Growth Scenario	+21	-14	-7	-1

Using all due caution, the principal conclusions we can draw are the following:

- The **Extended Fossil Scenario and the More Rapid Climate Change Scenario** can be characterized by a decline in the relative share of equities, particularly under the Extended Fossil Scenario, where it would be reduced by more than 30 pp compared with the central scenario. As the equity component diminishes, the bond component rises, up to +38 pp compared with the central scenario. Commodities saturate their constraint (maximum allocation of 10% of the market portfolio under the Extended Fossil Scenario) and real estate declines.

- As for the **Green Scenarios**, their equity component can increase by up to +20pp. This increase is made in part to the detriment of bonds, which decline by up to -14pp, but also commodities, which are clearly not favored under these scenarios.

Overall, **green scenarios tilt to equities and, secondarily, to real estate, to the detriment of commodities and bonds. The Extended Fossil and More Rapid Climate Change Scenarios do not favor risky assets, with the exception of commodities due to their higher expected return under the Extended Fossil Scenario.**

In a way that complements the previously cited variable approach, we can also **test the robustness of the allocation with respect to environmental risks** – summarized in the

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unfavorable scenarios (Extended Fossil and More Rapid Climate Change) under the stress test approach. In this context, we put the probability of occurrence at 10% for each of the unfavorable scenarios. As a result, the weight of the central scenario remains largely in the majority (80%).

The results show that ***(a)*** taking unfavorable scenarios into account deteriorates the efficient frontier, and ***(b)*** the portfolio's composition is distorted towards less risky assets.

a. The factoring in of climate change deteriorates the efficient frontier globally: some of the most effective risk/return tradeoffs are no longer accessible. This deterioration is nonetheless fairly measured.

b. The composition of the portfolio is modified: the percentage of risky assets (equity, real estate and commodity) decreases by 6pp, while the percentage in fixed-income (bonds) is raised by 6pp.

Table 9: Variation in the strategic allocation in the event of non-favorable scenarios

	Differential with respect to benchmark portfolio (for a given level of risk (CVaR=0)), in percentage points (pp)			
	Equities	**Bonds (incl. indexed)**	**Commodities**	**Real estate**
Scenario with stress tests	-5	+6	-0.5	-0.5

N.B.: This table gives the following allocation differentials for: equities = 45%; real estate = commodities = 10%; bonds = 24%; OATi = 11%.

Overall, the **deterioration of the efficient frontier and the increased level of risk tend to distort the composition of the portfolio towards the least risky assets (OATs and in particular OATi), to the detriment of risky assets (equities and, to a lesser extent, real estate and commodities).**

b) Introduction of environmental assets

By environmental assets, we mean assets that by nature are related to the environmental challenges or issues that we have selected: forests, carbon, land, farmland, weather derivatives, etc. More specifically, we examine the characteristics of forests and of carbon.

- Forests[11]

Forests constitute a very old market that includes institutional investors such as insurance companies and major pension funds. While the market is potentially big (3 million hectares in France for forests of more than 50 hectares, 3 billion hectares of total surface area worldwide), it is **not very liquid** (in 2007, transactions in France came to €1Bn, about 7% of the total value of this asset).

[11] F. C. Zinkhan, G. H. Mason, T. J. Ebner, W. R. Sizemore, *Timberland investments: a portfolio perspective*, 1992.

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The primary source of the return on this asset is biological: the growth of trees ensures production that grows over time, not only in volume but also in value (as the tree grows, its potential uses do as well: from heating to furniture to construction). Wood/timber prices are subject to cycles that are mainly linked to real estate construction (70% of total sales in value terms), but they can be smoothed out with a diversified portfolio of forest assets and an adapted cutting strategy. **Exceptional events – whose frequency may rise with climate change** (storms, drought) – can jeopardize a portion of this return, even if the diversification of the forest portfolio (essence, location, age) can theoretically limit the impacts of these disasters. **The yield of the forest also depends on land values** (including the option of converting forest to other, more profitable ends). **Finally, the return can come from other uses—environmental ones in particular—**which could develop in the decades to come: forests are carbon wells that could eventually generate carbon credits (they are already used for voluntary offset mechanisms but do not yet generate credits that can be exchanged in the European market). In addition, forests can help to fight against the loss of biodiversity, which could also find a valuation (for example, this is already the case with offsets for the loss of biodiversity caused by urban planners and developers).

Overall, the **forest is an asset with a low return, not particularly volatile and relatively decorrelated from other assets**:

Table 10: Principal characteristics of the forest asset

Return	Risk	Decorrelation within a diversified portfolio
*Biological growth (volume and value) *Price of wood is highly dependent on real estate and land values *Diverse sources, in part linked to environmental considerations =>Low return (2-3%/an), could be higher today because of trough in cycle and new sources of valuation	*Illiquidity (few transactions in the market), which warrants a long-term investment *Physical risks (fires, storms, heat waves), but diversification within the asset limits these risks *Risks related to changes in the wood price, but can be managed w.r.t the time of cutting =>Low volatility. Risk of capital loss grows with climate change (increase in the frequency of extreme events), but which can be limited via adequate diversification	*Weak correlation with equities and bonds; biological return decorrelated from economic return *Partial correlation with real estate

- Carbon

Carbon emissions trading (quota market, emissions trading) is one of the measures the public policymakers have implemented to ensure that environmental factors be taken more seriously

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by economic agents: for a given period, the public policymaker sets a global cap on carbon emissions and distributes it upstream among the players covered under the mechanism; over the course of the period, they can trade their rights – creating a market for them. This is the system that the European Union has been using since 2005.

The **Kyoto Protocol,** which sets a target for the reduction of greenhouse gas emissions (-5% compared with the level of 1990 for the industrial countries between 2008 and 2012, including -8% for the EU 15), states that governments can adopt flexibility mechanisms – emission allowances – to reach their objectives. **It is within this context that the EU has set up a market of quotas** (EUA or European Unit Allowances), covering manufacturing sectors that are high emitters (about 11 500 facilities that represent 45% of the EU's emissions over the 2005-2007 period (phase I).[12] To allowances granted to businesses are added – in defined quantities – the allowances generated by other flexibility mechanisms called for under Kyoto: via these project-based mechanisms, exchangeable rights to emit are generated via the financing and completion of a project to reduce greenhouse gas emissions in a developing country (Clean Development Mechanism or CDM) or in another country subject to reduction targets (Joint Implementation or JI).

After a first experimental phase, emission caps are being gradually lowered: -10% on average versus 2005 in phase II (2008-2012) and at least -21% by 2020. In its national allocation plan, which uses the emission cap it has been allocated, each Member State distributes permits to various sectors and facilities that are covered (free of charge or in an auction system, especially over the period 2013-2020). It then keeps a register with, for each facility, the allowances granted, emissions verified and allowances recovered (at the end of each year), as well as a trace of all physical transfers (purchases/sales).

In its first years of operation – and despite using a cap that was not very restrictive in the experimental phase – **the European carbon market has functioned properly, and has led to a reduction in greenhouse gas emissions**. So it is an effective instrument for combating climate change. The European example has been followed by other nations (Australia, New Zealand and Japan) and may also be adopted in the United States – these different regional markets may even one day combine to form a unified global market.

The preceding institutional framework enabled **the development of a deep and well-structured European carbon market**. In terms of volume, this market went from 262 Mt CO2 in 2005 to 1500 Mt CO2 in 2007. It is the world's biggest carbon market, since trades at the EU level represent about 80% of the value of the world market.

Players in this market include businesses (particularly in the energy sector, which represents 70% of all permits granted) and traditional participants (brokers, traders, various service providers). The OTC market accounts for 70% of all transactions, but there is also an organized market with a clearinghouse. There are both spot transactions (with delivery of rights or credits within 24 or 48 hours) and derivative contracts (mainly futures/forwards and to a lesser extent options and swaps), which allow players to hedge for risks related to price fluctuations or to transfer them to other players. The contracts pertain to EUAs, but also to CERs (Certified Emission Reductions, generated by clean development mechanisms).

[12] The permit market does not cover diffuse emissions related to transport or housing.

Transactions involving European quotas are mainly forward transactions, and cash/spot transactions represent less than 10% of the total for the European market.

In France, the organized market for emission rights is BlueNext (owned by NYSE Euronext and Caisse des Dépôts), Europe's leader in spot contracts. The British market, the European Climate Exchange (ECX), which is the most active and liquid market, specializes in derivatives contracts (futures and options in particular).

The direct purchase of carbon credits is possible, but investors tend to use carbon funds. These are investment vehicles that include capital for use in the purchase of carbon assets in the primary market. Mainly, they exploit the flexibility mechanisms put in place under the Kyoto Protocol to supply carbon assets (financing for emission reduction projects).[13] Initially created in the early 2000s by public players (the World Bank), since 2005 the market has taken off thanks to the arrival of institutional and private investors with a financial objective (a capital gain on the sale of credits generated by projects at a price that exceeds the cost of production) and not a compliance objective (use of credits generated to comply with an emission ceiling – at a lower cost than via the purchase of EUA credits).

Funds are mainly primary CDMs (for Clean Development Mechanisms). They finance projects in developing countries (China in particular), which generates emission allowances that can be resold. There are also secondary funds that allow investors to buy certified credits (the risk related to project financing thus disappears, but the expected return also diminishes). In both cases, the participation of institutional investors tends to support the emergence of a more effective carbon signal-price.

In the literature, permits are **generally classified under commodities**, but commodities with specific features (supply is administrative in terms of its origin, the quantity is limited, and the period of validity is also limited).

On the supply side, the price of carbon depends on the **regulatory constraint.** For example, at the end of phase I, prices collapsed because the cap was not restrictive enough (and because it was impossible to transfer accrued rights to the next phase). Aside from this structural determinant, other factors also come into play on the demand side: first of all, the stronger the **economic growth**, the greater the demand for allowances, which pushes prices upward. **Prices for fossil fuels (gas, carbon)** also play an important role in emission rights price trends. Simply put, the increase in the price of energy leads to the passage from the production of energy using gas to coal-based production, the result of which is an increase in the demand for permits (carbon emits more GHGs) and hence the price of emission rights. Finally, **temperature** (in particular, unanticipated variations in temperature, for example during cold winters) is an explanatory factor for coal/carbon prices.

It is still too early to be affirmative, but carbon appears to be **a highly volatile asset, relatively correlated to commodities**:

[13] Ian Thomas Cochran, Benoît Leguet, *Fonds d'investissement CO2 : l'essor des capitaux privés*, November 2007.

Table 11: Principal characteristics of the carbon asset

Return	Risk	Power of the decorrelation within a diversified portfolio
*Regulatory framework (emission ceilings by period) and amount of CER credits in supply *Economic growth, change in the price of fossil fuels and weather conditions on the demand side =>Little historical data; 7% over the first months of phase 2	*Regulatory risk, but general framework in the Climate-Energy Package (at least -21% by 2020) *Project risk (for primary CER credits resulting from clean development mechanisms) =>Little historical data; high volatility (50% over phase 2).	Significant correlation with short term fossil fuel prices

3) Factoring the environment in within major asset classes

An investor wishing to take into consideration the environmental problematics within a given strategic asset allocation must have an analytic grid that can be applied to different asset classes.

a) Analytic grid

The impacts of environmental problematics on the economy are mainly found in two dimensions – inter-sector dynamics and the development of new technologies – which must be approached differentially by an investor.

For the first dimension, an overview of work on the sectoral impacts (threats/opportunities) allows us to draw up a map that illustrates the impact of the problematics chosen on the sector dynamic, which also offers the investor a first analytic grid:

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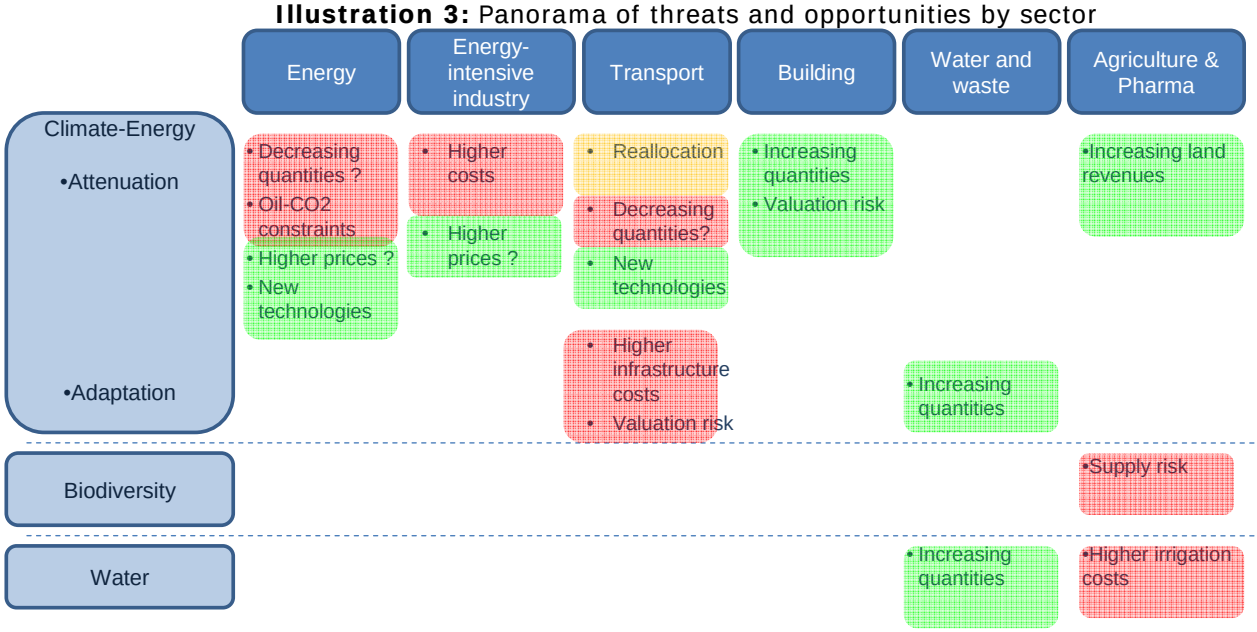
Illustration 3: Panorama of threats and opportunities by sector



Source: I Care Environnement

For the second dimension, while new environmental technologies (Clean Tech) offer numerous investment opportunities, the threats and opportunities they contain must be evaluated with precision, taking the following criteria into account:

- **Environmental durability**: an environmental technology comes with environmental impacts that must be assessed. In early phases, the environmental benefits are often over-estimated and the side effects are under-estimated. As a result, it would appear wise to make use of robust environmental methodologies (based on life cycle principles of analysis) to avoid making investments in technologies that disappoint over the medium term from an environmental perspective (for example, European bio-ethanol).
- **Energy relationship**: the economic profitability of a clean or energy efficient technology is directly related to the energy or fossil fuel savings they result in. Consequently, it is vital to thoroughly understand the cost structure (and in particular the energy component) of the clean technology, as well as the energy hogging technology it purports to replace. This enables us to update our understanding of the relationship between the technology's profitability and the price of oil or energy.
- **Regulatory dependency**: due to the high initial costs (learning curve or scale effects), numerous States are setting up incentive schemes to encourage the development of clean tech industries. These incentives (guaranteed purchase price for electricity, for example) help technologies become profitable, although this profitability is also due to regulation. There is a risk—albeit a managed one—that this regulation could be changed depending on policy orientation or politics, which entails complex multinational tracking.
- **Proximity of commercial break-even point**: The commercial breakeven is defined as the level of development of the technology that enables the latter to forego the regulatory support mentioned earlier. Knowledge of the timetable for this commercial breakeven point (related to the decrease in the cost of the technology) is critical for pricing the technology, since once this point is surpassed the risk mentioned above can be eliminated, and is often the trigger for the stepped-up adoption of the technology in question. This commercial break-even point is highly dependant on the price of energy.

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- **Market consensus**: finally, looking past the analysis of the fundamentals of the valuation of any technology, the existence of a consensus in the financial market with regard to the threats and opportunities of a technology leads to a valuation of the technology at a market price that cancels the opportunities for outperformance (reintegration of the theme by the market). For instance, the market for the manufacturing of wind turbine technology is considered to be relatively mature today and well understood by investors, which makes it less interesting for a given investor to pursue this technology. Conversely, the existence of very diverse opinions on the potential of a technology is synonymous with risk (threat) and hence with an opportunity for return for an investor who is better informed than its peers or more willing to assume certain types of risks.

b) The breakdown within asset classes

While sector analysis and the grid for evaluating clean technologies are widely applicable, environmental problematics have an impact on the principal asset classes whose intensity and characteristics differ significantly:

- **Private equity** (venture capital) is the asset class that is most directly impacted by the development of new technologies because it is this method of financing that many new tech companies use to ensure development.
- **Infrastructures and real estate** are two asset classes that correspond to the principal axes of climate-energy policies, as well as to water resources management policies (i.e., the development of new energy infrastructures, clean transportation infrastructures, water treatment and distribution infrastructures, and the transformation of existing buildings and dwellings into energy efficient units). Moreover, these two asset classes are particularly exposed to the direct environmental risk (natural disasters and catastrophes, global warming, etc.). Accordingly, the adoption of the environmental prism seems to be particularly important for investment strategies in these two asset classes.
- **Equities** are involved quite differently depending on the sector (environmental sectors versus the others) and the nature of the listed businesses (pure players or diversified companies). But if markets are efficient enough, the threats and opportunities are appropriately integrated into market prices and do not necessarily warrant a specific thematic approach.

4) Environmental considerations and stock-picking

Ex ante, in the context of delegated management, environmental factors can be taken into account **at the level of management mandates**; in this case, it fits in with a responsible investment strategy that takes into account extra-financial criteria in the portfolio research, construction and management. In addition, a more specific focus on certain environmental aspects is possible, such as:

- the prevention of pollution risks, especially those that are accidental, and impairment to biodiversity;
- the steady development of the eco-efficiency of manufacturing processes and the efforts made to promote and develop technologies that respect the environment, plus the use of renewable energies;

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- the policy of reducing CO2 and other greenhouse gas emissions, the volume and toxicity of waste and water consumption.

More specifically, and beyond the sector aspects that were mentioned above, the **stock-picking methodology,** whether for private equity, real estate, infrastructures or equities, must in particular take the following factors into account:

- **The level of environmental performance**: today, there are tools for obtaining quantified assessments of the environmental performance level of a business or an asset, particularly with regard to Carbon/Energy performance (Carbon Assessment) for businesses, Energy Performance Diagnostic for a building, etc.). A good level of performance limits the stock's exposure to increases in Energy and Carbon. In sectors or asset classes whose environmental performance has not yet been determined, an investor can buy performance at low cost.
- **The potential for improvement in environmental performance**: an average or poor environmental performance can in some cases be a source of profitability for the investor: certain remedial actions (intended to ensure compliance with code or the accepted standard) in the environmental sphere are profitable (see curve for the abatement of CO2). For example, in sectors where the level de performance is measured, investing in an asset that shows a weak performance, improving the level and then selling the asset can be profitable.
- **The position in the value chain**: sectors that are strongly impacted by environmental problematics, such as energy, transportation and construction, are obliged to rethink their value chain. Depending on the problematics and the sector, positions upstream or downstream may be more profitable, concentrations can create new barriers to entry, and market positions may be threatened. In the solar portion of the construction industry, access to solar grade silicon, as well as access to cells is becoming decisive for manufacturers of solar panels and systems. In the building industry, many players coming from many different perspectives (energy suppliers, equipment manufacturers) are trying to build a product around the idea of energy renovation for consumers. These two examples illustrate the need to understand the positioning strategies of businesses in these sectors undergoing rapid transformation.

Ex post, on the level of the whole portfolio, a measurement of the **environmental footprint** carried out at regular intervals (annually or once every two years) can also be the source of useful information about the portfolio's externalities, particularly with regard to its exposure to the carbon risk and its change over time. It can also serve as the basis of a **policy of corporate dialogue** with executives and businesses on the theme of global warming – rounded out by participation in group initiatives (the Carbon Disclosure Project and the Institutional Investors Group on Climate Change being two examples).

Tentative Conclusion

A few tentative conclusions can be drawn from this work:

- Climate change, but also the exhaustion of natural resources, the increasing water shortage and the loss of biodiversity seem to be the most relevant environmental problematics for the long-term investor.

- These different problematics must be considered from the perspective of both threats and opportunities, which themselves vary over time and depend on the actions taken by various players, policymakers in particular. In this respect, to be efficient—in other words, to enable economic agents, especially investors, to make the right decisions—environmental policy must be stable, predictable and consistent over time.

- An investor should try and integrate environmental challenges into the various levels of its investment policy: strategic asset allocation, selections made within asset classes, management styles, reporting and assessment.

- These various levels appear to be complementary when it comes to dealing with the major economic challenges that we face. Looking beyond this inventory, a more in-depth analysis of the various avenues is a necessity.

The original contribution of this document is to propose several ways in which environmental problematics might be incorporated into the strategic asset allocation. Working from long-term climate scenarios, it constructs medium-term economic and financial scenarios that allow us to redefine return/risk tradeoffs for various strategic assets and, in so doing, calculate a strategic asset allocation dependent on climate trends. At the strategic asset allocation level, the main results of the study show that the integration of environmental issues generally leads to lowering the weight of “risky” assets. Only one of the five constructed scenarios, the green growth scenario, reverses this finding.

- Another avenue explored consists of supplementing the portfolio with environmental assets such as carbon or forest, a source of protection or return based on the environmental problematics selected.

Some of the results presented in this document are relatively novel and necessarily fragile: it is under this dual aspect that we thought it would be interesting to share them with the investment community, as well as with anyone who is interested in these issues. Far from purporting to offer definitive answers to the questions it raises, this working document will have achieved its aim if it stimulates more in-depth work on these issues of capital importance.

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