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RESEARCH PAPER

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Responsible Investing

MIROVA'S INSIGHTS

Sustainable investment research

AN EXPERTISE OF NATIXIS
GLOBAL ASSET MANAGEMENT

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Responsible Investing

Mirova, Natixis Asset Management's responsible investment division, offers engaged investment management aiming to combine value creation and sustainable development.
Mirova favours a global approach to responsible investment and has a team of around forty experts in thematic investment management, fund managers specialising in different business sectors, engineers, financial and extra-financial analysts, experts in project financing and solidarity finance. Mirova has also developed a research partnership with the University of Cambridge and actively participates within various international organisations.

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Sustainable development starts with responsible investment.

Responsible investment is a powerful lever to develop a sustainable economic model.

To meet this challenge, we base our investment decisions on the strategies of forward-thinking companies and focus on creating long-term value. Our goal is to develop a new responsible investment model.

Mirova is the Responsible investment division of Natixis Asset Management.

AN EXPERTISE OF NATIXIS GLOBAL ASSET MANAGEMENT

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“Offering investors solutions and creating value over the long term: this is Mirova’s ambition.

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By Philippe Zaouati,
Natixis AM Deputy CEO, Head of Mirova.

Head of development and member of Natixis Asset Management's executive committee since 2007, and deputy CEO since 2010, Philippe Zaouati is also head of Mirova, the responsible investment division of Natixis AM.

Since 2011, Philippe Zaouati has also been in charge of the European Fund and Asset Management Association's (EFAMA) working group on responsible investment. In 2012, he became a board member of the International Corporate Governance Network (ICGN).

Actively involved in promoting responsible savings, Philippe Zaouati was also recently appointed President of the SRI Commission of the French Asset Managers' Association (AFG).

Why we created Mirova

There are many ways of analysing the world today, many visions of the future, even though some facts stand out undeniably.

The current imbalance between growth and debt, the decorrelation with the real economy, the depletion of natural resources, and climate change issues all highlight the fact that the current economic development model is no longer sustainable.
Whether it is seen as one of the causes of this crisis or merely as a catalyst, the finance industry also represents a major part of the solution. This is particularly true for the investment industry.

We are convinced that we need to see finance from a new perspective in order to better understand the risks and opportunities of a changing world.

Many investors have already turned to socially responsible investing. Their impact remains negligible, however. Looking beyond SRI, investors are clearly seeking meaning and increasingly expressing concerns about asset allocation, models, risk approaches, benchmarking, etc. Responsibility has become a pivotal concept.

Investors are taking a broader view and are more concerned about the sustainability of their investments, the part they play in financing the economy, their responsibility as shareholders, the medium-term potential of their investments, and so on.

> The challenges of the future are investment opportunities to be seized. This is where we step in. This is our role.

> Offering solutions to investors and creating value together over the long-term: this is Mirova's ambition

The challenges of the future are investment opportunities to be seized. This is where we step in. This is our role.

We see responsible investment as a set of techniques, expertise and investment products that enable investors to direct their cash and savings towards companies committed to a better future, financing the infrastructure that is essential to energy transition and supporting a social and solidarity-based economy, and companies that help investors understand what is at stake and to play an active and responsible role.

Institutional investors and private savers, notably in Europe, are in search of returns and meaning for their investments.

This starts, obviously, with extra-financial research and the integration of ESG[1] criteria into portfolio management. But we need to go much further than this.

This is the objective we have set ourselves with Mirova, the responsible investment division of Natixis Asset Management. Offering solutions and creating value together over the long-term, this is Mirova's ambition.

Mirova's creation reflects our high ambitions in terms of responsible investment: to remain at the cutting edge and strengthen our position in the French market, and to become a key player on the international scene. We are not starting from scratch: we have been active, often the leaders, in several of the above-mentioned areas for many years now.

We decided to combine our different areas of expertise in a single investment division, one of its kind in Europe, and have organised our offering into four pillars:

1 Listed equity management

We are looking to identify and support companies in Europe and throughout the world that provide solutions for the future and that take into account their externalities, whether they be positive or negative.

Asset portfolio management primarily means selecting companies, projects and management teams; to do this, an analysis grid is used along with a vision of the world and the economy, driven by real expertise. This is what we set out to create, by putting in place a global thematic approach comprised of eight key sustainable investment themes.

(1) ESG: Environmental, Social/Societal and Governance.

“Mirova's creation reflects our high ambitions in terms of responsible investment.

2 Financing infrastructure[2]

The need is huge. We are lucky to have a team of experts in place who have demonstrated their know-how through investing in public infrastructure projects in France, and in renewable energies across Europe.

We are therefore looking to finance infrastructure projects that address the challenges of sustainable development and generate regular cash flow over the long term.

3 *Impact investing*[3]

We are leaders in impact investing in France and we are continuing to develop our capacity to select and follow projects with a direct social and environmental impact. Promoting these products beyond corporate saving schemes remains a key challenge.

We are therefore looking to invest a portion of assets in unlisted companies and structures with a strong social and/or environmental impact, by funding needs that are inadequately met by traditional financial channels in France, and by supporting projects which will have significant social impact, directly or through specialised institutions.

4 Voting and engagement

We offer investors our specific expertise in terms of extra-financial analysis, analysis of the resolutions of General Meetings, and shareholder engagement.

We support institutional investors and asset managers in exercising their voting rights and implementing engagement actions, the goal being to create long-term value for all stakeholders.

This expertise is developed by a team of around forty specialists, including experts in thematic investment management, fund managers specialising in different business sectors, engineers, financial and extra-financial analysts, experts in project financing and experts in solidarity finance.
This requires an in-depth understanding of global changes in technology, politics, regulations, society and markets around the world.

(2) The Infrastructure financing activity is managed by Mirova Environment and Infrastructure, a subsidiary of Natixis Asset Management.
(3) Impact Investing: Asset management with a social/environmental impact.

> We would like to offer a new way of seeing the investment industry, that provides direction by responding to the sustainable development challenges that affect us all, while still continuing to create value for our clients.

We have therefore signed an agreement with Cambridge University, based on a research partnership focusing on sustainable development themes as well as the establishment of a task force in 2013, the Investors Leaders Group.

If this wealth of expertise is our internal added value, we also believe that it should be public and shared in conversation with the network.
This allows us both to share these convictions and to question them regularly, in a process of improvement and continuous innovation.

This is precisely the purpose of this research paper, in which this first issue:

- outlines the fundamentals of our research methodology and investment process;
- provides an in-depth study on electric vehicles, one of the new technologies that could change our mobility and driving patterns while reducing the carbon footprint;
- presents our current position on shale gas, a highly topical and controversial issue;
- exposes, from an external view, the challenge facing a finance industry that better takes the general interest into account;
- gives an overview of key events of the last few months that sparked interest or laid the groundwork for a "sustainable" model of civilisation.

This publication and the ones that follow will provide you, our readers, with a clearer understanding of the world around us and its challenges, whilst defining the vision that drives us.

We would like to move away from ready-made moulds that at times place SRI into a kind of 'niche'.
We would like to offer a new way of seeing the investment industry that provides direction by responding to the sustainable development challenges that affect us all, while still continuing to create value for our clients.

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THE MIROVA APPROACH: CREATING SUSTAINABLE VALUE

Mirova, Natixis Asset Management's responsible investment division, offers engaged investment management that is committed to combining value creation and sustainable development.
This obviously begins with extra-financial research and the integration of ESG criteria (environmental, social and governance) in portfolio management. But it must go much further. The analysis of corporate social responsibility (CSR) thus requires a review of ESG issues as well as a financial analysis.
In order to identify the companies that effectively address the challenges of tomorrow, Mirova's experts have developed a unique approach to economic analysis based on 8 sustainable investment themes.
Using this approach, Mirova teams identify companies that develop solutions for the future and also embed CSR policies in their strategy. The aim is to ensure that companies address key sector issues.

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MIROVA'S RESEARCH PHILOSOPHY

Given the ethical nature of the challenges of sustainable development, a transformation of society is vital. Like any process of change, this can present both risks to be avoided and opportunities to be seized.

To this end, Socially Responsible Investment (SRI) has to be understood, not as the implementation of a rigid ethic, but rather as a dynamic process aiming to encourage investment in projects that are the most in accord with the challenges of sustainable development.
Therefore, despite being two distinct matters, ethical and financial concerns overlap and are potentially compatible.

By **Hervé Guez**,
Head of responsible investment research - Mirova's investment division

> We can no longer think of short-term profit maximising models as being optimal.

Ethics and profit are two very distinct matters. An ethic that only seeks profit is worthless, it is simply a calculation. SRI, however, presents itself as a virtuous form of investment, offering sustainable, long-term financial yields. Would the two notions of ethics and profit be reconcilable via SRI, for example? Or have we merely created a trend, a *greenwashing* avatar?

This is the question that Mirova, Natixis Asset Management's responsible investment division, hopes to answer through its research and investment philosophy.
Mirova and its teams are seeking to answer the double demand of their clients, namely, to promote the transition towards a sustainable economy, whilst still delivering good financial performance.

Offering pertinent investment solutions in terms of SRI, however, firstly requires a good understanding of:

- the relevant challenges
- the way in which economic players are likely to respond to them
- what investors can hope to gain in the long term.

1| New challenges, new opportunities

1|1 A change of paradigm

Sustainable development is not compatible with solely seeking to maximise profit in the short term

Despite its numerous advantages, our system, which we can define as a 'market economy', must let go of its historically rooted beliefs that:

- increased monetary wealth is equivalent to better well-being
- maximising in the short term is equivalent to optimising in the long term.

It is, of course, on these two beliefs that the market economy and the financial markets have organised themselves over the last few decades. Indeed, assuming rationality and perfect information, financial mathematics offer a strong basis for the *homo economicus* calculator. Thus, in a free and deregulated market, whilst maximising profit in the short term, it would participate in a collective movement that optimised the general interest.
In such a model, science and economic agents have an ethical justification and can therefore legitimately focus exclusively on what really counts:

- increased GDP
- maximised short-term profit for all.

So what have we learned since the golden age of monetarist theories? The idea of *homo economicus* itself has been undermined. Our species is (re)discovering that it is complex and full of contradictions, being both egotistic and calculating, but also altruistic and disinterested. As the cognitive sciences, sociology or even behavioural finance bear witness, we are not just using our reason to act, and we are for the most part conformist, not to say submissive, in the face of force of habit and of numbers.

So, we can no longer think of models maximising short-term profit as being optimal.

The Universal Declaration of Human Rights as a principle of our model of society

This movement is equally accompanied by a (re)questioning of the purpose of the economy. Although it may appear that monetary wealth corresponds to improved well-being, empirical studies show that the correlation is non-linear.[1] In addition, well-being is a partly relative notion and can thus be affected, for example, by an increase in inequality.

Increased monetary wealth must be put back into its correct role: that of a means to an end which could be described as one where, in a democratic movement, each of us seeks to fulfil our needs through a quality of life that allows us to make full use of our individual potentials.

This objective can be achieved by completely fulfilling, or even surpassing, the Universal Declaration of Human Rights (UDHR).

This objective translates into demands for:

- individual fundamental freedoms
- a standard of living that ensures health and longevity
- a quality of life allowing access to knowledge, employment and culture.

One single planet

In the search for quality of life, our industrial civilisation must also face a harsh reminder of the finite nature of our planet, both in terms of its resources, and in its capacity to absorb and recycle our waste.

So, faced with a spectacular demographic and technological increase, we can surmise that the warning signs are multiplying, including:

- climate change
- multiple instances of local pollution altering the environment and human health
- pressure on natural resources
- direct threats to biodiversity.

These elements lead us to believe that our industrial project is harming the environment and must reinvent itself. All the alarm signals are dangerously flashing and 'we can no longer turn a blind eye while our home is burning.'[2] Today, we all need to be conscious that **the environment must be of primary concern**, not for the aim of preserving Nature (a fully respectable objective in itself) but as a **necessary condition in the search for a development model for human aspirations.**

A new industrial revolution[3] is therefore necessary (some people have already started), in order to reconcile our ambitions for civilisation with their natural limits, to find a path towards a sustainable civilisation.

> “Although it may appear that monetary wealth corresponds to improved well-being, empirical studies show that the correlation is non-linear.

(1) Also on this topic, Easterlin's paradox, 'The Happiness-Income Paradox Revisited', Easterlin R. et al., 2011. In addition, note for the first time a decrease in life expectancy in the United States, despite an increase in GDP.
(2) Speech from the President of the French Republic at the UN in 2002.
(3) As Jeremy Rifkin proposes in his book, 'The Third Industrial Revolution'.

112 Corporate social responsibility integrated into a strategic vision of the company

On a macroeconomic level, a society's progress is not based solely on its economic growth. This observation, known also as the Easterlin paradox, gives rise to numerous research efforts aiming to establish other indicators in addition to the essential GDP.

This calling into question of GDP, the sum of companies' added values, implies substantial microeconomic changes. Indeed, in a more open and mobile world, where the weight of transnational companies is in competition with the power of the State, the latter owe it to themselves to favour a business model that integrates general interest issues.

This is, therefore, contrary to the famous statement by Milton Friedman, that has been deeply embedded in our minds, according to which the only social responsibility of a company is to increase its profits.

We are taking part in a structural movement aiming to return all of its legitimacy to the concept of Corporate Social Responsibility (CSR) and to do this at different levels:

- at the UN level: the Ruggie report in 2011 highlighting the direct responsibility of companies in terms of Human Rights
- at an European level: the Howitt report of the European Parliament in progress on the role of CSR
- at national levels.

However, these current changes are not without resistance. This resistance is all the more genuine since companies have often never taken Milton Friedman's statement literally, and have not stopped implementing, and communicating about, their altruistic practices (sponsorships, societal practices and so on). **We are still a long way from progressing beyond philanthropy to actually integrating public interest with profitability within corporate objectives.**

CSR, therefore, rests on an ethical basis:

- a system of shared values (the Human Rights corpus)
- concern for future generations, implying in particular 'natural' capital management.

CSR can only be efficiently implemented if company governance is transformed. **It is necessary to move away from the short-termist logic of maximisation of shareholder value and towards the search for the creation of long-term value.** For this new approach, we must bring together all company stakeholders, such as managers, shareholders, employees, authorities, etc., to face the challenges of sustainable development.

Therefore, the CSR analysis demands a review of environmental, social and governance (ESG) challenges as well as a financial analysis.

Two drivers of sustainable development: risk management and opportunity development

More specifically, there are two drivers that can integrate the challenges of sustainable development into an economic strategy:

> "A new industrial revolution is therefore necessary... in order to reconcile our ambitions for civilisation with their natural limits.

> "It is necessary to move away from a short-termist logic of maximisation of shareholder value and towards the search for the creation of long-term value.

“We are witnessing a transformation of CSR policies which, whether as separate elements or linked, integrate nevertheless into the heart of company strategies.

- The first driver is a ‘re-internalisation of negative social and environmental externalities’.[4] These initiatives limit risk and will be virtuous over time. However, due to their holistic nature, it is often a case of complex management of the challenges of sustainable development. This makes it possible to identify the risks, rather than the opportunities to be seized.

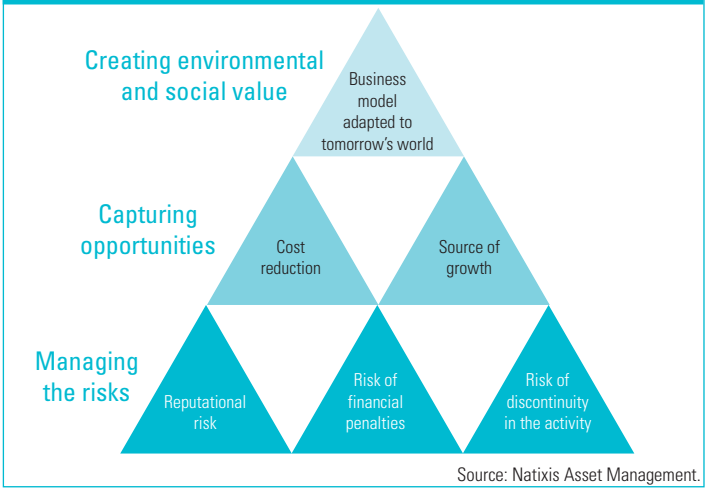
- The second driver of change is **technological and societal innovation when it becomes a structuring element of the economic project** and enables these same social and environmental challenges to be overcome. This second driver often stems from the logic of business opportunities.

These two approaches naturally complement each other and are sometimes combined: how can you sell products and services with social or environmental benefits without being concerned about their effects?

Conversely, how can you try to reduce your negative impact without wanting to develop and promote more virtuous products and services?

In some activities, these two drivers merge. For example, in the retail sector, good risk management of the supply chain could implement a labelling system that could become a differentiating element of the offer.

Figure 1: From risk management to the business models of tomorrow



Source: Natixis Asset Management.

The challenges of sustainable development are becoming more and more apparent, whether through their physical manifestations (e.g. climate, energy, resources) or through the increasing expectations of legislators and consumers on the matter.

In this context, **we are witnessing a transformation of CSR policies which, whether as separate elements or linked, integrate nevertheless into the heart of company strategies.**

What impact does CSR have on the creation of profit?

In answer to the question, ‘Does CSR create profit?’ it is tempting to say that the question has been poorly formulated.

(4) A negative externality refers to a situation where the actions of economic players have a negative impact on a third party that was not part of the initial objective. In other words, the ‘internalisation of externalities’ is making the person responsible ‘pay’ for the damage they cause.

First of all, and as previously explained, we believe that it is no longer possible to think that 'maximising' in the short term, is the key to 'optimising' everything in the long term.

Re-internalising negative externalities can have positive or negative effects on profit, depending on the horizon and perimeter of investment.
In the framework of a classic financial analysis of a future cash flow update, we can see the difficulty in modelling the financial benefits of a CSR approach:

- How to quantify the financial benefits of good management of a carbon footprint, given the uncertainties that exist on the future of the price of carbon when three-quarters of the valorisation of a company go beyond the five-year horizon?

- What benefits can we anticipate from a responsible management of the investment chain aiming to avoid the incidence of extreme reputational risk?

On the contrary, it is possible that bad practices can create profit in the medium to long term:

- For example, if the sustainability of the system is ensured by a collective effort, it is therefore possible to benefit from it by adopting the behaviour of a 'freerider' who will benefit from the positive effects of other companies' expensive actions.

- Another example is if the sustainability of the systems assumes the reduction of the use of fossil energies over the next forty years, valorisation of a 'major' oil tanker will, at least during this period, be higher the more fossil resources it will have extracted (the opposite of what is desired in the general interest).

In other words, it is difficult with the current models to valorise the profit we can expect from good management of environmental and social risks that often have impacts on either the long-term horizon or on probable weak occurrences in the short term.[5]

However, **when CSR translates into environmental and societal innovation, the search for profit and CSR quality often converge.**
The success of these approaches, from an economic, but also environmental and societal point of view, depends on whether these innovations find a market. When a management decides to orientate its R&D towards solutions that allow the intelligent and controlled management of energy because they are looking to a future where this resource can no longer be wasted, it goes without saying that from this positioning they would hope to gain an economic return, and not just an environmental benefit. When another management is convinced that the development of their company exists primarily through its capacity to show the healthy added value of its products and services through appropriate labelling, yet again, corporate and general interest combine.

In tautological terms, **good CSR quality is therefore a source of long-term profits if the challenges of sustainable development materialise.**

"When CSR translates into environmental and societal innovation, the search for profit and CSR quality often converge.

(5) It would be interesting to follow the progress of the creation of investment decision models based on scenario approaches rather than on discounted cash flows.

From the company's point of view, it is financially logical to invest in their CSR policy when the management is convinced of the pertinence of these long-term challenges, and when remuneration mechanisms do not send contradictory signals aiming to promote short-term profit to the detriment of the long term.

What, therefore is the role of an asset manager faced with this new paradigm and these changes within the companies they invest in?

The role of the investor: reconcile ethical and financial value

Many people question whether SRI creates yield. Asking the question in this way makes hardly any sense because, as previously mentioned, ethics and yield belong to two distinct orders.

How can you argue with an individual who is happier enjoying a few quickly earned millions, perhaps to the detriment of collective wealth, of their own life expectancy, or even those of their eventual children? Or again, why should the creation of long-term value by a company be of any interest to a shareholder who has the facility to move almost instantly into and out of capital?

Some empirical works have sought a potential statistical response to this question. It is hardly surprising that they have so far shown that, globally, there was no significant gap between the performance of SRI funds and that of traditional funds.
However these works are not of a convincing character. One of the main issues is the extreme heterogeneity of the SRI methodologies that make such SRI funds difficult to compare with each other.
How can you compare the financial results of an SRI 'exclusion' fund (that does not invest in tobacco or defence enterprises) with those of an SRI 'best-in-class' fund (that invests in companies with the best practices, without excluding sectors)? Clearly, it is extremely hazardous to try to infer a positive correlation between CSR quality and valorisation, and therefore between SRI management and financial performance.

Should we conclude that there is no relationship between anticipated financial performance and SRI management, and then choose between ethics and financial performance, or even subject one to the other? We do not believe so.

- First of all, this is a category of investors whose interests should naturally be driven towards SRI: **long-term investors** such as pension funds or life insurers.

Indeed, for this category of investors, long-term sustainability of the system is not only an ethical choice, but imperative to good active-passive management. As holders of shares, they are obviously interested in the creation of shareholder value, but in the long term, and without this performance having a negative impact on their other investments, they need to know:

- ➜ other companies where they are also shareholders or creditors
- ➜ employees whose retirement and other contributions are funding these long-term investors
- ➜ the countries in which these investors are equally large bond holders; long-term investors are therefore also concerned that companies in which they are shareholders do not harm the natural or human capital of these countries (not to mention their tax returns) to the point of endangering their solvency.

> « SRI has to be understood, not as implementing a fixed ethic... but as a dynamic process aiming to encourage investment towards the most suitable projects for sustainable investment challenges.

In short, the long-term general interest of the society and that of these long-term investors are closely linked. Thus, **SRI is proving to be a favourable initiative for preserving the financial interests of these 'universal stakeholders'**.

- **For investors whose investment horizon is much shorter** and who can allow themselves very targeted investment strategies, SRI could equally prove to be a wise choice. Since they are based on physical data (such as demographic increase, climate or natural resources), we believe that the challenges of sustainable development will have a profound effect on the functioning of our economy and will require new regulations and behavioural changes on behalf of consumers. In this hypothesis, **companies who will have best integrated these challenges of sustainable development, either in terms of managing their existing industrial processes or in innovation, will benefit from a competitive advantage.**

In other words, **if the challenges of sustainable development have an ethical foundation, they also require a transformation of society and, like all processes of change, are the bearers of risks to avoid and opportunities to seize.**

In this vision, SRI has to be understood not as implementing an ethic aiming to 'separate the wheat from the chaff', a priori and in a fixed way, but as a dynamic process aiming to encourage investment towards the most suitable projects for sustainable investment challenges. So, as relevant as these two distinct orders are, the ethical and financial preoccupations intersect and can prove to be compatible.

It is still necessary to define the concrete methods that make up this form of investment and, even before that, the research sources and methodology necessary to the construction of these investment solutions.

This raises the following question: If ethical and financial value, without becoming mixed up, can be compatible across multiple asset classes, why does SRI remain a marginal form of investment? We need to lift the brakes on SRI development.

The main reluctance on behalf of investors is the hard-to-quantify nature of natural capital management and social benefits.

Despite what we know, both the macroeconomic (Human Development Index or green GDP) and the microeconomic indicators (extra-financial company evaluation) have large imperfections and remain significant areas for research: valorisation of biodiversity, extra-financial reportings, etc.
These imperfections represent even bigger obstacles in that, despite comparison tools or decision aids, financial models have become generalised as management instruments: quantitative management, benchmarked management, index management, etc.

Thus:
- many investors are extremely reluctant to change their methods for ethical and financial impacts that are difficult to quantify
- these difficulties in measurement also represent obstacles to the development of ambitious regulation favouring this form of investment.

> Even if the ethical and financial benefits of SRI approaches remain poorly quantifiable, it is clear that inaction will have much greater consequences!

These improvement issues and the harmonisation of extra-financial quality methods are therefore doubly important and it is undeniable that progress has to be made.

We can, nevertheless, regret that this technical argument is too often used by investors and regulators alike as grounds for not implementing the more voluntary initiatives.
Investment solutions do exist and their development can easily be favoured (reinforcing reporting obligations for issuers and investors, a European extra-financial rating agency, creation of sustainable bonds, etc.).
Even if the ethical and financial benefits of SRI approaches remain poorly quantifiable, it is clear that inaction will have much greater consequences!

It is now everyone's responsibility to face up to the new challenges ahead, to change our habits and actively participate in this growing movement and in this way speeding up:
- the improvement and spreading of good practices
- the benefical effects that we can expect on the sustainability of our development model
- and, ultimately, long-term yield.

Of course, management should also raise more awareness of sustainability topics amongst their clients and market institutions. This is what Mirova is striving to do.

Mirova's aim is to promote a range of investment products, all of which offer ethical solutions, and thus to participate in the development of sustainable investment. Mirova's purpose is perfectly in tune with the role one can legitimately expect from financial players: finance the real economy and contribute, through an active allocation of capital, promoting investments in the most promising long-term projects.

2 | The Mirova's approach

2 | 1 Different forms of responsible investment

In order to fully respond to the challenges of sustainable development, Mirova has developed a comprehensive range of complementary products and services in its determination to combine ethics with the requirement for performance.

Voting and engagement

Engagement is as much an essential part of responsible investment for companies as it is for market authorities, regulators and legislators. There are many reasons why it remains difficult to translate the challenges of sustainable development into strong investment decisions: complex changes in the decision process to be implemented, scepticism about the proposed solutions, and so on. **Yet, in our opinion, it is becoming more and more difficult for players in the investment chain to remain silent and indifferent when faced with these challenges.** Shareholder engagement seems necessary even if only as a reaction to different regulatory initiatives.

In more pro-active terms, we believe that the issues of sustainability and long-term financing of the economy have become major

challenges that require a certain positioning and a capacity, on the part of the most directly concerned players, to ask questions including those below.

- How to drive the long-term financing of future projects if, at the same time, regulation 'discourages' risk-taking.
- How to take into account sustainable development challenges if the reporting is not appropriately developed.
- How to implement innovative processes if 'sheep-like' behaviour is preferred, reinforcing the role of credit rating agencies that are anyway being vigorously criticised.

On all of these topics, financial players must be able to express themselves in organisations that are not perceived as instances of lobbying in defence of their short-term financial interests.
Today these instances are often somewhat vague and unstable and would benefit from being better structured.
They must be a source of proposals in order to improve sustainable practices:

- upstream – in terms of the organisation of the market itself
- downstream – by leading a constructive and honest dialogue with companies whose practices could be considerably improved on the matter.

Of course, this engagement also involves, for shareholders, an enlightened exercise of their right to vote according to a policy that integrates these sustainable challenges.

Infrastructure

To succeed in a new industrial revolution necessitates a profound change in our infrastructure, particularly in order to adapt them to the energy transition: more renewable energies, more decentralisation and network interconnectivity and more high environmental performance buildings to respond to the needs of an increasing population. The construction of infrastructure of heavy social use (schools, hospitals, etc.) is also a response to the task of improving well-being in our societies.

Whilst public debt levels are leading to rigorous management policies in developed countries, financing infrastructure requires innovative sources of finance, calling notably on private investors and savings.

Offering solutions in this matter addresses an underlying trend and brings concrete solutions to the challenges of sustainable development.

Impact investing

Some savers are looking to invest in small, non-listed structure which are able to show their capacity to create jobs and save CO_2 and so on. Indeed, for some investors, environmental and social benefits are the priority.

From solidarity savings in France to other national experiments and European initiatives, again, a trend is appearing for these responsible investments with high environmental and social increases in value.

> The SRI approach avoids certain high risks (such as tobacco industry process, oil tanker accidents or nuclear risks).

Listed equities

In listed equity funds, Socially Responsible Investment covers multiple aspects, and is often difficult for the general public, and even professionals in some cases, to understand.

We have put these different forms into 3 categories in the table below. For each investment category, we investigated their capacity to create financial and ethical value.

Given the issues with companies' reporting that will take time to improve, the measure of environmental or social benefit is within the qualitative analysis and must therefore be investigated.

Table 1: Different types of SRI investment

SRI process	Ethical value	Expected financial value
ESG engagement through a constructive dialogue promoting the improvement of ESG quality in its participation.	• Related to the significance of the engagement results. • Related to the complementarity between an ESG selectivity process in the absence of significant engagement results on high-risk ESG values. > *Requirement indicator* Absence of high ESG risk value(s) or significant engagement results on risk values present in the portfolios.	• In most cases, weak financial value because the process only allows limiting the potential ESG risks. • In certain cases, high financial value in the long term if the results obtained allow a real transformation of company business models driven towards sustainable development. *Please note* • Engagement results are of benefit to all investors. • Results are non-measurable as it is impossible to compare fund performance with what it would have been in the absence of engagement results.
ESG selectivity within a benchmark management, setting a minimum threshold of ESG quality below which a company is no longer eligible for investment.	• Related to the ESG quality of minimum and medium funds. > *Requirement indicator* Existence of sectorial biases compared to traditional indexes, high selectivity threshold on ESG quality.	• Potentially positive, but probably a lot more negative, because if the process avoids the potential ESG risks, it takes financially attractive investment opportunities away from the portfolio manager despite their weak ESG quality. • Weak or high amplitude depending on the selectivity threshold and therefore inversely correlated to ethical value. *Please note* • Results are specific to the investor. • Results are difficult to measure because it requires a comparison between a real portfolio and a virtual portfolio which would have been obtained without an ESG filter.
ESG themes at the core of fundamental management, looking to invest primarily in companies whose industrial projects are the most adequate to sustainable development challenges.	• Related to the ESG quality of minimum and medium funds. > *Requirement indicator* Presence of values in which the part of revenue (or investments) in adequate projects for the challenges of sustainable development is significant enough, and ESG risks are controlled.	• In most cases, strongly positive over a long investment cycle (8 years) as values are only selected if they offer an attractive valorisation potential, independently of their presence and weight on the benchmark, though potentially negative as dependent on performance compared to the chosen investment theme with reference to other possible themes. • Relatively high volatility. • Results are specific to the investor.

Source: Natixis AM.

Broadly, we achieved the results shown below.

We have chosen to favour a thematic management where only those companies are retained whose industrial projects are closely or strongly in accord with sustainable development challenges, and whose deep financial analysis reveals the potential for long-term valorisation.

> “The ESG quality of the value is then what is at the core of the portfolio manager’s generation of ideas, which allows them to define their investment universe in a positive manner.

In our opinion, this approach seems to provide the best hope for the financial and ethical creation of value. It is complemented by a review of CSR quality and an engagement process with a view to favouring a diminution of residual ESG risk. The ESG quality of the value is then what is at the core of the portfolio manager’s generation of ideas, which allows them to define their investment universe in a positive manner. The portfolio manager can then involve themselves, without any benchmark constraints, in the values offering the best potential in terms of valorisation.
This choice is completely freed from a benchmarked ESG management where the ‘filter’ has a tendency to be seen as a constraint that prevents following the index, or denies eligible values that offer otherwise attractive financial profiles.

Like all core management processes, this kind of process requires both a high level of confidence in the management company’s capacity to generate alpha and the ability to accept a relatively high volatility in relation to traditional benchmarks.

Listed bonds

In bond funds, the engagement capacity linked to the creditor status is weak and therefore poorly implemented.

Furthermore, the capacity to create financial value by adopting a thematic style is weak, due to the nature of a bond itself, which ultimately is either:

- repaid at par
- or worth its recovery value in the event of a default.

Thus, there is hardly any valorisation potential to expect from good behaviour on behalf of the chosen investment theme.

In contrast, the SRI approach avoids certain high risks (such as tobacco industry process, oil tanker accidents or nuclear risks). A high ESG selectivity could be more easily absorbed by other performance drivers such as duration management, geographical and sectorial allocation and the allocation of asset subclasses.

In this asset class, therefore, we believe that a good compromise between ethical and financial value is that of a selectivity rate that supports sectorial biases for companies or geographical areas for the countries in terms of ESG risks.

Furthermore, this ‘ESG constraint’ will rely less on the capacity to perform (the frequency of oil spillages and nuclear accidents is limited) since the capacity to intervene in terms of BBB/BB ratings (generally offering a good risk-return compromise) will be flexible.

We stress that it is desirable that sustainable bonds develop in the same manner as certain bonds issued by the World Bank and, more recently, by some French regional communities. The funds raised by the bond are spent on specific projects with high socio-environmental value.

This type of bond would be particularly welcomed on behalf of the countries. Indeed, besides countries with high governance risks, implementing an ESG selectivity per country seems highly debatable. Such issues bring us on to the notion of ‘impact investing’.

FOCUS ON LISTED EQUITIES

Research at the core of the generation of ideas

For these approaches, it is necessary to understand the challenges of sustainable development that are often new, complex and controversial. To be able to understand them, identify trends and judge the adequacy of practices for these challenges therefore requires new expertise and innovative processes.

Understanding complex challenges

A good understanding of challenges primarily requires access to academic and fundamental research. Though some believe that this research is in the public domain and demands nothing but careful reading, in our opinion it is extremely important as practitioners to establish a close link with a research centre.[6]

Indeed, the complexity of numerous topics covered and the abundance of literature require a direct dialogue with experts in order to access the most pertinent information. This approach becomes a reality through the writing of reviews and summaries following advances in thinking and technological innovations. Our analysis of the challenges of sustainable development is therefore extended by specific studies about the challenges or about particular technologies (see our studies on the electric vehicle or shale gas, for example).

Identifying sustainable investment themes

We have identified the sustainable development challenges (see the section entitled 'ESG issues') divided into main sectors of activity, in order to better target the technologies, products and services that address the challenges of sustainable development.

This knowledge is used to our direct advantage in terms of investing in real assets or listed/private specialised companies. It is also used as a basis for identifying the most relevant companies that develop a range of products and services for a diverse client base.

Choosing a 'relative' approach with an 'absolute' requirement

Up to now, the world of SRI has been based around two main types of approach:

- **'Exclusion' approaches** that choose to not invest in certain controversial sectors such as tobacco, alcohol or weaponry.
- **'Best-in-class' approaches** that aim to identify the best CSR practices for each sector, without applying sectorial biases. The idea behind this approach is that the objective of sustainable development is to encourage each sector to make progress, without excluding any of them.

Today, we are convinced that these approaches are inadequate. If sectorial exclusions can be qualified as dogmatic, we believe it to be just as dogmatic to consider that all sectors are equal. The analysis must be objective and if evidence shows that certain sectors are more exposed in terms of risks or, on the contrary, benefit from opportunities, it seems to us absurd not to accept these conclusions.

Therefore, we chose an analysis which compares the challenges and practices per sector, but with some absolute requirements.

(6) Mirova has established a partnership with Cambridge University.

Table 2: Sustainable development challenges by investment theme

	Sustainable development challenges						
	Environment				Social		
	Climate change	Pollution	Resources	Biodiversity	Fundamental freedoms	Right to health	Right to development
Sustainable energy	■	■	■	■	■	■	■
Sustainable mobility	■	■	■		■	■	■
Sustainable buildings and cities	■	■	■	■	■	■	■
Sustainable consumption	■	■	■	■	■	■	■
Sustainable health		■	■		■	■	■
Sustainable ICT	■	■	■		■	■	■
Sustainable finance	Essentially indirect impacts						
Sustainable resources	■	■	■		■	■	■

■ Strong opportunities and/or risks ■ Significant opportunities and/or risks ■ Weak opportunities and/or risks

Source: Natixis AM.

For the environmental and social challenges, our analysis methodology consists of:

- **finding existing business opportunities** that provide solutions to sustainable development challenges
- **evaluating risk exposure throughout the life cycle of the company's products and services** (from extraction of raw materials to the end of the product's life)
- **identifying levers to reduce risk at each of these stages**.

Beyond this approach to the social and environmental challenges, we are also looking in financial terms for 'quality' companies offering medium-term valorisation potential. This analysis is enriched by a governance analysis that acts as a link between the financial and the sustainable development elements.

Research that associates both internal and external competencies

Implementing this methodology requires significant internal means. Indeed, we believe that there are currently no research providers capable of providing this turn-key absolute analysis on a global basis. We have therefore implemented a process that requires both our internal and external resources.

We have developed 8 sustainable investment themes that correspond to the fundamental needs of our societies:

Figure 2: Sustainable investment themes

Each of these topics is followed by a thematic group made up of internal financial analysts, portfolio managers and ESG analysts. These groups are primarily looking to define business models that seem the most suited to provide solutions to the challenges of sustainable development through their offer of products and services (see the 'Sustainable themes' identified by Mirova). Carrying out this type of work is a dynamic process that progressively integrates company advancements, exchanges with the scientific community, and so on.

On the basis of this analysis, we prioritise the most promising investment cases based on both the financial and the ESG aspects. In particular, our process strongly depends on external financial analysts from stockbrokers who generally tend to follow a limited number of companies for many years. These analysts therefore have an in-depth knowledge of business models.

This first screening is followed by a full internal analysis of financial and ESG opportunities and risks in order to retain the best investment ideas. This internal analysis is mainly based on contact with various different stakeholders, including direct access to management.
Besides this generation of ideas, that continuously evolves, these thematic groups follow the evolution of investments that have already been made.

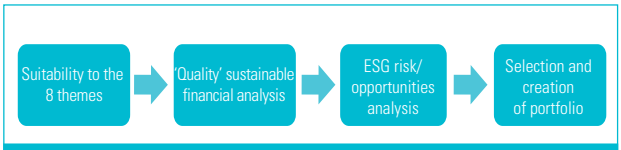


Figure 3: Stages of the listed equities investment process

This approach offers many advantages:

- it avoids the risk of being limited to the restricted universe of large European companies that are close to us and that we have been used to following
- it also limits informational biases by using analysts who work closely with management teams (large companies tend to communicate more than the smaller ones)
- last but not least, this approach allows us to get the best out of our resources, which are by nature limited, and to benefit from an analysis of the whole range of financial and extra-financial aspects, whilst being driven towards the objective of our clients: namely, to identify the winners of tomorrow in order to best manage their savings.

Short term thinking won't take you very far.

A financial industry out of touch with economic, ecological and social realities has no future.

That is why our investment decisions are motivated primarily by the industrial strategies of the companies we back. Our experts perform extensive analyses of sustainable business models that are engines for growth, employment and innovation, shaping the world of tomorrow.

Mirova is the Responsible investment division of Natixis Asset Management.

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ESG ISSUES
ENVIRONMENTAL SOCIAL GOVERNANCE

For Mirova, offering an engaged investment management committed to combining value creation and sustainable development obviously begins with extra-financial research and the integration of ESG (environmental, social and governance) criteria in portfolio management. But it must go much further.

The analysis of corporate social responsibility (CSR) thus requires a review of ESG issues as well as a financial analysis.

Mirova's philosophy is based on the conviction that integrating sustainable development issues can provide investors with responsible solutions.

FIGHTING CLIMATE CHANGE

1| Climate change and its implications

The scientific community estimates that it is 90% likely that human activities impact climate. The consequences of this can already be seen: an increase in the number of heat waves, ice melting in the North Pole, etc. Increased global warming also contributes to this trend: more drought, extinction of species, lower yields, increased coastal flooding, migration of tropical illnesses towards lower latitudes, and more.

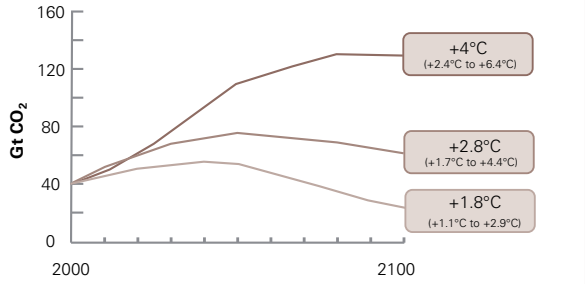
There are two possible types of action to be taken to limit the impact of climate change. Firstly, implementing mitigation strategies in order to reduce emissions and thus decrease the magnitude of climate change:

- We must change our energy consumption habits which represent around ⅔ of greenhouse gas emissions. Besides being an important contributor, our energy consumption is ever increasing, and 80% of it is still made up of fossil fuels (coal, oil, gas). Making this transformation will require major efforts from numerous sectors such as electricity production, transport, buildings and industry.
- We must also halt deforestation, which, through the removal of carbon sinks is responsible for almost 20% of climate change. This issue, which mainly affects the Amazon and forests in equatorial Africa and South East Asia, has numerous causes such as the conversion of forests to agricultural areas or pastures, and illegal logging.
- It is also essential to rethink our agricultural production methods which are currently responsible for around 15% of greenhouse gas emissions. In fact, the growing use of fertilisers in farming has resulted in a high potential contribution of greenhouse gas emissions to global warming (methane, nitrogen oxide).

Reducing emissions has to be a priority. Even if the amount currently invested in this seems high, the cost of inactivity will be much higher. However, even with important reduction efforts, some climate change is inevitable.

Secondly, therefore, specific adaptation strategies will need to be implemented to mitigate certain effects: protection of water resources, drought-resistant cultures, installation of breakwaters, and relocation of activities, among others.

Figure 1: Impact of different emission scenarios on the rise in temperature



Source: IPCC, 2007.

2| Climate change in business

Action plans to decrease the magnitude of global warming can take various forms, depending on the activity of the company. The following are amongst the most commonly used strategies:

- **Reduction of direct emissions.** All businesses can make a difference by reducing their direct emissions. This subject is particularly appropriate for large emitters, such as electricity utilities, cement and steel companies, refineries, papermakers or glassmakers. Implementing reduction strategies is necessary if they are to comply with, and anticipate, regulatory restrictions, or even to differentiate themselves from their competitors from the point of view of a client, the government or other stakeholders.
- **Solutions enabling the reduction of energy-related emissions.** Equipment suppliers to the sectors that emit the most, such as electricity production, transport, buildings or industry must seize the opportunity to offer innovative solutions to reduce their clients' emissions. For example, a construction group could offer low-consumption building solutions, allowing the company to differentiate itself from the rest whilst anticipating the evolution of thermal regulations.
- **Development of sustainable agriculture.** Companies involved in agricultural activities equally have a key role to play, especially in the fight against deforestation, and the reduction of agriculture-related emissions. For example, controlled-release fertiliser solutions would maximise yield and reduce the need for more cultivated land, while also reducing the overall need for fertiliser.

The issue of adaption will also affect businesses, but in the long term and in a more indirect way. The fight against drought, or the construction of dikes and floodgates will no doubt require the involvement of the private sector. Although some companies offer solutions that address these issues (i.e. irrigation and water management), very few offers are, at the moment, presented as comprehensive responses.

KEY FACTS ////////////////////////

- The average temperature could increase by 2–6°C between now and the end of the century. By way of comparison, around 20,000 years ago when the global temperature was 5°C less, Northern Europe was completely covered by a glacier.[1]
- The hottest 13 years since 1850 have been during the last 15 years. [2]
- The melting of the North Pole ice cap reached a record high in September 2012 when its surface area was almost half the average it had been between 1979 and 2000.[3]
- If a reduction in CO_2 emissions could be limited to a cost of 1% of global GDP, inactivity could lead to much higher estimated costs of up to 20% of global GDP.[4]

(1) IPCC, 2007, Review of climate change. • (2) World Meteorological Organization, 2012, Press Release No. 942. • (3) National Snow and Ice Data Center, 2012, Arctic sea ice shatters previous low records; Antarctic sea ice edges to record high. (4) • Stern N., 2006, The Economics of Climate Change.

POLLUTION CONTROL

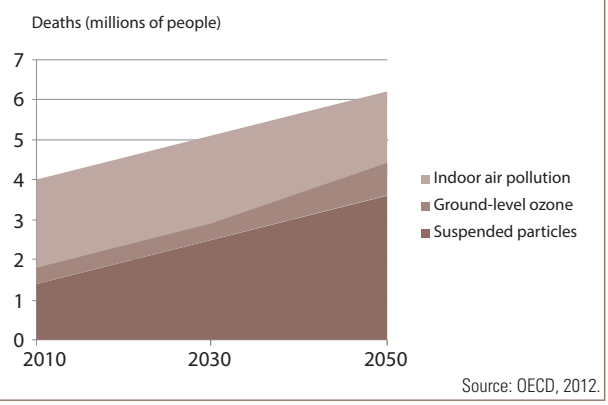
1| Definition and implications

The French chemist Lavoisier once said, 'Nothing is lost, nothing is created, everything is transformed.' From the copper in our mobile phones, to the carbon in plastic packaging, or even the nitrogen in fertilisers, everything is dispersed and diluted, not only into the air, but also into the water and the ground. The Earth possesses natural mechanisms, such as the carbon or nitrogen cycle, to recycle chemical elements. However, our way of life and the growth in population have led to increasing exchange volumes and, therefore, the saturation of these bio-degradable capacities. There are concrete illustrations of this issue: the accumulation of mercury in fish, sulphur emissions that cause acid rain, oil spills that damage ocean life, or excess nitrogen from fertilisers that leads to the overabundance of green algae which is harmful to the development of certain species.

We regard 'pollution' as any degradation of the natural balance caused by the introduction of substances through human activity, particularly if they are harmful. Pollution can be chemical, biological, electromagnetic, bacterial, thermal, radioactive or genetic in origin. Above a certain threshold, pollution can become toxic and harm human health: chronic cadmium poisoning, abnormalities in new-born babies due to radioactivity or dioxins, and so on.

As a result of growing environmental awareness over the second half of the 20th century, numerous types of pollution harmful to human health have been identified, understood and subsequently reduced. Some policies led to bans on easily isolated substances such as lead present in car fuel, because of its human toxicity, and CFC gases, destroyers of the ozone layer. However, society is far from resolving its pollution issues.

Figure 2: Global premature deaths linked to environmental risks with no new policy development before 2050



Source: OECD, 2012.

2| The role of business in the control of pollution

Public authorities have implemented tools to re-internalise the negative externalities of pollution based especially on the 'polluter pays' and precautionary principles. While companies should at least comply with these regulatory requirements, they can also play a more proactive role in reducing pollution. There are numerous approaches using the principle of the 'circular economy' that can reinvent industrial ambitions by reducing, recycling and reusing material and energy flows.

For example:

- **Promotion of eco-conception** in the planning phase of products, considering and reducing the environmental impacts on the whole life cycle. This lever requires innovation and collaboration throughout the whole value chain.
- **Collecting, sorting and recycling waste**: utilities can offer these traditional services to communities, but specialised players can also play a part in recycling waste, for example with the anaerobic digestion of agricultural manure and slurry (muds) or the use, in cement manufacturing, of blast-furnace waste from steel-making.
- **Development of industrial pollution treatment activities** such as equipment specialising in measuring, controlling or filtering liquid and solid toxicities from water.

KEY FACTS ////////////////////

- Industrial pollution is as damaging to health as malaria.[5]
- One litre of spilt oil can spread over a surface area of **1,000 m²** of water, cutting off the oxygen supply to fauna and flora for several years.[6]
- It is estimated that, each year, several million tons of plastic waste end up in the oceans.[7]
- Every year, the largest multi-national mining companies spill more than **180 million** tons of hazardous mine waste into rivers, lakes and oceans.[8]
- The financial cost of pollution from the 3,000 biggest companies in the world equates to **1,600** billion euros.[9]

(5) Blacksmith Institute Green Cross Switzerland, 2012, The World's Worst Pollution Problems: Assessing Health Risks at Hazardous Waste Sites. • (6) ADEME, A chaque déchet des solutions: huiles minérales et synthétiques entières usagées. • (7) UNEP, Distribution of Marine Litter. • (8) Earthworks MiningWatch Canada, 2012, TROUBLED WATERS – How Mine Waste Dumping is Poisoning our Oceans, Rivers, and Lakes. • (9) UNEP FI / Trucost, 2010.

PRESERVATION OF RESOURCES

1| Definition and implications

Whether they are renewable (such as agriculture, forestry, water) or non-renewable (fossil fuels, i.e. oil, gas, coal, metals), resources are either limited or not renewed fast enough to sustainably provide for our needs.

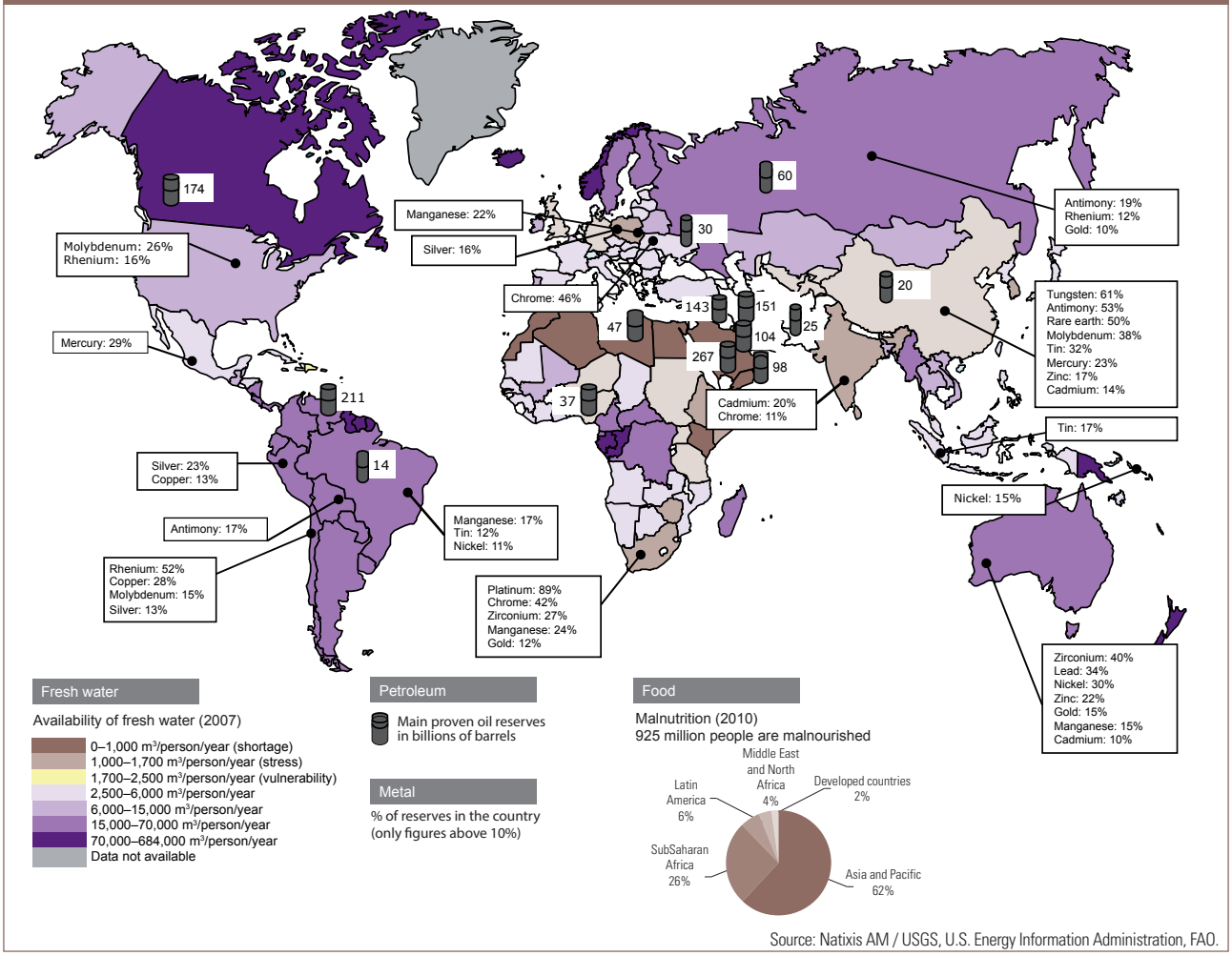
Based on current consumption habits, most estimates reckon the majority of energy and mining reserves to be sufficient for less than 100 years. Indium, tin, zinc and gold resources, among others, are all going to diminish rapidly. Numerous experts now agree on the idea of a peak in oil production occurring before 2030.

Beyond the aspect of depleting resources, the technical demands of increasingly complex extractions make oil and mining deposits more and more energy intensive.
Current freshwater resources are around 18,500 litres per person per day. With demographic growth and increased consumption, (agriculture, industry, and so on), forecasts estimate that available world resources per inhabitant will decrease and dangerously approach the threshold defined by the United Nations Environment Programme (around 7,000 litres/inhabitant/day).

Another resource to consider is arable land that may not be sufficient to ensure the food security of an estimated population of 9 billion individuals in 2050, whilst at the same time preserving biodiversity.

At this stage, alternative solutions are still limited: renewable energies and energy efficiency for fossil fuels, recycling and substitution for scarce metals, or improving yields through sustainable agricultural practices such as irrigation, fertilisation and crop protection.

Figure 3: Availability of world resources (water, petroleum, food and metals)



Source: Natixis AM / USGS, U.S. Energy Information Administration, FAO.

PRESERVATION OF RESOURCES

21 The role of business in the preservation of resources

The ambition of these economic players must be reoriented towards a circular economy. All these businesses can incorporate a means of reducing their strong dependency on limited resources into their strategies: eco-conception, industrial ecology, valorisation of by-products and function-oriented business models are all interesting concepts that respond to the challenge of preserving resources. The resources mentioned represent the raw material of all activities. So much so that all sectors can be more or less affected by resource management.

- **Sectors with a direct link include:** agriculture, metals and mining, oil companies, pulp and paper producers, recycling companies and water distribution services.
- **Sectors more indirectly affected include:** transport (car dependency on petrol and steel), consumption (dietary habits guiding agriculture or fish farming) and Information and Communications technology.

KEY FACTS //////////////////////

- If developing countries were to match Western living standards, the population's ecological impact in 2050 would be equal to **72** billion inhabitants.[10]
- **1.5** Earths would be necessary to satisfy the current needs of humanity.[11]
- Metals with global reserves of less than **30** years: indium, antimony, palladium, lead, gold, tin, zinc, chrome, silver and molybdenum.[12]
- Although conventional oil production peaked in 2005, **98%** of road transport still relies on oil.[13]
- **13** million hectares of forest are destroyed each year.[14]

(10) Jared Diamond, 2008: What's your consumption factor? • (11) Global Footprint Network and WBCSD, Vision 2050, 2010. • (12) USGS, 2012. • (13) IFP, 2009: French document on the advantages and disadvantages of energies for transport. • (14) FAO, 2010: World deforestation decreases, but remains alarming in many countries.

PROTECTING BIODIVERSITY

1| Biodiversity and its implications

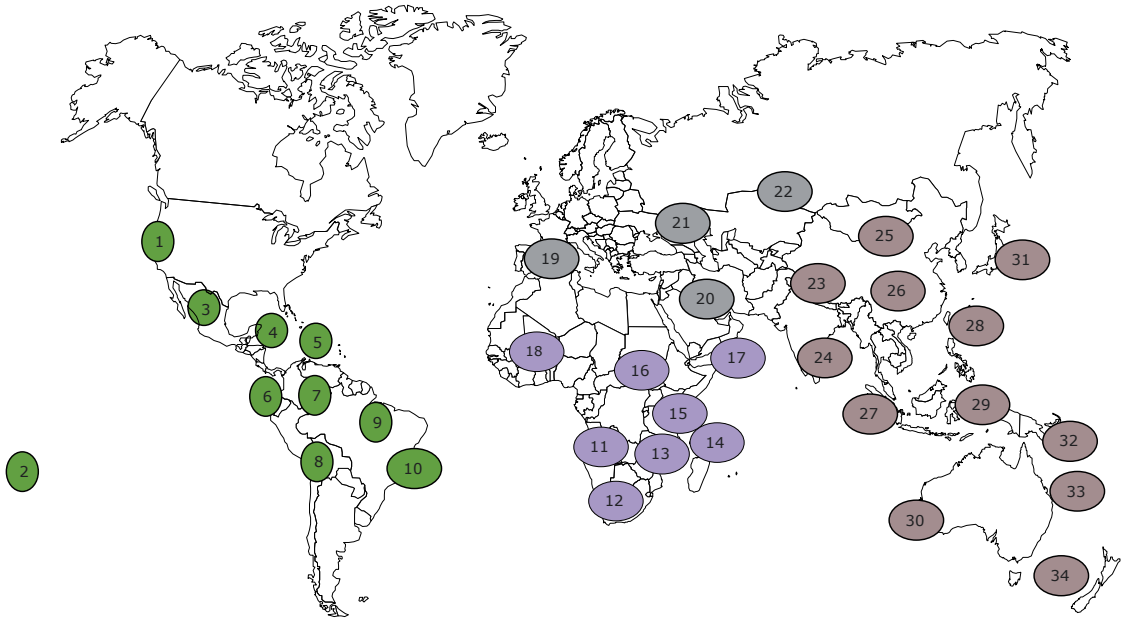
Biological diversity, also known as biodiversity, encompasses the number, variety and variability of living organisms and the range of ecosystems in which they live and interact. Beyond the ethical implications, preventing a loss of biodiversity is important since our society is completely reliant on the natural richness of the planet for food, energy, raw materials, clean air and clean water.

Over the past decades, biodiversity has been lost at an alarming rate due to deforestation, climate change, pollution, unsustainable harvesting of natural resources, and the introduction of so-called 'alien species' to areas where they are not native. The International Union for Conservation of Nature (IUCN) says that the current rate of extinction may already be as high as 10,000 times the natural rate – an estimated one in four mammals, one in three amphibians, and one in eight birds are threatened with extinction. A reduction or loss of biodiversity may undermine, not only the environment, but also economic and social goals. *The Economics of Ecosystems & Biodiversity* (TEEB), a global UN study, judged that economic loss may add up to US $2–4.5 trillion per year due to the ongoing losses of biodiversity and the degradation of ecosystems.

Effectively protecting sensitive ecosystems and managing protected areas form a major part of the solution to this extinction crisis and to decreasing economic cost. The 1992 Convention on Biological Diversity was the first legally binding treaty to recognize that biodiversity is 'a common concern of humankind'. In 2010 the UN declared the period from 2011 to 2020 as the 'UN Decade on Biodiversity' and set various related targets, such as preventing the extinction of known threatened species and conserving at least 17% of inland water, and 10% of coastal and marine areas. It also includes keeping pollution and the impact of the use of natural resources within safe ecological limits and ensuring agriculture, aquaculture and forestry, among others, are managed sustainably.

Figure 4: The 34 biodiversity hotspots

A biodiversity hotspot is a defined as a geographical region that contains at least **1,500 endemic plant species** and has lost at least **70% of its primary vegetation.**



1. California floristic province
2. Polynesia and Micronesia
3. Madrean pine-oak and woodlands
4. Mesoamerica
5. Carribean Islands
6. Tumbes-Chocó-Magdalena inc. the Galapagos Islands
7. Tropicales Andes
8. Valdivian rain forest
9. Cerrado
10. Atlantic forests
11. Succulent Karoo
12. Cape Floral Kingdom
13. Maputaland-Pondoland-Albany
14. Madagascar and the Indian Ocean Islands
15. Western Africa coastal forests
16. Eastern Afromontane
17. Horn of Africa
18. Guinean Forest of West Africa
19. Mediterranean Basin
20. Iran and Anatolia
21. Caucasus
22. Mountains of Central Asia
23. Himalayas
24. Western Ghats and Sri Lanka
25. Mountains of Southwest China
26. Indo-Burma
27. Sundaland
28. The Philippines
29. Wallacea
30. South West Australia
31. Japan
32. Eastern Melanesian Islands
33. New Caledonia
34. New Zealand

Source: OECD, 2012.

PROTECTING BIODIVERSITY

21 The role of business in the protection of biodiversity

When exploring natural resources, companies can perform their activities mindful of damaging impacts on biodiversity. As both prevention and cure are important, corporations should assess the potential effects of their activities on local biodiversity prior to the initiation of a new site, and should have mechanisms to address accidents such as spills. These elements are an integral aspect of our investment process.

Beyond the impact on biodiversity of climate change and pollution, certain industrial activities can have direct impacts on biodiversity, such as:

- **Dams and their reservoirs:** In order to construct dams, utility companies must regulate river flows and flood river banks and plains to build reservoirs. In fact, the world's 40,000 existing reservoirs cover a total area in excess of 500,000 km^2. Thus, while dams provide a cleaner alternative as an energy source, beyond their impact on local communities, they also result in environmental disturbance. They can block the movement of migratory fish and change the temperature, oxygen conditions and nutrients in the water, all of which directly impact species' ability to adapt to their environment.
  Utility companies can mitigate such risks by a range of actions, including by avoiding the construction of dams in areas rich in biodiversity, by facilitating the migration of river species, by maintaining natural seasonal river flow cycles and by sustaining water quality.

- **Sailing ballast:** Each year about 10 billion tonnes of ballast water, used in vessels for stability, are transported and exchanged around the world. Deballasting operations involve the discharge of waste water, which contains exotic and often invasive species, causing negative impacts on the local marine environment. It is important that marine transportation companies use filtration, ultraviolet or other effective ballast water treatment to ensure a only minimum of invading alien species.

KEY FACTS //////////////////////

- In 2010, nearly two-thirds of the globe's ecosystems were considered degraded as a result of damage, mismanagement and a failure to invest in their productivity.[15]
- The 2008 Red List of Threatened Species states that **1.8** million species out of an estimated **13** million have been described as endangered.[16]
- According to some estimates, projected loss of ecosystem services could increase the risk of famine, due to a loss of up to 25% of the world's food production by 2050.[17]
- Ecosystems, from forests and fresh water to coral reefs and soils, deliver essential services to mankind estimated to be worth over USD **72** trillion a year – comparable to World Gross National Income.[18]
- In 2010, 20 targets were set in Nagoya to preserve biodiversity. The costs of implementation were estimated at between 60 billion and 150 billion euros.[19]

(15) UNEP, 2012, Ecosystem Restoration Conference of the Parties to the Convention on Biological Diversity. • (16) UCN, 2008, Wildlife in a Changing World : An Analysis of the 2008 IUCN Red List of Threatened Species. • (17) UNEP, 2009, The Environmental Food Crisis The environment's role in averting future food crisis. • (18) UNEP, 2010, Dead Planet, Living Planet Biodiversity and Ecosystem Restoration for Sustainable Development. • (19) European Commission, 2011, Our life insurance, our natural capital : an EU biodiversity strategy to 2020.

FUNDAMENTAL FREEDOMS

1| Fundamental freedoms: a core element of human rights

Fundamental human rights are indivisible and almost impossible to prioritise due to the fact that they are all interconnected. However, as Amartya Sen perceives in his 'capabilities approach', there are certain core rights and freedoms that are essential to the dignity and development of mankind.[20] As a whole, these rights can be grouped under the concept of fundamental freedoms.

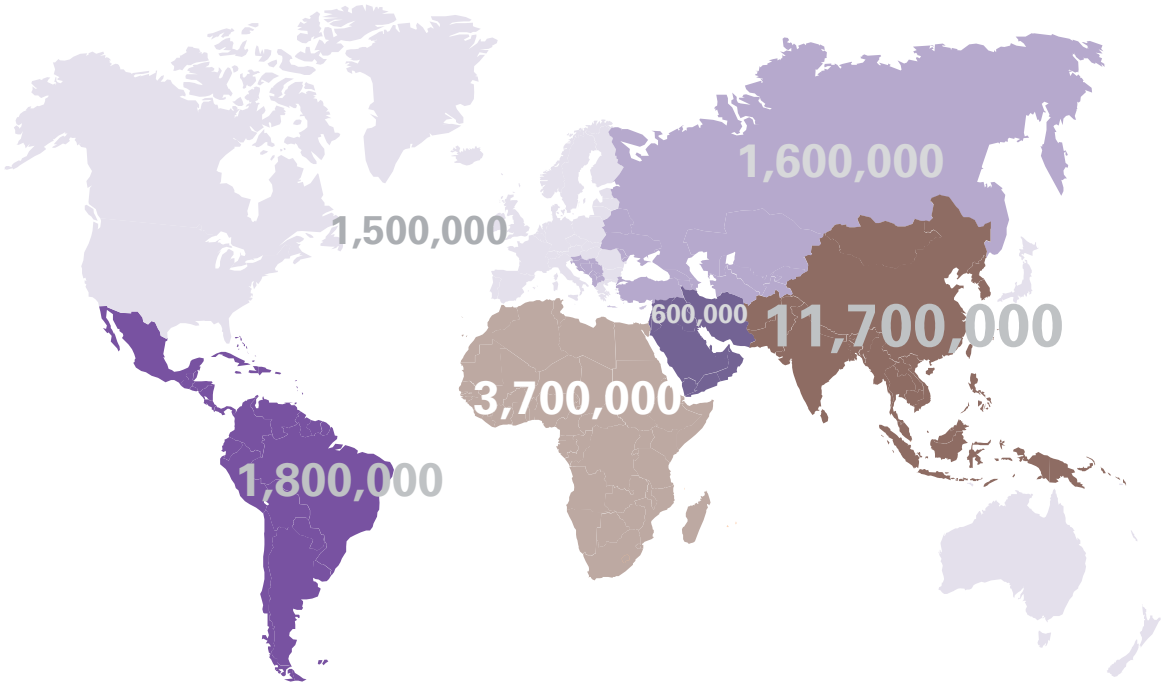
It is first and foremost important to protect the physical and moral integrity of every individual: this includes the right to life, humane treatment, freedom of choice and equal treatment. Thus, any form of endangering others, such as enslavement, forced labour or degrading conditions, constitutes a direct attack on a person's fundamental freedoms.

Major international standards protect all groups that are particularly vulnerable (including ethnic or religious minorities, women, children, people with disabilities, and indigenous groups). Child labour and all forms of discrimination therefore violate fundamental rights.

Other aspects, such as the freedom of association and the right to collective bargaining, are also essential for the protection of other fundamental rights. Freedom of opinion and expression, the right to information and respect for one's private life are, in turn, part of the fundamental freedoms in the sense that they are essential gateways to the individual's fulfilment and the development of the person's capabilities.

(20) The concept of capabilities was created by Amartya Sen, Indian economist and winner of the 1998 Nobel prize for economics. Through this concept, Sen states that individual well-being is no longer measured by usefulness, but by the freedom to choose the type of life which the individual wishes to lead.

Figure 5: Number of victims of forced labour by region



Source: ILO, 2012.

FUNDAMENTAL FREEDOMS

21 The role of business in respecting fundamental freedoms

Fundamental freedoms must, above all, be protected by national governments, but companies also have a significant role to play. John Ruggie[21] outlines, in his *Guiding Principles*, published in 2011, that businesses have a duty to protect these rights, and to provide remediation to any violation, by implementing effective measures.

These principles clarify obligations on businesses. On the one hand, the principles define the minimum scope of human rights to respect, i.e. those that make up the basis of the Universal Declaration of Human Rights, the two associated Covenants,[22] and the eight core ILO Conventions. On the other hand, they highlight the direct responsibility of businesses, over and above that of government.

The exposure of businesses to fundamental issues of freedom varies strongly according to both their sector of activity and their geographical location. In terms of a CSR (Corporate Social Responsibility) company analysis, it is necessary to understand how the company can offer solutions to address these issues and evaluate the way in which risk exposure is managed. This analysis looks at each stakeholder in the area of responsibility: employees, suppliers and subcontractors, clients and local populations.

To ensure the respect and promotion of fundamental freedoms, it is necessary to review a number of aspects. For example:

- **Working conditions, particularly in the supply chain:** risks of exploitative working conditions (such as forced labour, child labour or unsuitable conditions) are high up in the value chain, particularly when suppliers and subcontractors are working in developing countries, notably in the textile and food sectors. The aim of a CSR analysis is therefore to examine preventative measures in place (such as charters and training) as well as audit controls and recovery measures in the event of bad practice (including complaint mechanisms for employees, controversy reviews which have taken place and corrective measures).

- **Respect for freedom of association and collective bargaining:** the freedom of Trade Unions is generally well respected in countries where regulations are strict on the matter (essentially Europe), but they are, however, often ignored in less legally restricting zones (including the United States and emerging countries). The CSR analysis therefore examines the measures in place to ensure that fundamental freedoms are respected and promoted across all of a company's geographical locations (e.g. signature of international framework agreements). It also seeks to examine potential bad practices, such as anti-union campaigns, intimidation and unfair dismissal.

These examples illustrate a few aspects of an analysis of companies' respect for fundamental freedoms, but the list is by no means exhaustive. The analysis is based around diverse criteria for each stakeholder in a particular area of responsibility (for instance, non-discrimination, or the protection of clients' private information).

(21) J. Ruggie is the UN Secretary General in charge of the issue of human rights in business. In 2011, he published a set of 'Guiding Principles' to implement a 'Protect, Respect and Remedy' framework for human rights endorsed by the UN Human Rights Council. • (22) International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.

KEY FACTS //////////////////////

- **215 million children work globally**, many full-time.[23]
- **21 million victims of forced labour worldwide – 3 people out of every 1,000** are therefore trapped in a job into which they were forced by coercion or trickery, and from which they cannot escape.[24]
- **34 countries** have not ratified the ILO regarding the right to association and **15 countries** have not ratified the anti-discrimination convention.
- **80%** of the world's population live in regions where **freedom of press is not fully respected.**[25]

(23) ILO website, 2012, http://www.ilo.org/global/topics/child-labour/lang--en/index.htm#a3. • (24) ILO, June 2012, http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_182005/lang--en/index.htm. • (25) Freedom of the Press, 2012, Freedom House, http://www.freedomhouse.org/sites/default/files/Booklet%20for%20Website.pdf.

THE RIGHT TO HEALTH

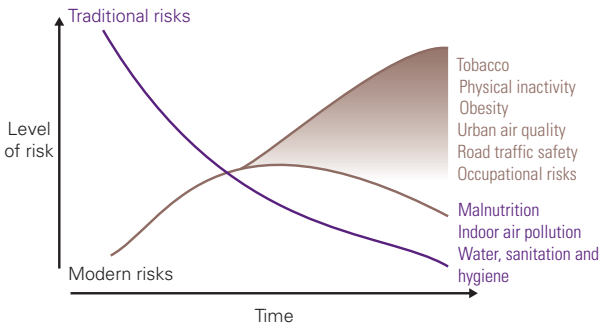
1| The right to health, one of the basic themes of the concept of Human Development

The right to health is enshrined in numerous international and regional instruments on human rights and, more significantly, in the Universal Declaration of Human Rights.[26] It is also stated in the constitution of most countries, and is one of the UN's Millennium Development Goals. As a fundamental human right, health is an essential pillar for development. A development that is sustainable and goes beyond the economic factors by taking into account key issues such as health and longevity. This can be witnessed from the creation of the Human Development Index or the measuring of economic performance or social progress such as that of the Stiglitz Commission.[27]

The right to health covers many aspects including the existence of health services, equitable access to health care for all, a safe and healthy working environment and a healthy diet. However, a significant proportion of the global population do not benefit from these rights, which are vital to a respectable level of human development.

It is a fact that almost 20% of the world's population does not have access to basic health care, that millions of fatal accidents occur in the workplace each year, and that 1.4 billion adults are overweight or obese.

Figure 6: Evolution of main health risks



Source: OMS, 2009, *Global health risks, mortality and burden of disease attributable to selected major risks.*

2| The role of business in respecting and promoting the right to health

As a fundamental human right, the right to health must primarily be protected by national governments, but companies also have a significant role to play. In his *Guiding Principles*, published in 2011, John Ruggie outlines that businesses have a duty to protect these rights, and to remedy any violation by implementing effective measures.

These principles clarify obligations on businesses. On the one hand, they define the minimum scope of the human right to respect, i.e. those that make up the basis of the Universal Declaration of Human Rights, the two associated Covenants,[28] and the eight core ILO Conventions. On the other hand, they highlight the direct responsibility of businesses, over and above that of government.

The exposure of businesses to health issues varies strongly according to both their sector of activity and their geographical location. In terms of a CSR company analysis, it is necessary to understand how the company can offer solutions to address these issues and evaluate the way in which risk exposure is managed. This analysis looks at each stakeholder in the area of responsibility: employees, suppliers and subcontractors, clients and local populations.

To ensure the respect and promotion of the right to health, the following aspects must be reviewed:

- **Health and safety in the workplace:** employees and subcontractors in certain activities, such as construction or the extractive industries, are susceptible to significant health and safety risks, (e.g. increased accident rate and exposure to toxic substances leading to potential occupational diseases). The aim of a CSR analysis is therefore to examine the main sources of risk, and evaluate management systems and the results obtained (such as improved indicators). The prevention and management of psychosocial risks also feature in this section of the CSR analysis.

(26) Article 25.1 of the UDHR. The Right to Health is also mentioned in Articles 7.b and 12 of the related Covenants on Economic, Social and Cultural Rights. • (27) The Commission on the measurement of economic performance and social progress was created at the beginning of 2008 under a French government initiative.

(28) International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.

THE RIGHT TO HEALTH

- **Development of products to address health issues:** due to the nature of their activities, certain companies in particular are in a position to provide solutions to some health-related issues. For example, pharmaceutical groups can favour access to medicine for all, especially in emerging countries (such as flexible prices or skills transfer). As for the food sector, companies can contribute to a more healthy diet, particularly by reformulating their products (reduced sugar, salt and saturated fatty acids). In this respect, the CSR analysis seeks to identify the best positioned players in the domain and, similarly, those whose products could be harmful to human health.

- **Protection of local populations:** certain activities can have direct impact on the overall health of local populations. For example, extractive industries are a particular nuisance for the surrounding communities (dust emissions and air/water pollution, for instance). It is therefore necessary to evaluate preventive measures (e.g. filtration mechanisms), consultation arrangements and even remedial measures in the event of an increased number of complaints. A controversy review is systematically carried out for strongly exposed sectors.

These examples illustrate a few aspects of the respect and promotion of the right to health analysis by companies, but the list is by no means exhaustive. The analysis is based around diverse criteria for each stakeholder in the area of responsibility.

KEY FACTS //////////////////////

- More than **2.3 million** deaths each year are caused by **accidents at work or occupational diseases.**
- Around **20% of the global population** does not have access **to basic health care.**[29]
- **6.9 million children** under the age of 5 **died in 2011,** 58% of them from infectious diseases.[30]
- **2.8 million people die e**ach year as a result of being **overweight** or **obese.**[31]

(29) OECD, August 2005, Private Health Insurance for the Poor in Developing Countries?, http://www.oecd.org/dev/35274754.pdf • (30) WHO, 2011, http://www.who.int/gho/child_health/mortality/mortality_under_five/en/index.html • (31) WHO website, 2012, http://www.who.int/features/factfiles/obesity/en/index.html.

THE RIGHT TO DEVELOPMENT

1| Improving quality of life and access to education, cornerstones of the development of 'capabilities'

Access to a decent standard of living is one of the core fundamental human rights, and poverty eradication is a UN Millennium Development Goal. The Universal Declaration of Human Rights and the International Covenant on Economic, Social and Cultural Rights thus emphasise the right to basic products and services ('food, clothing, housing, medical care and necessary social services'), the right to employment, decent and fair remuneration, social welfare and physical and intellectual property. However, more than a billion people across the globe are still living on less than $1.25 per day,[32] 925 million suffer from malnutrition[33] and 100 million have no access to housing.[34]
Employment, which should improve these vital living conditions, is still a major issue, given that 200 million people worldwide do not have access to work, and more than 850 million employed people and their families live on or below the poverty line.[35]

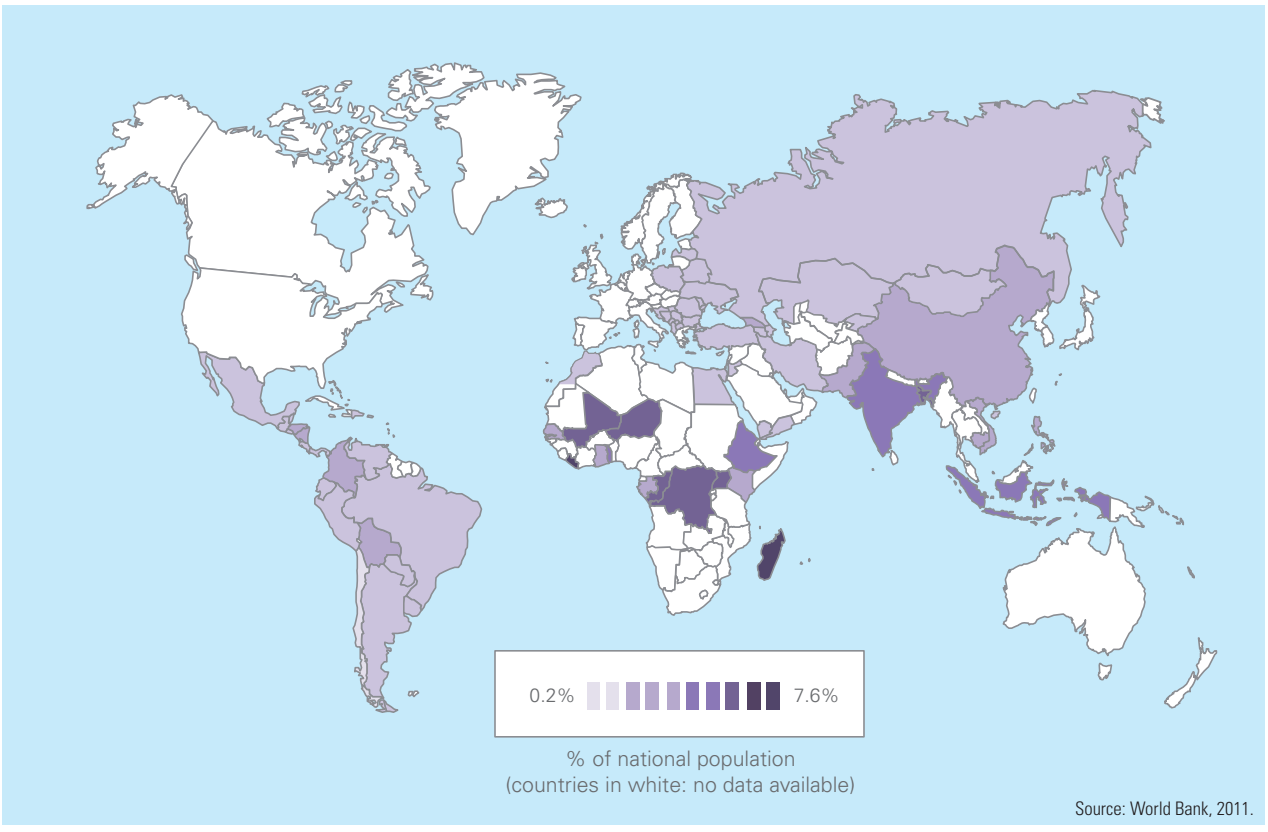
Beyond satisfying basic needs, the aim of Human Development is to allow personal fulfilment, as Amartya Sen outlines in his 'Capability Approach' (see the *Fundamental Freedoms* section).

Access to education, knowledge and culture is thus considered as one of the principal levers in the development of individual capabilities. Reducing the number of illiterate people, which today stands at almost 800 million worldwide, is therefore a key challenge for Human Development.

(32) World Bank, 2011. • (33) FAO, http://www.fao.org/docrep/012/al390e/al390e00.pdf. • (34) UN, 2005, 'Press report by special reporter on right to adequate housing', http://www.un.org/News/briefings/docs/2005/kotharibrf050511.doc.htm.

(35) ILO, January 2010, http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_120465/lang--en/index.htm.

Figure 7: Ratio of population living on less than $1.25 per day (PPP – % population)



THE RIGHT TO DEVELOPMENT

21 The role of business in respecting the right to development

As a fundamental human right, the right to development must, above all, be protected by national governments, but companies also have a significant role to play. John Ruggie outlines in his *Guiding Principles*, published in 2011, that businesses have a duty to protect these rights, and to remedy any violation by implementing effective measures. These principles clarify obligations on businesses. On the one hand, the principles define the minimum scope of human rights to respect, i.e. those that make up the basis of the Universal Declaration of Human Rights, the two associated Covenants, and the eight core ILO Conventions. On the other hand, they highlight the direct responsibility of businesses, beyond that of the government.

The exposure of businesses to development issues varies strongly according to both their sector of activity and their geographical location. In terms of a CSR company analysis, it is necessary to understand how the company can offer solutions to address development issues and evaluate the way in which risk exposure is managed. This analysis looks at each stakeholder in the area of responsibility (employees, suppliers and subcontractors, clients, local populations).

To ensure the respect and promotion of the right to development, it is necessary, for example to review the following aspects:

- **Remuneration policies:** The aim of a CSR analysis is to make sure the company fulfils the minimum legal requirements, notably in identifying potential controversies, and if measures are in place that go beyond their obligations (e.g. employee shareholding schemes, social welfare, company benefits). The analysis does not stop at employees, it extends to suppliers and subcontractors too (for example, the respect and promotion of a living wage, particularly in developing countries).

- **Development of products and services for all:** due to the nature of their activity, some sectors in particular are able to contribute to development by offering a range of products and services aimed at low-income populations (Bottom of the Pyramid or BOP). The CSR analysis aims to identify proactive initiatives such as flexible pricing or tariffs based on income prioritising basic products including food, medical care and housing. Given the importance of education in Human Development, particular attention is paid to offers favouring access to knowledge and culture.

These examples illustrate a few aspects of the analysis of companies' respect for the right to development, but the list is by no means exhaustive. The analysis is based around diverse criteria for the areas of responsibility of each stakeholder; for example, sustainable restructuring and training policies aiming to preserve employability, contributions to the economic development of local populations or protection of the property of indigenous people.

KEY FACTS //////////////////////

- More than **1 billion people in the world live on less than $1.25 per day**, **and 925 million of them suffer from malnutrition.**
- There are currently **100 million homeless** and **1.6 billion** inadequately housed people in the world.
- The number of **unemployed** people reached **212 million** in 2009, thus equating to a world unemployment rate of 6.6%.[36]
- **796 million** people in the world over the age of 15 are **illiterate**.[37]

(36) ILO, 2010, 'Global Employment Trends'. • (37) UNESCO, 2012, 'The Economic & Social Cost of Illiteracy', http://www.worldliteracyfoundation.org/The_Economic_&_Social_Cost_of_Illiteracy.pdf

RESPONSIBLE GOVERNANCE

1| Renewed governance in the wake of new sustainable growth challenges

Since the financial crisis, a range of reforms have been launched by governments and regulators, which announce a change of paradigm in corporate management and supervision practices, on a national and supra-national level. Indeed, the crisis highlighted the need to reinforce corporate governance practices to 'ensure strong, sustainable and balanced growth and to build a stronger international financial system' as outlined by the finance ministers and central bank governors of the G20 member countries.

In light of challenges both environmental (such as pressure on resources, climate change, biodiversity impact and pollution), and those related to human development (food security, access to health care, working conditions, and so on), the question arises of corporate economic growth models. Faced with this challenge, a governance system has to convey the sustainability of the company and encourage a strategy oriented towards long-term value creation in the interests of all its stakeholders.

This shift has led us to rethink the disciplinary approach and governance incentive as defined by the agency theory, in order to propose a more integrated governance approach combining economic growth challenges and social responsibility issues.

We therefore define a responsible governance system as the optimal structure of the distribution of decision-making and control powers between strategic and long-term players in the company, i.e. executives, shareholders and employees, in order to align the interest of these stakeholders, with a primary objective of long-term value creation for the company.

2| Main governance issues

There are three major governance issues:

- **Adequacy of governance structure and distribution of powers with a long-term vision of the company.** The analysis of this issue aims, on the one hand, to evaluate the balance of power within the supervisory authorities regarding the risks inherent in the ownership structure, and, on the other hand, to measure the effectiveness of the functioning of the Board, including:
  - its ability to challenge strategic issues
  - controlling the executive
  - taking into account the interests of all stakeholders in decision-making.

- **Balance in value distribution between the various company stakeholders and its impact on the company's sustainability.** The analysis of this issue aims to assess the level of correlation between compensation systems for the company's strategic actors (managers, shareholders and employees) and the creation of long-term value.

- **Respect for business ethics and the interests of stakeholders in the day-to-day operations of the company.** The analysis of this issue aims to evaluate the contribution of governance mechanisms towards an effective corporate governance system through a quality assessment of:
  - financial and non-financial information
  - internal control and risk management
  - business ethics.

KEY FACTS //////////////////////

• France

- Publication of the AFG Corporate Governance Code 2013.
- Publication of the 2012 AMF report on Corporate Governance and Directors' Remuneration.
- Bill on Corporate Governance expected for spring 2013 that could introduce:
  - A shareholders' vote on remuneration policies
  - Compulsory attendance of employee representatives on the Board.

• Europe

- Publication of a European Commission action plan end 2012; this plan includes a schedule of measures and provisions that are set to be finalised in 2013.
- Publication of an ESMA report in 2013 following a consultation on the role of consulting companies.
- In Germany: Ongoing consultation on proposed amendments for the Corporate Governance Code aiming to introduce restrictions on directors' remuneration.
- In Switzerland: Referendum 'against rip-off salaries'; Minder Initiative expected March 2013.

SUSTAINABLE THEMES

Mirova's philosophy is based on the conviction that the integration of sustainable development considerations into investment decisions makes it possible to offer investors responsible investing solutions.

In order to identify the companies that effectively address the challenges of tomorrow, Mirova's experts have developed a unique approach to economic analysis based on 8 sustainable investment themes.

Using this approach, Mirova teams identify companies that develop solutions for the future and also embed Corporate Social Responsibility (CSR) policies in their strategy.

The aim is to ensure that companies address key sector issues. For example, within the 'Sustainable buildings and cities' theme, the assessment of construction material companies focuses primarily on the energy efficiency of materials used, but also on other criteria used within the framework of a review of CSR practices, such as CO_2 emissions resulting from the production process, health and safety at work, respect for fundamental human rights and business ethics.

Regardless of their industry, these companies can take action in many ways: technological innovation, sustainable products or services and more, all of which are part of a long-term strategy and can contribute to the creation of a more sustainable development model.

8 sustainable themes

SUSTAINABLE ENERGY

80% of the world's energy consumption comes from fossil fuels[1]

3 billion people rely on burning wood and coal for warmth and cooking[2]

2006 year when conventional oil production peaked[3]

1| The challenge: supporting the energy transition

Reduce our dependency on fossil fuels…

For more than a century, the massive use of fossil fuels (coal, oil and gas) has led to considerable advancements in the majority of human activities: mobility, housing, industry, agriculture and health. Today, we know that climate change and the rarefaction of fossil resources are jeopardising our development model. To address this issue, it is vital to make a rapid transition towards not only low-carbon energy resources, but also a more energy-efficient economy. The necessary changes are colossal: world energy consumption is continuing to increase and fossil fuels still represent 80% of global energy supply.[1]

…whilst promoting access to energy for all

Beyond these environmental issues, there is also a social implication. Around 40% of the population still has no access to modern forms of energy and relies on burning wood and coal for warmth and cooking,[2] which often results in numerous respiratory problems.

A range of solutions

Well-known solutions to these issues already exist: improving energy efficiency, and the massive use of renewable energies. However, the implementation of these solutions is too slow: energy efficiency efforts are not enough to stop the increase in energy consumption, and renewable energies represent less than 15% of world production.[1] As such, these solutions will still require considerable further innovation.

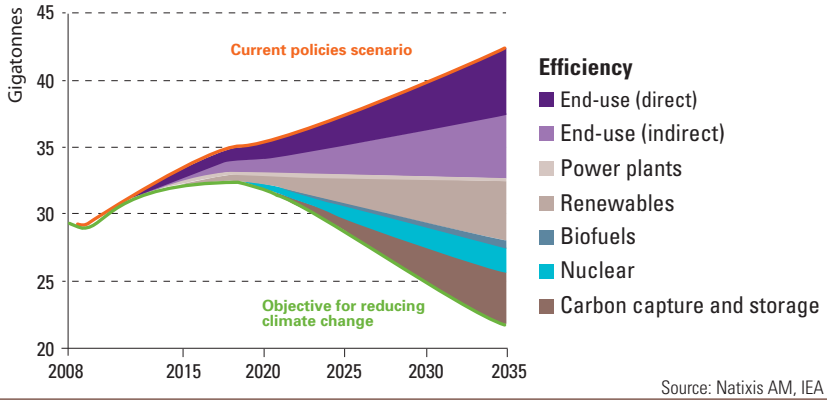
Other, less consensual, solutions can equally provide answers to climate change. Natural gas, due to its reduced carbon footprint compared to that of oil and coal, can act as transitional energy. Nuclear energy, despite its security risks, also has the advantage of being a zero greenhouse gas resource.

Changes driven by regulatory and market developments

These changes are supported both by increasing regulatory pressure and by rising energy prices. With regard to regulation, international awareness of climate change led to the establishment of various treaties such as the Kyoto Protocol, the Copenhagen Agreement and the development of carbon markets in various parts of the world (including Europe, California, Australia and certain Chinese provinces). Although disagreements persist among countries on the type of reforms to be implemented at an international level, there is a strong consensus on the fact that it is necessary to act rapidly.

In addition to regulations, increased pressure on energy prices has been a strong incentive for change. For example, between 2003 and 2008, the 'third oil shock' resulted in a fivefold increase in price per barrel of oil, and a threefold increase in the price of gas.

(1) International Energy Agency, 2009, Energy Balance for World. • (2) United Nations, 2012, Energy and Sustainable Development. • (3) International Energy Agency, 2010, World Energy Outlook.



Source: Natixis AM, IEA (World Energy Outlook 2010).

Figure 1: Reduction in emissions through technology in the IEA's '450 Scenario' making it possible to limit the increase in temperature to 2°C

SUSTAINABLE ENERGY

21 Responsible solutions

1 Energy efficiency

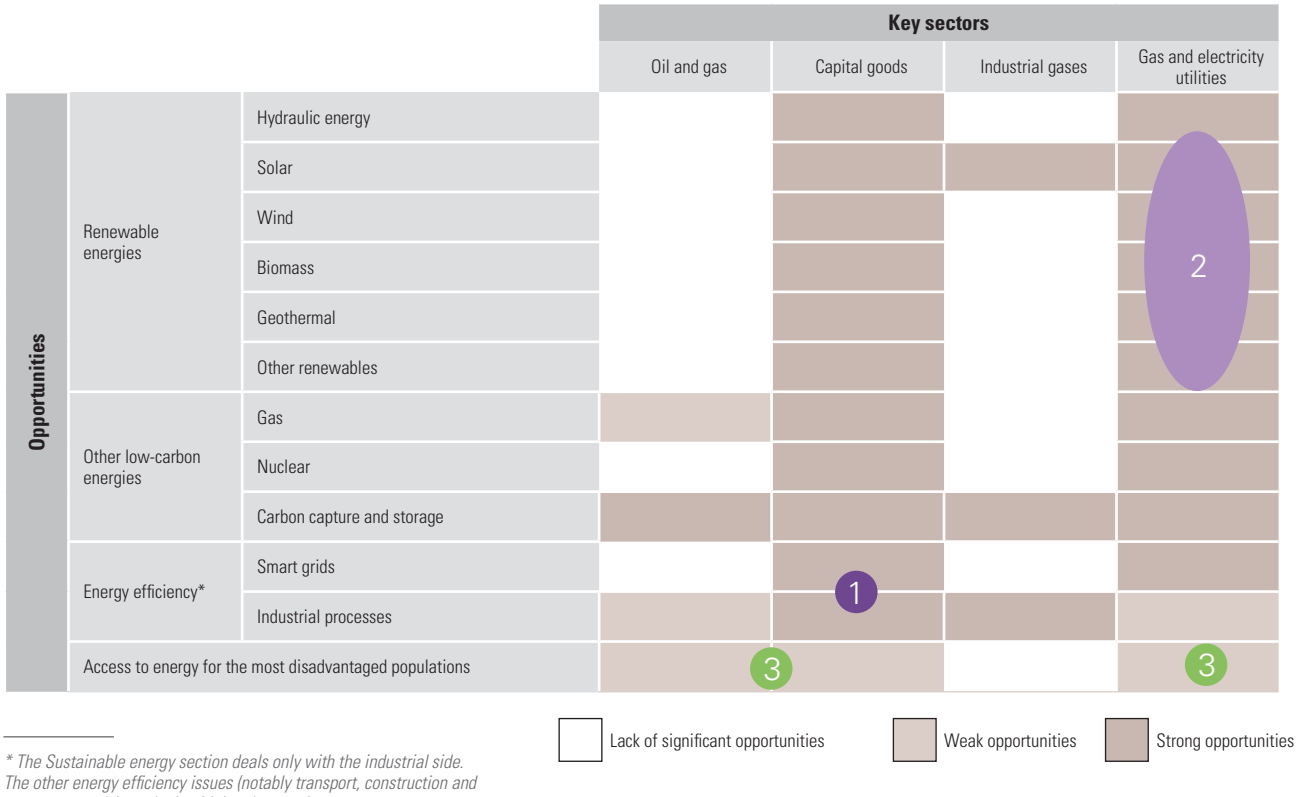
'The cheapest and most ecological energy is the energy we don't consume.'
Producers of capital goods offering energy-intensive machinery to their customers have important improvement levers in terms of the energy efficiency of their products, such as improving electrical turbine output, industrial motor optimisation and low-loss electrical transmission. Players offering the most innovative solutions can differentiate themselves by offering their customers lower energy consumption, reduced costs and a smaller overall environmental footprint.

2 Renewable energies

Electricity providers are among those most impacted by the necessity to reduce their carbon intensity (gCO_2/kWh) by investing in renewable production capacities and replacing thermal production capacities. While the production cost of renewable energy is still significantly higher than that of thermal energy, the need for development of these technologies has now become both a necessity and a window of opportunity, driven by regulation and consumer demand.

3 Reduction of the energy gap

Issues related to the access to energy are part of a much wider framework involving questions of development under governmental competencies. Private companies, however, can also contribute solutions. Besides philanthropic projects, some companies, for example, offer products specially designed to facilitate access to modern energy for disadvantaged populations. While these initiatives remain rare, the needs of these populations are enormous, representing both an economic and a social opportunity.



** The Sustainable energy section deals only with the industrial side. The other energy efficiency issues (notably transport, construction and consumer goods) are dealt with in other sections.*

SUSTAINABLE MOBILITY

15% of global greenhouse gas emissions come from the transport sector[4]

3 times more mobility in 2050 than in 2000[5]

30% of the world's population does not have access to all-weather roads[6]

1| The challenge: travel better, together

Rethink mobility as a rare resource…

In a freer and more globalised world, the population strives to travel more. Today, mobility is moving further away from being a sustainable development model: air-quality deterioration in cities, CO_2 emissions, oil resource consumption and deterioration of ecosystem services due to transport networks.
As fossil fuels become rarer and the effects of climate change, environmental degradation and increasing urbanisation are more evident, our societies now have no option but to turn towards a more moderate, fairer, cleaner, safer and intelligent sustainable mobility.

…whilst at the same time bridging the mobility gap

Today, mobility is an unequally spread privilege amongst human beings. Whether it is in the outer suburbs of developed countries or in developing countries deprived of infrastructure and transport facilities, mobility has become the reflection of social inequalities.

Tools for technological and organisational progress are key

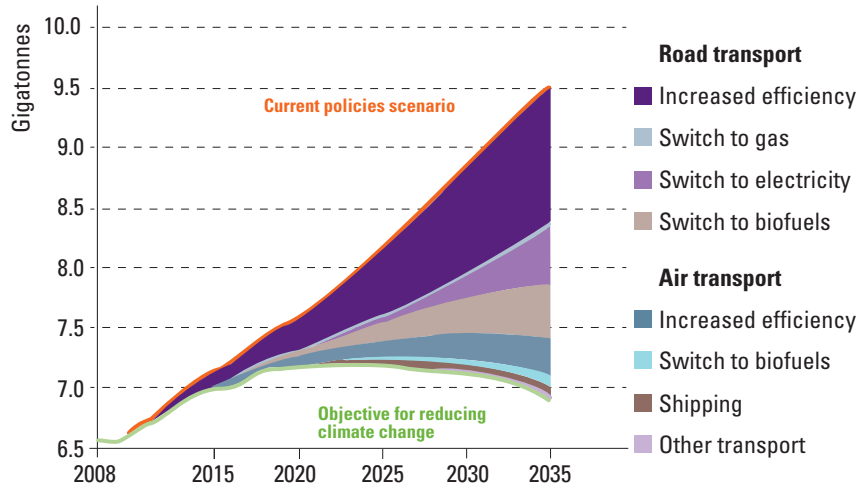
Whether they are brought about through stricter regulations (for example, public transport subsidies, fuel taxes, urban charging schemes or ecological bonuses/penalties) or through voluntary initiatives, some economic players are offering innovative solutions for 'progress tools' related to sustainable mobility.

The transition towards sustainable mobility provides an unprecedented opportunity for those first in line to step into the next era of oil shortages by developing alternative mobility solutions and technologies.

The challenges of sustainable mobility are as much technological as they are organisational.

- **Technological** in terms of enhanced vehicle energy consumption and the development of breakthrough technologies such as fuel cell and electric/hybrid vehicles to reduce our oil dependency.
- **Organisational** in terms of the new way of looking at travel that goes beyond the means of transport.

(4) International Energy Agency, 2009. • (5) OECD, 2011,'Transport Outlook'. • (6) World Bank, 2007.



Source: Natixis AM, IEA (World Energy Outlook 2010).

Figure 2: Transport sector CO_2 emissions forecast

SUSTAINABLE MOBILITY

21 Responsible solutions

1 Improving combustion engine performance

At the top end of the value chain, car manufacturers and car equipment manufacturers, chemical engineers and tyre manufacturers have numerous ways of optimising vehicle consumption (per kilometre for passenger transport and per kilometre and per ton for freight transport) such as aero-dynamics, lightening vehicles, reducing rolling resistance and internal energy consumption management. The most innovative players can differentiate themselves by offering their clients both a reduction in their energy consumption and thus their costs, and a reduced environmental footprint.

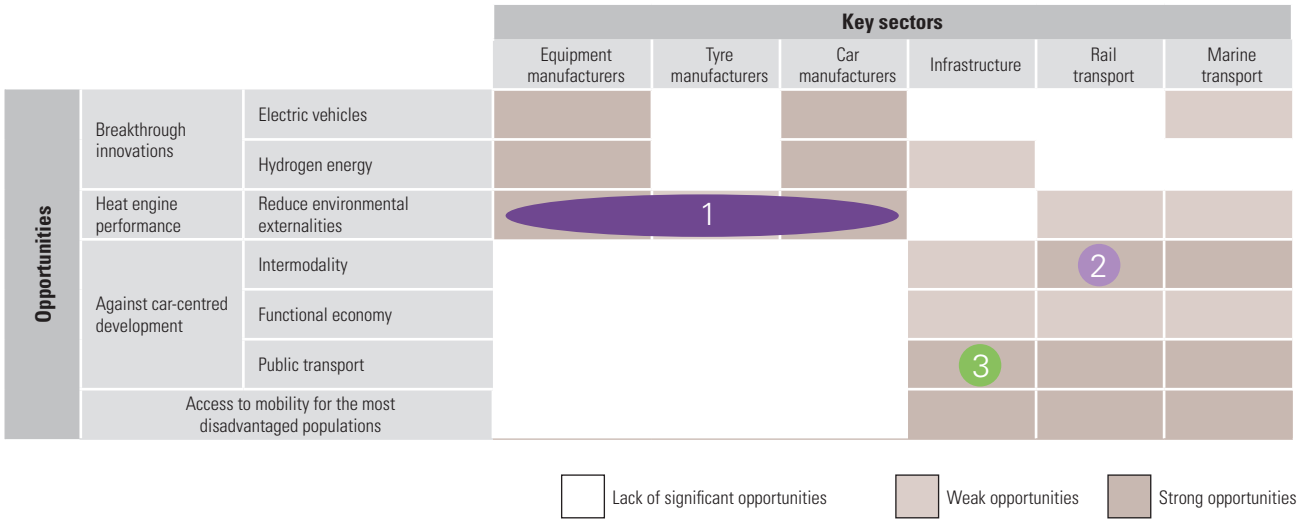
2 Promoting rail transport

Thanks to mostly electric engines, the rail transport sector has a much smaller environmental footprint than that of road transport. This ecological advantage must represent one of the essential factors in public policy on sustainable mobility, endowed with integrated and multimodal development logic. Rail transport should benefit greatly from an increasing global demand for transport, estimated at 12% across all modes between now and 2020.

3 Combined transport linking urban and suburban areas

Public transport is definitely the sector of the future. Tram-trains, the metro and trolleybuses are set to double their share of the market between now and 2025.[7]
The tram-train, which is able to travel both on tram tracks in urban areas and on rail tracks in the outskirts, will benefit from this renewed interest. This mode of transport enables travelling with ease from town centres to neighbouring cities, without having to change transport type.

(7) UITP, 2009, 'Public Transport: the smart green solution!'.



SUSTAINABLE BUILDINGS AND CITIES

35% of the world's energy is consumed by buildings[8]

100 million homeless people in the world[9]

70% of the planet's population will live in urban areas in 2050[10]

1| The challenge: eco-friendly thinking and responsible cities

Increasing environmental challenges…

As energy consumers, greenhouse gas emitters and, to a lesser extent, water consumers, buildings are a source of major environmental impacts. CO_2 emissions generated during the production of building materials, combined with massive energy consumption in the use phase, put buildings right at the heart of environmental concerns.

Considering the population increase and the rapid rate of urbanisation, needs in terms of construction are ever increasing (buildings, infrastructure, etc.), which further intensifies the environmental challenges associated with this subject.

…and numerous catalysts accelerating profound changes in the building sector

Given the scope of the challenges, measures are being put in place to move buildings towards a more sustainable model. Introducing carbon markets in different parts of the world should lead, for example, to the production of less pollutant heavy materials (e.g. cement). Furthermore, regulatory measures leading to more energy-efficient buildings are increasing. These include the European Energy Efficiency Directive aiming for 'nearly zero-energy buildings' by 2020; the 'Better Buildings Initiative' programme in the United States; and ambitious objectives in China in terms of green building in the 2011–2015 five-year plan. The development of labelling and certification (HEQ,[11] BREEAM,[12] LEED,[13] etc.) also promotes environmental efficiency in the macro-sector.

Solutions offering both environmental and economic opportunities

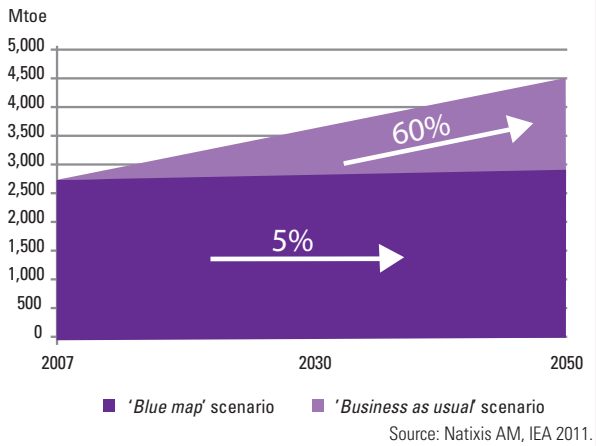
The massive environmental challenges are, however, matched by a proportional number of improvement methods. In other words, the potential solutions are numerous: low-carbon cements, eco-construction reducing the environmental footprint of the early stages of construction, but, more specifically, optimising the use phase by focusing on the heart of the impacts (such as improved thermal insulation, and the control and management of water and energy consumption). Energy efficiency requires investment, but this will reduce the energy bill in the more-or-less long term, depending on the adopted solutions.

Access to housing – a social challenge to overcome

Although the issues of sustainable building are primarily environment-related, the social challenges cannot be ignored. The UN estimates that there are more than 100 million homeless and 1.6 billion inadequately housed people worldwide. These figures are set to increase due to the growing population in emerging countries. Nevertheless, housing remains a fundamental human right.[15] The building sector therefore has a major role to play in access to housing for all and in housing quality improvement for low-income populations.

(8) International Energy Agency (IEA), 2008, 'Energy efficiency requirements in building codes, Energy Efficiency for new buildings'. • (9) UN, 2005, The Human Right to Adequate Housing, special reporter publication. • (10) UN, World Urbanization Prospects, The 2011 Revision. (11) HEQ: High Environmental Quality. • (12) BREEAM: BRE Environmental Assessment Method. • (13) LEED: Leadership in Energy and Environmental Design. • (14) IEA, , 2011, Technology Roadmaps, Energy-efficient buildings: heating and cooling equipment. • (15) Article 25.1 of the Universal Declaration of Human Rights.

The International Energy Agency's 'Blue map' scenario[14] is a hypothesis according to which, amongst other things, the energy consumption of buildings could increase by only 5% between 2007 and 2050, mainly due to energy efficiency efforts. According to the 'Business as usual' scenario, the increase could be up to 60% over the same period.



Source: Natixis AM, IEA 2011.

Figure 3: Evolution of the energy consumption of buildings according to different scenarios

SUSTAINABLE BUILDINGS AND CITIES

21 Responsible solutions

1 High standards for eco-construction and eco-renovation

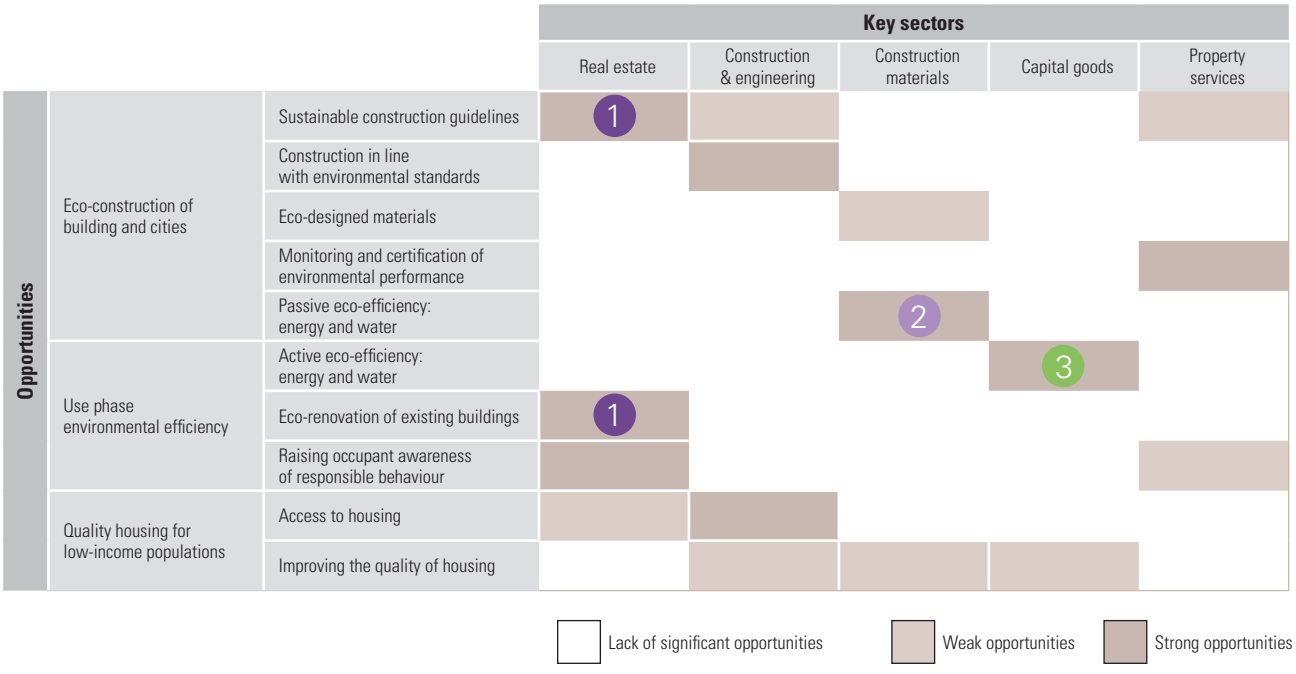
A real estate company, for example, needs a set of detailed guidelines for builders for new developments and, equally, for the renovation of existing assets to improve their environmental performance. The best positioned players facing these challenges efficiently anticipate the implementation of regulations and meet the increasing demand from buyers and tenants who are more and more concerned about these matters. A significant proportion of certified assets (e.g. HEQ, BREEAM, BREEAM In-Use, LEED) indicates a proactive approach.

2 Passive energy efficiency in buildings

The use phase in buildings has the largest environmental impact in the industry, arising mainly from high energy consumption. Heating and air conditioning alone are responsible for more than half of total consumption. Efficient thermal insulation considerably improves passive energy efficiency in buildings and therefore reduces the energy bills. Manufacturers of insulation materials such as glass wool, stone wool or high performance glass are particularly well positioned to address this issue.

3 Active energy efficiency

Like eco-efficient construction material manufacturers (see Point 2), electrical equipment providers can offer lasting solutions to reduce energy consumption. This is a matter of actively improving energy efficiency by proposing, for instance, consumption measurement systems (smart meters), building automation (detection and automatic lighting), programming devices (e.g. to turn off office computers and ventilation) or even heating management systems.



SUSTAINABLE RESOURCES

30% of agricultural output worldwide is wasted across the food chain[16]

6,900 billion m^3 water demand in 2030 (vs 4,500 billion today)[17]

40 to 50 times more precious metals in electronic waste than in mines[18]

1| The challenge: preserving resources whilst sustainably supporting our needs

Increasing pressure on all types of resources[19]

Never before have our societies been confronted with such tension about supplies of minerals, water, agricultural products, and so on, due to demographic growth and increased living standards. We have realised that there is not an endless supply of some non-renewable resources. This also applies to renewable resources that are currently being exploited beyond their renewal rate (including fish, forests and water).

Agriculture and forests: ensuring sufficient production whilst preserving ecosystems

21st Century agriculture has a difficult role to fulfil in producing enough food to satisfy the needs of an increasing population, as well as providing agricultural products for the biofuel and green chemistry markets. All of this whilst preserving soil fertility, quality of water, biodiversity and climate. Improving yield and exploitation rates through sustainable agricultural practices and limiting loss of crops are the main levers to work on towards a sustainable agriculture and achieving a 'new green revolution'.

Water: developing infrastructure and technologies

Although the current quantity of water on Earth is relatively constant, fresh water is an unevenly distributed resource. Local imbalances are already apparent in numerous regions suffering from water shortages, and these are accentuated by the increase in demand for water as well as climate change. As 70% of water is consumed by the agricultural sector, this issue is strongly linked to that of food security and, more widely, that of health. Favouring investments in increasing supply (infrastructure, treatment) and improving use efficiency (mainly through improved irrigation techniques) are key measures to guarantee sustainable access to this resource.

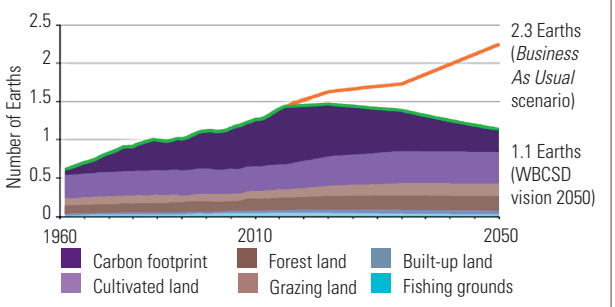
Waste and recycling: optimising resources

Business models based on a linear, 'extract–transform–dispose' economy are exposed to growing risks, ranging from increased commodity prices to the risk of supply chain disruption. These fundamental trends are set to increase with the urbanisation of the population and rising costs of resource-extraction. We are convinced that the key economic players in favour of circular development (industrial ecology, recycling, etc.) are going to seize opportunities for economic, social and environmental value creation.

Metals: preserving quality reserves

To address the issues of a decline in reserves and of the increasing environmental impact of mineral extraction from lower-grade ores, recycling is a solution, but it will remain technically limited. Reducing the environmental impact of mining, preserving reserves by using recycled/substitution metals, and providing metals which contribute to the growth of green technologies are all examples of solutions which have yet to be developed.

Figure 4: How many 'Earths' are we consuming?



Source: Natixis AM, Global Footprint Network and WBCSD vision 2050, 2010.

The equivalent of 1.5 times the Earth's natural resources is consumed each year and this ratio could increase to 2.3 times in 2050 if production methods do not change.

(16) UK Government Office for Science, January 2011, 'The Future of Food and Farming: Challenges and Choices for Global Sustainability'. • (17) 2030 Water Resources Group, 2009 'Charting the water future'. • (18) Global e-sustainability Initiative (GeSI), 6 July 2012, 'E-waste: Annual Gold, Silver 'Deposits' in New High-Tech Goods Worth $21 Billion+; Less Than 15% Recovered'. • (19) Although resource management concerns all sectors, certain activities are more directly linked to exploitation and the processing of raw materials. We have divided the sustainable resources investment theme into four sub-sectors: Agriculture and forests, Water, Metals, Waste and recycling (fossil fuels are covered by the Energy investment theme).

SUSTAINABLE RESOURCES

21 Responsible solutions

1 Slow or controlled-release fertilisers

The efficiency of nitrogen fertilisation is one of the major objectives of modern agriculture. Excess input of fertilisers compared to the amount needed by plants escapes into the ecosystem and leads to the proliferation of green algae and dead zones. Slow or controlled-release fertilisers, by which nitrogen is released little by little, based on the volume the plants can absorb, reduce loss. Today, these fertilisers are used in high-value-added agriculture and are beginning to be used in cereal farming.

2 Micro-irrigation

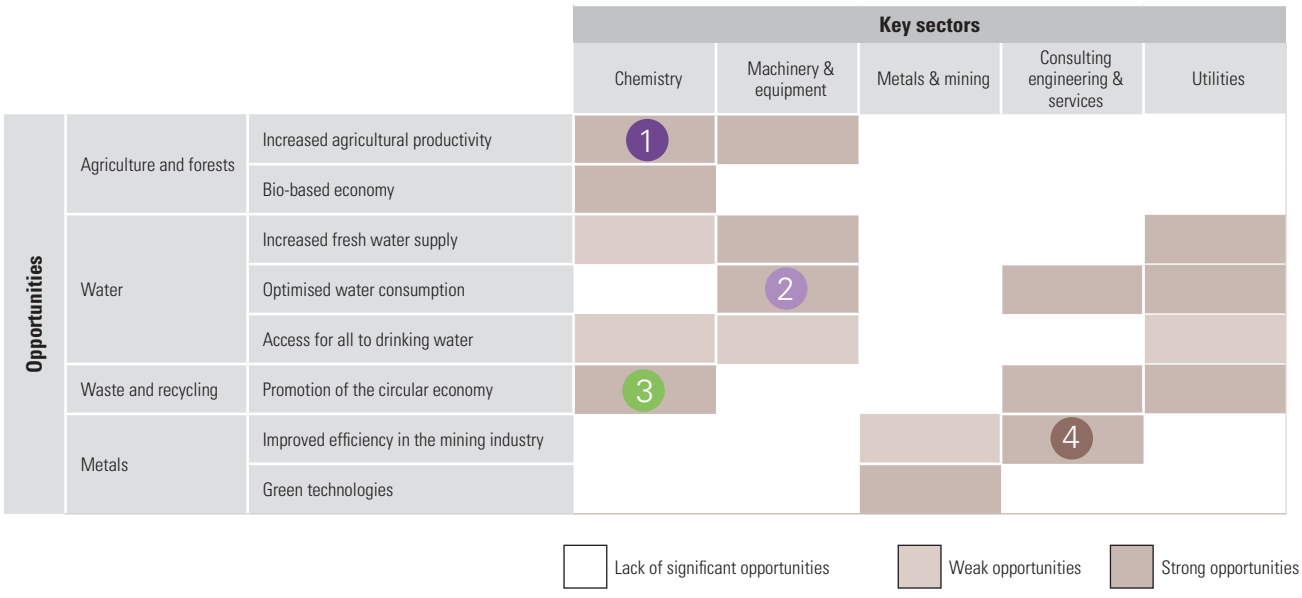
Micro-irrigation, also known as 'drip irrigation', is the most modern and most water-economical irrigation technique. It is mostly used in vegetable, fruit and flower production. The use of micro-irrigation has increased over the last few decades due to the production of affordable systems for small farms.

3 Recycle metals from urban deposits of e-waste

Waste from electronic equipment increases by 40 million tons each year. By 2020, for example, the volume of e-waste in China will triple. Specific collection and separation networks have therefore developed several initiatives which are showing promise, such as recycling mobile phone batteries. Recycling metal (cobalt, nickel, copper, rare earths, etc.) from used rechargeable batteries and other types of waste is a win-win opportunity on an environmental and economic scale.

4 Metal reclamation technologies and treatments

Extraction yields from mining and metallurgical companies can be increased by key players offering metal reclamation and treatment technologies from effluents, smoke residues and production site dust and waste.



SUSTAINABLE CONSUMPTION

3 billion new 'active' consumers[20] to join the middle classes between now and 2030[21]

4.16 Earths would be necessary if the world population were to adopt the current consumption pattern of the United States[22]

1.4 billion adults are overweight[23]

1| The challenge: separating consumption from the environmental footprint

Our current model: global over-consumption…

We are currently a global population of 7 billion people, and we are already using the equivalent of 1.5 Earths! Our current consumption habits rely on a continuing increase in resource usage and environmental impacts. Given the increasing demographic and economic growth forecasts in emerging countries, the strong increase in middle-class consumers will reinforce this pressure on the planet.

…full of significant imbalances

At the same time, more than a billion people are still living on less than $1.25 per day, which does not allow them to satisfy their basic needs. Another example is that the number of people suffering from chronic hunger is still very significant, though the number of overweight people has surpassed this figure. So, how can we improve the quality of life of a growing population whilst at the same time preserving their natural capital?

Increasing awareness of these issues amongst consumers

The answer to this question lies primarily in the hands of the consumers themselves. Consumer awareness of sustainable development is increasing, not just in Europe (72% of Europeans say they would be prepared to buy ecological products despite their being more expensive, according to Eurostat)[24] but equally in emerging countries (45% of Chinese people say they would pay more for an ecological product, according to a National Geographic[25] study).

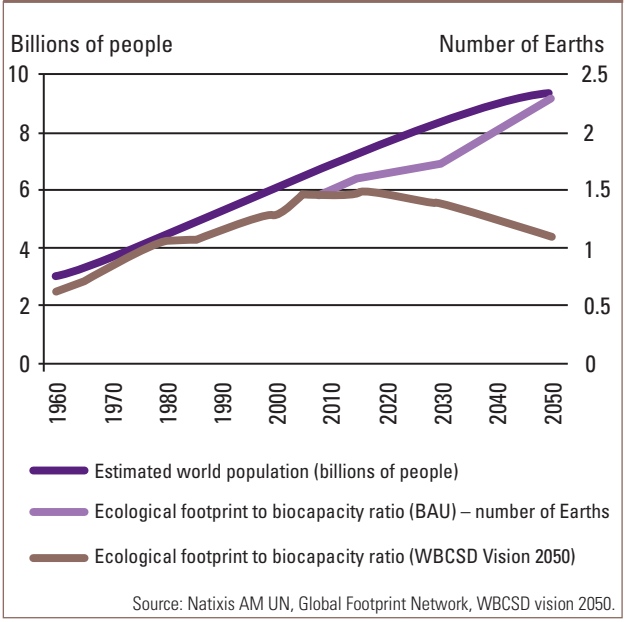
Although there is still a discrepancy between these statements and the act of buying, these figures are continuing to rise. In the same way, an underlying trend around natural products, health and well-being is becoming concretely apparent in consumer behaviour around the world. In 2011, Euromonitor International[26] estimated the global health and well-being market at more than 600 billion USD.

New business models to develop

These challenges constitute opportunities for businesses in the consumer sector: to bring more value, whilst at the same time reducing the environmental footprint of their products throughout their whole life cycle, and actively encouraging behavioural change on the part of their clients. Numerous initiatives already exist (Fair Trade, sourcing of raw materials from sustainable origins, high nutritional value products, and so on) but they remain marginal.

In order to address the challenges of sustainable consumption, a change of scale is required. Players offering robust and integrated solutions as part of their business model will be favoured in this investment theme.

Figure 5: Evolution of the ecological footprint to biocapacity ratio under the Business as Usual (BAU) scenario and the 'WBCSD Vision 2050' hypothesis



Source: Natixis AM UN, Global Footprint Network, WBCSD vision 2050.

(20) 'Active' consumers in this context refers to the adult population (over 20 years of age) whose daily spending is between 10 and 100 USD (PPA), i.e. the 'middle class' and above. • (21) OECD, 2010, Emerging Middle Class in Developing Countries. • (22) Global Footprint Network. • (23) WHO, May 2012. • (24) European Commission Directorate General, 2011, Special European Barometer 365. • (25) National Geographic, 2012, Greendex 2012, Consumer and the Environment: A world tracking survey. • (26) Euromonitor International, June 2011.

SUSTAINABLE CONSUMPTION

21 Responsible solutions

1 Responsible procurement

The production of agricultural raw materials creates major environmental and social challenges and represents one of the main impacts of a food producer. Companies wishing to buy their raw materials from sustainable and responsible sources (e.g. fish that is 100% MSC[27] certified, or Fair Trade coffee) are providing a relevant response, both to sustainable development challenges and to consumer expectations.

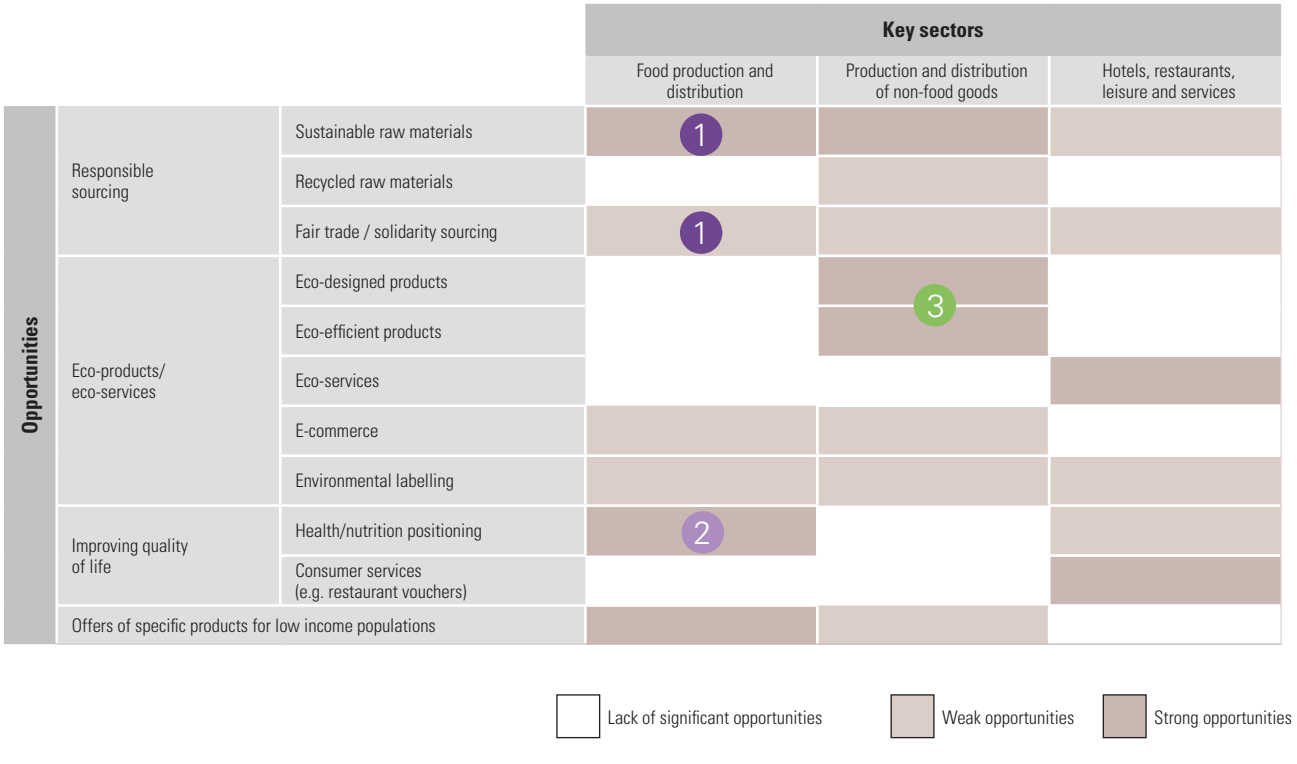
2 Plant-based ingredients

Plant-based natural ingredients are a good alternative to chemical products derived from oil, in particular for the agrifood industry (for example, aromatic extracts, colourants, natural preservatives), but also for other industries such as cosmetics (for instance, ingredients from plants known for their anti-ageing and hydrating properties). They also improve the healthy/well-being/natural profile of a product. This kind of player can also have a significant role in helping businesses in the food sector with their product reformulation (for example, improving the nutritional profile, or the substitution of synthetic ingredients suspected of harming health or the environment).

3 Development of eco-products

Eco-products aim to reduce the environmental footprint across the whole life cycle, by offering a reduced, even positive, impact on at least one of the key phases of the product, i.e. during production, use or end of life. In general, businesses tend to position themselves on two product categories: eco-designed products, offering an environmental advantage during the production phase (e.g. products designed using recycled materials); and eco-efficient products, offering an environmental advantage during the use phase (e.g. low-emission household electrical appliances).
Key players in the sector looking to include these kinds of products in their product mix, going beyond niche products, are favoured in this particular investment theme.

(27) Marine Stewardship Council.



SUSTAINABLE HEALTH

~20% of the world's population do not have access to basic health care[28]

15% of the world's population have some form of handicap[29]

~8% of the world's population are over the age of 65[30]

1| The challenge: ensuring the right to health and longevity for all

Changing trends create new social challenges

There are numerous macro-trends that impact the health investment theme, causing key players in the industry to rethink their activities. A combination of demographic growth in developing countries and low public budgets allocated to health has complicated access to even the most basic forms of health care. The Millennium Development Goals highlight the importance of a partnership with the private sector to 'provide access to affordable essential drugs in developing countries.' In developed countries, the ageing population has led to the appearance of new forms of disease, which often raises the question of caring for people suffering from loss of independence. Over-medication is also a major problem in countries where health care systems are costly and unequally taken care of by the government.

Promote access to health care for all with effective positioning in new markets

The Sustainable Health investment theme primarily aims to support businesses which overcome the obstacles to promoting equitable access to health care products and services in developing, as well as developed, countries. Beyond the charitable aspect (donations, revenue-based prices, etc.), the major challenge remains the creation and generalisation of sustainable and independent health care systems, particularly in developing countries. The investment theme equally promotes skills-transfer, and support for the creation of infrastructure and finance mechanism initiatives. Well positioned players in this sector could also attract new markets, whilst reinforcing their social acceptability.

Improve quality of life and independence

The ageing population and the increased number of dependent people have brought about the emergence of two increasingly important challenges for the key players in this investment theme:

- Strengthen support for those who are dependent (due to age, an illness or a handicap) in specialised establishments or at home.

- Reduce suffering for people with serious illnesses such as cancer, who have to undergo painful treatment and suffer unpleasant side effects.

Innovation, a keystone in the development of sustainable health

Numerous factors make R&D crucial for key players in the sector: the end of flagship medicine patents, the emergence of new pathologies, the increasing number of patients suffering from loss of independence but still aspiring to a better quality of life, and the lack of competencies in certain areas. Innovation therefore constitutes the main lever for improvement, with the development of new molecules, and more targeted treatments, the focus on preventative solutions to reduce over-medication, the development of personalised treatments to improve patients' quality of life, and the sharing of expertise to promote access to health care for all.

(28) OECD, August 2005, 'Private Health Insurance for the Poor in Developing Countries?' • (29) WHO, June 2011, 'Disability and Health'. • (30) World Data Bank.

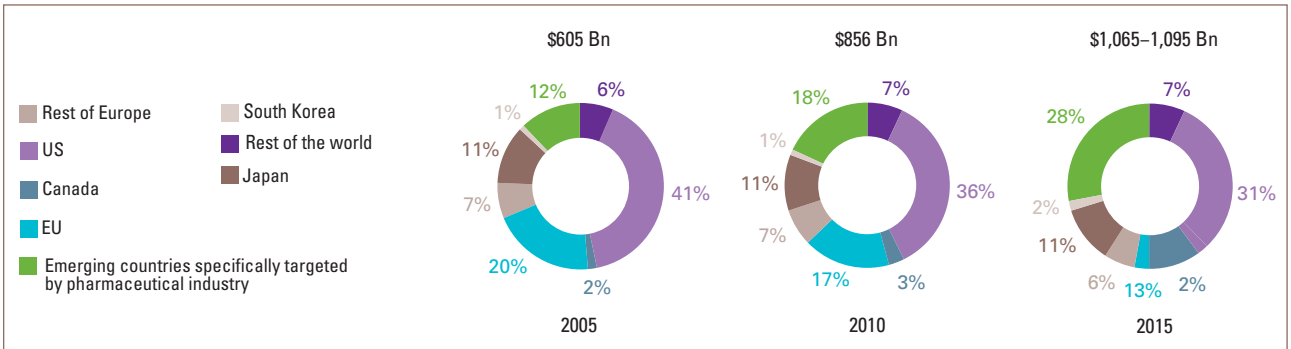


Figure 6: Evolution of health care spending by geographical zone

Source: Natixis AM, IMS Market Prognosis, April 2011.

SUSTAINABLE HEALTH

21 Responsible solutions

1 Adapting to local challenges

Adapting operations to local challenges is a key element for the health-related sectors. For a pharmaceutical company, it serves as a way to systematically implement specific approaches to address local medical needs in each new location within a country. These include the directing of R&D towards priority diseases in situ (e.g. infectious diseases), local income-related pricing practices, and increasing public awareness through teaching methods adapted to improve screening, diagnosis and treatment.

2 Contributing to sustainable local health care systems in developing countries

Sustainable access to health care for all is paramount to the development of autonomous and sustainable health care systems. The investment theme therefore focuses on players which implement proactive initiatives in this direction. For a medical equipment group, for example, the purpose is to contribute to the development of health infrastructure in emerging countries, and the promotion of skills-transfer through training aimed at health professionals to enable them to make more efficient use of equipment. By taking constructive steps of this sort, companies prepare their future markets, potentially gain market share and thus reconcile growth with social responsibility.

3 Developing cutting-edge expertise in personalised medicine

Personalised medicine is born out of the fact that two people with the same disease may respond differently to the same treatment, often due to genetic differences. Adopting this new approach therefore offers new perspectives since it consists of treating patients whilst taking into account other parameters, such as their biological profile and the molecular characteristics of their disease.

For example, using personalised medicine would make it possible to detect early on whether or not the patient would be responsive to treatment, thereby enhancing targeted care, increasing efficiency, reducing side effects and improving patients' quality of life.

The Sustainable health investment theme therefore targets pharmaceutical companies offering advanced approaches in this area.
For example, in the case of serious diseases like cancer, it will target a subgroup of patients who share specific genetic characteristics and whose tumours have the same molecular abnormalities. By obtaining this almost tailor-made molecular mapping, the proposed treatment is adapted to maximise the chances of a cure.

				Key sectors			
				Pharmaceutical and biotechnological groups	Medical equipment	Medical services	Mutuals and insurance
Opportunities	Access to health care		Flexible prices adapted to incomes and/or the local situation	1			
			Development of sustainable health care systems		2		
			Finance mechanisms				
	Access to health care	Innovation	Sharing intellectual property				
			Skills-transfer				
	Innovation		Personalised medication / targeted treatment	3			
			Cutting-edge research in key pathologies	1			
	Independence and quality of life		Products and/or services reducing dependency and/or improving quality of life for the elderly and/or disabled				

Lack of significant opportunities | Weak opportunities | Strong opportunities

SUSTAINABLE INFORMATION AND COMMUNICATIONS TECHNOLOGY

15% of global CO_2 emissions could be reduced by 2020 due to ICT technology[31]

~2% of global greenhouse gas emissions were from the ICT sector in 2007 (expected to double by 2020)[32]

10% increase in telecommunication penetration rate will increase the annual GDP growth rate by up to 1%[33]

1| The challenge: offering tools to advance sustainability

The role of ICT in reducing global emissions

The Information and Communications Technology (ICT) sector has a significant role to play in the fight against climate change by enabling sectors such as transport, buildings, power and industry to optimise their energy consumption. Key players in ICT believe that their technologies could contribute to a reduction of up to 15% of global CO_2 emissions by 2020.

Potential opportunities are diverse:

- Smart grids: improving network efficiency, developing management solutions for electricity demand ('demand–response').[33]
- Transport: optimising truck routes, developing low-emission vehicles.
- Buildings: better automation of energy-consuming devices (lighting, heating, air conditioning), improving building design.
- Industry: optimising electric motors, ICT-driven automation.
- Dematerialisation: teleworking, videoconferencing, e-paper.

The ICT sector can improve its own energy efficiency

The ICT sector contributes around 2% of world greenhouse gas emissions, a contribution equal to that of the global aviation sector. This figure is set to increase rapidly in years to come. To put this into perspective, the number of PCs will increase to around 4 billion by 2020, compared to approximately 1 billion in 2007. As a result, emissions linked to the use of PCs, mobile phones, telecom infrastructure and data centres could double between 2007 and 2020.

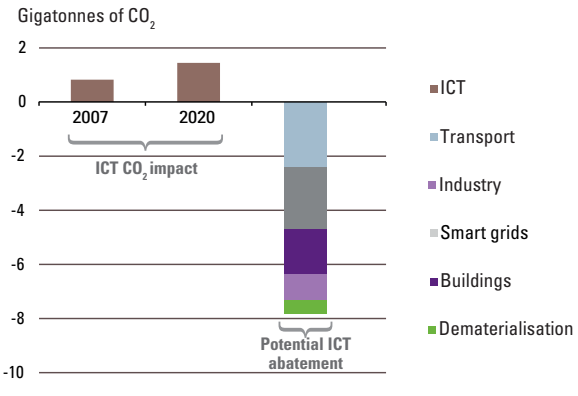
It is, however, possible to make significant changes in energy efficiency to limit the emissions associated with such growth.

Key players have estimated that further technological advances in terms of energy efficiency could compensate for the increase in the demand for PCs between now and 2020. This trend has been supported by customers such as the American government, which requires that IT purchases must be Energy Star compliant. Companies and individuals have also started to include environmental factors in their purchasing decisions.

Important social opportunities

The ICT sector and in particular publishers, broadcasters and other content creators, have an important role to play in further developing access to information, education, communication and culture. Accessible products that improve access to, and the use of, mobile communication and the Internet have a positive impact on the lives of individuals and on the economy. To put this into perspective, it is estimated that a 10% increase in the telecommunications penetration rate would result in a growth of 1% of GDP. While these issues affect everyone, they are even more significant for disadvantaged populations. For example, one of the UN's development goals relating to ICT prioritises equitable access across countries as well as the communities within them.

Figure 7: ICT impact and potential abatement



Source: Natixis AM, GeSI, McKinsey, 2008.

(31) GeSI – McKinsey, 2008, SMART 2020 – 'Enabling the low carbon economy in the information age'. • (32) ITU, 2012, The Impact of Broadband on the Economy: Research to Date and Policy Issues. • (33) 'Demand–response' is a model for electricity producers, used in collaboration with their customers, to reduce electricity demand during peak hours by planning the use of different appliances. This model allows both reduced costs for the electrician and reduced environmental impact from electricity generation since 'peak electricity' is usually • produced by the most polluting technologies.

SUSTAINABLE INFORMATION AND COMMUNICATIONS TECHNOLOGY

21 Responsible solutions

1 Limitation of the environmental impact of buildings

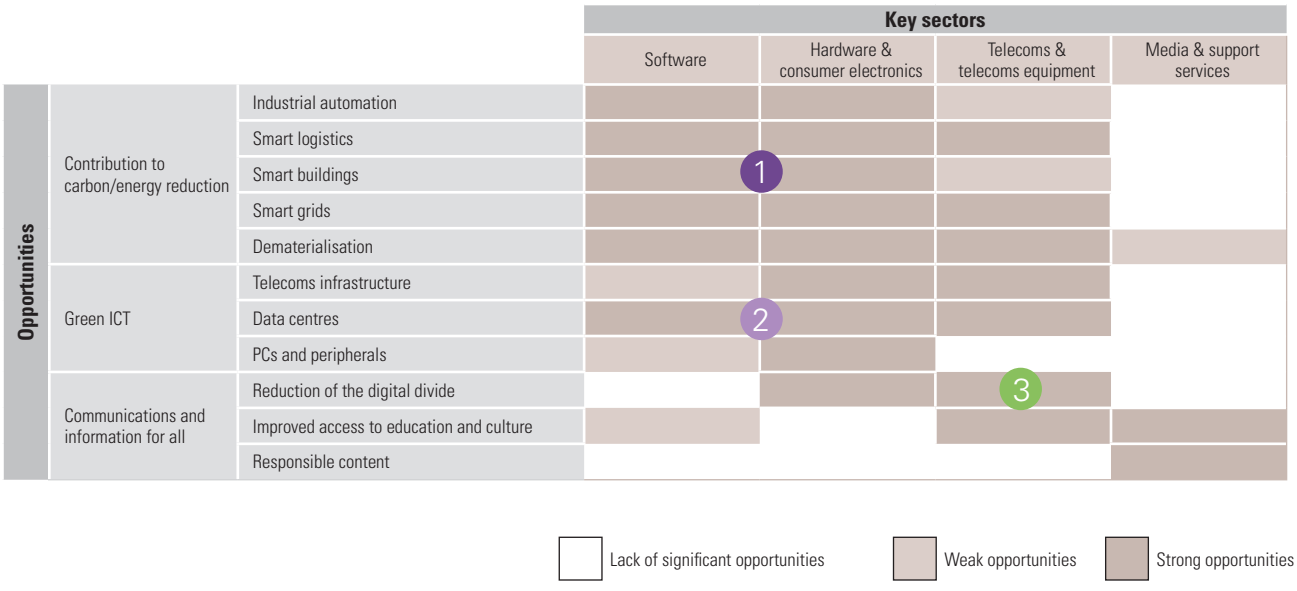
Modelling software can make a significant contribution to CO_2 and energy savings in the day-to-day running of buildings. This software would allow engineers and architects alike to evaluate the energy use of a building, using simulations to determine how design could influence energy reduction. Another example is that of building management systems (BMS), which can monitor automated lighting, heating and cooling, resulting in more efficient energy consumption.

2 Reduction of data centre energy consumption

With the emergence of the Internet, data centres are regularly blamed for their high, ever increasing consumption of electricity. Even if this is true, solutions exist to reverse this trend. Energy performance differs significantly from one data centre to another due to differences in server technologies and building design, and there are, therefore, ways of improving these performances. Certain players are currently offering solutions to dramatically reduce energy consumption, thus reducing their clients' energy bills as well as their environmental footprint.

3 Mobile banking

Telecommunications companies in Africa have established partnerships with financial institutions to provide underprivileged and/or remote communities with access to basic financial services where the traditional banking system does not yet exist. Through the use of mobile phones, users are able to access their account balances, and make transactions, payments, credit applications, and other similar operations.



SUSTAINABLE FINANCE

87% of growth in the socially responsible investment (SRI) market in Europe between 2007 and 2009. In 2010, 'core' SRI reached 10% of assets under management[34]

>50% of the earnings of companies of the MSCI All Country World Index could be at risk from environmental costs[35]

2.5 billion individuals have no access to bank accounts or credit[36]

1| The challenge: financing a positive economy

Favouring investments which contribute to positive change

The financial sector plays a key role in allocating financial resources and incentivising clients. It is therefore the sector's responsibility to catalyse the necessary transition towards a more sustainable economy. For example, through their investment decisions, banks can favour companies working with renewable energies, from equipment manufacturing to distribution. A positive contribution can also be made by financing projects that assist sustainable economic growth, whether through creating infrastructure, allocating funds to microfinance or granting loans to social businesses. Insurance products can also promote sustainable behaviour, for example, by charging lower premiums for electric vehicles and energy-efficient homes.

Screening for environmental, social and governance risks

The environmental and social impact of the finance sector is somewhat limited compared to other industries, notably energy or retail. However, the financial sector invests in companies present in such industries and provides financing for projects that directly impact both the environment and society.

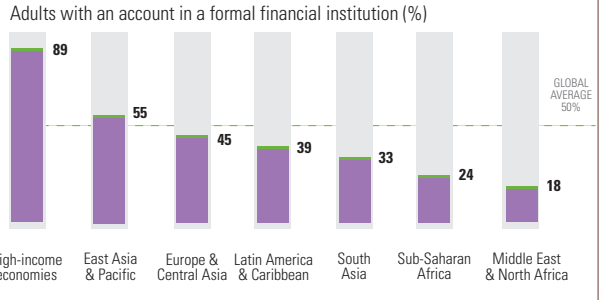
By integrating environmental, social and governance (ESG) criteria into their investment and loan analyses, investors can reduce the indirect impact of their funding and, in the long term, promote greater risk mitigation for their corporate clients. In 2003, the launch of the Equator Principle (a voluntary standard for assessing and managing environmental and human rights risks in project finance) marked the beginning of the financial sector's recognition of their indirect environmental and social responsibility.

Since then, various other subsectors have launched similar initiatives, such as the Principles of Responsible Investment (PRI), the Sustainable Stock Exchange (SSE) and most recently, the Principles for Sustainable Insurance.

Reaching the underbanked

The World Bank estimates that 2.5 billion people currently have no access to financial services such as bank accounts or credit. Through responsible microfinance, by offering services such as savings accounts, credit and insurance to low-income communities, the finance sector can help these populations in both developed and developing countries to manage their assets, generate income and reduce financial risk.

Figure 8: Bank account penetration



Source: Natixis AM, World Bank / Demirguc-Kunt and Klapper 2012.

(34) Eurosif, 2010, European SRI Study 2010 – USSIF, Sustainable and Responsible Investing Facts. • (35) UNEP, 2010, Universal Ownership: Why environmental externalities matter to • institutional investors. • (36) World Bank, 2012, Who are the Unbanked?

SUSTAINABLE FINANCE

21 Responsible solutions

1 Integrate ESG factors within investment selection criteria

Some asset managers establish processes to integrate ESG risks as part of their investment criteria. As a result, these analyses will highlight the issuers who offer solutions to sustainability challenges, and reduce their exposure to those who do not adequately manage or try to limit their negative socio-environmental impact. A similar screening process can be implemented for analysing private equity investments and corporate loans.

2 Encourage ecological behaviour

Some insurance companies encourage clients to adopt more eco-friendly practices through the products that they offer. They can implement a differentiated premium pricing for those who purchase low-emission vehicles or homes certified by environmental organisations. Additionally, insurers can offer homeowners a service whereby, in the event of a covered loss, the insurance company will cover the cost of upgrading the property to eco-friendly standards.

3 Invest in social businesses

Investors can also play a role in promoting sustainability by financing for-profit businesses whose product and/or service has a specific social or environmental goal. These kinds of investments are usually known as *impact investing*. Examples of such companies include providing school transportation in rural areas, selling affordable, nutrient-rich meals in impoverished communities or installing solar panels in locations previously dependent on expensive diesel energy generation. By investing in such business models, investors are able to generate measurable social and environmental impacts in addition to a financial return.

			Key sectors				
			Retail banks	Corporate investment banks	Asset management	Insurance	Diversified financials*
Opportunities	Financing the real economy	Financing the production of goods and services					
		Screening ESG issues in products and services			1		
	ESG in risk management	Investing in companies which mitigate environmental issues					
		Promoting ecological behaviour through products and services				2	
		Putting in place a policy of impact investing			3		
	Green investing	Providing access to finance in low-income communities					
	Social products	Financing infrastructure in developing economies					

Lack of significant opportunities | Weak opportunities | Strong opportunities

**Diversified financials include a range of companies providing services to businesses, such as stock exchanges, rating agencies and credit companies.*

There is nothing as solid as the real economy.

The days of short-term profitability are behind us. Our goal is to achieve durable value creation by examining the sustainability of business models, exercising our responsibility as shareholders and taking concrete engagements.

Mirova is the Responsible investment division of Natixis Asset Management.

AN EXPERTISE OF NATIXIS GLOBAL ASSET MANAGEMENT

mirova Responsible Investing

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Responsible Investing

MIROVA RESEARCH

SHARING DIVERSITY & EXPERTISE: THE MIROVA SPIRIT

Appraisals by Mirova, Natixis Asset Management's responsible investment division, are produced by a team of around forty specialists: including experts in thematic investment management, fund managers specialising in different business sectors, engineers, financial and extra-financial analysts, and experts in project financing and solidarity finance.

Though this wealth of expertise represents our internal added value, we also believe it should be made available to the outside world through networking and conversation. As a result, our beliefs will be shared and frequently questioned, allowing a process of continuous improvement and innovation. An in-depth understanding of technological, political, regulatory, social and trading developments in the world is also essential in order to identify the levers for sustainable economic development.

This forms the reasoning behind the publication of studies and themed documents from Mirova's team of ESG research and engagement analysts, which is presented below.

STUDIES

Mirova, the responsible investment division of Natixis Asset Management, offers an engaged investment management aiming to integrate value creation and sustainable development.
In order to do this, a deep understanding of the latest global developments regarding technology, politics, regulation, society and commerce is absolutely essential in order to identify the sustainable economic development levers.

This forms the reasoning behind the work of Mirova's team of ESG research and engagement analysts, who are presented below, who continue to provide publications on the latest key issues within the framework of a responsible approach.

ELECTRIC VEHICLES
REALLY ON TRACK?

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INTRODUCTION

Even though transport is today responsible for half the world's petroleum consumption and roughly 15% of greenhouse gas emissions, alternative solutions still remain underdeveloped. The electric vehicle, the figurehead of low carbon transport solutions, responds to the challenges of a more sustainable mobility by a reduction in CO_2 emissions and by not being dependent on oil. This technology is already the object of massive investment by car and auto part manufacturers. Numerous models have been marketed and will continue to flourish.

United States	Europe	Japan
Leaf (Nissan) – 2010	I- MiEV (Mitsubishi) – 2011	I-MiEV (Mitsubishi) – 2010
I-MiEV (Mitsubishi) – 2011	C-Zéro (Citroën) – 2011	Leaf (Nissan) – 2010
Focus Electrique (Ford) – 2011	Ion (Peugeot) – 2011	
Fit EV (Honda) – 2012	Mia (Mia Electric) – 2012	
Roadster (Tesla) – 2008	Leaf (Nissan) – 2011	
	Fortwo ED (Smart) – 2012	
	Fluence ZE (Renault) – 2011	
	Twizy (Renault) – 2011	
	Roadster (Tesla) – 2010	

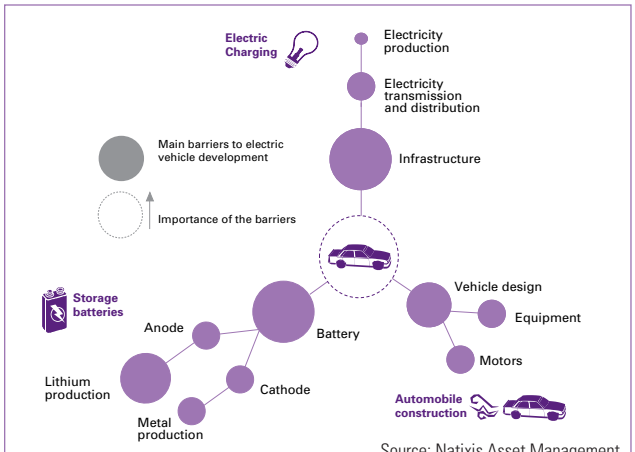
Source: Natixis Asset Management.

Figure 1: Electric vehicle markets

However, at this stage, we have to admit that electric vehicle sales have not taken off, despite an enticing positioning as regards environmental challenges. Less than two years after the launching of their electric models, Peugeot and Citroën, who sold approximately 7,000 models, are attempting to drastically lower sale prices to dispose of their stocks. Mia Electric, which designs only electric vehicles, is hardly surviving and is basing its hopes on requests for proposals from large private groups. Even though Nissan reached the threshold of 37,000 vehicles sold with the 'Leaf' model, they are increasingly worried by the slippage in their objectives, notably in the United States. Incidentally, the American economic situation is no more favourable for General Motors, which is selling way below the initial objectives with the Chevrolet 'Volt', the range extender electric model, the production of which is regularly shut down due to overstocks. Despite the fact that sales have not been more impressive for older electric models, such as the Peugeot '106' electric (1995) or Citroën 'Saxo' electric (1997), expectations for the electric vehicle have so far remained quite high. It seems premature, on the basis of only these experiences, to conclude that the automobile sector is taking the wrong road with the electric path.

Although this relative failure could be blamed on a price that is still too high, or on a lack of confidence in models which are still perceived as 'not mature', we believe that technological developments are still numerous and encouraging, and should lead to a much stronger presence of electric vehicles on the road to a more sustainable future.

In this critical period for the electric vehicle, we propose to revisit the advantages expected from this type of model, the obstacles to its deployment and the technological evolution under study. This analysis of the risks and solutions across the entire value chain will provide us with a better understanding of the circumstances under which the electric vehicle is tenable, and of the firms which could deploy the appropriate technological and organisational levers to reduce or circumvent the obstacles to the development of the electric vehicle.



Source: Natixis Asset Management.

Figure 2: Electric vehicle value chain

Even though it is difficult to predict which technologies will be winners, we consider the electric vehicle value chain to be a promising source of investment which responds to the challenges of sustainable mobility. In addition to technological advancements, the rapidity of its development will depend also on other factors, such as general regulations on CO_2 or those specific to the automobile, investment in the low carbon production of electricity, the adaptability of electric networks, and the setting up of adequate infrastructures to provide the electricity.

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1 | The design of a petrol-less automobile: the electric sector

1.1 The electric vehicle – technology

A 'new old' technology

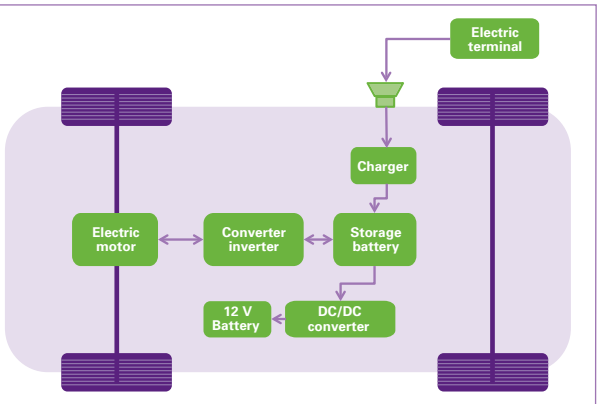
'Breakthrough' technologies must respond, both to the challenge of the depletion of resources by resorting to energy sources other than oil, and to the challenge of climate change by reducing CO_2 emissions. The electric vehicle comprises a new type of propulsion using potentially different energy sources and, in this sense, is considered to be a breakthrough vehicle.

However, the electric vehicle is not new technology. The first prototypes appeared in 1835, but the technology was really 'democratised' thanks to technological advancements in lead storage batteries from 1890. Electric vehicles were then introduced in Europe and the United States where they were used as city taxis. In 1894, Charles Jeantaud presented a two-seater electric vehicle called the 'Phaëton'. Although the first to participate in an automobile race, the 'Phaëton' model was beaten by the 'Jamais contente' (Never satisfied) manufactured by Camille Jenatzy and equipped with Michelin tyres, which drove faster than 105 km/h in 1899 (INA 1968). Despite a promising beginning, the slow progress made on batteries compared to the accelerated development of internal combustion engines relegated the electric vehicle to a position of secondary importance. Since petrol was cheap, the internal combustion engined vehicle became a means of personal transport and the electric vehicle, because of its poor range and high price, was forgotten from 1910 onwards.

How electric vehicles work

An electric vehicle, also called 'Battery Electrical Vehicle' (BEV), is propelled solely by an electric motor powered by the energy obtained from onboard batteries. The components of an electric vehicle are: an electric motor, a storage battery, a converter-inverter, a charger and a battery of a lower voltage with a DC/DC converter.

The converter-inverter translates the various signals (acceleration, braking, etc.) to control the electric motor, i.e. either to convert mechanical energy into electrical energy, or vice versa, depending on the driving phase. The charger converts the mains network electricity into direct current to recharge the batteries. Finally, the low voltage battery draws from the storage battery via the DC/DC converter, to supply the auxiliary systems (air conditioning, radio, heating, etc.).



Source: Natixis Asset Management / ANFA, 2011.

Figure 3: Components of an electric vehicle

One of the characteristics of the electric motor is reversibility. It is capable of:

- producing a mechanical force from electricity during the traction phases
- producing electricity from a mechanical movement during the braking phases.

This double capability allows electric vehicles to recover the energy produced during braking, and thus recharge the batteries. In fact, the movement of the wheels driven by the vehicle's momentum produces electricity, which is recovered by the batteries.

The electric vehicle differs from an internal combustion engine vehicle in that it has no clutch system, which means no gear shifting. The dynamic performance of this type of motor is superior to that of an internal combustion engine, with faster acceleration over a distance of 100 metres for two vehicles of the same type, and a smooth driving style with no risk of stalling and no engine noise.

There are currently three types of electric motor:

- asynchronous electric motors with an efficiency limited to ~80%, but at a lower cost
- synchronous electric motors with permanent magnet rotors, requiring rare earths
- synchronous electric motors with coil-wound rotors, more restrictive and costly in terms of electronics, but not requiring rare earth.

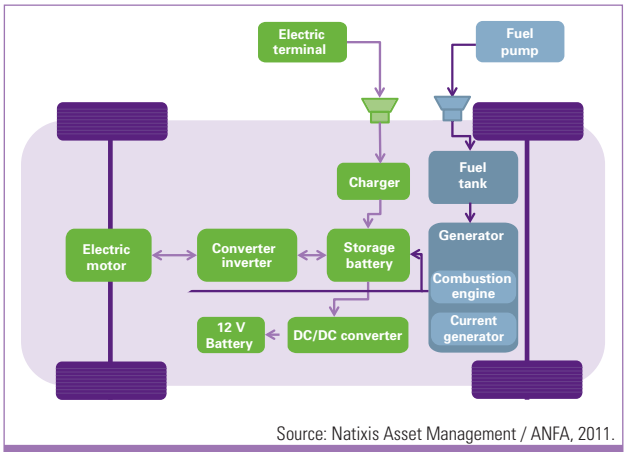
Motor technologies	Continuous current motor	Asynchronous motor	Permanent magnet rotor	Wound rotor
Manufacturers using this motor technology	Not used on current models; this type of motor was present on electric models marketed during the 1990s.	Better adapted for hybrid / electric vehicles: Tesla, Mia, Renault (Twizy), Chevrolet (Volt)	Electric vehicles: PSA (ion and C-zero), Mitsubishi (MiEV), BMW (future ActiveE) Hybrid vehicles: Toyota (Prius), PSA (Hybrid series)	Renault (Zoe, Fluence, Kangoo ZE), Bolloré (Bluecar)
Advantages	Easy driving at high speed.	Robust, Compact, Reliable, Low cost.	Mainten-ance saving.	Easy driving at high speed.
Disadvantages	Limited efficiency, high rotational speed, heat losses difficult to evacuate.	Heat losses Efficiency limited to ~80% diminishing over time.	Uses rare earth in the magnets.	Restrictive in terms of maintenance. Requires an electrical contact with the rotor.

Source: Natixis Asset Management / Expert VE, 2012.

Table 1: Electric motor technologies

An alternative: the range extender electric vehicle

The range extender electric vehicle, also called the 'Range Extender Battery Electrical Vehicle' (REBEV), is also solely propelled by an electric motor. However, this model has onboard a current generator and a fuel tank to recharge the batteries over longer distances. The electric motor has a power rating below that of an electric vehicle motor. It has enough batteries to ensure a range of approximately 60 km in pure electric mode without the use of the internal combustion engine. So, with a full tank and a battery recharged beforehand, the vehicle can travel approximately 500 km (Valeo 2010). Its operation is very close to that of a rechargeable hybrid vehicle except for the propulsion, which is only electric in the case of a range extender electric vehicle.



Source: Natixis Asset Management / ANFA, 2011.

Figure 4: Components of a range extender electric vehicle

Automobile and auto part manufacturers

Currently, the key players with the largest presence in the electrical vehicle sector are: Renault, Nissan, Chevrolet, Tesla and Mia Electric. Even though PSA Peugeot Citroën marketed two models designed by Mitsubishi, the group's commitment is more evident on hybrid diesel and rechargeable hybrid vehicles. Few manufacturers produce batteries in house. The table below lists the existing partnerships.

Battery manufacturers	Electric vehicle manufacturers	Model(s)
NEC/AESC	Renault Nissan	Fluence ZE(2011), Kangoo Express ZE (2011), Twizy (2011) Leaf
LG Chem	Renault General Motors Hyundai Motor Ford Volvo	Zoe (2012) Volt (2011) BlueOn (2012) Focus Electric (2013) C30 EV (2013)
Sanyo Electric (Panasonic)	Toyota Ford Volkswagen Suzuki	IQ EV (2012) Fusion, C-Max, Fusion Energi, C-Max, Energi plug-in e-up (2013), Golf blue e-motion (2013) PHEV Swift
A123 Systems	BMW Daimler GM Geely	ActiveHybrid 3 HEV, ActiveHybrid 5 HEV Hybrid bus Chevrolet Spark EV PHEV sedan
SB Limotive	BMW Fiat PSA Peugeot Citroën Volkswagen Daimler	Mini E e500 3008 HYbrid4 Porsche Cayenne, Touareg Hybrid N/A
GS Yuasa – Lithium Energy Japan	Honda Mitsubishi PSA Peugeot Citroën	Fit / Jazz EV MiEV C-Zero, Peugeot Ion
Hitachi	GM Daimler	Hybrid cars N/A
Johnson Controls	BMW Daimler Ford	N/A N/A N/A
Tesla Motors	Tesla Motors Toyota Daimler (Mercedes)	Roadster (2008), Model S (2013), Model X (2014) RAV4 EV Class B EV (2014), Classe A E Cell

Source: Natixis Asset Management / manufacturers and battery manufacturers.

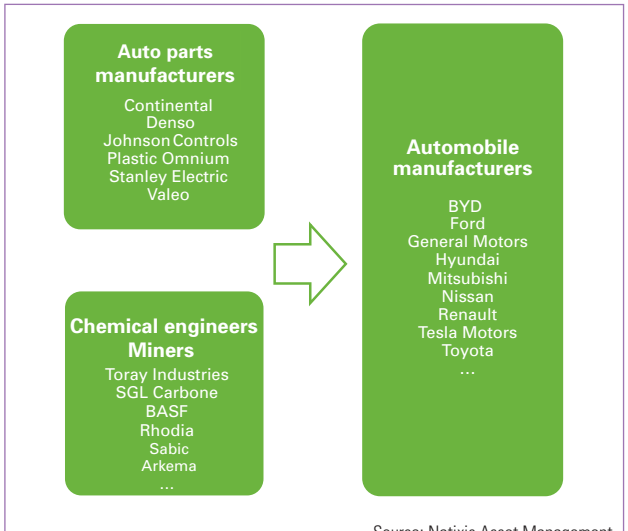
Table 2: From battery to manufacturer

Some conventional vehicle structure can be adapted to contain electric motors as well as storage batteries; however, automobile manufacturers are giving more and more priority to the design of specific chassis for electric vehicles, providing more range. Vehicles can vary widely in the way they are organised, with an electric motor in the front or the rear of the vehicle, and the batteries located under the floorboard.

Automobile and auto part manufacturers are faced with major challenges relating not only to the electric motor and the lightening of the vehicles, but also to the management of the consumption of the auxiliaries (heating, air conditioning, radio, and so on).

Technical assessments of the electric vehicle focus on the battery and the motor. A technological breakthrough is important to manufacturers whose knowledge of the internal combustion engine is becoming less useful. The deployment process of the electric vehicle implies de facto a confrontation between manufacturing experts in auto mechanics for internal combustion engines and firms concerned with the electric model: electric motor manufacturers, battery makers, auto part manufacturers, chemical engineers, etc. With diesel or petrol vehicles, the positioning of the manufacturers with respect to one another was relatively established. The advent of the electric vehicle shook up the entire sector: the leading global manufacturers are finding themselves falling behind, and the newcomers will become the major players within ten years.

Aware of this opportunity and of the growth of its automobile market, China has set ambitious objectives to deploy the electric vehicle and place its manufacturers among the world's best. Beyond the manufacturers, the internal combustion engine chain is affected as a whole: for example, the specialised auto part manufacturers (exhaust, foundry, engine parts, etc.) will experience a drop-off in their turnovers. Conversely, battery suppliers and auto part manufacturers specialising in making vehicles lighter will occupy an increasingly dominant place in the automobile sector.



Source: Natixis Asset Management.

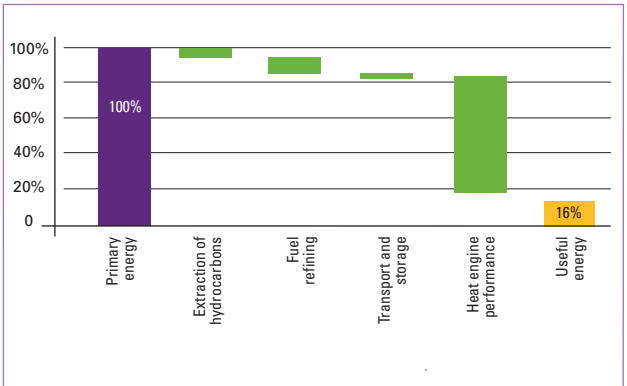
Figure 5: Vehicle design value chain

112 Interesting environmental performance

Similar energy efficiency

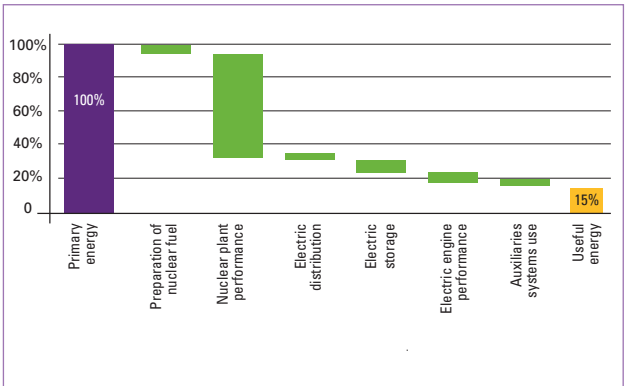
Regardless of the electrical motor technology deployed, when we consider the life cycle of combustion and electrical energies as a whole, the electric vehicle's efficiency[1] is equivalent to that of a petrol vehicle. Considering the vehicle by itself, the maximum efficiencies are 35% for the petrol vehicle, 45% for the diesel vehicle and between 80% and 95% for the electric vehicle's motor. However, to obtain real efficiencies, we should also integrate the losses due to:

- the extraction of raw materials (oil for combustion; gas, uranium, etc. for electric)
- the distribution from the central plant to the plug/pump
- the storage
- driving changes in the city or on the motorways
- the operation of the auxiliaries (heating, air conditioning, radio, and so on).



Source: Natixis Asset Management / U.S. Department of Energy – Manicore, 2012.

Figure 6: Energy efficiency of the combustion chain



Source: Natixis Asset Management / U.S. Department of Energy – Manicore, 2012.

Figure 7: Energy efficiency of the electric chain

(1) The energy efficiency of an engine or motor is the ratio between the energy supplied to the petrol engine or electric motor and the returned mechanical energy. To avoid useless energy losses, the optimising of this efficiency is a key research theme for manufacturers.

When we integrate all this data, the efficiency of the electric motor remains equivalent to that of a petrol engine. Energy expenditure is not the same for both chains. Thus, the losses of internal combustion engine vehicles are located in the automobile's engine, with an efficiency of around 20% (which means that only 1/5 of the energy released by the fuel's combustion is converted into mechanical energy, the rest being dissipated in the form of heat), while the electric chain is ineffective in terms of energy at the level of the central plant, whose efficiencies are around 30%. Note, also, that the energy used for the auxiliaries (heating in winter, headlights, windscreen wipers, radio, etc.) is more optimised for an internal combustion engine vehicle (which, for instance, reuses for heating the heat energy otherwise lost).

An interesting carbon footprint

The CO_2 emissions generated by an electric vehicle are zero during the usage phase 'from the plug to the wheel'.

However, the emission of carbon dioxide per kWh of electricity produced varies from country to country, depending on the electrical mix. The production of electricity can come from multiple sources, for example, coal, oil, gas, nuclear or renewable energies. So the interest in terms of CO_2 emissions depends heavily on the energy mixes. The table below points out the countries for which the electric vehicle represents an environmental opportunity. The consumption of an electric vehicle varies between 0.15 kWh/km (city car) and 0.25 kWh/km (utility vehicle). Multiplying this consumption by the CO_2 emissions per kWh of produced electricity, we obtain the CO_2 emissions per kilometre travelled in gCO_2/km.

Considering that a petrol vehicle 'from the well to the wheel' is responsible for ~150 gCO_2/km and that a diesel vehicle is responsible for ~135 gCO_2/km, the electric vehicle only offers advantages in certain geographical zones. The deployment of the sector implies large investments which can discourage some manufacturers who have a mitigated carbon profit on their sales areas.

On the other hand, we can see that the vehicle's size has a great influence on the CO_2 emissions generated. Both of these factors (electrical mix of the sales areas and range of proposed vehicles) can, in some cases, explain the differences in strategies applied by the manufacturers. For example, Renault is extremely interested in developing the electric vehicle with approximately 30% of its sales in France and market share in small vehicles.

Nonetheless, to be complete, it is also necessary to include electric vehicle production in the life cycle analysis. In this respect, manufacturers are not giving out much information. In the case of an internal combustion engine vehicle, greenhouse gas emissions are generated for:

- production of the materials used (plastic, aluminium, glass, steel, rubber, liquids, electronics, etc.)
- assembly in the factory (movements of employees, freight, shutdowns, waste, R&D, etc.).

Electricity mix in 2008	Fossil	Coal	Gas	Oil	Nuclear	Hydraulic	Renewable energy	Emissions (CO_2/kWh)	Emissions of CO_2/km (0.15 kWh per km)	Emissions of CO_2/km (0.25 kWh per km)
World	67%	41%	21%	5%	14%	16%	2%	446	67	111
North America	66%	43%	21%	2%	18%	13%	3%	446	67	111
USA	71%	49%	21%	1%	19%	6%	4%	488	73	122
Latin America	26%	3%	14%	15%	2%	63%	3%	177	27	44
Brasil	14%	3%	6%	4%	3%	80%	4%	88	13	22
EU	55%	28%	24%	3%	28%	10%	7%	346	49	81
Germany	62%	44%	13%	5%	23%	3%	12%	438	62	104
France	10%	6%	3%	1%	77%	11%	2%	80	12	20
Italy	79%	15%	45%	19%	0%	3%	18%	414	62	104
Russia	69%	19%	48%	2%	16%	16%	0%	361	54	90
Africa	83%	43%	28%	12%	2%	15%	0%	525	79	131
Middle East	99%	5%	58%	36%	0%	1%	0%	470	71	118
China	81%	79%	1%	1%	2%	17%	0%	645	97	161
South Korea	65%	39%	20%	7%	34%	1%	0%	430	65	108
Japan	66%	27%	26%	13%	24%	7%	3%	402	60	100
India	83%	69%	10%	4%	2%	14%	1%	618	93	154
Australia	93%	79%	10%	3%	0%	5%	2%	695	104	174

Source: Natixis Asset Management / International Energy Agency, 2010 / European Commission, 2012.

Table 3: Electricity mix by country

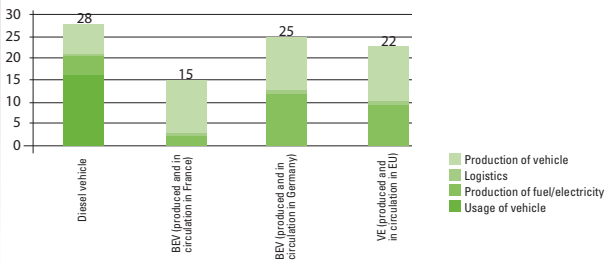
For each tonne in an internal combustion engine vehicle, the emissions linked to the manufacture of the materials are estimated at 950 $kgCO_2eq$, and for assembly, another 10% according to the French Environment and Energy Control Agency, ADEME, which gives us ~1,500 $kgCO_2eq$ for a vehicle tonne (ADEME/Carbon Balance Sheet of Companies and Communities, 2010). The service life of a vehicle is approximately 150,000–200,000 km. So if we consider an internal combustion engine vehicle with an unladen weight of 1,200 kg, we obtain between 9 and 12 gCO_2eq/km. Therefore, we can consider that ~10 $kgCO_2/km$ has to be added to obtain a global balance sheet of CO_2 emissions for an internal combustion engine city car.

This calculation is not given for the electric vehicle. However, the emission factors are not the same. Automotive design platforms may be identical to those of the internal combustion engine vehicles or specific to an electric motorisation which optimises the vehicle's performance, which is already impacting on the CO_2 emissions during production. Moreover, the production of an electric vehicle, particularly with respect to the motor and the batteries, implies a supply of different raw materials and new manufacturing processes. Renault issued an analysis of the life cycle[2] of an electric vehicle of type Fluence ZE (Renault, 2011). According to this document, the production of an electric vehicle in France generated 15 $teCO_2$ globally, while a diesel vehicle type Laguna DCI 110 generates 28 $teCO_2$. The bar graph and table in Figure 8 show the extent of the CO_2 emissions due to the production of an electric vehicle subject to the following assumptions:

- CO_2 emissions/km from 'well to wheel' in France for a vehicle consumption of 0.2 kWh/km: 16 gCO_2/km[3]
- CO_2 emissions/km from 'well to wheel' in Germany for a vehicle consumption of 0.2 kWh/km: 83 gCO_2/km
- CO_2 emissions/km from 'well to wheel' in Europe for a vehicle consumption of 0.2 kWh/km: 65 gCO_2/km
- CO_2 emissions/km from 'well to wheel' of a diesel vehicle: 135 gCO_2/km (110 gCO_2/km during the usage phase and 25 gCO_2/km during the fuel production phase)
- Average service life: ~150,000 km
- Percentage of the contribution of the support functions and logistics to the CO_2 emissions in the global carbon footprint: 1.5% (Renault, 2011).

The details in Figure 8 show that an electric vehicle would reduce CO_2 emissions by 20% with respect to a diesel vehicle over an average complete life cycle in Europe. The production of an electric vehicle would then negatively compensate for a part of the CO_2 emissions avoided during the usage.

Renault's aim is to sell its electric vehicles in France where the gain in CO_2 is approximately 50%, but this calculation may explain the reluctance of some other manufacturers. However, these figures are to be reconsidered on account of the potential improvement of the energy mixes in many countries, as well as the increasing efficiency in the production of electric vehicles with economies of scale. Moreover, we do not have other data to confirm or invalidate these first results.



Phases	Usage of the vehicle	Production of the fuel/ electricity*	Support functions and logistics	Production of vehicle from supply of raw materials to end of life	Total
Diesel vehicle	110 gCO_2/km x 150,000 km = 16.5 tonnes	25 gCO_2/km x 150,000 km = 3.8 tonnes	1,5% x 32 tonnes = 0.5 tonnes	28 tonnes – (16.5+3.8+0.5) tonnes = 7.2 tonnes de CO_2	28 tonnes
Electric (France)	0 tonne	16 gCO_2/km x 150,000 km = 2.4 tonnes	1,5% x 32 tonnes = 0.5 tonnes	15 tonnes – (0+2.4+0.5) tonnes = 12.1 tonnes de CO_2	15 tonnes
Electric (Germany)	0 tonne	83 gCO_2/km x 150,000 km = 12.5 tonnes	1,5% x 32 tonnes = 0.5 tonnes	12.1 tonnes**	25 tonnes
Electric (EU)	0 tonne	65 gCO_2/km x 150,000 km = 9.8 tonnes	1.5% x 32 tonnes = 0.5 tonnes	12.1 tonnes**	22.3 tonnes

Figure 8: CO_2 emissions from the production of an electric vehicle (tonnes)

Response to a health challenge

Talking only about CO_2 emissions, some countries do not have a great interest in developing the electric vehicle without applying in parallel a strategy for lowering the carbon intensity at the level of electricity production. However, the electric vehicle also offers the advantage of not emitting polluting particles (fine particles, gases, odours, increases in exhaust fumes, and so on). According to the WHO, more than 1.4% of deaths in the world are probably induced by polluting particles in the air. They are also probably responsible for the reduction of 8.2 months in life expectancy in the EU 15, and 10.3 months in the new EU states. Fine particles of 2.5 micrometres in diameter (PM2.5) are the most dangerous. Many urban areas are supporting the fight against atmospheric pollution: urban tollgates, exemptions, reductions and subscription options are an additional argument in favour of the electric vehicle.

(2) CO_2 emissions generated all through the life cycle: production of the vehicle, end of life of the vehicle, production of electricity, use of the vehicle, and logistics.
(3) Natixis Asset Management, European Commission, 2012.

113 Electric vehicles – still penalised for their economic performance

The purchase price of the electric vehicle is higher than that of a vehicle with the same internal combustion engine size.

New marketing options are thus proposed:

- vehicle purchase
- vehicle rental
- vehicle purchase and battery rental.

As we can see in the table below, the global price of an electric vehicle over eight years varies from 27,000 to 50,000 euros.

Thus, the electric vehicle remains more expensive than an internal combustion engine vehicle.

Another factor which is not in favour of the electric vehicle also has to be taken into consideration: this type of vehicle is marketed as a 'secondary vehicle'; in fact, its usage being reduced to short distances implies a strong likelihood of needing another car for longer trips.[4]

Moreover, in our calculation, we considered an average distance of 15,000 kilometres per year, that is, an average of approximately 40 kilometres per day. Below a number of daily kilometres, the difference between an internal combustion engine vehicle and an electric vehicle is intensified because the cost of the fuel per kilometre does not compensate for the initial cost of the battery.

Thus, the electric vehicle is technically limited to trips shorter than about 150 kilometres, but must travel at least 40 kilometres to remain within a reasonable profitability scheme.[5] In this context, company fleets appear to be the potential customers best suited for this type of vehicle.

These prices are to be re-evaluated based on the subsidies allotted by the governments supporting the development of cleaner mobility. Such governmental assistance can take several forms including, for example, purchase premiums and tax incentives. These are needed to accelerate the development of the sector.

However, it should not be overlooked that these subsidies are going to diminish. We think that the deployment of the electric vehicle sector will require technological advancements to significantly reduce the price of the batteries to render the electric vehicle affordable without subsidies.

(4) On this point, Renault is considering commercial proposals to allow someone to rent an internal combustion engine vehicle for the duration of a trip and recover their electric vehicle on their return, thus eliminating the problem of long journeys.

(5) General Council of Industry, Energy and Technology (CGIET), 2011.

Table 4: Commercial supply of electric vehicles

Electric vehicle	Marketing mode		Consumption (kWh/km or litres/100km)	Fuel costs (euros)	Global price over 10 years or 150,000 km (€)
Renault 'Zoe'	Car purchase: €15,000 + rental of batteries for €100/month		0.15 kWh/km	2,340	26,940
Peugeot 'Ion'	Car rental: €499/month		0.12 kWh/km	1,872	49,776
Citroën 'C-zéro'	Car rental: €459/month for 4 years, and then €260/month for 4 years		0.12 kWh/km	1,872	36,384
BMW 'Mini E'	Car rental: €475/month		0.21 kWh/km	3,276	48,876
Mitsubishi 'Mi-EV'	Purchase and resale after 10 years = €32,700 – €5,486	Repairs/servicing = €4,800	0.12 kWh/km	3,024	35,038
Nissan 'Leaf'	Initial down payment of $1,999 (€1,425) + $349/month (€250/month)		0.15 kWh/km	3,780	29,205
Internal combustion engine	Purchase and resale after 8 years = €9,000€	Repairs / servicing = €5,000	5 litres/100km	7,800 €	22,000 €

Source: Natixis Asset Management.

Assumptions

Average kilometrage: ~15,000 km/year, that is, 120,000 kilometres travelled in eight years – Resale value calculation with a loss in value of 20% per year – Average electricity price in Europe: ~€13/100 kWh (Eurostat 2011) – Average electricity price in Japan: ~ €21 /kWh (Fournisseur électricité 2010) – Fuel expenditure: (consumption x 120,000 km x price of electricity) – Average cost in repairs/servicing = €600/year

2 | Barriers to development

2.1 Upstream: raw material resources

Vehicle structure

Electric vehicles are benefitting more and more from specific chassis to optimise performance and range. Here, space and weight gains are top priority. In this context, the auto part manufacturers must integrate lighter materials, such as carbon fibre and plastic. These new components will also face their own challenges in terms of resources, recycling and environmental footprints. These factors must be taken into account by auto part and automobile manufacturers.

Electric motors and electrical circuits

Rare earth elements (REEs)

The manufacture of synchronous electric motors with permanent magnets requires the use of rare earth elements (neodymium). 97% of the production of REEs comes from China, which is reducing its exports little by little to give priority to its own internal demand. China holds only 50% of the world reserves (USGS, 2012), but has set up large storage capacities to eventually control the market of technologies depending on REEs. Thus, this resource does not pose any problems in terms of reserves, but remains uncertain in terms of supply.

A European Commission Report published in 2010 lists neodymium as one of the most critical raw materials for the EU economy. Early in 2011, Chinese authorities announced China's intention to limit the quantity exported to 14,446 tonnes in 2011, and to subsequently set up annual export quotas in accordance with the rules of the World Trade Organization.

China also has the advantage of knowing the separation processes indispensable for the production of REEs. It will take a long time for other countries to catch up with this know-how. However, reserves of REEs are present in many other places, including the Commonwealth of Independent States, United States, India and Australia. Many of them are already investing in rare earth mines.

As a result, this topic must continue to be watched to ensure the supply of REEs and avoid slowing down the deployment of the electric sector. Recourse to another type of motor not requiring REEs also remains possible: the synchronous motor with coiled rotor (more demanding and costly in terms of electronics).

Copper

The supply of copper used in electrical circuits (and in lithium-ion batteries) can also prove complicated due to an increasing demand, notably from China, and in view of variable levels of copper production. An electric vehicle uses twice as much copper (~50 kg) as an internal combustion engine vehicle.[5] However, these considerations are limited to the supply. Given that reserves are moderate and not rare and that recycling capacities should improve, we do not consider that copper can limit the development of the electric vehicle.

To sum up, these last two resources do not pose any problem in terms of reserves, but only in terms of supply. The difficulties can be circumvented by a more significant investment in production.

The analysis of the potential limits on the resources used in storage batteries is presented later in the next section (see 'Raw materials: the most decisive barrier in the choice of technologies' later in this article).

2.2 The storage battery: keystone of the sector

Various battery technologies coexist

To store the produced electrical energy, this type of vehicle has to contain a storage battery. The first batteries were made of lead. Today, several technologies are competing with different characteristics relating to:

- the usable power corresponding to the motor's peak power
- the specific energy corresponding to the quantity of energy stored per kg of battery and, indirectly, to the vehicle's range
- the operating temperature range
- the number of cycles corresponding to the service life and cost per kWh.

Table 5 summarises the characteristics of the main batteries in use in the electric vehicle. Considering the elements presented in the table, we can see that:

- lead (pb) batteries continue to used, particularly for scooters and electric bikes, or for forklifts
- nickel-cadmium (Ni-Cd) batteries can no longer be used for reasons of toxicity
- nickel metal hydride (Ni-Mh) batteries are used extensively for hybrid vehicles (Toyota Prius, Toyota Auris, BMW X6, etc.), but are not suitable for electric vehicles or rechargeable hybrids which require power batteries capable of storing much more energy (insufficient range) and longer charge/discharge cycles
- zebra batteries (installed in the CITROEN/VENTURI Berlingo used by the French postal system) do not have sufficient power to be suitable for electric vehicles with more and more powerful motors
- lithium-ion ($LiCoO_2$) batteries are the most widely used on current generations of electric vehicles

(5) General Council of Industry, Energy and Technology (CGIET), 2011.

Table 5: Battery characteristics

Batteries	Pb	Ni-Cd	Ni-Mh	Zebra	$LiCoO_2$	Li-Po	$LiFePO_4$	LPM
Date of appearance	~1850	~1900	~1990	~1990	<2000	<2000	<2000	<2000
Specific energy (Wh/kg)	40	50	80	120	150	190	120	110
Peak power (W/kg)	700	-	900	150	1,500	250	800	-
Number of cycles	~500	1,500	1,000	1,000	1,200	2,000	2,000	1,800
Costs (€/kWh)	~200	~600	~1,500	~500	~500	~1,500	~1,000	~1,500
Advantages	Low cost	Reliability	Cyclability (i.e. service life)	Specific energy, cyclability	Specific energy, power	Space gains	Cyclability	Space gains
Limits	High toxicity of lead,[1] Low specific energy (i.e. short range)	High toxicity of cadmium,[2] Low specific energy, Memory effect	Cost, Uses rare earths (e.g. lanthanum), Self discharge capacity (30%)	Limited power, High self-discharge (12%/day)	Cost, Requires a BMS[3] to prevent risks of explosion	Limited power, Cost	Problem of temperatures for charging	Cost, Low temperature performance

Source: Natixis Asset Management / ANFA, 2011 / General Council of Industry, Energy and Technology (CGIET), 2011/ ADEME, 2005 / Mines-Energie, 2005.

(1) Recycling lead batteries has a disastrous effect on the health of populations in charge of recycling. The Blacksmith report has identified it as the most toxic industrial activity in terms of the number of years of life lost (Blacksmith Institute, 2012). • (2) Official journal of the EU, 'Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment'. See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0019:002 3:en:PDF. • (3) The Battery Management System (BMS) ensures temperature control and removes the risk of explosions.

- lithium-polymer (Li-Po) batteries, still expensive, are mainly used on small models (mobiles, laptops), but are also beginning to appear on electric bikes and electric cars (Venturi Fetish, etc.)
- lithium iron phosphate ($LiFePO_4$) batteries are beginning to appear on the electric vehicle market (MIA Electric Mia)
- lithium metal polymer (LMP) batteries, still very dear, are installed in Bolloré Bluecars.

We should also note the advancements made on the promising lithium-air technology, the energy density of which is higher than 2,000 Wh/kg, but which is subject to other disadvantages, such as low specific power and the risks of corrosion.

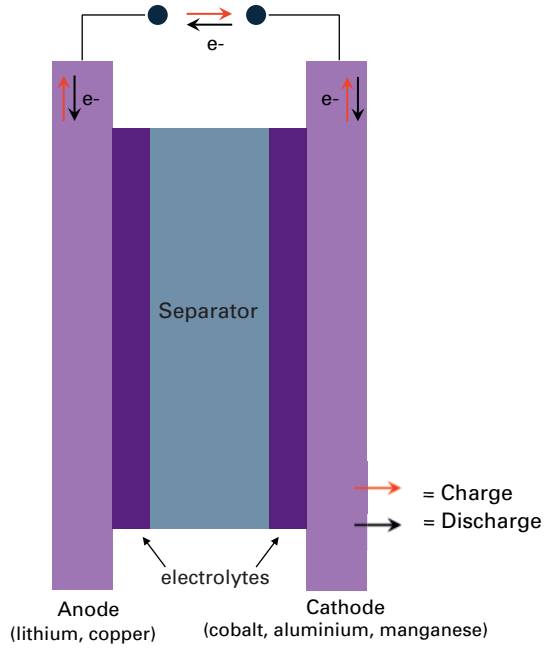
At this stage, only batteries using lithium seem to be suitable for electric vehicles and rechargeable hybrids. The sales distribution of rechargeable batteries by technology confirms this trend: 70% lithium-ion, 10% lithium-polymer, 10% nickel metal hydride and 10% nickel cadmium.

For the rest of this section, we will concentrate on the case of lithium-ion batteries, considering their predominance on today's market.

Battery safety: The electric vehicle's 'licence to operate'

Some lithium batteries are subject to the risk of explosion and gas releases. Two electrodes that come into contact during the manufacturing or recharge phase of the battery caused by the formation of lithium dendrites can trigger a short-circuit, provoking a thermal runaway condition and therefore an explosion. So, to prevent the formation of dendrites, the charge temperature has to be maintained within a certain range. Thus, all lithium-ion batteries must be equipped with these Battery Management Systems (BMS) to keep the temperatures under control.

Figure 9: Lithium-ion battery operation



Source: Natixis Asset Management.

Lithium-ion batteries can be built with two anode types, lithium titanate and graphite, and five cathode types: cobalt oxide ($LiCoO_2$), NCA ($Li(NiCoAl)O_2$), NMC ($Li(MnCo)O_2$), manganese oxide ($LiMn_2O_4$) or iron phosphate ($LiFePO_4$). For each cathode type, thermal runaway – more or less intensive – can take place at different temperature ranges.[6]

Cathode name	Cobalt dioxide	NCA	NMC	Iron phosphate	Manganese oxide
Formula	$LiCoO_2$	$Li(NiCoAl)O_2$	$Li(MnCo)O_2$	$LiFePO_4$	$LiMn_2O_4$
Specific energy (Wh/kg)	-	529	476	424	419
Temperature range	180°C to 370°C	210°C to 330°C	230°C to 290°C	180°C to 320°C	200°C to 250°C
Thermal runaway speed	up to 360°C/ minute	up to 290°C/ minute	up to 60°C/ minute	up to 10°C/ minute	up to 10°C/ minute

Source: Natixis Asset Management / General Council of Industry, Energy and Technology (CGIET), 2011.

Table 6: Cathode technologies

The table above shows that cathodes producing the best specific energies, i.e. the longest travelling ranges, are also those which are the most exposed to the risk of thermal runaway with cobalt dioxide presenting the greatest risk.

The lithium-ion battery, the most common in use, has among the lowest risks of thermal runaway with a manganese dioxide cathode. However, other criteria impact on the choice of cathodes, such as cost, lifetime, specific power, or even time required to recharge.

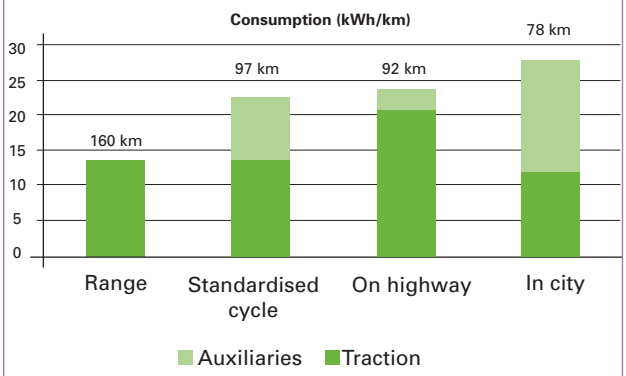
We can see that this topic has created diverging opinions and that the risks specific to the electric vehicle can prove detrimental to consumer confidence. But the internal combustion engine has also its own specific risks (explosion, for example) which have been accepted and even ignored by drivers for years. The electric vehicle has not yet progressed this far in the minds of the general public.

Range of lithium-ion batteries: a less and less important topic

The range of an electric vehicle, which is clearly less than that of a vehicle with an internal combustion engine, depends on the capacity of the batteries on board the vehicle and the consumption needed to drive it. The average range attained today is approximately 150 km. Usage must therefore be limited to short trips. Given that 90% of daily trips are less than 80 km, the electric vehicle has its place in many situations and for a precise usage.

The ranges given correspond to those that can be attained under optimum conditions. In reality, the range corresponds to 75% of the range claimed by the manufacturers under normal usage conditions. Thus, in the case of the future Renault Zoe, claimed as 220 km, the reality in terms of range corresponds to 165 km. The way the vehicle is driven – smoothly or nervously – has an important impact on the vehicle's range. As a result, driver training would be a good idea. It should also be noted that the auxiliaries (heating, air conditioning, lighting, windscreen wipers, radio) can not be ignored as range reducers, but are omitted today in the claims made for ranges. The tests are performed under optimum conditions (smooth driving, no wind, no heating or air conditioning), which explains the differences between the real range and the claimed range. The Strategic Analysis Centre conducted three scenarios to represent the importance of the auxiliaries on an electric vehicle's range.

Figure 10: Range variations in electric vehicles depending on usage



Source: Natixis Asset Management / General Council of Industry, Energy and Technology (CGIET), 2011.

Assumptions

Battery capacity of 22 kWh, range of 160 km in standardised cycle with an average speed of 33.6 km/h, consumption linked to traction of 13.8 kWh/100 km (city car).

– Driving in standardised cycle under winter conditions (–5°C outside), average speed of 33.6 km/h, consumption linked to traction of 13.8 kWh/100 km and auxiliary consumption of 3 kW to ensure heating.

– Driving on highway under winter conditions (–5°C outside), average speed of 100 km/h, consumption linked to traction of 21.0 kWh/100 km and auxiliary consumption of 3 kW to ensure heating.

– Driving in city under winter conditions (–5°C outside), average speed of 18.8 km/h, consumption linked to traction of 12.0 kWh/100 km and auxiliary consumption of 3 kW to ensure heating.

Some projects show that it is possible to extend the range with photovoltaic panels on the roof. By accepting the optimum assumptions,[7] solar energy would help recovering 750 Wh in three hours, giving a range of nearly 5 km.

(6) Sandia National Laboratories, 2010.

(7) A 1 m² panel on the roof of a city car consuming 0.15 kWh/km, solar lighting of 1,000 W/m² equivalent to the power supplied by the sun at noon in clear weather at a temperature of 25°C, a panel yield of 25%; thus, a delivered power of 250 W/m².

Table 7: Tesla Motors models

Tesla models	Marketing date	Chassis	Battery capacity	Range	Price
Roadster		Combustion – adapted from Lotus Elise	56 kWh	395 km (245 miles)	€95,000 €
Model S	2013	Specifically designed for an electric motor	85 kWh	480 km (300 miles)	€84,900 €
Model X	2014	Specifically designed for an electric motor	85 kWh	–	Comparable to the Model S price

Source: Natixis Asset Management / Tesla Motors, 2012.

Even though most of the ranges claimed are limited to 150 km, Tesla Motors proposes models attaining two and even three times this range.

Using lithium-ion technology, the company also equips the Toyota RAV4 and the future Mercedes Benz Class B with batteries, while keeping secret the technological advancements that allow it to attain such a range.

We do not consider range as an insurmountable obstacle for the electrical sector. On the one hand, technological evolution will progressively increase the range. On the other hand, on the consumer side, we are witnessing today a paradigm change concerning the car's place in our societies. Formerly, in developed countries, the coveted car symbolised financial success par excellence. Today, behaviours have evolved; the Y generation is less obsessed by big-engined cars than by the practicality and adequacy of the vehicle to their way of life. With soaring urbanisation, inter- and peri-urban area movements will create fewer and fewer kilometres travelled and range will be less and less a barrier to purchase.

Lithium-ion battery service life: not a priority issue

The service lives of lithium-ion batteries vary from 7 to 8 years, that is, approximately 200,000 km. Despite remaining in the same order of magnitude, battery service life can vary according to the following parameters: number of cycles, usage and charging mode, type of driving, number of fast or incomplete charges, and so on.

However, the service life should not be an inconvenience for the consumer when renting batteries from the manufacturer. The rental system adopted in many commercial offers in the sector allows customers to change batteries without being concerned about it.

Considering the progress that is being made in the recycling of cobalt and lithium, the service life of the batteries is not, in our opinion, a high priority topic.

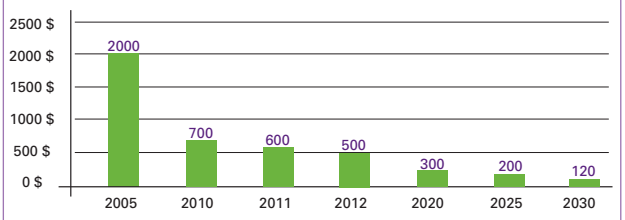
Battery cost: a key indicator for the development of the sector

The range of electric vehicles depends on the capacity of the onboard batteries. Existing vehicle battery capacities vary in most cases between 15 and 30 kWh with ranges around 150 km.

Up to now, one of the main factors slowing down the development of lithium-ion batteries was their cost.

However, this has significantly dropped over these last years and should continue to do so, as shown in the bar graph below.

Figure 11: Lithium-ion batteries, price variation (€/kWh)



Source: Natixis Asset Management / Roland Berger, 2011 / Bloomberg New Energy Finance s.d.

At this stage, the price of lithium-ion batteries remains high mainly because of the raw materials (Rolland Berger, 2012). In fact, for a vehicle with a 16 kWh battery, a range of 150 km and a sales price of €30,000, it would be necessary to count on a cost of €8,000 for the battery alone, i.e. nearly 30% of the vehicle's price.

Technological improvements reducing the electricity consumption per kilometre could also lower the cost of the electric car. Today, electricity consumption varies between 0.15 kWh /km and 0.25 kWh/km according to the vehicle's category, and covers the vehicle's drive chain, lighting, heating or air conditioning. Lower energy demands for these items would extend the range without increasing the stored capacities.

An electric vehicle cannot recover the evacuated heat lost by the internal combustion engine. As a result, heating and air conditioning are taken directly from the energy on the battery. But in very cold winters, the energy consumed by the heating equals the consumption of the drive chain. Therefore, it will be necessary to add an independent heating system, for example, electric heating resistances or less demanding equipment in terms of battery power, such as a heat pump or a heat storage device. Eventually, research will find the way to recover the energy losses from the drive chain (batteries, power electronics and motor) to heat the passenger compartment. Conversely, in very hot periods, the air conditioning can also absorb up to half the power needed for driving.

Lighting, another energy consumer, may also be saved through the wider use of xenon lights and/or various Light Emitting Diodes (LEDs). Resorting to the use of solar panels could also provide additional energy to maintain the characteristics linked to comfort and driving safety.

Integrating all these new technologies, however, increases the cost. Nonetheless, we are confident about the trend towards lower costs in the medium term. However, we consider that the cost of batteries is one of the main handicaps faced by development over the short term.

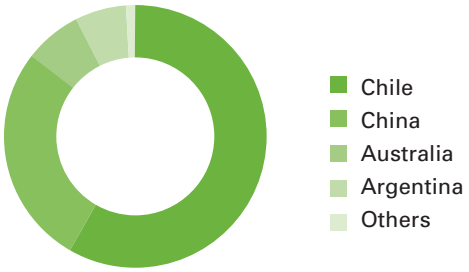
Raw materials: the most decisive barrier in the choice of technologies

The lithium-ion battery, the most commonly used battery technology in the development of the electric vehicle, is also the most problematic in terms of raw materials. In fact, lithium-ion batteries principally use lithium and cobalt.

Lithium, recycling sectors to be developed

Although lithium is a relatively abundant element, much of it is difficult to access. Lithium is present in sea salt in very small quantities, as well as in salt deserts, minerals, oil fields or even oceans (Bihouix, 2010). While resources are estimated at 34 million tonnes, lithium reserves amount to 13 million tonnes (USGS, 2012) and are distributed as shown in the chart below:

Figure 12: World lithium reserves



Source: Natixis Asset Management / USGS, 2012.

The annual production in 2011 was 34,000 tonnes and usage is distributed as follows: glasses and ceramics (29%), batteries (27%), lubricating greases (12%), continuous casting of steel (5%), air conditioners (4%), polymers (3%), primary aluminium production (2%), pharmaceutical products (2%), other (16%). 9,180 tonnes were used for batteries.

According to reports, estimations vary widely on the quantity of lithium needed to produce a capacity of 1kWh for a lithium-ion battery, ranging from 80 grammes to 246 grammes of lithium depending on the chemical processes:

- 425 grammes of lithium carbonate equivalent (LCE), i.e. 80 grammes of lithium (Dundee Capital Markets, 2009)
- 87 grammes of lithium (Bihouix, 2010)
- 840 grammes of LCE, i.e. 158 grammes of lithium (Reuters, 2011)
- 600 grammes of LCE, i.e. 113 grammes of lithium, to 1.3 kg of LCE, i.e. 246 grammes of lithium, depending on the cathode types (Argonne National Laboratory, 2009).

By taking an average/high assumption of 150 grammes of lithium per kWh produced and an average consumption of 0.2 kWh/km, we obtain the information in Table 8.

Table 8: Lithium quantities required per vehicle type

	Electric vehicles (EV)	Hybrid rechargeable vehicles (PHEV)
Consumption (kWh/km)	~0.15	~0.20
Electric range (km)	130	50
Capacity (kWh)	19.5	10
Quantity of lithium required (kg)	2.9	2.9

Source: Natixis Asset Management, 2012.

To these, we must add the batteries of fuel cell vehicles that are equipped with lithium-ion batteries storing a capacity of ~1.5 kWh (Balkan Star Automotive Ltd. 2011).

In its 'Blue map' scenario, where CO_2 emissions linked to transport are 30% below the level of 2005, the International Energy Agency (IEA) predicts that the annual sales of electric vehicles and rechargeable hybrid vehicles will increase, starting from 2015, to reach 7 million in 2020 and 100 million in 2050.[8] With this scenario, the stock of electric vehicles and rechargeable hybrid vehicles would be 1.1 billion vehicles, with 524 million electric vehicles and 603 million rechargeable hybrid vehicles, which represents a demand of 2.4 million tonnes over 35 years. We should point out that the IEA estimates are very optimistic concerning the growth of electric and rechargeable hybrid vehicles.

In every case, lithium is not regarded as a fossil fuel, due to the fact that it is 98% recyclable. Once the first generation of batteries are worn out, the reuse of the lithium will constitute a new source. To preserve the raw material resources and lower the manufacturing cost of batteries, the development of recycling appears to be a major challenge today, even though, at this stage, it is not economically as profitable as resorting to the raw material (Les Echos, 2010).

There are two solutions for recovering the materials of the electric car battery: chemical or thermal. The recycling sectors are still to be created and will also be the new players in the model. The European Union has set a stringent recycling objective of 45% for portable equipment batteries by 2016. In 2006, 20% of all batteries were recycled. Moreover, since 2005, the European Directive on End-of-Life Vehicles (ELV) has imposed on manufacturers the duty to recycle or reuse 85% of the vehicle's weight, rising to 95% in 2015.

Even though the application of this directive to electric vehicles is not clear, the considerable weight of the batteries in an electric vehicle may make battery recycling a serious regulatory issue. The 'European strategy for energy efficient and clean vehicles', rendered public on 28 April 2010 by the European Commission, hopes to encourage European research programmes on the recycling and reuse of batteries. In addition, the United States announced in August 2010 that the federal government would subsidise lithium battery recycling projects within the framework of the American Recovery and Reinvestment Act.

(8) IEA, 2009.

Another important point in the development of the electric vehicle is the diversification of lithium supply sources. Today, 85% of the production is controlled by 4 companies: Rockwood via Chemetall and Talison (buyout in 2012), SQM, and FMC (Lithium Americas 2012) / (Usine Nouvelle 2012).

Cobalt, a limited resource

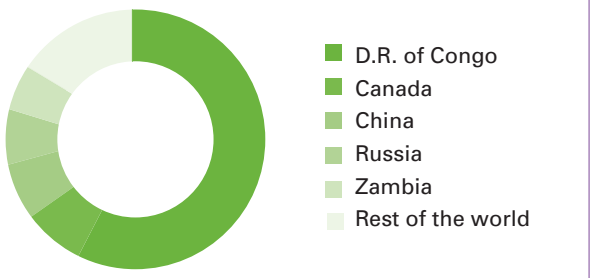
The lithium-ion technology also uses cobalt to manufacture cathodes. 45% of the cobalt reserves, estimated at 7.5 million tonnes, are located in the Democratic Republic of the Congo (DRC) (USGS, 2012).

Although its resources are not considered to be rare, cobalt is problematical due to its strong presence in the DRC which is particularly known for mineral conflicts linked to the money obtained through trafficking.

Batteries represent 25% of the usage of cobalt. Given that cobalt is a subproduct of the extraction of other metals (essentially copper and nickel, but also lead and zinc), its production is indexed on the production of other resources. In 2011, the annual production was 98,000 tonnes. But the production of an electric car requires approximately 3 kg of cobalt (Bihouix, 2010).

Thus, with the current production of 98,000 tonnes/year (USGS, 2012) and all uses restricted to that for batteries, it would be possible to produce only 33 million electric vehicles annually. Also, remember that the recycling ratio represents today only 24% of consumption (Chemical Society of France / Société chimique de France, 2012).

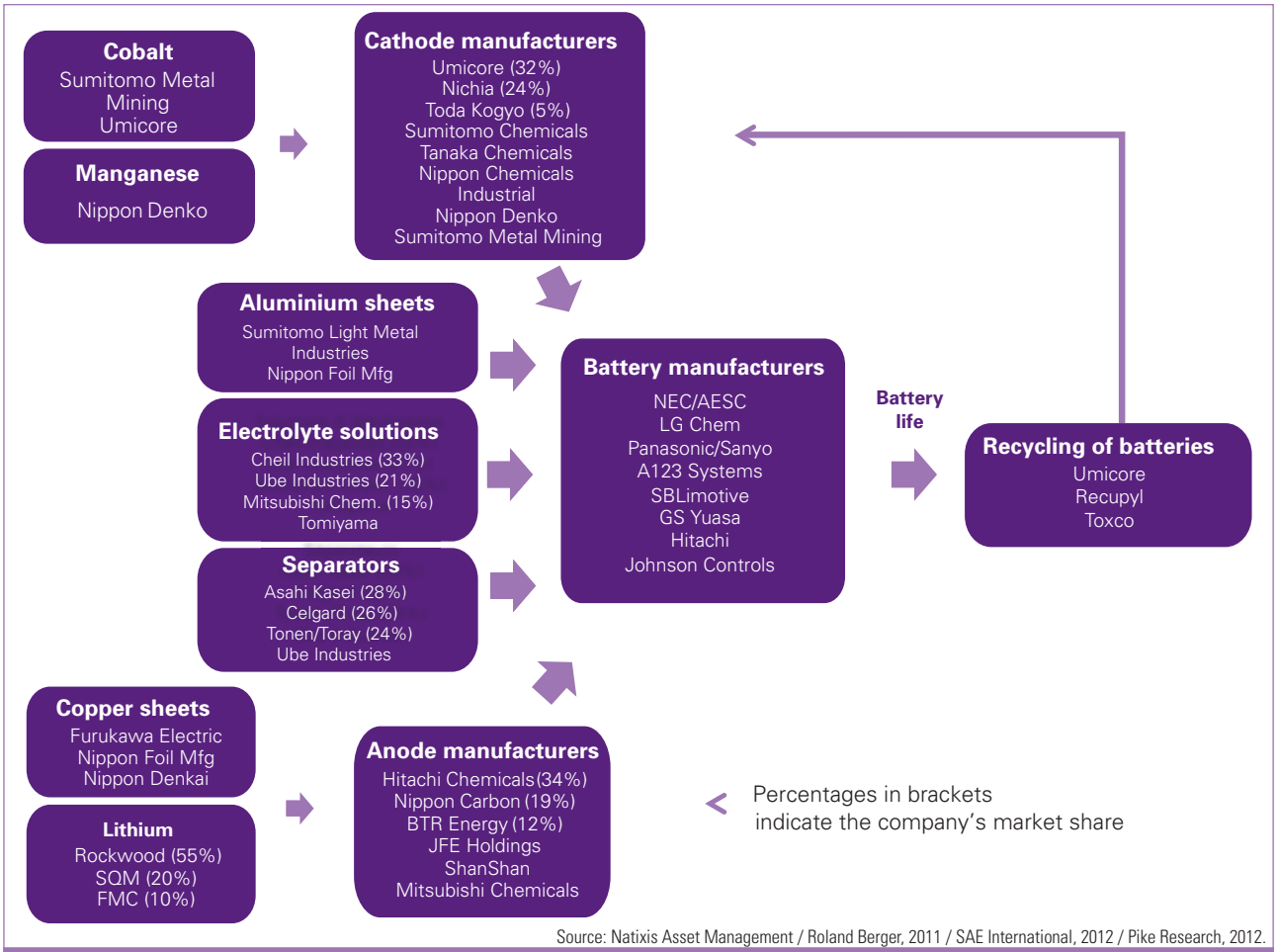
Figure 13: World cobalt production



Source: Natixis Asset Management / USGS, 2012.

As a result, to avoid limiting the electric vehicle's development, it is necessary either to increase cobalt production (which could eventually pose a problem for the reserves) or to turn to other technologies which do not use cobalt (lithium polymer, lithium iron phosphate or lithium metal polymer).

We estimate that raw materials may constitute one of the most difficult barriers to overcome in the long term with a large-scale deployment, not for the electric vehicle, but for the lithium-ion battery technology.



Source: Natixis Asset Management / Roland Berger, 2011 / SAE International, 2012 / Pike Research, 2012.

Figure 14: Lithium-ion battery production value chain

Battery manufacture and end of life depend on only a very few players

From the production of raw materials for anodes and cathodes to recycling at end of life, the challenges centring around the batteries of electric vehicles are significant.

The companies listed in Figure 15 have, de facto, a leading role, whether concerning lithium or cobalt. The figure below demonstrates the following particular points:

- the lithium-ion battery market is oligopolistic over most of the segments, with between 60% and 85% of the market shares held by only three companies
- the companies involved in lithium and cobalt recycling are few (due to the economic factors indicated previously in this section)
- finally, the sector is dominated by Asiatic companies.

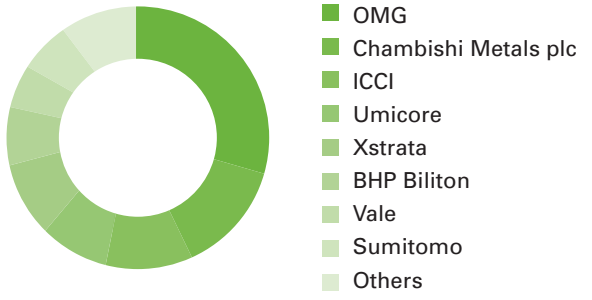
Figure 15: Battery producers

United States	South Korea	Japan
A123 Systems	LG Chem	NEC/AESC
Johnson Controls	SB LiMotive	Panasonic/Sanyo
Sumitomo Group	Cheil Industries	GS Yuasa
Rockwood		Hitachi
FMC Lithium	**Belgium**	Mitsubishi Chemical Holdings
Chile	Umicore	UBE Industries
SQM		Nichia

Source: Natixis Asset Management.

With cobalt, production is more diversified. Here, too, though, there are too few companies developing recycling methods.

Figure 16: Cobalt producers (2011)



Source: Natixis Asset Management / Cobalt Development Institute, 2012.

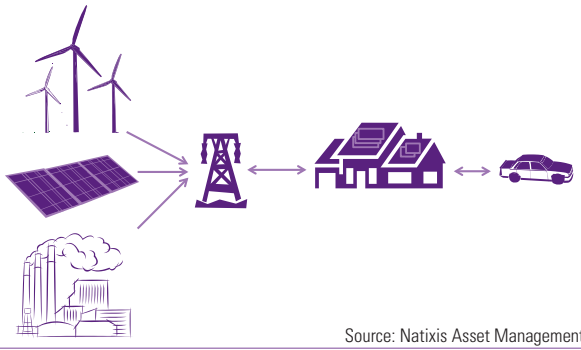
213 Downstream: production and distribution of electricity

Supply of electricity

To ensure the supply of electricity, energy producers and distributors must also involve themselves in providing a regular supply. It should be noted that the development of the electric vehicle can also provide opportunities through:

- accelerating the deployment of intelligent electric networks (also called smart grids) and counters; frequently recharging electric vehicles could encourage staggered recharge hours to avoid excessive peaks in consumption
- offering new systems to store the energy with the 'vehicle-to-grid' concept, which assumes energy transfers from the grid to the vehicles and, conversely, from the vehicles to the grid.

Figure 17: The 'vehicle-to-grid' concept



Source: Natixis Asset Management.

Thus, electric and rechargeable hybrid vehicles will be capable of transferring energy from their batteries to the electricity network: a means for electricity distributors to occasionally respond to energy consumption peaks, and for vehicle owners to become energy suppliers by selling the electricity stored in their automobiles when the car is parked. Even though this system is an opportunity for development, electricity producers and distributors do not foresee any major evolution on this storage system before 2030.

The development of the electric vehicle also requires a network system which allows electric vehicle owners easy access to recharging infrastructure outside their homes.

Beyond suppliers of charging terminals, this network system requires the involvement of companies and communities whether for private or public locations: public roads, parking areas, supermarkets, service stations, company parking lots for employees, and so on.

At the moment, electric terminals have been installed, in most cases, in response to the needs of a company fleet or electric card organised services in self-service stations, such as exist in seven cities in France.[9]

(9) Initiative at Angoulême with Mia Electric (Mia), Auto Bleue at Nice with Peugeot (Ion), AutoCité at Besançon with Peugeot (Ion), Autolib' at Paris with Bolloré (Bluecar), Moebius at Rueil-Malmaison with FAM (F-City), Mopeasy at Neuilly with Peugeot (Ion), Yélomobile at La Rochelle with Citroën (C-Zéro) and Mia Electric (Mia)

Lithium-ion battery recharging: a vital electrical network, but not a problem in the medium term

There are several recharging modes: slow charge (~5 hours for a 16 kWh battery), fast charge (~30 minutes), exchange of batteries (a few minutes), or charging by induction. The real charging time depends on the remaining battery charge level, the battery energy capacity and the power level of the charge.

The vehicle can be recharged by connecting it to the mains on slow charge with a simple 230-volt, 16-amp plug or with an additional three-phase, 32-amp installation that provides a semi-rapid charge in 3 hours. The slow charge presupposes the availability of a garage for private users, and rules on sharing for joint properties with various users. The installation of a terminal or a slow-recharge plug costs less than 1,000 euros.

The fast charge recharges the battery to 80% in 30 minutes, but this charging mode damages the battery because the current and heating are more intense. Moreover, the fast charge can create large demand peaks if all users want to recharge at the same time, which would imply an energy supply often richer in carbon than the basic electric production to guarantee the offer during the peaks. The price of a fast-charge terminal is around 10,000 euros depending on power and usage (Legrand / Schneider Electric) and has shown a tendency to drop in the last few months.

More generally, whether the recharge is performed rapidly and externally, or slowly at home, the management of the electricity demand should be matched to the development of smart counters and smart networks. For example, to avoid having all users recharging their batteries at once, around 8 p.m. after returning from work, smart counters will make it possible to trigger the recharges at different times during the night, to spread out demand.

The next option considered is to exchange batteries (a system experimented with by Better Place). However, the activity of these exchange stations is facing the following two problems:

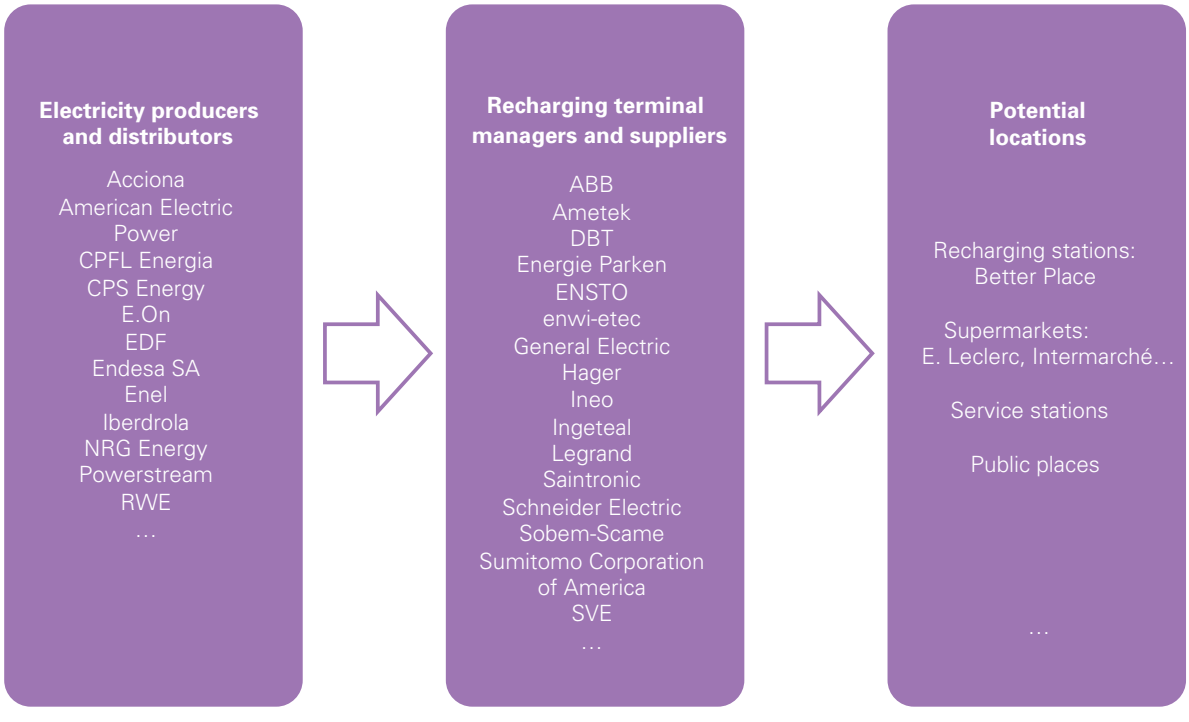
- no battery standardisation has been established, and thus the concept concerns only some batteries
- this system significantly increases the operating cost since it demands a large, permanently available stock of batteries to ensure that exchanges can take place whenever required.

Furthermore, these battery exchange stations require a lot of space for rapidly recharging the batteries (semi-fast charge) in order to be able to reissue them.

Finally, charging by induction permits recharging the battery without connecting the vehicle to the electricity network. Once parked on the induction plate, a vehicle equipped with an energy sensor can receive the induction and transform it into current. This method is in the experimental phase.

Most recharging should be performed at home on slow charge. However, fast charging must be externally accessible. Legrand estimates that the potential for recharging terminal installations in France is in the order of 400,000 public terminals and more than 4 million private ones by 2020.

Moreover, within the borders of France, in accordance with Article 57 of the French Grenelle II Act, it is mandatory to:



Source: Natixis Asset Management / Pike Research, 2012.

Figure 18: Electricity supply value chain

- install terminals in residential, commercial and public structures as of 1 January 2012
- set up recharging equipment in existing commercial and public buildings mainly used for a workspace by 2015
- provide the opportunity for co-owners and tenants to connect vehicles in existing apartment buildings (Legifrance 2012).

We estimate that the electric network of recharging terminals does not pose any particular problems for the development of the vehicle. Many companies are already positioned on terminal technologies, and regulations are also stimulating a faster deployment.

CONCLUSION

The electric vehicle is a breakthrough technology which responds to the major challenges of the automobile and, more globally, of mobility by eliminating CO_2 emissions and pollutants during the vehicle's usage phase and, in the case of favourable energy mixes, reducing the use of fossil resources.

This type of vehicle is, however encountering many obstacles at this stage: high prices, insufficient recharging means and restrictive range, forcing consumers to reconsider their relationship with the automobile. These inhibiting factors, among others, explain the half-hearted sales results of the first electric vehicles recently placed on the market.

To ensure the development of the electric sector, it is necessary to spur on its development in many areas.

- **Supply of raw materials**: the number of companies supplying the required raw materials is limited, creating oligopolistic markets, and recycling is currently almost non-existent.
- **Battery technologies**: several technologies are currently competing, but none of them can guarantee: to not use rare resources; to provide enough specific energy and power for a range exceeding a hundred kilometres; to guarantee risk-free usage; and, finally, to achieve a cost that will allow a reduction in the global price of the electric vehicle.
- **The electric motor**: each of the three technologies present in the electric vehicles marketed presents its own set of restrictions, from the supply of rare metals to low efficiency and maintenance constraints.
- **Vehicle structure**: an electric vehicle must have a chassis which is specifically designed for electric usage, and a structure integrating more and more light materials to increase the available range.
- **The network of electricity terminals**: assuming that the IEA scenario of a reduction of 30% of CO_2 emissions in 2050 compared with 2005 will be achieved, it will be necessary by then to provide for an infrastructure allowing the recharging of an installed base of more than one billion electric and rechargeable hybrid vehicles in circulation.

To meet these challenges, the entire electric vehicle value chain will have to work together: mining and metal companies, battery manufacturers, recycling companies, electricity suppliers, recharging terminal managers, auto-part manufacturers and automobile manufacturers, etc. Searching for solutions to overcome these obstacles is, in itself, a source of opportunities for investment.

The breakthrough is not only technological, but also behavioural: the feeling of ownership gradually disappears with the introduction of rental systems and the vehicle becomes merely an urban transport vector. More globally, from a sustainable mobility viewpoint, the automobile's usage is bound to evolve.

We consider that the electric vehicle has a role to play in the automobile sector. Initially, this type of model seems to be especially appropriate for company fleets. Beyond that, as far as it is destined to remain urban, the electric vehicle could, in the medium or long term, interest private owners of a small car who drive short distances, provided improvements have been made on all the aforementioned points.

But until this different concept of the use of an automobile is generally accepted, rechargeable hybrid or electric vehicles with range extenders seem to provide a suitable transition.

These two categories allow both travelling short distances in electric mode in the city and maintaining the possibility of going farther in internal combustion mode. They thus represent a good alternative way to progressively reduce the sector's dependency on fossil fuels, without enormously altering the usage of the car. Beyond the breakthrough technologies, it should not be forgotten that the automobile sector still has a significant margin with respect to technological progress in internal combustion engine types and that these latest advances are also among the solutions to the problems of attaining cleaner mobility.

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LIST OF FIGURES

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Responsible Investing

SHALE GAS AND UNCONVENTIONAL GAS
NEW RESOURCES, NEW CHALLENGES

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November 2012

INTRODUCTION

Alternative solutions to traditional energies are progressively emerging in light of high energy prices. Shale gas and, more generally, unconventional gas are amongst those set to play an increasing role in world energy supply, mainly due to the importance of reserves in numerous regions.

Up to now, unconventional gas has essentially been developed in North America in response to the reduced production of conventional gas. Exploitation of these resources was possible due to innovations from American companies (notably combining horizontal drilling and hydraulic fracturing techniques).

In North America and Europe, such techniques have sparked numerous controversies regarding their environmental and social impacts. Water pollution, land use and impact on climate change are the most frequently emphasised issues. Despite these controversies, the American example, which ultimately separated oil and gas prices, led to a profound change in the balancing of energy prices and is now being seriously considered by politicians in many countries.

The aim of this document is to provide an insightinto the environmental and social impacts of the exploitation of these resources.

THE EXTRA-FINANCIAL RESEARCH POSITION ON UNCONVENTIONAL GAS

Following the analysis of various environmental and social impacts associated with the exploitation of unconventional gas, we hold the following position:

- **In general, we consider gas, as a substitute for more pollutant energy sources such as coal or fuel oil, to be a transitional solution in the fight against climate change, depending on the country.**

  In the special case of unconventional gas, we believe that this resource can be used as a substitute for more pollutant sources, for instance:
  - for coal in electricity production
  - for imports originating from countries with less strict environmental regulations
  - for modes of transport that impact heavily on the environment, such as leaks in pipelines and high energy consumption of liquefied natural gas (LNG).

  Using unconventional gas can therefore reduce greenhouse gas emissions.

- **However, exploitation of unconventional gas presents additional risks with regard to traditional fields,** e.g. the risk of water table contamination, the issue of land use, and greater climatic impact than that of conventional gas. On the basis of current knowledge, we believe that measures taken by operators to limit these impacts must be examined case by case.
  - In the most favourable cases (exploitation in sparsely populated areas, exploitation in a sufficiently controlled and regulated area, use of the best available techniques, the operator's good safety reputation), we believe that these additional risks can be sufficiently monitored. In these cases, for unconventional gas we hold a position similar to that of conventional gas.
  - In other cases (exploitation in a densely populated area, lack of transparency in the techniques used, reservations about control systems, poor safety reputation), using these resources will lead to a negative bias in the environmental and social analysis of the operators involved.

- **This position will be followed up over time in order to:**
  - take into account the most recent research on local impacts, particularly on water resources
  - ensure that the development of these resources (unconventional as well as conventional gas) makes a transition towards a more sustainable energy mix without hampering the development of renewable energies and energy efficiency solutions.

In our opinion, these last two solutions must remain a top priority and are consequently strongly favoured in our analyses.

QUESTIONS AND ANSWERS ON UNCONVENTIONAL GAS

What are unconventional gas resources?

Even though there is no official definition of unconventional gas resources, they are generally defined as any type of gas which requires specific techniques for underground extraction.

Today there are three types of unconventional gas:

➜ **Tight gas**
This gas is very similar to conventional gas apart from the fact that the reservoir rock that contains it is practically impermeable, making the exploitation of this resource more difficult.

➜ **Shale gas**
Located in a source rock as it has yet to migrate to a 'reservoir rock' unlike conventional gas or tight gas. In almost all cases, this source rock is even less permeable than tight gas.

➜ **Coalbed methane (CBM)**
This gas is similar to shale gas except that the source rock is a coal field.

Today, these three types of gas are the only ones that are industrially exploited. In addition, methane hydrates in the gas associated with water molecules are generally classified in the unconventional gas category. However, the exploitation of this last resource is set to remain at the experimental stage over the coming years.

In all cases, whether for conventional or unconventional gas, the exploited resource is always 'natural' gas, that is, mainly methane (CH_4).

Will these resources play a major role in the world energy supply?

Today, only North America has developed significant production of unconventional gas. The exploitation of this resource has allowed the United States to maintain its production close to its consumption and to avoid imports. Unconventional gas currently represents 45% of the production of gas; it may reach around 90% in 25 years. This huge growth will be due, in particular, to the production of shale gas, while the production of tight gas and coalbed methane (CBM) should remain stable over the coming years.

On a global scale, the potential for unconventional gas resources requires further study. The International Energy Agency (IEA) estimates that these resources could potentially double current gas reserves.

What are the techniques used to enable exploitation of these resources?

The main problems encountered in the exploitation of unconventional gas are linked to the low permeability of the rock. In the exploitation of conventional gas, vertical drilling is the only form of drilling necessary as the gas contained in the reservoir rises naturally due to the pressure difference. With unconventional gas, in most cases the use of vertical drilling alone would only collect a marginal quantity of gas, thereby hampering the profitability of exploitation.

A combination of technological innovations has provided solutions to these difficulties.

➜ **Hydraulic fracturing**

The first innovation is the use of hydraulic fracturing. This technique consists of injecting large quantities of a mixture of water, sand and chemical products underground at high pressure. The mixture will create cracks in the rock, which artificially increases its permeability. However, in most cases, hydraulic fracturing on a vertical drilling is not sufficient to extract large quantities of gas.

➜ **Horizontal wells**

The second innovation is the creation of horizontal wells, which maximises the contact surface between the gas-bearing rock and the drilling well. Usually the horizontal part of these drillings is between 1 and 2 km long. This technique is used in combination with hydraulic fracturing. Numerous fractures are made on the horizontal section of the well, thereby maximising the well's yield.

Other techniques, such as multi-well pads, which consist in creating several horizontal wells from a single drilling site, are also frequently used in the exploitation of these resources.

What are the consequences for water resources of unconventional gas exploitation?

The highest risk resides in pollution following the hydraulic fracturing operations. Indeed, potential underground leaks due to casing defects, or leaks associated with the transport of fracturing products and waste water can lead to contamination of water tables. Though there have been some cases of contamination that have resulted in convictions, these were rare cases of bad practice due to a lack of experience with these new resources on the part of the operators and the authorities. Even though greater attention must be paid to these safety issues, it seems unreasonable to cast doubt on the entire sector for these reasons.

What are the local disturbances associated with unconventional gas exploitation?

Due to the low permeability of the rocks containing these resources, unconventional gas exploitation requires drilling sites to be very close together. Even with techniques such as horizontal drilling or multi-well pads, it is necessary to make 1 to 4 drillings per km^2 over very large areas (several thousand km^2). For example, by the end of 2008, Barnett Shale in Texas had a total of 12,000 wells for the exploitation of shale gas.

The exploitation of just one site requires drilling operations to be carried out 24 hours a day for 6 to 12 months, and involves between 4,300 and 6,600 lorry trips. Though some measures can be taken to alleviate disturbances (use of less noisy equipment, construction of walls to limit the sound impact), the exploitation of these resources remains very invasive and is already encountering strong opposition in densely populated regions, such as on the north-east coast of the United States, and in Europe.

Is unconventional gas exploitation compatible with the fight against climate change?

Except for methane leaks, the CO_2 impact of unconventional gas is almost equal to that of conventional gas. However, uncertainties prevail on the existence of additional methane leaks, which could heavily impact the balance of CO_2 in unconventional gas compared to conventional gas.

In all cases, as for conventional gas, the CO_2 impact for unconventional gas is less than that of coal for electricity production. For this reason, in addition to energy efficiency measures and the development of low carbon energies, there is potential for unconventional gas to play a temporary role in the reduction of CO_2 emissions.

SUMMARY

1 | What is unconventional gas?

There is no precise definition for unconventional gas. This category, which encompasses a range of varied resources, is rather defined as being the opposite of conventional gas. As explained hereafter, unconventional gas differs from conventional gas by where it is found underground. However, the exploited resource is the same, since it is mainly methane (CH_4).

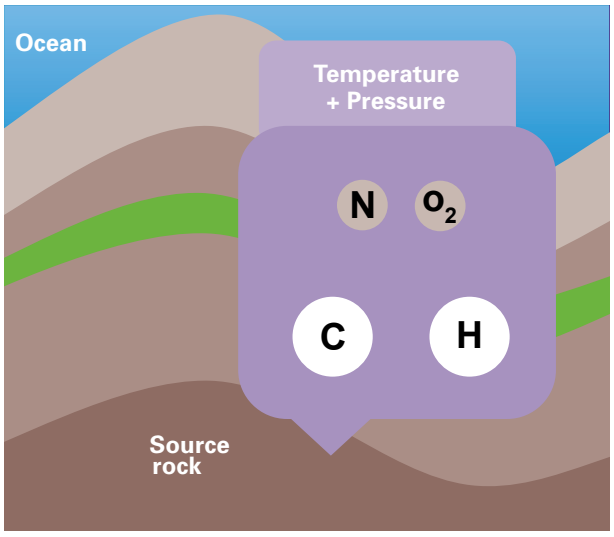
It should be noted that some players consider that the term 'unconventional' is no longer relevant from the moment these resources are significantly exploited by the industry.

The formation of gas and oil reservoirs

Oil and gas are derived from the transformation of organic matter (algae, plankton, etc.) during a process which lasts several millions of years.

Stage 1: the deposit of organic matter

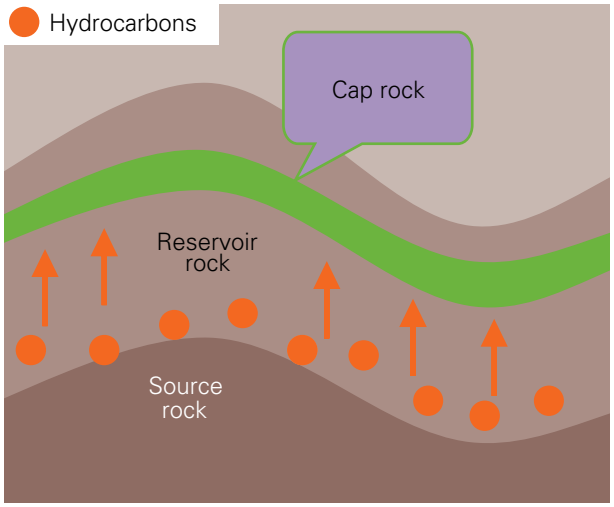
Organic matter is essentially composed of carbon (C), hydrogen (H), nitrogen (N) and oxygen (O_2). When it is destroyed by living organisms (e.g. aerobic bacteria), or becomes oxidised, the hydrogen molecules form water by combining with the oxygen (H_2O) and carbon molecules, CO_2.
However, a very small part of this organic matter (~0.1%) is deposited on the seabed where it mixes with mineral matter (clay, sand).
In this environment it is protected from oxygen and living organisms and can thus be preserved. Under certain conditions (hot climate, proximity to large river mouth conveying large quantities of vegetative waste, etc.) the proportion of organic matter can amount to 1–2%.
The mixture of mineral matter and organic matter thus forms the future source rock where the hydrocarbons will be produced.



Stage 2: sedimentation

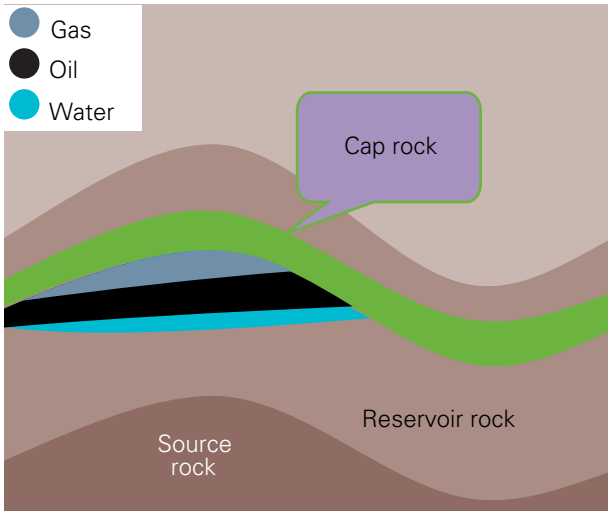
Sediments* are deposited on this source rock over several millions of years. Under the weight of successive layers, the source rock caves in from a few metres to a few hundred metres.
In doing so, the temperature and the pressure increase; between a depth of 2,000 and 5,000 metres, these increases lead to chemical reactions which transform the carbon and hydrogen molecules into kerogen and then hydrocarbons (oil and gas).

(*) Residues of variable sizes originating from the erosion of rocks or residues of organic activities (shells) or results of chemical reactions (e.g. certain carbonates).



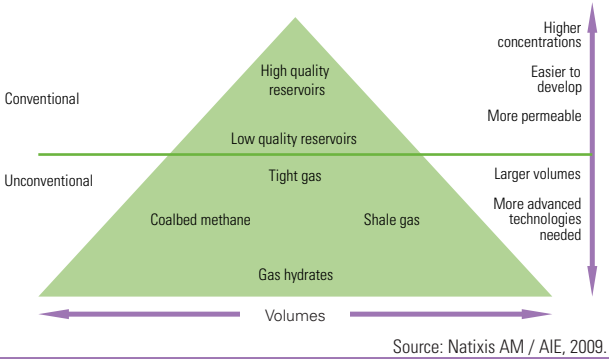
Stage 3: migration and trapping

Even though the source rock is practically impermeable, the pressure is such that the hydrocarbon molecules, which are lighter than water, rise towards the surface by moving through the interstices and porosities of the rocks that they encounter. If nothing stops them, the most volatile molecules escape into the atmosphere, while the heaviest molecules become oxidised in the form of bitumen near the surface (the largest reservoir of bitumen being the bituminous sands of Athabasca, Canada).
However, if during their migration these molecules encounter an impermeable layer (composed of salt, marl, etc.) with a geometry preventing any migration, the molecules will accumulate under this cap rock.
The porous rock containing the hydrocarbons is called a reservoir rock. It is this accumulation that constitutes the hydrocarbon fields.



Source: Natixis AM / IEA, 2009.

The three main types of unconventional gas which are most intensively exploited today are shale gas, tight gas and coalbed methane (CBM).



Source: Natixis AM / AIE, 2009.

Figure 1: Summary of the various types of conventional and unconventional gas

111 Tight gas

Tight gas is rather similar to conventional gas because it has migrated to a reservoir rock. The only difference is that the reservoir rock has a low permeability, rendering the exploitation of the reservoir more difficult. Since the differences between conventional gas and tight gas are fairly small, some countries count these resources in their conventional gas reserves. Tight gas is generally located at a depth of 1,500–3,000 m.

112 Shale gas

What distinguishes shale gas from conventional gas is that this gas has not yet migrated and is therefore still present in the source rock. Shale gas is generally located at a depth of 1,500–3,000 m.

113 Coalbed methane (CBM)

Coalbed methane (CBM)[1] is present in coal deposits. Indeed, the coal formation process implies the production of methane. The formed methane can be found in the form of a pocket, known as firedamp. It can also be absorbed by coal, in which case coalbed methane (CBM) is formed. CBM is generally produced in coal fields that are too deep, or of too poor a quality, to be exploitable. Gas can also be produced in the exploitation of coal mines in order to limit explosion risks and supply an energy source for the exploitation of the mine.

These fields are generally located at a depth of 800–1,200 m, but some formations can be found at depths of just a few hundred metres.

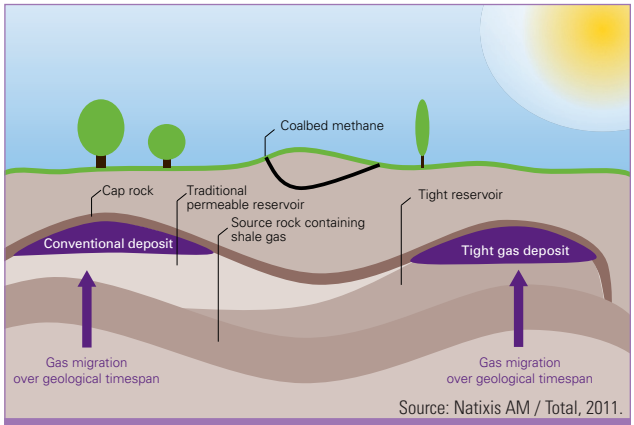


Figure 2: Illustration of the geological location of unconventional gas

Shale gas, tight gas and coalbed methane (CBM) are the only types of unconventional gas currently exploited and they will continue to be developed over the coming years. For unconventional gas, this study therefore focuses on these three resources. There is also a fourth type of unconventional gas in the form of methane hydrates.

114 Gas hydrates

Gas hydrates are another form of unconventional gas resource with potentially very significant reserves (several times greater than conventional gas reserves). Gas hydrates are methane molecules derived from the decomposition of organic matter, which become 'associated' with water molecules under certain conditions (high pressure, low temperature, small quantities of methane).

In practical terms, this transformation process from methane to gas hydrates takes place under permanently frozen soils (permafrost) and in ocean sediments.

The International Energy Agency (IEA) thinks it unlikely that significant production of gas hydrates will take place over the next 25 years. Note that, if these resources were to be exploited, there is a significant risk that, in parallel with the extraction of methane, the operations might lead to unintentional emissions of methane into the atmosphere. Since methane is a gas with a global reheating potential (GHP) that is 25 times greater than CO_2, these emissions, depending on their quantity, could strongly degrade the CO_2 impact of this resource.

Finally, it should be noted that gas hydrates are a topic of concern in the study of climate change. Indeed, many climatologists have expressed the possibility of 'positive' feedback loops: the heating of the planet provokes the melting of the permafrost, which will release methane that will in turn intensify global heating. Even though these feedback loops are mentioned in the Intergovernmental Panel on Climate Change (IPCC) reports, their consequences on climate change are not quantified in IPCC scenarios.

Note that some gas resources, such as sour gas,[2] gas located in the arctic area, and deep offshore gas, are sometimes also considered as unconventional resources.

21 Reserves and production

211 Reserves[3]

Proven reserves of unconventional gas represent only 4% of total proven gas reserves (~7 trillion cubic metres (tcm) out of a total 182 tcm). Half of these proven reserves are located in the United States. However, exploration of these resources is still very recent and so far has only been conducted on basins that are already in exploitation in the United States.

(1) The terms Coal Seam Gas and Coal Mine Methane (CMM) are also used.

(2) Sour gas extraction requires special treatment due to high ratios of hydrogen sulfide (H_2S) and carbon dioxide (CO_2).
(3) See Appendix 1 for details of the various methods of accounting for reserves.

Units used in quantifying fossil energies

The standard units used for measuring energy are the Joule (and its derivatives: MJ, GJ, TJ) and the Wh (kWh, MWh, GWh, TWh). However, the Joule is more of an academically used unit and the Wh is a unit mainly used for electricity.

For fossil energies, the main units used are:

➜ Tonne of oil equivalent (toe)

To compare the energy consumptions of various energy sources (fossil or not), the term 'tonne of oil equivalent' (toe) is generally used.

For example, 1 toe of gas is a quantity of gas which releases the same amount of energy as a tonne of oil. Even though this unit resembles a weight unit, the tonne of oil equivalent is an energy unit, the reference to weight being used only as an analogy: 1 toe = 41.9 GJ. The following units are also used: ktoe (10^3 toe), Mtoe (10^6 toe), Gtoe (10^9 toe).

➜ Barrel

To quantify oil production, consumption or reserves, the oil barrel is generally used. The barrel is a volume unit: 1 barrel = 159 litres. However, the barrel can be converted into energy by making certain assumptions about the energy content of the oil. For instance, on average, 1 oil barrel is equivalent to ~0.14 toe. To give an order of magnitude, world oil consumption is currently between 80 and 90 million barrels per day (mb/d).

➜ bcm/tcm

To quantify gas production, consumption or reserves, billion cubic metres (bcm) or trillion cubic metres (tcm) are generally used. As for the barrel, bcm and tcm can be converted into energy by making certain assumptions on the energy content of the gas. On average, 1 bcm of gas is equivalent to ~825,000 toe.

➜ MBtu

Another frequently used unit for gas production is the British Thermal Unit:* 1 Btu ~ 1,060 J. Since this unit is very small, the units are generally expressed in thousands of Btu (MBtu) or millions of Btu (MMBtu). However, many organisations consider the acronym MBtu to mean 'millions' of Btu and not 'thousands' of Btu.** For gas prices, in particular, the price is frequently expressed in $/MBtu, systematically meaning millions of Btu and not thousands of Btu.

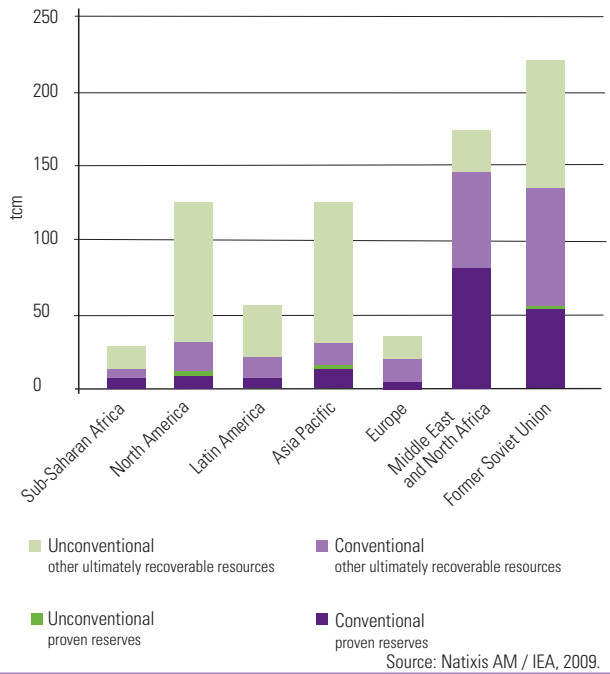
(*) This unit corresponds to the quantity of heat necessary to raise the temperature of one pound of water by one degree Fahrenheit at a constant pressure of one atmosphere.
(**) The M of MBtu originates from the Roman numbering system in which M means thousand. It can be easily confused with the M of the International System of Units (SI) which means million.

Shale gas, as we are going to see, is set to become the main production source for the United States (see Figure 4) and is present in many basins. The Barnett Shale in Texas is the historical basin where the exploitation of shale gas has been developed. This basin remains the most developed, with around 12,000 wells in 2008. Other basins are being developed, notably Haynesville (on the Texas-Louisiana border), Fayetteville (in Arkansas) and the Marcellus Shale (in the North of the United States).

Continued efforts must still be made to quantify the unconventional gas resources in the rest of the United States and even more so in the rest of the world. Once these limits are taken into account, there is no doubt that the ultimate resources of unconventional gas will be very significant. Excluding methane hydrates, the IEA estimates approximately 380 tcm of remaining ultimate resources compared to 404 tcm for conventional gas, that is, almost twice the amount of gas resources.

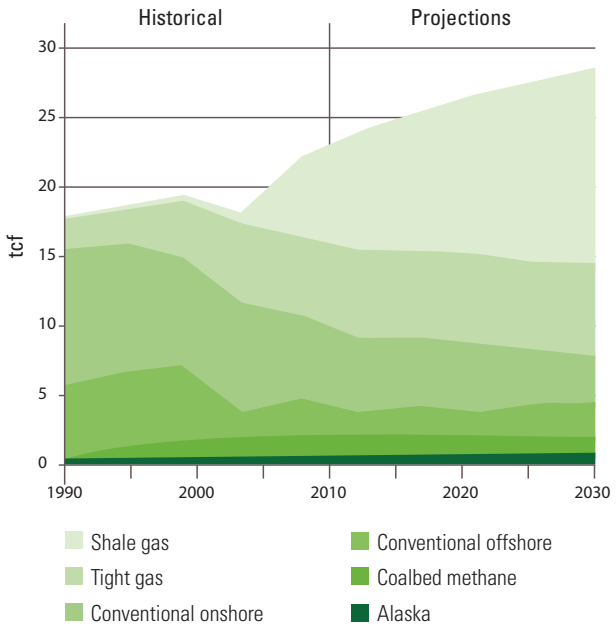
These resources also present the advantage of a geographical redistribution of resources. If these resources were to be massively exploited, areas such as North America or Asia Pacific could exhibit reserves comparable to the Middle East or Russia, which today possess the greatest share of reserves. The existence of large-scale resources in countries other than the traditional exporters presents a significant interest for consumer countries, which could then reinforce the diversification of their supply sources.

Figure 3: Geographical distribution of gas resources (conventional and unconventional gas)



Source: Natixis AM / IEA, 2009.

Figure 4: Natural gas production profile for the United States



Source: Natixis AM / US Energy Information Administration, 2012.

212 Production

Even though unconventional gas represents only 4% of proven reserves, in 2008 the production of unconventional gas accounted for 12% of world production (~400 bcm on a world production of ~3,000 bcm). This percentage is set to increase over the coming years. IEA predictions foresee a contribution of approximately 20% by 2035.

Up to now the production of unconventional gas has been almost exclusively centred in North America. **In 2008, the United States and Canada represented 90% of the world production of unconventional gas:**

- 300 bcm for the United States, that is, roughly half the national production, broken down into shale gas, tight gas and a little coalbed methane

- 60 bcm for Canada, that is, approximately one-third of national production, essentially tight gas).

In the United States in 2008, tight gas was the main source of unconventional gas production (~65% of unconventional gas production), followed by coalbed methane (~20%) and shale gas (~15%). However, according to the US DoE, even though the production of tight gas and coalbed methane should remain relatively stable over the next 25 years, shale gas should experience very strong growth, which will not only compensate for the decline in the production of conventional gas, but also increase the total production of natural gas by 25% in the US. This trend, made possible by gas price increases and new exploitation techniques (see Section 3.1), explains the increased interest in shale gas compared to other types of unconventional gas.

It should be noted that, although the emergence of coalbed methane, and shale gas in particular, is relatively recent, the production of tight gas has existed for more than 40 years in the United States.

A list of the players present in the exploitation of unconventional gas is given in Appendix 3.

3 | Techniques and extraction costs

311 Techniques

Before going into detail about exploitation techniques for unconventional gas, it is necessary to briefly explain the extraction process for conventional gas. The principle of conventional gas extraction is relatively simple, though in reality, it requires considerable technical skill. Given that gas reservoirs are under pressure, it 'suffices' to connect the reservoir to the surface with a vertical drilling for the gas to rise naturally up the drill pipe.

The myth of the cave

A gas or oil reservoir is often represented as an underground 'cave' where hydrocarbons are likely to be located, though in reality, it's a different story. A reservoir is effectively a rock with pores which allow hydrocarbons to stay inside the rock. These pores can sometimes be interconnected.

Therefore, two parameters are generally used to characterise a reservoir:

- **Porosity**, measured as a percentage which represents the volume of voids and pores in the rock.
- **Permeability**, measured in Darcy (milliDarcy: mD, microDarcy) which represents the level of interconnection of the pores and therefore, the aptitude of a fluid, liquid or gas to circulate in the rock.

This aptitude also depends on the fluid's viscosity (the lower the viscosity, the easier it is for the fluid to circulate in the rock).

Even though a high porosity indicates a strong capacity for hydrocarbons in a rock, this does not mean that it will be easy to exploit the resource. Some rocks, such as volcanic pumice stones, have good porosity, but the pores are isolated from one another which prevents any circulation of liquids.

NB: In the same way, this representation in the form of an underground cave, or an underground river, is common for aquifers; it is also just as erroneous. Like hydrocarbon reservoir rocks, aquifers are underground rocks that are sufficiently porous and permeable to allow the circulation of water.

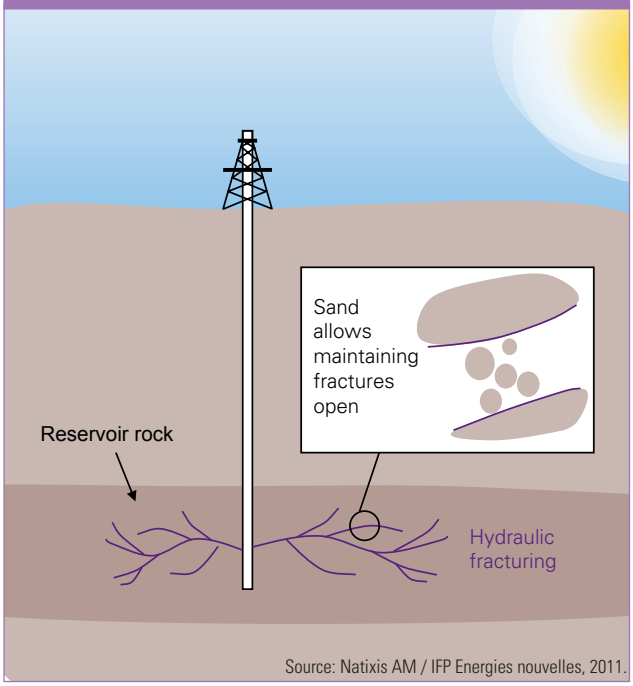
Tight gas[4] and shale gas are found in rocks with low permeability. This is also often the case for coalbed methane. Therefore, a traditional vertical well would extract only a very small quantity of gas since there is poor circulation of fluid inside the rock. It was necessary to turn to other techniques to exploit these resources.

Hydraulic fracturing

To make gas exploitation profitable in low permeability rocks, it is necessary to artificially create the rock's permeability. The technique used, called hydraulic fracturing, consists of injecting a mixture of water (~95%), sand (~5%) and chemical products (<0.2%) into the deposit at high pressure and in large quantities. The pressurised water fractures the rock, and the sand keeps the fractures open to allow the gas to circulate. The chemical products are used to facilitate the operation: biocides limit the growth of bacteria in the drill pipe, hydrochloric acid dissolves any rock debris in the pipe, special products reduce losses through friction and keep the sand suspended in the water.

It should be noted that hydraulic fracturing is not a new technology. It was commercially introduced by the American company, Halliburton, at the end of the 1940s. Halliburton asserts that since the 1940s more than one million hydraulic fracturings have been made, enabling the extraction of ~17 tcm (a total of 90 tcm of gas has been consumed since the beginning of gas exploitation).

Figure 5: The basics of hydraulic fracturing



Source: Natixis AM / IFP Energies nouvelles, 2011.

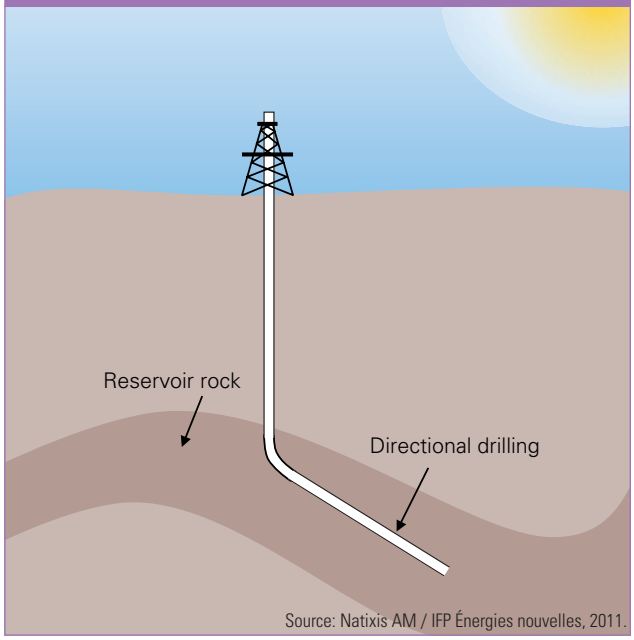
The recourse to fracturing is standard in the exploitation of shale gas and tight gas, and is frequently used for the exploitation of coalbed methane. This technology is also used to improve the recovery ratio of traditional fields, just as much for gas as for oil.

(4) Initially, tight gas corresponded to gas present in reservoirs with a permeability of less than 0.1 mD in the United States. Today, tight gas is more present in reservoir rocks (like conventional gas), though it is not possible to exploit the field with traditional extraction techniques.

Horizontal or directional drilling

Directional drilling is another technique which has helped to significantly improve the recovery ratio for reservoirs with low permeability. Hydrocarbon reservoirs can have very variable geometries. Directional drilling orients the direction of the drilling to maximise the surface contact between the drilling well and the reservoir, thus improving the recovery ratio.[5]

Figure 6: The basics of directional drilling

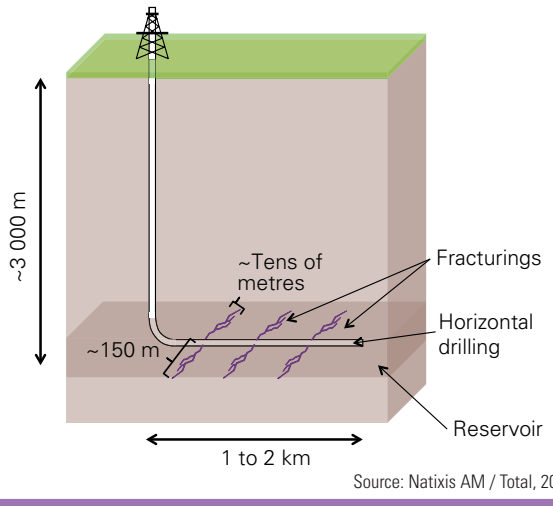


Source: Natixis AM / IFP Énergies nouvelles, 2011.

Conventional wells could already be inclined a few degrees in relation to the vertical. Directional drilling makes it possible to drill so that the deep-down section is horizontal in relation to the vertical section. In general, the horizontal part measures around 1,000–2,000m, though longer distances are indeed possible (the record exceeds a length of 10,000 m).

This technique, which was first experimented with in 1929 in Texas, only became developed commercially in the 1980s within the framework of the exploitation of conventional fields.

It is now possible to combine the horizontal drilling and hydraulic fracturing techniques. This combination makes it possible to multiply the hydraulic fracturings along the entire horizontal section of the drilling (30 fracturings on average for a horizontal section of 1,000 m) therefore greatly improving the recovery ratio. Figure 7 shows the combined use of both techniques.



Source: Natixis AM / Total, 2011.

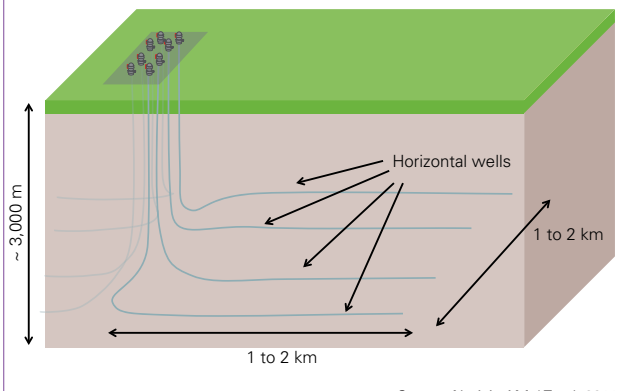
Figure 7: Combined use of hydraulic fracturing and horizontal drilling techniques

This combination of hydraulic fracturing and horizontal drilling first took off during the 2000s at the Barnett Shale site in Texas. Such a technique enabled the profitable exploitation of shale gas and has almost become standard in shale gas exploitation, and more and more frequent in tight gas exploitation. It is also sometimes used in coalbed methane exploitation.

Multi-well pads

Today, to optimise a drilling site it is possible to carry out several directional drillings on one single site. This technique, called multi-well pads, increases the quantity of gas extracted on a single site; it also reduces costs and the number of exploitation sites needed.

This technique can be used to make approximately 20–30 drillings from one single site, and multi-well pads are generally made up of six to eight wells.



Source: Natixis AM / Total, 2011.

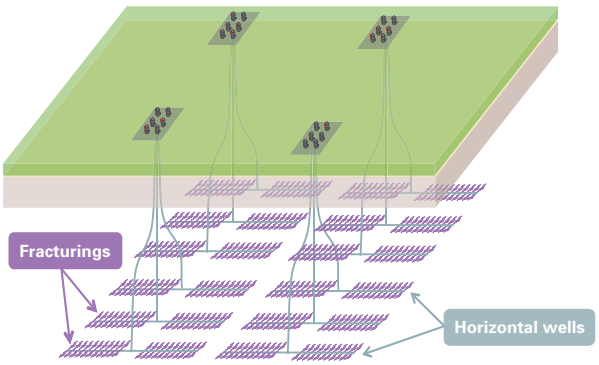
Figure 8: Example of a multi-well pad

This multi-well pad technique is also used in combination with hydraulic fracturing and horizontal drilling. The combination of these three techniques optimises yields (see Figure 9).

(5) Conventional fields located under areas that are difficult to access can also be reached with directional drilling. For example, by using this technique, onshore drilling can be used to reach areas where, with a traditional vertical drilling technique, it would have been necessary to carry out offshore drilling.

Since unconventional gas resources are normally very spread out, these installations have to be repeated many times. Thus, to exploit a field, it is necessary to install 1–4 production sites per km². Since fields extend over tens of thousands of km², the impact on the land use can potentially be very significant (see Section 4).

Figure 9: Coverage of a given area using all three techniques



Source: Natixis AM / Chesapeake / Statoil, 2008.

Specific features of gas exploitation

As already mentioned, the strong growth of shale gas production in the United States was only possible due to the combination of these techniques and, in particular, the significant use of hydraulic fracturing. For example, at the Marcellus Shale site in the United States, industrialists estimate that 90% of the wells will be made using the three techniques combined.

Tight gas uses more or less the same exploitation techniques as shale gas. The only difference is due to the fact that, depending on the reservoirs, the permeability of the rock may be better and therefore may not necessarily require horizontal drillings. However, these techniques, which improve the yield of the wells, are being used more and more.

As for coalbed methane, directional drilling with hydraulic fracturing is less frequently used, even though this technique is being more widely employed.

It should be noted that, for coalbed methane, once the drilling is complete, and before gas production begins, it is often necessary to pump out large quantities of water which is naturally present in the coal fields. The state of the water can be clean or slightly polluted, or it may even require special treatment, though each case is different.

312 Production stages[6]

More specifically, exploitation of unconventional gas resources using the aforementioned techniques takes place in several stages.

(6) See the Chesapeake Company website for videos illustrating the various production stages of a shale gas field: http://www.chk.com/Media/Educational-Library/Animations/Pages/default.aspx.

- **Preparation of the pad**

The first stage consists of levelling a pad of approximately two hectares to accommodate the various items of equipment needed for the exploitation of the field. A road also has to be built to access this pad.

This stage lasts approximately one month. Earth moving equipment (bulldozers, diggers, etc.) is used to perform the operations.

- **Drilling**

The vertical part of the drilling is similar to a traditional gas or oil drilling (several steel pipes filled in with cement to isolate the drilling of the surface area covered). The horizontal part is carried out with specific tools.

This drilling stage lasts approximately 1–2 months to make a single horizontal well, and 6–12 months for a standard installation with six multi-well pads. On the surface, this stage is characterised by the presence of a derrick to do the drilling.

- **Reservoir fracturing**

Once the drilling is complete, the reservoir fracturing stage can begin. First of all, the horizontal section of the drill pipe is perforated at several points to allow the circulation of fluids between the pipe and the reservoir. Once the pipe is perforated, a mixture of water, sand and chemical products is pumped at high pressure into the drilling to create micro-cracks in the rock. 10,000–30,000 m³ of water is then pumped underground. A highly variable amount of water rises to the surface (between 15% and 80%). The recovered water is stored in containers or water storage pits. It can also be reused for other fracturings (to create other wells for multi-well pads) or sent to a sewage treatment station.

This reservoir fracturing operation, including all the water treatment operations, also lasts 1–2 months for a single horizontal well, and therefore 6–12 months for six wells. On the surface, the derrick is replaced by a fleet of lorries to pump the mixture into the drilling.

- **Cleaning and testing the site**

Once the fracturing operations are complete, the site must be cleaned, e.g. transporting the waste away for treatment and excavating the retention tank. The drilling must also be tested before production can begin.

These operations last 1–2 months for one single production site. On the surface, earth moving equipment is necessary, as well as lorries to transport the waste.

- **Production**

Once all of these pre-production operations are complete, the only thing left to do on the site is place the 'frac tree' or 'christmas tree' on the wellhead and install the tanks to store the extracted resource.

The well then produces natural gas for 10–15 years. Note that it can happen that, after a given time, the well is refractured to increase its production capacity.

As explained in the previous section, the exploitation of coalbed methane often requires an additional pumping stage to pump out the large quantities of water that are naturally present in the coal fields.

Table 1 summarises the duration of a standard shale gas site exploitation.

Table 1: Estimation of the duration of a standard shale gas site exploitation
(multi-well pad, 6 horizontal drillings with hydraulic fracturing)

Pre-production (intensive activity on the exploitation site)	Production (reduced activity on the site)
1–4 years	10–15 years

Source: Tyndall Centre, 2011.

313 Costs

The IEA provides an estimation of the production costs of unconventional gas compared to other types of gas.

Figure 10 shows that the production costs of unconventional gas, i.e. tight gas, shale gas and coalbed methane (CBM), are between $2.70/MBtu and $9/MBtu.

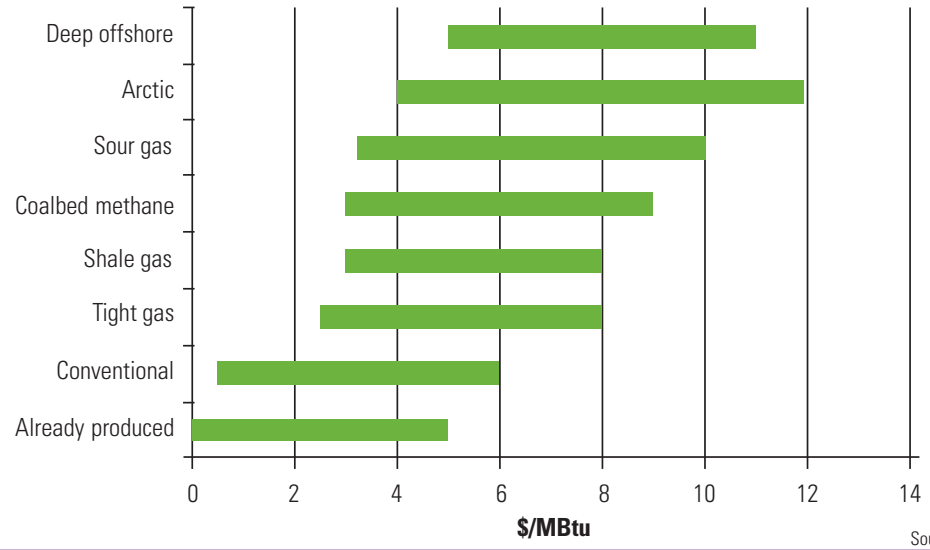
These costs are to be compared with:

- gas that has already been produced with a production cost below $5/MBtu
- conventional gas with costs between $0.5/MBtu and $6/MBtu
- sour gas between $3.10/MBtu and $10/MBtu.

Transport costs also have to be added to these production costs. The transport can be carried out by pipeline or by conversion units converting the gas into liquefied natural gas (LNG) for shipment by boat. The IEA estimates the transport cost by pipeline to be between $0.30/MBtu and $1.20/MBtu for 1,000 km and between $3.10/MBtu and $4.70/MBtu for transport by LNG.

Taking into account these various parameters, the IEA estimates, for example, that the shale basins currently exploited are profitable for a gas price (excluding transport) of between $3/MBtu and $6/MBtu.

Figure 11 shows that the production of gas from unconventional gas resources leads to increased production costs. However, this does not mean that one can conclude that the exploitation of unconventional gas leads to a rise in the price of gas.



Source: Natixis AM / IEA, 2009.

Figure 10: Production costs of various types of gas

Gas prices

Unlike oil, gas is difficult to transport and requires the construction of heavy infrastructure (pipelines, LNG terminals) for its transport. There are consequently major gas price differences between various consumption areas.

Three main consumption areas are generally distinguished:

➜ Europe

Western Europe, which has extremely limited gas resources, relies heavily on imports by pipeline from Russia, Norway and Algeria.

➜ Japan

Japan and South Korea are historically the major gas consumers of the Asian region. Neither of these countries has gas resources, and both are isolated from major production sites. They had to set up infrastructure to import massive amounts of LNG from Malaysia, Australia, Indonesia, the Middle East, Russia and other countries, justifying the higher purchase prices for this area.

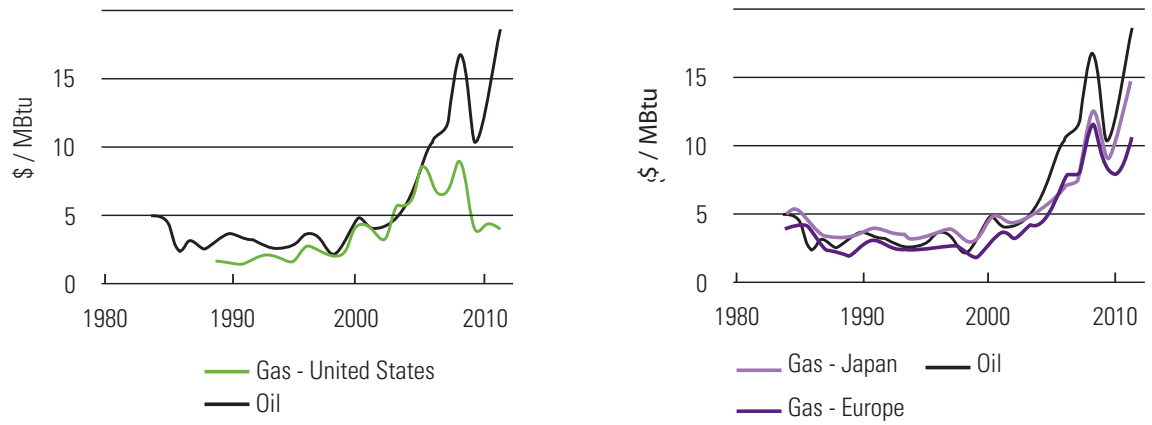
In both of these areas, prices are generally fixed by long-term contracts indexed on the price of oil.

➜ United States

The United States historically produced enough conventional gas to satisfy its needs. However, in the 1980s, production was no longer sufficient to face growing demand, despite the fact that US production covered between 80% and 90% of demand.
During the 2000s, the production drop in conventional gas should have led to a considerable increase in LNG imports and therefore a price increase in the area. However, the unexpected boom in unconventional gas in the United States disrupted these forecasts.

As explained, the price of gas is completely uncorrelated with production costs and is generally indexed via long-term contracts based on the price of oil. The boom in unconventional gas enabled the United States to reduce its use of imports and to avoid having to match its gas prices to those in Japan.

Figure 11: Evolution of the price of gas in relation to the price of oil (1984–2011)

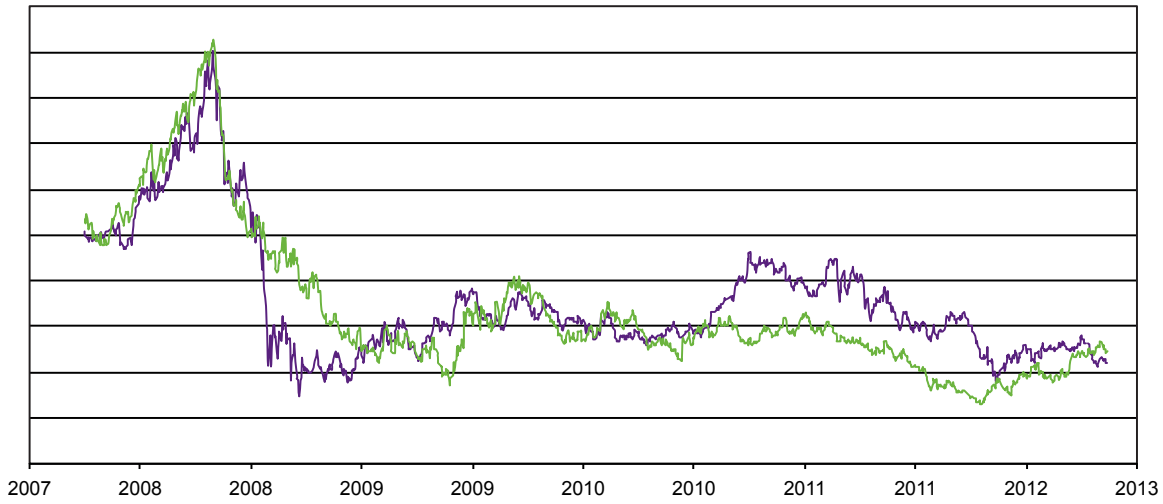


Notice on these charts that since 2005, the year when unconventional gas experienced strong growth in North America, the price of gas in the United States was dramatically uncorrelated with the price of oil, contrary to Japan and Europe, where gas prices evolved similarly to the price of oil.

Source: Natixis AM / BP, 2012.

This lack of correlation between the price of gas and oil due to the exploitation of unconventional gas and the issue of energy independence explains the continued interest in shale gas on the part of many political bodies. The paradox is that the drop in the price of gas was so great that it degraded the profitability of these exploitations, and consequently adversely affected the profitability of the companies that had invested in these resources. The graph in Figure 12 shows the strong correlation between the price of gas and Chesapeake's share price; Chesapeake is one of the main operators of shale gas in the United States.

Figure 12: Evolution of the price of natural gas in the United States compared with the value of the Chesapeake company's shares



In green: the evolution of the price of gas in the United States.
In purple: the stock market evolution of the shares of Chesapeake, one of the main shale gas operators in the United States.

Source: Bloomberg.

4 | Main environmental and social impacts

4.1 Climate change

There is a current debate surrounding the impact of unconventional gas on climate change.

There are two types of issue here:

- increasing the size of gas reserves would not be compatible with the fight against climate change
- the CO_2 footprint of unconventional gas would be greater than the footprint of conventional gas.

Would increasing the size of gas reserves be compatible with the fight against climate change?

Some players consider that current conventional gas reserves are already sufficient to exceed the CO_2 emission objectives and that, as a result, the use of additional unconventional resources would not be compatible with the fight against climate change.[7]

For gas on a global scale, it is certain that conventional resources would be sufficient to cope with demand in the next 20 years. Nevertheless, there are huge imbalances between the countries possessing gas reserves and the countries consuming them.

Thus, if the United States had not had access to unconventional gas, the drop in conventional gas production could have been compensated for in a number of ways:

- Importing liquefied gas with a CO_2 footprint greater than that of the gas produced on site (due to additional transformation and transport operations).
- Increasing recourse to coal the reserves of which are abundant in the United States, but where the CO_2 footprint is greater than that of gas.
- Significantly improving energy efficiency and/or increasing renewable energy production.
  Although this option would have been the most favourable in terms of the climate, it would have required major efforts which do not correspond to the policies currently in place in the United States. In addition, even if such efforts were deployed with a view to fighting climate change, they would, above all, have to limit the recourse to coal (more CO_2 intensive) and not the recourse to gas.

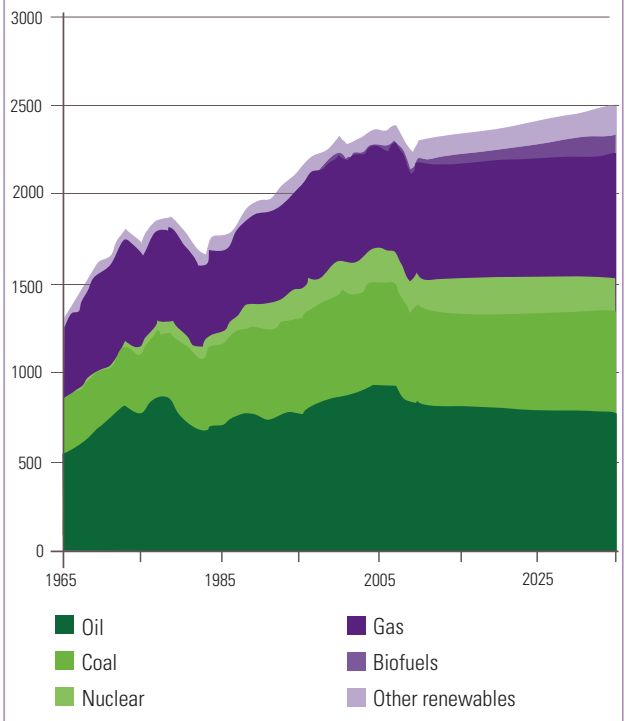
It is, therefore, not so easy to conclude that the US's choice to exploit unconventional gas has a negative impact on climate change.

Note that, between 2005 and 2010, the CO_2 energy emissions of the United States dropped by 7%. The International Energy Agency attributes this drop not only to an improvement of the energy efficiency in transports, but also to a 'major transfer' from coal to gas in the production of electricity.[8]

(7) On this subject, see in particular the study published in Nature magazine: Greenhouse gas emission targets for limiting global warming to 2°C, 2009 (10.1038/nature08017), Meinshausen, M., Meinshausen, N., Hare, W., Raper, S. C. B., Frieler, K., Knutti, R., Frame, D. J. & Allen, M.

(8) Financial Times, 23 May, 2012, 'Shale gas boom helps slash US emissions (http://www.ft.com/intl/cms/s/0/3aa19200-a4eb-11e1-b421-00144feabdc0.html#axzz2AOgv1Bl1).

Figure 13: History and predictions of energy consumption in the United States

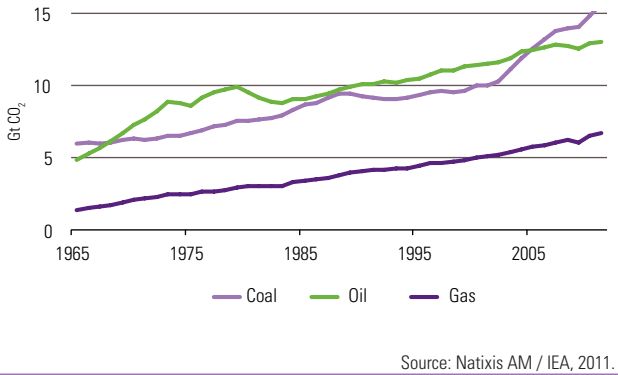


Source: Natixis AM according to BP, 2012 for the data 1965–2011 and US Energy Information Administration, 2012 for the growth rates 2011–2035.

Similarly, if China were to succeed in reducing its coal consumption by exploiting unconventional gas present in its subsoil, there would be a significant reduction of the country's CO_2 output.

We can see from these two examples that, even if energy savings and renewable energies report much more favourable CO_2 footprints, the recourse to unconventional gas is not *a priori* necessarily incompatible with the CO_2 emission reduction strategies, particularly in countries which rely heavily on coal.

The urgency to limit the recourse to coal is now stronger than ever after the greatest growth experienced by this energy over the last 10 years. Since the mid-2000s, coal has thus become the main source of greenhouse gas emissions ahead of oil.



Source: Natixis AM / IEA, 2011.

Figure 14: Estimation of greenhouse gas emissions per fuel (1971–2009)

However, it is still difficult to determine whether the discovery of new gas reserves will contribute to increasing the use of fossil energies or will limit the use of coal. The table below lists the main arguments for each of the approaches.

Table 2: Summary of the main arguments for and against the use of new gas resources

For	Against
• The carbon footprint of gas is half the size of that of coal for the production of electricity. • Coal is a low-cost fuel with a significant amount of reserves. A reduction of gas consumption would automatically lead to an increased use of coal.	• Even though gas has a better carbon footprint compared to other fossil energies, it remains a major source of greenhouse gas emissions. • The discovery of new resources contributes to reducing the price of fossil energies which will delay the development of renewable energies and the implementation of energy efficiency measures.

Given the arguments in Table 2, it is clear that a simple calculation will not provide the answer to the question, 'Is increasing the size of the gas reserves compatible with the fight against climate change?'.

Would the CO_2 footprint of unconventional gas be higher than that of conventional gas?

As explained in Section 3, the extraction techniques for unconventional gas are significantly different from those used for conventional gas.

For **shale gas**, the Tyndall Centre, an English climate change research centre, published a report on additional sources of emissions linked to the extraction of this resource. The report concludes that the additional emissions in the life cycle approach are between 0% and 3%. These additional emissions are due to a great extent to the hydraulic fracturing processes. The other significant sources of emissions in order of importance are: horizontal drilling, transport of water and waste water, and treatment of waste water.

Since extraction techniques are more or less the same for **tight gas** and **coalbed methane**, it is estimated that the additional emissions associated with the extraction of these types of gas are in the same order of magnitude as for shale gas.

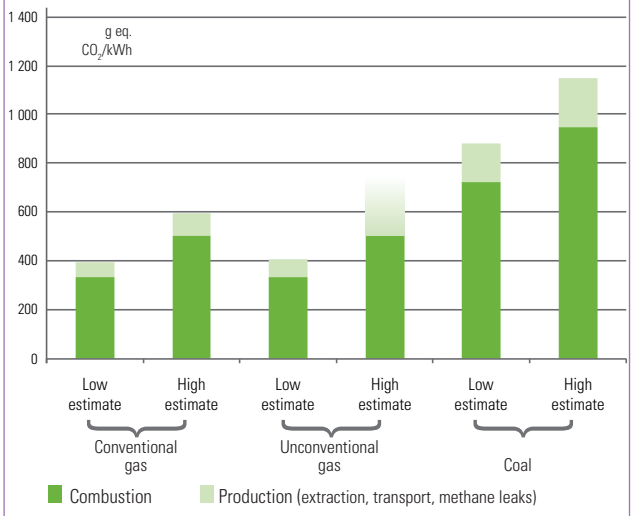
However, the Tyndall Report does not take into account possible additional gas leaks during the extraction process. As a reminder, extracted natural gas is composed almost exclusively of methane.
Since methane has a global heating potential 25 times greater than that of CO_2, the slightest additional leak will have very significant consequences on the gas's carbon footprint.
For example, the French Environmental and Energy Control Agency (ADEME) estimates that additional leaks amounting to 1% will raise the gas's global impact by 10%. This question is therefore very sensitive.

However, no study to date has quantified these leaks on a representative well sample. Only a study conducted by Cornell University researchers (Howarth R. W., 2011) has tried to quantify them.

Even though this study encountered much criticism (see Appendix 2), it is worth noting that it considers that additional methane leaks linked to the exploitation of shale gas vs. conventional gas are around 2%, which, in the life cycle approach, leads to an estimated 20% increase in CO_2 emissions from the exploitation of shale gas compared to conventional gas.

By taking into account these various elements, the bar graph below shows, for the production of electricity,[9] the greenhouse gas emissions in the life cycle approach associated with the production of one electric kWh for each fuel type. Note that in all cases gas remains a higher performing fuel than coal in terms of CO_2 emissions (see Appendix 2 for more details on the assumptions made).[10]

Figure 15: Estimation of greenhouse gas emissions for the production of electricity (conventional gas, unconventional gas and coal)



- For gas, the high bar sections correspond to power plants with an efficiency of 40%, corresponding with a low estimation of the efficiency of the power plants installed base throughout the world; the low bar sections correspond to an efficiency of 60%, corresponding with the highest performing gas power plants.
- For coal, the high bar sections correspond to power plants with an efficiency of 36%, corresponding with an estimation of the power plants installed base throughout the world; the low bar sections correspond to an efficiency of 47% corresponding with the highest performing coal power plants. The lighter green section of the high estimation of unconventional gas corresponds to the uncertainty of the existence of additional methane leaks.

Source: Natixis AM estimations based on ADEME.

However, other means of producing electricity, particularly renewable energies or nuclear, have significantly lowered CO_2 emissions for the production of electricity based on gas.

Table 3: CO_2 emissions per energy source (life cycle analysis)

Energy sources	Technology	Greenhouse gas emissions (g eq. CO_2/kWh)
Natural gas	Open circuit gas turbine	440
	Combined circuit gas turbine	400
Solar	Photovoltaic	100
Biomass	Biomass plant	30
Wind	Onshore	30
	Offshore	10
Nuclear	Light water reactor	15
Hydroelectricity	Large	20
	Small	5

Source: European Commission, 2007.

Even though there are energies emitting less CO_2 than unconventional gas, we estimate that the exploitation of unconventional gas can be compatible with the fight against climate change. The relevance of employing these resources must be evaluated vs. local contexts. In each case, it is necessary to try to understand, in particular, whether or not these new resources can replace other, more polluting, resources.

412 Water management

Beyond the climate aspects, unconventional gas is highly controversial in terms of water, particularly because of the fears of contamination of water tables and significant water consumption.

Water table pollution risk

The pollutants

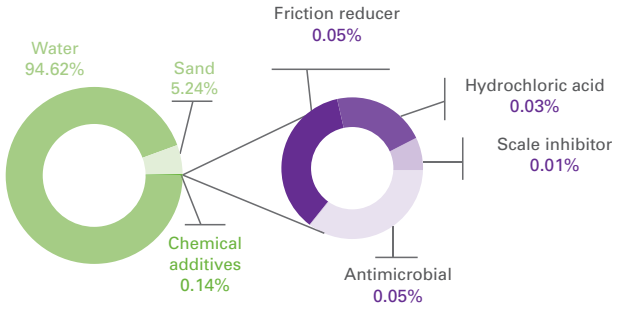
During drillling operations and unconventional gas exploitation, operators must ensure that there is no possible connection between drilling and water tables.
Indeed, various pollutants can affect the integrity of the water tables:

- Drilling sludge
Just as with traditional drilling, drilling fluid has to be used to control the pressure in the drilling and evacuate the drilled rock debris. This fluid is usually composed of oil or water, salts or other particles which improve the sludge density, as well as various chemical products. This fluid is generally toxic.

- Fracturing fluids
As already mentioned, during hydraulic fracturing, a mixture of water (~95%), sand (~5%) and chemical products (<0.2%) is injected to fracture the rock, to prevent the fractures from closing and to allow the gas to flow into the well. The purpose of the added chemical products is to improve the efficiency of the fracturing and hence the well's profitability.

(9) The production of electricity is the use which makes the most sense in comparison with gas and coal. Both of these energies are heavily used throughout the world for the flexible production of electricity.
(10) Using different assumptions, a study dedicated to this question of the gas's carbon balance sheet conducted by Deutsche Bank and the Worldwatch Institute comes to the same conclusions on the natural gas/coal comparison: DB/Worldwatch Institute, 2011, Comparing Life-Cycle Greenhouse Gas Emissions from Natural Gas and Coal, http://www.worldwatch.org/system/files/pdf/Natural_Gas_LCA_Update_082511.pdf.

Figure 16: Composition of chemical products used in hydraulic fracturing



Antimicrobials *prevent the occurrence of bacteria in the reservoir, which would otherwise lower the yields. This type of product is used notably for water treatment, as a disinfectant, or for medical sterilisation relating to anti-microbial agents.*
Scale inhibitor *allows a homogeneous distribution of the sand in the fluid. This type of product is used notably for water treatment, and is found in household cleaning products or de-icing agents.*
Hydrochloric acid *dissolves some rock types in order to improve the reservoir's permeability. This type of product is used notably in swimming pools or household cleaning products.*
Friction reducer *makes it possible to reduce the power used to inject the fluid. This type of product is used notably for soil and water treatment, or as an absorbant in babies' nappies.*

Source: Natixis Asset Management / IFP Énergies nouvelles, 2011.

In the United States, the composition of these chemical products has for a long time been protected by industrial trade secret rights, leading to many questions from the population. Since 2010, pressed particularly by the US Environmental Protection Agency (EPA), voluntary publication of the chemical products used has become the norm for manufacturers. With this information, we now know that the fluids contain dangerous or carcinogenic substances, even when present in small quantities. The industry is currently searching for alternative solutions to reduce the dangerous nature of these products.

- Natural elements

Clay characteristically retains organic matter, heavy minerals and radioactive elements. But hydraulic fracturing disturbs the formation and so when water is forced to circulate in these formations, it can rise, loaded with toxic substances, and pollute water tables.

Table 4: Example of 'natural' pollutants appearing in natural deposits

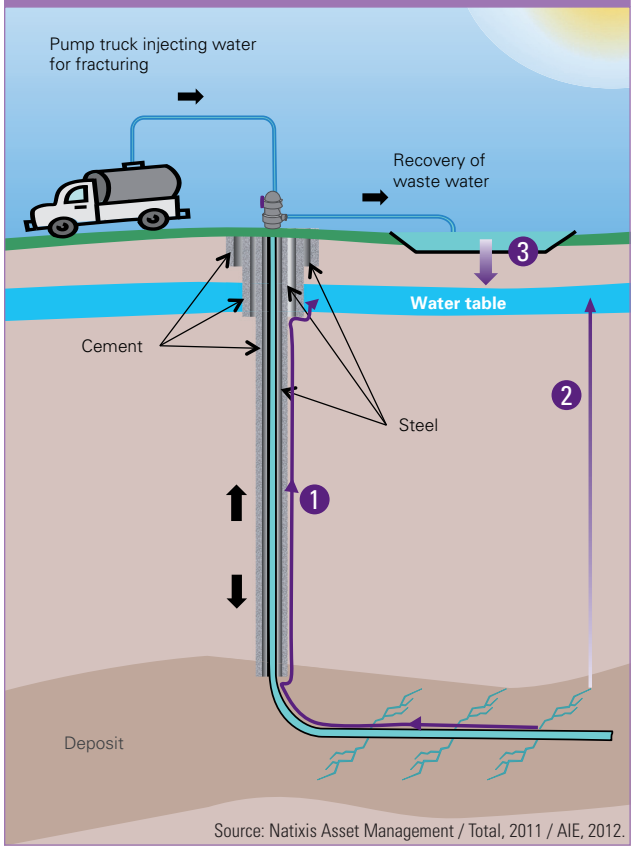
Pollutants	Examples
Fluids coming from the formation	Brine
Gas	Natural gas (methane, ethane), CO_2, nitrogen, helium, hydrogen sulphide
Traces	Mercury, lead, arsenic
Radioactive elements	Radium, thorium, uranium
Organic matter	Organic acids, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs)

Source: EPA, 2011.

Possible connections between drillings and water tables

Since the fracturing fluid contains both chemical products and natural elements that are dangerous for human health, it is absolutely necessary to prevent it from coming in contact with water tables used as a source of drinking water.

Figure 17: Main water table contamination risks



Source: Natixis Asset Management / Total, 2011 / AIE, 2012.

Contamination risks fall into three categories:

- Improper sealing 1

Oil and gas drillings, both conventional and unconventional, pass through the water tables which are usually located several hundred metres below the surface. To isolate the drilling from the water tables, operators install several steel pipes (casings) surrounded by special cement. The pipes must be 'cemented' with great care. Beside preventing the fluids circulating inside the drilling from coming into contact with the water table, it is important to make sure that fluids do not rise 'behind' the steel casing. If this cementing is not performed correctly, there is a risk that some of the injected fluid may rise through the hole made for the drilling, but outside the casing, and contaminate the water table.

The quality of the casing is important, even for traditional drilling, to prevent the drilling fluid from contaminating the water tables. Hydraulic fracturing makes this stage even more crucial. This technique requires much larger water volumes and much higher pressures than those for traditional drillings, which consequently increases the risks of deterioration of the steel and cement barriers.

For existing wells, some cases of imperfect sealing of the cement column have already led to water table contamination problems. For instance, in May 2011, the Chesapeake company was ordered to pay a fine of $900,000 for contaminating water in Bradford county. Nevertheless, these are isolated cases showing bad practice due to a lack of experience with these new resources on the part of operators and of the authorities. Even though greater attention must be paid to safety issues, it seems inappropriate to question the entire sector for these reasons.

- **Connection between the fracture area and water tables** 2

For the deepest drillings, it seems highly unlikely that fracturing the rock will generate fractures up to water tables located at a depth of a few hundred metres, since the fracturing takes place at a depth of 1,000–3,000 m and the fractures do not theoretically exceed one hundred metres. Some scientists stress the risk that hydraulic fracturing can intensify existing natural fractures and so create potential paths toward the surface.[11] Up to now, no proven case of pollution of this type has been reported.

- **Poor surface water management** 3

Two surface water management issues can lead to contamination of the water tables:

- *handling and routing of waste water on the surface.* The routing of residual water to water treatment units generates risks of accidental spills – all the more possible if the water treatment units are not located close to the sites.
- *water storage pit leaks.* As already mentioned, waste water loaded with suspended particles passes through storage pits on site. The waterproofing of these pits is generally ensured by a plastic covering. There is a risk of defective waterproofing of the basins.

In both cases, these risks are highly comparable to other industrial activities. This point must be watched by the regulator, but is not relevant enough to bring the entire sector into question.

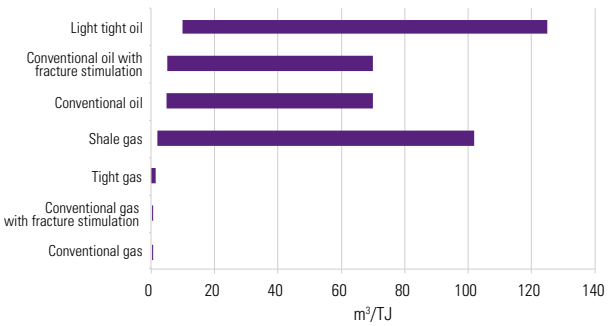
The US EPA is currently working on a new study on the impact of the exploitation of shale gas on underground water.[12] This study should provide new elements for the evaluation of these risks.

Water consumption

Shale gas and tight gas

The volume of water required for a drilling and its hydraulic fracturing varies according to the geology of the exploitation areas and the depth of the well, but is usually between 10,000 and 30,000 m³. As shown in Figure 18, between the uncertainties on well yields and the differences of water quantities to be used depending on the geology, there is a wide range of water consumption for the production of hydrocarbons.

Figure 18: Estimation of water consumption per energy type



Note: for oils, the figures include 5–15 m³/TJ necessary for refining. Also for oils, the high sections correspond to operations of assisted recovery where water is injected in the drilling to increase the pressure in the reservoir and increase yields.

Source: Natixis Asset Management / AIE, 2012.

However, despite these large variations from one field to another, it can be concluded that hydraulic fracturing demands larger water volumes than traditional hydrocarbon exploitation. In arid areas, this can create local competition issues with other uses such as agriculture, other industrial activities or local community consumption. Even though this water consumption can effectively lead to issues in some regions, it does remain well below the water consumption for agriculture.[13]

To reduce this consumption, manufacturers are trying to increase the recycling of fracturing water. Once the fracturing is completed, some of the water rises to the surface. The flowback water is between 15% and 80% of the injected water, depending on geological conditions. After treatment, most of the water can be used again for hydraulic fracturing.

This issue of water consumption must, therefore, be locally analysed according to the availability of water resources. Operator actions consisting of establishing a dialogue with local communities and setting up the best techniques available are expected to limit water needs. In areas under water stress, the project's viability is questionable from both an economic and a societal point of view.

Characteristics of coalbed methane

One characteristic of coalbed methane is that it is located in reservoirs containing large quantities of water. Since this water must be extracted before the field can be exploited, the result is that, even with fracturing operations, coalbed methane fields are generally water producers rather than water consumers. However, the extracted water requires special treatment.

Hydraulic fracturing techniques pose new contamination risks for water resources. Contamination cases due to poor fracturing quality have already led to convictions for some operators. However, the technical challenges to be met are comparable to other industrial activities. Even though this point calls for greater attention on the part of regulators to supervise operator practices, it should not bring the entire sector into question.

(11) See notably Warner and al., 2012, Geochemical evidence for possible natural migration of Marcellus Formation brine to shallow aquifers in Pennsylvania – summary available at: http://www.pnas.org/content/109/30/11961.
(12) See http://www.epa.gov/hfstudy/.
(13) Agriculture represents ~70% of global water consumption.

413 Land use and local disturbance

Land use

The area occupied by an unconventional gas exploitation site is relatively limited.

- During the drilling and fracturing phases, the area used is between one and two hectares (that is, a square of 100–150 m per side).
- In the production phase, the used surface is no more than 0.4 to 1.2 hectares. Access roads and corridors must be added to this surface to allow water, gas and electricity to circulate.

However, even though an exploitation site occupies only a relatively small surface, placing a field of shale or tight gas in production requires creating between 1 and 4 exploitation sites per km^2 over very large surfaces (several thousand km^2). These figures take into account the creation of horizontal multi-well pads to reduce soil occupancy; a technique which is becoming the norm. The impact would be even more significant if these techniques were not used.

The local impact of deposits that are close together can have a significant effect on the bird's-eye view of the land.[14]

Although this view may be alarming, it is important to remember that many human activities have a major impact on land. Besides cities, farming activities have also profoundly altered landscapes.[15] In addition, although the bird's-eye view may seem significant, the visual impact from the ground will greatly depend on the project's installation site: relief, vegetation, population density, etc.

In all cases, it is obvious that the exploitation of gas is much more invasive than that of conventional resources. First of all, unconventional gas resources are much more diffused. The IEA estimates, for example, that the density of ultimate resources in American shale gas is 0.04–0.6 bcm/km^2 compared to values of approximately 2 bcm/km^2 for conventional fields (up to 5 bcm/km^2). In addition to this low concentration of resources, the issue of low permeability (which requires a greater number of drillings to exploit the resource) has to be dealt with. Globally, the exploitation of unconventional gas requires closer drillings on more extended surfaces than for conventional gas.

Therefore, in terms of land use, unconventional gas causes problems similar to those related to solar or wind energies.

Local disturbance

Besides the issue of land use, many other problems are associated with the exploitation of unconventional gas. In particular, for each exploitation site, drilling operations are a major source of sound and light pollution. Each horizontal well requires one to two months of drilling, 24 hours a day. An exploitation site with six horizontal wells will therefore require six to twelve months of drilling. Given that it is necessary to reproduce the exploitation sites at a density of between one and four sites per km^2, there is potential for considerable disturbance caused to local populations.

Along with the disturbance associated with drilling operations, the exploitation of shale gas requires a greater number of lorries. The creation of a single exploitation site would need between 4,300 and 6,600 lorry trips. Besides the local disturbance, this increased traffic might require an adaptation of road infrastructure. Some US States have consequently raised special taxes on gas operators to finance the repairs of road infrastructure.

In the case of the United States, even though some operators have made concerted efforts to limit disturbance (use of less noisy equipment, building of walls to limit sound impact, etc.), the exploitation of these resources remains extremely invasive.

Other impacts

The exploitation of unconventional gas might also cause low amplitude earthquakes. However, it should be noted that induced earthquakes are not specific to unconventional gas and that this phenomenon has already been observed many times in the exploitation of conventional hydrocarbons, during the filling or rapid draining of large dams, and during mining.

Finally, closely compacted drillings and the building of access roads can have major consequences on local biodiversity.

For example, the exploitation of tight gas at the Jonah Field in Wyoming is accused of having caused a massive decline in some bird populations (the sage grouse, for instance).

The exploitation of unconventional gas calls for the creation of exploitation sites at very regular intervals (1–4 sites per km^2). On each site, intensive operations (drilling, lorry traffic) take place for 6 to 12 months. Globally, even though concerted efforts can be made to reduce these impacts, the disturbance remains significant.

This issue may seem relatively insignificant in sparsely populated areas as in some US States. On the other hand, in more densely populated areas (on the north-east coast of the United States, or in Europe), it is already becoming a major braking force on the development of the resource.

(14) For example, drillings at the Barnett Shale site located north of Fort Worth, Texas [Lat: ~33,12; Long: ~-97.38] (http://goo.gl/maps/1pXn2) or at the Marcellus Shale site in the Allegheny National Forest of Pennsylvania [Lat: ~41,50; Long: ~-79,19] (http://goo.gl/maps/BzunU). Each white spot corresponds to an exploitation site.

(15) For comparison, a bird's-eye view of farming activities can also have an impressive impact: http://goo.gl/maps/02LFD or http://goo.gl/maps/C68YA, for example.

5 | Viewpoint of various stakeholders

5.1 Regulations

Positions on the exploitation of shale gas vary from one country to another, from prohibiting shale gas exploitation, to moratoriums, to authorising it. If the exploitation of this resource were to increase, numerous regulations would emerge to control practices and minimise environmental and social risks.

However, it should be noted that increasing controls would lead to delays and costs relating to the recruitment and training of experts able to inspect the installations and evaluate risk.

Country	Main regulations
UNITED STATES The United States represents 75% of world unconventional gas production.	Regulations controlling the exploitation of shale gas differ from one US State to another. Nevertheless, as a general rule, these regulations remain flexible and have clearly contributed to the shale gas boom in the United States. First of all, it should be noted that in the US, landowners possess the mining resources located under their ground, contrary to French law, for example, which stipulates that, from the moment there are mining resources contained under their ground, these resources do not belong to the landowner, but to the State. This US feature allowed exploitations to rapidly develop as landowners benefitted from exploitation revenues of their subsoil. On the other hand, historically, underground injections for hydraulic fracturing were never subject to regulation, i.e., they were not governed by the Safe Drinking Water Act. In 1997, the US Court of Appeals of the 11th Circuit declared that the hydraulic fracturing used for the production of coalbed methane in Alabama was indeed an underground injection and should have come under the Safe Drinking Water Act. As a consequence of this legal decision, a study was conducted by the US EPA on the risks to drinking water associated with hydraulic fracturing. In 2004, the EPA declared that the risks were minor, and in 2005 the Energy Policy Act gave details on the definition of underground injection by explicitly excluding hydraulic fracturing without diesel. Note that New York State, which possesses large shale gas reserves, decided on a moratorium in December 2010, prohibiting the use of hydraulic fracturing techniques. According to the New York State Governor's statements, this moratorium, still in force, may shortly be terminated.
CANADA Canada represents 5% of world unconventional gas production.	Quebec decided on a moratorium on hydraulic fracturing pending a complete report on the environmental impact of shale gas exploitation. Exploration work may continue, but without recourse to hydraulic fracturing. In the rest of the country, hydraulic fracturing is authorised.
FRANCE No site currently in exploitation. France would be, with Poland, the European country with the largest shale gas resources.	Since June 2011, France has prohibited the use of hydraulic fracturing. This decision was confirmed by the new government in June 2012.
POLAND Exploitation under development. Poland would be, with France, the European country with the largest shale gas resources.	The Polish government is thinking about tax incentives to favour the development of shale gas.
CHINA Exploitation still hardly developed. Very large potential reserves.	In 2011, the Chinese government's 12th five-year plan gave the green light for the exploitation of shale gas.

512 Industry

The gas and oil industry stresses the positive aspects of unconventional gas exploitation, while acknowledging the existence of minor environmental risks. Casing defects are considered to be the main risk (even though they also exist on a smaller scale for conventional gas) due to the multiple drillings needed for unconventional gas. Hydraulic fracturing, as such, is not considered to be a major challenge by the industry, as it is a proven technique used since the 1940s in conventional hydrocarbon drillings.
Moreover, the industry frequently emphasises that the chemical products used represent only a small percentage of the injected solution (<1%) and water volumes can be reduced by treatments and by concerted R&D efforts (e.g. electric arc, fracturing by propane, without water and without chemical products). Still, according to the industry, the use of shale gas offers advantages in terms of global warming and facilitates the transition to a low-carbon economy.

513 Society

Conversely, a large number of NGOs and society activists are strongly opposed to unconventional gas exploitation. The documentary 'Gasland', released in 2010, contributed notably to the controversy by filming an American citizen living in a shale gas exploitation area setting fire to his water tap, thereby indicating the possible methane contamination of water resources.[16]

(16) The film's images and in particular the fire and faucet scene are available on the film's website: http://www.gaslandthemovie.com/about-the-film/media-kit.

The arguments most often put forward by society are:

- The volume of water necessary for hydraulic fracturing is enormous.
- The chemical products used in hydraulic fracturing present soil and water table pollution risks that can lead to health problems.
- The exploitation of shale gas destroys the countryside due to the multitude of wells to be drilled and the road infrastructure to be built.
- The large number of lorries needed to transport the water (clean and waste) and other materials and equipment disturb residents (noise pollution and road accident risks).
- Unconventional gas has a negative impact on the fight against climate change. In particular, the development of this resource will slow down the boom in renewable energies and the implementation of energy efficiency measures.

The major differences between the diverse regulations and viewpoints of stakeholders clearly show the highly subjective character of the evaluation of this technique. It seems very unlikely that a consensus will emerge on these topics, even in the medium to long term. Natixis Asset Management's position, outlined at the beginning of this study, is based on various viewpoints and is susceptible to change over time, based on new scientific data.

APPENDICES

Appendix 1 – How are hydrocarbon reserves (gas, oil, coal) defined?

In general, there are three types of reserves in identified reservoirs:

➜ **Proven reserves (1P or P90)**
Proven reserves are described in terms of volumes of already discovered gas, oil or coal and for which it is estimated that there is a chance that 90% will be extracted under current economic and technological conditions. Only these proven reserves are systematically published by the industry.

➜ **Proven + probable reserves (2P or P50)**
Proven + probable reserves correspond to the proven reserves to which are added volumes of already discovered gas, oil or coal for which it is estimated that there is a chance that 50% will be extracted under current economic and technological conditions. The amount of these reserves is not systematically published, but it is generally on the basis of a calculation of these reserves that the industry decides whether or not to exploit a field.

➜ **Proven + probable + possible reserves (3P or P10)**
Similarly, proven + probable + possible reserves take into account the additional quantities corresponding to volumes of already discovered gas, oil or coal for which it is estimated that there is a chance that 10% will be extracted under current economic and technological conditions.

Given their definition, these reserves are habitually being constantly re-evaluated. Although exploitation reduces reserves, various factors can increase their size.

In particular:

➜ New fields can be discovered and exploited.

➜ Extraction techniques can be improved, which increases the hydrocarbon recovery ratio.[17]

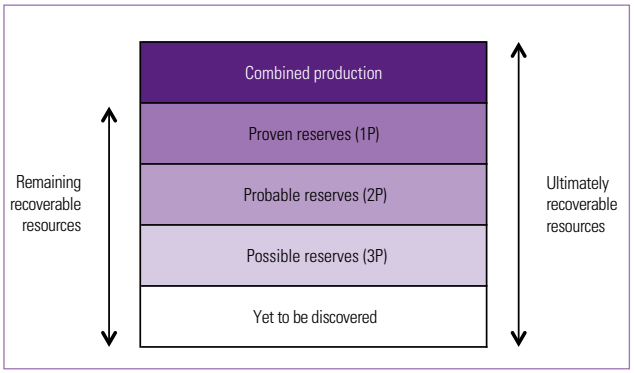
➜ Economic conditions can change. In the case of oil, for example, profitable reserves for a barrel at $100 are much more significant than for a barrel at $20.

➜ For oil, since the OPEC countries' production quotas (⅔ of world oil reserves) are set according to their proven reserves, it is in the interests of these players to change the estimation of their reserves to adjust their production. The problem is the same for private players, for whom the amount of reserves is an important parameter for the company's valuation.

To quantify the hydrocarbons which will be exploited on the ground, the term 'ultimate resources' is used. These ultimate resources correspond to the 1P, 2P and 3P reserves, plus the resources yet to be discovered. The remaining ultimate resources correspond to these ultimate resources minus what has already been produced.

Note: ultimate resources must not be confused with resources in place. Resources in place correspond to all the hydrocarbons contained in reservoirs, regardless of the economic or technical possibility of exploiting them.

This classification applies to conventional and unconventional gas, oil and coal resources.



(17) For conventional oil, for example, this recovery ratio is, on average 35%, with very large variations depending on the fields. For conventional gas, the recovery ratio is generally close to 80%.

Appendix 2 – Can shale gas emit more CO_2 than coal?

In 2011, researchers from Cornell University, one of the most prestigious American universities, published a study on the impact of shale gas exploitation on climate change (Howarth R. W., 2011).
The main conclusion of the study is that shale gas has a greater impact on climate change than coal. The study also estimates that, in some cases, this conclusion can also apply to conventional gas.

This conclusion was strongly criticised by industrialists[18] for several reasons:

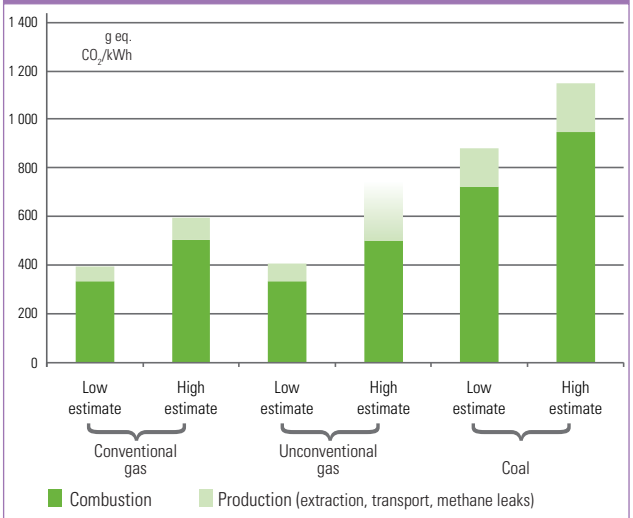
- The study insists on taking into account the Global Warming Potential (GWP) over 20 years, while almost all studies use a GWP over 100 years. However, this choice is not without its consequences because, in the study, it multiplies the impact of methane leaks by three. Taking into account this GWP over 20 years, shale gas has an impact between 20% and 100% higher than coal. The study estimates that the potential in 20 years is more relevant because it is necessary to greatly reduce greenhouse gas emissions in the coming decades. However, this choice does not correspond to the standard practices of environmental evaluations.[19]

- Even in the case of the use of a GWP over 100 years, the study concludes that unconventional gas has an impact equivalent to that of coal. This conclusion was similarly strongly criticised. The study estimates that only the well creation stage generates the differences of methane leaks between conventional gas and shale gas. These additional leaks do not increase the CO_2 footprint of shale gas by more than 20% compared to conventional gas. Other methane leaks are the same for conventional gas and shale gas.
  An important point is that, in this study, conventional gas has a much more unfavourable footprint than in most other studies (-15% compared to coal in the Cornell study, while in most of the studies, for example, the French ADEME, the CO_2 footprint is -40%). This difference is due to a very high leakage ratio over the entire life cycle (extraction, transport, combustion) in the study (2–6%), while the generally accepted values use a much lower ratio (~1%).

Finally, other factors increase the gas's footprint, such as taking into account GWPs above the values recommended by the IPCC or the comparison of both energies per energy content without taking into account the efficiency of electric power plants, which is the main use for which both of these energies compete.

Globally, the revelation of this study is in the measurement of additional leaks linked to shale-gas-specific extraction processes. However, these estimations are based on very few production sites and the data is strongly contested by industrialists. Even if these figures were proven, the shale gas footprint would only be approximately 20% higher than that of conventional gas, which remains much better than the environmental footprint of coal.

Figure 19: Estimation of greenhouse gas emissions for the production of electricity (conventional gas, unconventional gas and coal)



- For gas, the high bar sections correspond to power plants with an efficiency of 40%, corresponding to a low estimation of the efficiency of the power plants installed throughout the world; the low bar sections correspond to an efficiency of 60%, corresponding to the highest performing gas power plants.
- For coal, the high bar sections correspond to power plants with an efficiency of 36%, corresponding to an estimation of the power plants installed throughout the world; the low bar sections correspond to an efficiency of 47%, corresponding to the highest performing coal power plants.
** The lighter green section of the high estimation of unconventional gas corresponds to the uncertainty of the existence of additional methane leaks.*

Source: Natixis AM estimation according to ADEME.

In other words, this study questions the CO_2 footprint, not only of shale gas, but also of conventional gas. Since the estimations on conventional gas are counter to most of the reference sources, these values must be approached with caution. However, the approach taken by the Cornell researchers focuses on the uncertainties that prevail on the environmental impacts of gas, considering, in particular, the methodological choices and the uncertainties on methane leaks. This point is being specifically followed up by our extra-financial research team.

(18) See, in particular, the American oil and gas producers' site: http://www.energyindepth.org/2011/05/five-things-to-know-about-the-cornell-shale-study/.
(19) The standard choice of a GWP over 100 years is linked to the fact that the United Nations Framework Convention on Climate Change (UNFCCC), in the framework of national inventories, recommends using the global warming values over 100 years.

APPENDICES

Appendix 3 – Companies currently involved with unconventional gas

Country	Company	Shale gas	Tight gas	CBM
Australia	Santos Limited	X	X	X
China	Petro China	X	X	X
	Sinopec	X	X	X
Brazil	OGX Petroleo e Gas	X		
France	Total	X	X	X
Italy	Eni	X		X
Norway	Statoil	X	X	X
Spain	Repsol YPF	X	X	
United Kingdom	BG Group	X	X	X
	BP	X	X	X
	Royal Dutch Shell A	X	X	X
Canada	Canadian Oil Sands	X	X	X
	Sucor Energy Inc.	X	X	X
United States	Anadarko Petroleum Corp	X	X	X
	Apache Corporation	X	X	X
	Chevron Corp	X	X	X
	Conoco Phillips	X	X	X
	Devon Energy Corporation	X	X	X
	Exxon Mobil Corp	X	X	X
	Hess Corp	X	X	
	Marathon Oil Corporation	X	X	X
	Occidental Petroleum Corp.	X	X	
	Quicksilver Resources Inc	X	X	X
	Range Resources Corp.	X	X	X

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mirova
Responsible Investing

MIROVA'S FOCUS

A deep understanding of the latest global developments regarding technology, politics, regulation, society and commerce is absolutely essential in order to identify the sustainable economic development levers according to Mirova, the Responsible investment division of Natixis Asset Management.

This forms the reasoning behind the work of Mirova's team of ESG research and engagement analysts, who are presented below, who continue to provide publications on the latest key issues within the framework of a responsible approach.

Focus

mirova
Responsible Investing

FRANCE'S VERSION OF 'SAY ON PAY'

Written 18/11/2012

> We would like to renew Corporate Governance to gain real control of remuneration at general meetings
>
> announced Pierre Moscovici, French Minister of Economy and Finance, at the Council of Ministers on 13th June 2012.

In the light of current international regulatory measures, it is understood that future legislation will no doubt include the introduction of the Say on Pay principle in France.

What is Say on Pay?

This movement, which gives corporate shareholders a greater voice in setting management pay (fixed or variable) was introduced in the United Kingdom in 2002 and, subsequently, by numerous other countries in the world.

In recent years, media coverage of various scandals relating to the remuneration of certain executives has raised public concern and has resulted in an amendment of the principle of executive remuneration, notably in giving shareholders the right to scrutinise management remuneration.

A multi-approach principle

From a legal or binding obligation…

In the **United Kingdom**, this right is a legal obligation, whereas in countries such as Germany it is regarded at present as a voluntary corporate initiative; the second major difference being that the vote can be mandatory or advisory.

By way of example, a law was adopted in the **Netherlands** in 2004 to introduce a mandatory vote on executive remuneration policy, with **Sweden** and **Norway** following suit in 2006 and 2007 respectively. Boards are therefore initially compelled by law to submit executive remuneration policies to the General Assembly, and then to take votes into account by altering their choice in the event of a rejection of the resolution.

…to an obligatory, but purely advisory initiative…

In contrast, **Italy** opted in 2012 for the introduction of a mandatory but still advisory vote, in line with the **United Kingdom**, **Belgium**, **Denmark** and the **United States**.

The situation in **Australia** is rather different, in that their Say on Pay, introduced in 2005, saw an amendment at the beginning of this year, allowing shareholders to trigger a vote on directors' re-election if over 25% of shareholders were to vote against the remuneration report at two consecutive general meetings, and if a spill resolution (following the rejection of the proposal) was passed by 50% of the votes. At the same time, this amendment was associated with the banning of directors, executives and their closely related parties from voting on executive remuneration.

…that is voluntary in its application

Finally, in **Canada**, **Switzerland**, **Luxembourg**, **Germany** and **Spain**, the application of Say on Pay is voluntary for businesses, and is therefore not a legal obligation, but rather a recommendation of their respective Corporate Governance codes.

Indeed, numerous codes feature in their legislation following the 2004–2005 European Commission recommendations regarding listed company directors' pay and remuneration policies in the financial services sector. In May 2012, Michel Barnier, the European Internal Markets and Services Commissioner, proposed:

- to introduce mandatory Say on Pay in listed companies.
- to submit to a shareholder vote on a bonus cap, (expressed as a percentage of fixed remuneration exclusively for banks), as well as a maximum difference between the highest and lowest salaries within a particular company.

Towards a Say on Pay *à la française*?

As a result, we believe that it is highly likely that future legislation, for which the French Treasury launched a public consultation in August 2012, will include the introduction of a shareholder vote on executive remuneration.

Consequently, we can wonder whether this vote will be of an advisory or a mandatory nature, although this distinction should be kept in perspective, in view of the fact that a company not taking into account 20–30% of votes against a resolution is liable to expose that company's image to a significant risk. It therefore makes sense to consider an advisory vote as having just as strong an impact as a mandatory one.

Key Say on Pay challenges

So, the underlying question is the precise subject on which investors will be called to vote.

Will it involve the approval of:

- the report regarding remunerations?
- the structure of executive remuneration?
- their variable remuneration policies?

Practices differ from country to country:

- Belgium having opted for a vote on the approval of the remuneration report
- Germany, Sweden, Italy or the Netherlands focused more on the structure of executive remuneration
- In Denmark, they are concentrating on a variable remuneration policy
- In Switzerland or in the United Kingdom, certain votes include directors' remuneration.

The French version of Say on Pay should focus mainly on executives' compensation, since the package of directors attendance fees is already voted on at General Meetings, as are golden parachutes, defined-benefit pension schemes, attribution of stock options and performance shares.

The Say on Pay principle highlights several fundamental questions such as the respective responsibilities of the Board and the General Assembly, and the legitimacy or even the competencies of shareholders to give their opinion on corporate management remuneration policy. **However, there is no doubt that it will result in an improvement in transparency and a necessary enhancement in the dialogue between issuers and investors.**

However, this increased transparency represents only one answer to the question of executive compensation. The objective to achieve remains the alignment of the structure and evolution of their remuneration with the long-term interests of their company and society as a whole.

Executive remuneration is thus certain to remain a live topic of debate over the next few years, both internationally and in France.

> Media coverage of various scandals relating to the remuneration of certain executives has raised public concern and has resulted in an amendment to the principle of executive remuneration.

SANDY, A MESSENGER FOR GLOBAL WARMING?

Written 08/11/2012

Each extreme climate event, such as Hurricane Sandy, rekindles the debate on the consequences of climate change. Although there is still no scientific evidence proving the link between global warming and the increase in the intensity of these phenomena, these events are a harsh reminder of how sensitive our economies are to climatic vagaries and, therefore, encourage us to strengthen action to reduce CO_2 emissions.

On the night of the 29th of October 2012, after causing considerable damage and numerous deaths in the West Indies, Hurricane Sandy hit New York and the rest of the east coast of the United States.

Sandy had a devastating impact, causing more than one hundred deaths, 50 billion dollars' worth of damage, petrol shortages, electricity cuts, and the evacuation of hundreds of thousands of people.

Right in the middle of the American election campaign, this hurricane forced candidates to address the issue of global warming, a subject that had been otherwise evaded.
Following Barack Obama's election, he stated that, like many Americans, 'We want our children to live in an America that isn't threatened by the destructive power of a warming planet.' However, his room to manoeuvre is limited as the House of Representatives remains under the control of the Republicans, a large majority of whom are opposed to any climate-related regulations.

A complex link between hurricanes and climate change

Although Sandy has pushed numerous policy makers into addressing the issue of climate change, the link between the two phenomena remains uncertain. **It is difficult, for example, to say that Sandy is a result of climate change**.

As a Category 2 hurricane, it was not exceptional in its intensity. Katrina, which ravaged New Orleans and Louisiana, was a Category 5 cyclone – the maximum category possible. Even for the North of the United States, where cyclones are less frequent, Sandy did not have any extraordinary characteristics.

New York had already been hit by a Category 3 cyclone in 1938. The damage caused by Sandy was only because its path took it through very densely populated areas.
In more general terms, while some consequences of global warming are currently known to a near-certainty (increased drought, loss of biodiversity, increase in coastal floods, etc.), the link between hurricanes and climate change still needs more extensive research. Specialists, particularly the IPCC (Intergovernmental Panel on Climate Change), estimate that climate change could increase their intensity. However, they still underline significant uncertainties that exist today in the analysis of these phenomena.

A crucial issue for the insurance sector

In any case, Sandy has reminded us of the sensitivity of our societies to climate conditions. The insurance sector, especially the reinsurance companies, who act as 'insurers of insurers' for major disasters, is highly exposed to these issues.

> ‘ Right in the middle of the American election campaign, Sandy forced candidates to adress the issue of global warming.

The German company, Munich RE, the world's Number One in reinsurance, recently produced a report on climate events over a long period. The company estimates that, over the last 30 years, the losses associated with climate events, storms, floods, heat waves and drought have been multiplied by:

- 5 in North America
- 4 in Asia
- 2.5 in Africa
- 2 in Europe
- 1.5 in South America

The increased losses are primarily due to socio-economic factors: increasing population, urban sprawl and economic growth. They have all increased the probability of a hurricane hitting a populated area with expensive infrastructure, compared to 30 years ago. The reinsurer, however, estimates that these socio-economic factors are not, by themselves, responsible for these figures and that climate change has also played a role in the increase of such losses.

> "Due to their devastating effects, hurricanes mobilise opinion more easily than long-term trends.

Amongst climate events, the issue of storms is crucial for any insurance company in the United States, because storms there represent 76% of losses. The existence of a link between climate change and storms is therefore an interesting topic for the sector.

As part of its study, Munich RE carried out a specific task to examine this specific point. They estimate that their statistical analyses, adjusted by socio-economic factors, show an increase in the cost of these storms over the last 40 years.

On the basis of this analysis and of the observation of weather developments over the same period, the company estimates that it is likely that climate change is the root cause of this increase. Munich RE are thus strengthening the case of those who support the idea of a link between global warming and the increase in the intensity of hurricanes.

Due to their devastating effects, hurricanes mobilise opinion more easily than long-term trends. If the possibility of a link between hurricanes and climate change is important for insurance companies in adjusting their risk premiums, this issue is only a supplementary element underlining the urgent need to act against climate change.

Regardless of the conclusions scientists will reach regarding this link, the consequences experienced as a result of climate change are already broadly severe enough to demand action as quickly as possible.

> "Although the consequences of global warming are now known with near certainty, the link between hurricanes and climate change still requires significant research.

THE DODD-FRANK ACT AND CORPORATE SOCIAL RESPONSIBILITY

Written 08/11/2012

While the Dodd-Frank Wall Street Reform and Consumer Protection Act 'Dodd-Frank', enacted in 2010, focuses on assuring stability in the US financial markets, it also hopes to improve transparency and provide investors and citizens with tools to hold companies accountable for their actions.

On this second point, in August 2012, the Securities and Exchange Commission (SEC) issued the detailed implementing rules regarding the sections relating to **conflict minerals (Section 1502) and payments to governments by resource extraction issuers (Section 1504)**.

Conflict minerals

Section 1502 hopes to fight human rights abuses in the war-torn Democratic Republic of the Congo by making companies accountable for buying 'conflict minerals'. These minerals – tantalum, tin, tungsten and gold – are those believed to fund Congo's militias and prolong conflict despite a formal end to the war in 2003.

While these minerals do not have as high a visibility as 'blood diamonds', their contribution to the conflict financing the paramilitary forces has been even more important in the Congo.

The regulation applies to companies listed in US stock exchanges with products that contain tantalum, tungsten, tin or gold that are necessary to the functionality or production of a product. These minerals are commonly found in electric components, thus involving industries such as electronics and communication, automotive and medtech, among others.

Corporate Social Responsibility for the entire sector involved

The companies concerned must make 'a reasonable effort' to determine the origin of the specified metals used in their products and must file a public Conflict Minerals Report with the SEC.

If a company cannot ensure that its minerals are conflict free, it will have to detail in the report:

- the products manufactured that have not been found to be conflict free
- the facilities used to process the conflict minerals in those products
- the country of origin of the conflict minerals in those products
- the efforts made to determine the location of origin with the greatest possible accuracy.

Companies have until May 2014 to make their first disclosures of whether the minerals they use in manufacturing are conflict free.

Conflict minerals: origin and use

Mineral	% Global production from Congo	% of Global production used in electronics
Tantalum	15–20%	~60–70%
Tin	2.3%	35–45%
Tungsten	2–4%	<20%
Gold	<1%	<20%

Source: Enough Projects (2009), BSR (2010), Resolve (2010).

An incentive-driven regulation

Although the SEC itself has no punitive power, it believes that by making the reports public, the risk of reputational damage, investor divesting and lawsuits will motivate corporations throughout the supply chain for these minerals to take the reporting process seriously.

The SEC, however, does recognise that compliance is a matter of will, but also of means. Between the final vendor of the electrical equipment and a mine lie several layers of merchants, warehouses, traders, smelters, processors and electrical component makers.

While companies do have two years (four years for small companies) to declare those of their products which are 'DRC Conflict Undeterminable', the SEC has estimated that the initial cost of implementing the rule among its issuers is between 3 and 4 billion dollars.

While Section 1502 of Dodd-Frank will involve mining companies indirectly, its Section 1504 is drafted specifically for the extraction industry. The new rule regarding payments to governments includes exploration, extraction, processing, and export, or the acquisition of a licence to commercially develop oil, natural gas or minerals. It requires all US-listed extraction companies to file all payments over $100,000 by project, government and category (i.e. taxes, royalties, licence fees, etc.) along with their fiscal year report, starting in September 2013.

The first step towards more transparency within the sector

The ruling was welcomed by various civic society groups as a way to help fight back-room deals and exploitation in developing countries with large mineral or hydrocarbon reserves. It was, however, considered excessively stringent by others, notably the American presidential candidate, Mitt Romney, who pledged that he would repeal certain parts of Dodd-Frank. With the recent results of the American election, there is now less of a chance that the law will be revoked.

As the SEC progresses in this matter, Europe is now facing pressure to revise its 2004 Transparency Directive to support the establishment of a global standard.

One of the main discussions is around a proposal that would create a new loophole by exempting corporations from reporting payments if a law in a country where they are operating bars such disclosures.

- Some industries have argued that such rules could force companies out of Angola, China and Qatar, important markets which have laws restricting financial disclosure
- Others call attention to the fact that such exemption could incentivise countries to develop repressive laws outlawing transparent reporting.

Conclusion

Sections 1502 and 1504 should be viewed in the context of a growing number of regulations promulgated in the US and elsewhere that cover human rights, company-to-government transactions, international business dealings, resource extraction and supply chains. Seen in this light, these regulations may require a broader strategic response from the electronics, oil, gas and mining industries than simply complying with a single provision of one piece of legislation.

As for us, the investors, it offers new data with which we can further learn about improving governance in natural resources, deter corrupt behavior, and favour responsible companies.

> ‘Society has welcomed this regulation, feeling that it strengthens the struggle against corruption in developing countries rich in natural resources.

THE US DROUGHT OF SUMMER 2012 AND ITS IMPLICATIONS

Written 08/11/2012

As a result of the severe drought that took place in the US in the summer of 2012, cereal prices have reached a record high. US farmers have registered record profits for 2012, partly due to agricultural insurance indemnities. As a result, investments into fertilisers, inputs and new agricultural equipment are set to remain high for the coming 2013 harvest season.

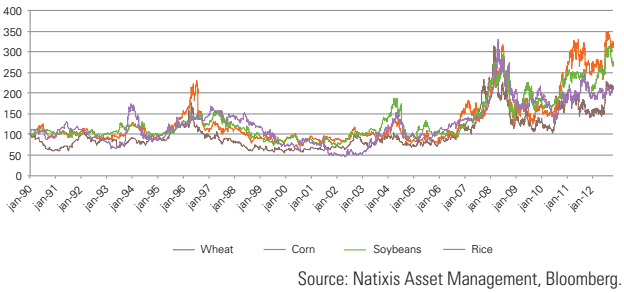
The worst US drought in over 6 decades

In July and August 2012, the United States experienced its worst drought since the 1950s. In mid-August, according to US weather services, a total of 87% of corn acreage and 85% of soya bean acreage were affected by the drought. More than half of these acreages were subject to an extreme or even exceptional drought.

The United States is the number one world corn producer and exporter (almost 60% of global exports) and one of the main exporters of soya beans.

In July and August 2012, cereal prices were up 45%, exceeding even the high price levels incurred during the 2007–08 crisis, marked by the hunger riots in numerous African countries, Indonesia, the Philippines and Haiti. However, the situation in 2012 cannot be compared to that of 2008; farmers no longer face the same liquidity issues as they did during the financial crisis and certain harvests such as wheat and rice remain globally at a satisfactory level.

Between July and August, the USDA (US Department of Agriculture) cut their corn and soya bean production forecasts by 17% and 12% respectively. Corn and soya bean yields were revised downward by 26% and 18% respectively over the last 4 months (to 123 bushels/acre and 36 bushels/acre respectively).



Source: Natixis Asset Management, Bloomberg.

Change in cereal prices since January 1990

- In 2012, **production of US corn** was set to decline 13% compared to 2011 despite an increase of 5% in cultivated areas. At the end of September, corn stocks represented a mere 5.5% of consumption (stocks to use), the lowest level in 26 years.

- In 2012, **soya bean production** was expected to decrease by 8% in the United States with a historically low level of stock (130 million bushels). Such weak inventory levels, whether corn or soya beans, mean that prices are set to remain high over the coming months.

Pressure on protein and bioethanol producer margins

Meat, poultry and dairy producers were amongst the most affected players who took the full brunt of the increased prices of cattle feed, largely by-products from corn and soya bean production. These price increases took place while, at the same time, 55% of pastures used by US live-stock producers were in very poor condition. Unlike farmers, few livestock producers benefit from agricultural insurance. On August 12th, in response to the drought, the US Secretary of Agriculture announced a $170m support plan within the framework of the USDA Federal Food Nutrition Assistance programme for livestock producers (in the form of purchases of different types of meat).

The cereal price surge during the summer rekindled the debate on the competition imposed on the food industry by the bioethanol industry ('food vs fuel').

For the record, 40% of domestic corn production in the US goes towards the production of ethanol. Within the framework of the Renewable Fuels Standard (RFS), US oil companies are obliged to blend 10% of ethanol into gasoline they produce.

The mandate set by the RFS forecasts a 5% increase in ethanol production to 13.2 billion gallons in 2012, an amount which is set to reach 15 billion gallons by 2015, before the arrival of second generation ethanol (for a doubling of total production capacity by 2022).

On the 21st August, following numerous calls from American Congress members and José Graziano da Silva, Director-General of FAO, during the summer, the EPA (Environmental Protection Agency) opened a public consultation to help determine an eventual revision of ethanol blending objectives. This consultation does not predjudge in any way the EPA's final decision which must be made no later than 13th November 2013.

Favourable prospects in Latin America

Other parts of the world have experienced extreme weather conditions which have had a strong impact on harvests.

Russia went through an unusual drought period in the spring, which led to a 30% decrease in yields in numerous regions. Following a 25% decrease in 2012, the production of Russian wheat will barely cover the needs of the domestic market, let alone any export.
Ukraine and Kazakhstan, equally confronted with unfavourable weather conditions, saw a decrease in wheat production equivalent to that of Russia. As a result, the price of wheat rose 26% in June and July. At the end of September, stock ratio of wheat to consumption was at 25.5% (the lowest for 5 years).
In **India**, the monsoon season was disappointing in 2012 (22% lower than normal), which delayed the start of the new planting season (usually in mid-June).
In **China**, despite a severe drought in the first half of 2012 (H1 2012), wheat and rice harvests were satisfactory, with an increase of almost 3% in the country's grain production.

Brazil is amongst the main beneficiaries of the US drought, as the country is set to gain market share in the global cereal trade.

According to the USDA, Brazil is going to become the number one exporter of **soya** beans in 2012 (37.6 mt) with a global market share of 40%, ahead of the United States (30.2mt).

Some US protein producers have already decided to purchase their grain from Brazil, where **corn** exports should increase by 18% in 2012 (reaching a record level of 15mt).

In 2012, with the spread of the second harvest (between May and July) that benefitted from sufficient rains, total corn production in Brazil is set to increase by 29% to 72.8mt according to BIGS (Brazilian Institute of Geography and Statistics).

This increase in volume should go hand in hand with record margin levels (based on high grain prices) for farmers, supporting high purchases of agricultural input in H2 2012 in this part of the world.

Record profits for US farmers thanks to insurance proceeds

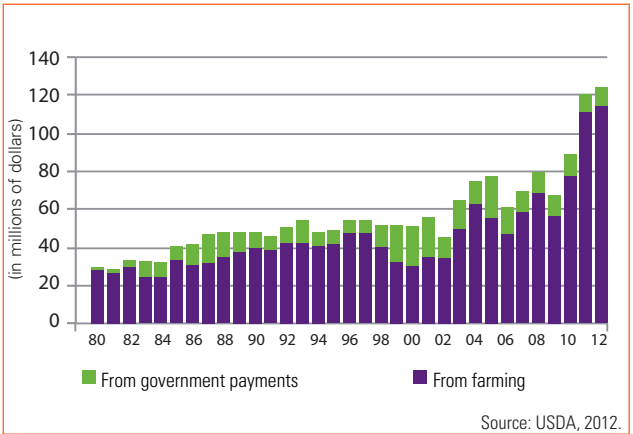
The summer 2012 drought was possibly one of the most severe agricultural disasters recorded by the US insurance industry in over five decades.

According to the risk modelling and consulting firm, AIR Worldwide, the cost of the disaster could rise to $13bn, borne for the most part by the Federal Government (up to $10–12bn), the remaining loss of $1–3bn being borne by private insurers.
In addition to this loss-sharing system, the FCIC (Federal Crop Insurance Corporation) anticipates that the government will subsidise a portion of the premiums paid by the farmers. Since the 1930s, a large proportion of US farmers have made use of crop insurance. To understand the full extent of the damage caused by the disaster will take until the end of 2012, and will also depend on the price of grain at harvest time.
According to the USDA, profits made by US farmers increased by 3.4% in 2012 reaching a record level of $139.3bn due to both:

- ➜ an increase in cereal prices, partly compensating for the decrease in volume
- ➜ insurance indemnities.

In 2013, US farmers are expected to maximise their yields as a result of a comfortable level of cash-flow and a strong price environment. The area planted should reach a record high of an estimated 96 million acres in 2013 in the United States. On a global level, the USDA forecasts an increase of 1.4% in area cultivated for the 2012–13 season, compared to an average annual growth of 0.2%.

These forecasts are an early indication of increased spending on fertilisers and other agricultural inputs, but also agricultural equipment, in the expectation of a record harvest in the United States in 2013.



Source: USDA, 2012.

US Net Cash Farm Income

Towards a recovery of investment in agricultural inputs and equipment in 2013

Agricultural equipment orders postponed to 2013

Demand for agricultural equipment is highly correlated with farmers' gross income. In spite of the drought, the USDA forecasts a 2% increase in revenue for farmers in 2012 (up to $337m).

In anticipation of receiving insurance indemnities in the latter part of 2012, farmers may have adopted a wait-and-see attitude in the autumn and chosen to postpone any new equipment orders until the beginning of 2013. The events of the summer partly justify the US company, John Deere's announcement of a downward revision of their 2012 sales objectives.

In the long term, the agricultural machinery sector's fundamentals remain favourable due to necessary replacements in mature markets (US, Europe), and increasing mechanisation in emerging markets.

Fertilisers:
weak short-term visibility on the potash market

Given the fall in agricultural yields, fewer inputs were taken from US soil during the 2012 season, which could have an impact on demand for certain fertilisers over the coming months.

- For **nitrogen fertilisers**, short-term prospects are more favourable as they need to be applied annually. The supply/demand balance on the **urea** market is set to support prices in Q4 2012, with an expected reduction in Chinese exports (a tax increase on urea exports was expected as of 1st November) and a substantial amount of orders from the US and India. However, prospects on the urea market for 2013 are mixed due to the arrival of new capacities in countries where production costs are low, such as the EEC, Russia and North Africa.

- In North America, **phosphate fertiliser** prices have increased by 6% since July and stocks are 30% below average. The price trend in the last part of the year depended on both the needs of the US farmers in the autumn and the scale of the decrease in demand from India (India represents around half the amount of global imports). Following a cut in government subsidies on the purchase of phosphate fertiliser, Indian farmers have resorted to nitrates, which are more affordable than phosphates.

Demand in Latin America, on the other hand, which represents almost 25% of the phosphate market, continues to grow at a solid rate (+9% per year).

- Short-term visibility remains weak on the **potash** market, notably due to the delay in new contracts with China and India initially planned for H2 2012 (together, these countries represent almost 40% of world potash consumption).

Two of the main global potash producers, the Canadian company, Potash Corp and the Russian company, Uralkali, have recently announced a cut in their sales forecasts for Q4 2012, mainly due to the postponement of new orders from India (due to a weak Indian currency) and China (increased local production) towards the end of 2012 / beginning of 2013. Besides added pressure from China to obtain a price inferior to $470/t, as negotiated in H1 2012, the increased level of potash inventory in the US (39% above average in 5 years) at the end of September will no doubt lead to a price decrease in 2013.

Increasing demand for seeds / crop protection products

Numerous factors support a dynamic growth in demand for crop protection products in 2012–2013:

- High grain prices
- Low level of stock-to-use ratio
- A good start to the season in Latin America in autumn 2012 (increased area planted in soya beans, increased demand for sugar cane crop protection products).

Given the strong correlation between the price of cereal and crop protection products, renegotiations of contracts which took place in the autumn should lead to an average price increase of 5%.

An increased frequency of extreme weather events?

The question of a link between an increased frequency of drought periods (and extreme weather events in general) and climate change is the topic of numerous debates within the scientific community. Part of the community considers that a lack of hindsight and an insufficient amount of reliable statistics concerning these phenomena over the last few centuries make it impossible to come to a conclusion based on past trends.

However, an increasing number of scientists, including experts from the Intergovernmental Panel on Climate Change (IPCC), believe that climate change has already driven changes in weather patterns, such as heat waves, very high temperatures and intense rains, over the last 50 years.

Thus, in its report published in February 2012, the IPCC suggests that the frequency, length and intensity of extremely warm temperatures will multiply in an increasing number of regions across the world. Despite the lack of data and certainty concerning the various factors relating to heat waves, the report suggests that an intensification of drought across Southern Europe, the Mediterranean region, Central Europe, Central North America, Central America, Mexico, North-East Brazil and Southern Africa is likely. Likewise, the report emphasises the probability of an increased frequency of phenomena such as tropical storms, but is more reserved on the question of a link between climate change and floods.

Beyond the role of climate change in the occurrence of extreme weather events, the consequences of these episodes of drought are consistent with the expected impacts of global warming: an increase in temperatures and water cycle disruptions.

What are the implications for farming methods in the longer term?

Last summer's US drought highlighted once again the significant volatility of the price of cereal that farmers have to deal with, and the added risk in the background of food price inflation, particularly in emerging countries. **In this context, reducing the impacts of climate change represents a key challenge for the agricultural sector.** One of the responses lies in the diversification of agricultural practices:

- No-till farming – reducing the use of agricultural machinery in fields allowing for a better carbon sequestration in soil
- Organic farming – respecting natural processes with the use of composting
- Crop rotation – combining crops such as lucerne and sorghum in certain parts of the US where corn dominates.

Beyond reducing its contribution to greenhouse gas emissions, the agricultural input market also has a key role to play in adapting to climate change.

Seeds

The demand for seeds offering an increased resistance to drought is set to increase in years to come.

This will call for:

- A choice of late varieties more resistant to high temperatures
- Research on plants whose roots burrow deeper into the soil
- Hybridisation technique improving corn harvests in a moderate drought environment.

According to the Syngenta group, the market for drought-resistant seeds, even without taking extreme drought episodes like the one in summer 2012 into account, could represent up to $500m in the United States.

The Swiss company works on integrated solutions, combining drought-resistant hybrid seeds (Agrisure Artesian) with water optimising solutions. To this end, Syngenta went into partnership with the US group Lindsay, a specialist in modern centre-pivot technology and automation (propelled by electric motors) providing a more precise application of fertilisers and crop protection products, with the added benefit of cost savings.

Crop protection products

In the majority of cases, increased temperatures lead to increased threats to harvests. A rise in humidity in the air encourages plant disease and increased weed competition, particularly for corn, which requires increased prevention efforts. Bio control is an alternative method to protect plants, and one that is less harmful to the environment and human health than the use of chemical products.

This method favours the use of natural mechanisms and interactions (invertebrates, insects, fungi, bacteria, viruses, pheromones, etc.) to fight against various different parasites. Today, biocontrol or the use of 'natural warriors' remains a complementary addition to secondary markets or in association with traditional chemical solutions and seed distribution.

Fertilisers/agricultural machinery

For this sector, responsible for the majority of the agricultural industry's greenhouse gas emissions, evolution lies in the development of advisory services provided by agronomists and solutions adapted to local conditions.

Examples of such solutions include improving:

- spreading equipment
- developing tools to determine more precisely the right timing
- the right location and amount of fertiliser to add over the course of growth
- the use of slow- or controlled-release fertiliser.

To address the key issue of water management, the use of precise irrigation techniques, such as drip or micro-irrigation, will result in economies in both cost and water.

In terms of technological improvement, the consequences of climate change and the increasing number of drought periods should reinforce the demand for tractors equipped with GPS systems to follow the weather, monitor harvests and carry out precision farming.

BISPHENOL A: TOWARDS AN INCREASING REGULATORY FRAMEWORK

Written 14/12/2012

On the 13th December 2012, the French Senate definitively adopted a law aiming to remove bisphenol A from all food containers.

By 1st January 2013, all containers destined for children under the age of 3 should be free from this substance. This ban will cover all food containers by 1st July 2015 (extended deadline from the first text approved by the National Assembly in October 2011 which set the ban for January 2014).

Bisphenol A (BPA), a synthetic chemical that has been used for more than half a century in the industry, has been suspected since the 1990s of being harmful. For many years, suspicions have been multiplying in the scientific community and **there are many voices in favour of denouncing a 'worldwide health scandal', often compared to that of asbestos**. These suspicions are accompanied by a strong tendency, in various parts of the world, to reinforce regulations on the matter as a precautionary measure.

> Bisphenol A (BPA), found in a wide variety of products, is a controversial chemical substance that is suspected of being an endocrine disruptor.

What is bisphenol A? Where is it used?

Bisphenol A is a synthetic chemical used mainly in the manufacturing of:

- **plastics such as polycarbonate** (⅔ of world production)
- **epoxy resins** (⅓ of world production).[1]

A wide variety of industrial sectors use this substance, which is found in numerous products.

- **Polycarbonate** is a rigid and transparent plastic that is both heat and shock resistant, and is used in a wide range of products such as DVDs, computers, household appliances, spectacles, contact lenses, reusable water bottles and medical equipment.
- **Epoxy resins** are mainly used as a covering for industrial and consumer applications, such as food, canned drinks, and protective layers for electronic, marine and medical usages, etc.[2]

Why is there concern over this substance? Where is the evidence?

BPA is strongly suspected of being an endocrine disruptor, partially responsible for the large, and as yet unexplained, increase in illnesses linked to the hormonal system, such as some forms of cancer, as well as fertility and obesity problems.

The whole of the population is heavily exposed to this substance; according to a study published in 2005 in the Environmental Health Perspectives Journal, BPA is present in the urine of 95% of the Western population.

(1) Information provided by PlasticsEurope's PC/BPA-group, www.bisphenol-a-europe.org. • (2) For a more complete list: http://www.bisphenol-a-europe.org/uploads/BPA applications.pdf.

Today, oral exposure to BPA is predominant and is considered the greatest cause for concern (skin exposure, particularly with regard to thermal papers used for receipts, was also identified to a lesser extent).

Amongst the most sensitive to BPA are pregnant women, new-born babies and young children. BPA tends to transfer in small quantities into food and drink which is stored in materials containing this substance; such a transfer is increased under the influence of heat or acidity. This is why, apart from toys and childcare articles, food containers are the most affected by this issue, despite only representing less than 5% of BPA applications.

Public health agencies throughout the world have already fixed tolerable daily intakes (TDI) at 0.05 mg/kg of body weight. However, an increasing number of studies have shown health issues in animals and strong suspicions in humans too, even at low levels of exposure.

What regulations are in place?

Today, due to lack of unanimity within the scientific community, none of the public health agencies (WHO,[3] EFSA[4] in Europe or the FDA[5] in the United States) have reviewed their BPA evaluation. It should also be highlighted that the European Chemicals Agency (ECHA),[6] under the REACH Regulation framework, does not at the moment include bisphenol A in its list of substances of concern.

However, many countries have already introduced bans regarding this substance, as a precautionary matter.

Canada was the first to ban the use of BPA in baby bottles; since 2010, the substance has been classed as 'potentially harmful to human health and the environment'.
Several countries have followed suit by implementing partial or total bans on food containers aimed at children (some states and counties in the **United States, Costa Rica**, **Brazil**, **Malaysia**, etc.).

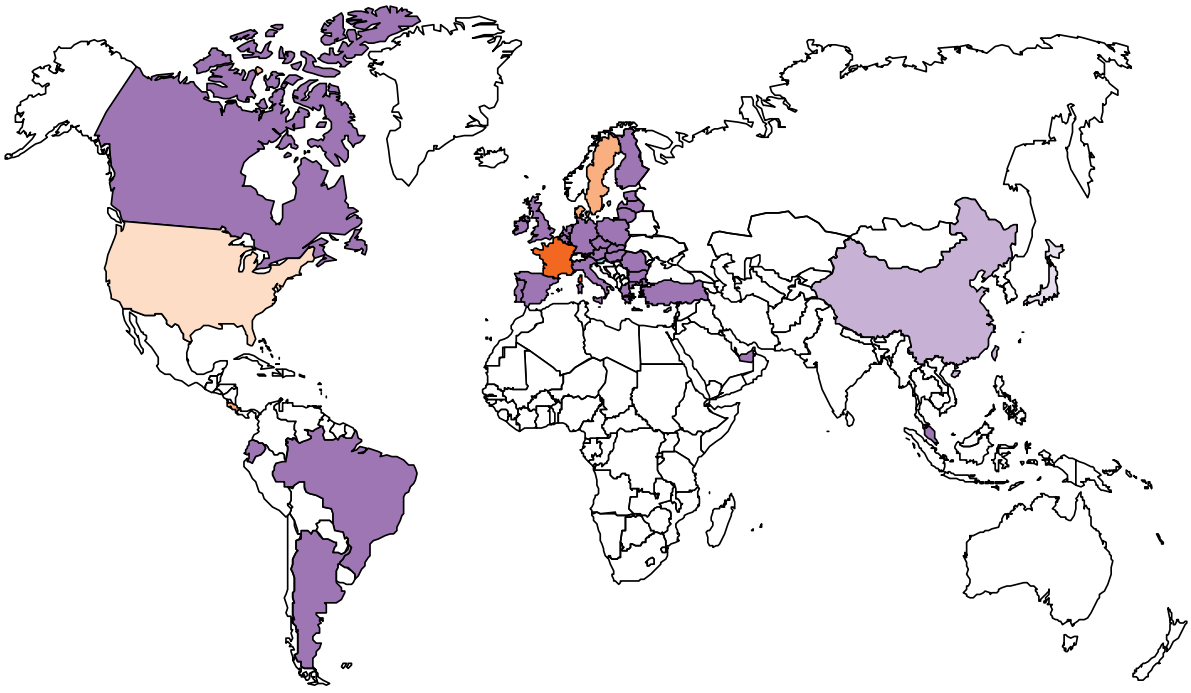
In the United States, the FDA continues to carry out complementary evaluations of the substance. Despite their position on the substance remaining unchanged, in July 2012, the agency announced the immediate removal of BPA in baby bottles. They also declared that they were reacting to the demands of the industry that, due to consumer demand, had already eliminated the substance from its products.

In **France**, the use of BPA in baby bottles has been banned since 2010. In October of 2011, the French Agency for Food, Environmental and Occupational Health Safety (ANSES) published two reports relating to the health effects and the usage of bisphenol A, confirming strong scientific concerns about BPA. Following the publication, the Senate definitively voted a law in December 2012 aiming to ban the manufacture, import, export and placing of food products on the market for all packaging, containers or utensils containing BPA as of January 2014 (date postponed to July 2015 by the Senate in first reading). This ban is set to be applied as soon as 2013 for containers aimed at children under the age of 3 years.

With regard to the **European Union**, despite the absence of sufficient scientific proof from the EFSA, the Agency has expressed some reservations about the effects of BPA on new-borns. The regulatory procedure was therefore begun with the adoption (effective since March 2011) of the ban of BPA in baby bottles. The European Commission has in addition asked the EFSA to review its BPA evaluation (an opinion on this is expected in spring 2013). Likewise, the ANSES has asked the ECHA for a more strict classification of bisphenol A as being toxic to reproduction (response expected early 2013).

> Despite the absence of scientific proof of the harmfulness of BPA, we are seeing a progressive reinforcement of regulations through the application of the precautionary principle.

(3) WHO: World Health Organisation. More info at www.who.int • (4) EFSA: European Food Safety Authority. More info at www.efsa.europa.eu • (5) FDA: Food and Drug Administration. More info at www.fda.gov • (6) ECHA: European Chemicals Agency. More info at www.echa.europa.eu.



Source: Natixis Asset Management on public data basis, October 2012.

Bisphenol A (BPA) regulations map

BPA alternatives: risks and opportunities for key players in the food and chemical industries

As previously mentioned, the main sources of bisphenol A exposure are found in food packaging and containers, and mainly coatings in metal-based tins and drinks cans, as well as jar lids. If responsibility for the production of this substance is mainly down to the chemical industry (Dow Chemical and Bayer being the main producers), the players most exposed to the risk of controversy are the users, i.e. businesses in the food sectors.

> ‘Though there are a few alternatives to BPA in polycarbonates, substitution is much more difficult in epoxy resins.

Given the progress of debates, even if the health risk is not recognised, BPA still constitutes an increasing regulatory risk for food producers, first and foremost for the manufacturers of preserved products, canned drinks and products for children. Banning the use of bisphenol A in food containers raises the question of the existence of substitutes proven to be harmless. Bisphenol A substitutes are specific to material, use, industrial procedure, etc.

Polycarbonate substitutes are not major causes for concern. Numerous alternative materials exist (more than 21 substitutes were identified by ANSES)[7] including glass, stainless steel and ceramic, as well as other older and more widely used plastic materials such as polyethylene or polypropylene which are used in the manufacturing of baby bottles. PET is also a substitute, though its harmlessness has not yet been completely proven. More innovative materials have also been developed by American and Korean companies, for example, Tritan Copolyester™ developed by Eastman Chemical Company or Ecozen® by SK Chemicals.

(7) ANSES, September 2011, Note on the results of the call for contributions following publication of the reports on the health effects and uses of bisphenol A (BPA) and list of BPA alternatives and/or substitutes, June 2012, http://www.anses.fr/Documents/CHIM2009sa0331.pdf. (in French only)

In contrast, the search for epoxy resin substitutes seems more difficult.

Used as a protective layer between food and its metallic container, BPA-based resins have certain safety advantages in terms of food security and conservation length (flexibility, adherence, fight against corrosion, etc.), which justify their general use. For example, 95% of metallic food containers have traces of BPA in the United States.[8] Different preserved food properties imply adapted substitutes for each product (acidity, fat content, etc.).

Despite these difficulties, many companies, particularly American ones, are either already using BPA-free packaging or have announced BPA elimination objectives (Heinz, Tupperware, Eden Foods, etc.). Some alternative materials exist or have been developed (18 substances identified by ANSES).

Other than materials such as glass, many substitutes are already in use:

- some American companies specialising in organic food, such as Eden Foods, use oleoresins (already used before the 1960s)
- several Japanese companies choose to insert a PET film to reduce BPA transfer
- other companies create product ranges where the BPA transfer from packaging to food is limited (for example, Bonduelle's vapour range that contains zero juice).

Innovative materials have already been developed, such as isosorbide diglycidil ether from Archer Daniels Midland. While we have 50 years' experience in using BPA, we need to confirm that the existing substitutes have no long-term undesired health effects.

In addition, there are still numerous substitutes to be found, as well as proving their harmlessness. In general, the development of this type of coating requires 1–3 years of work, followed by a toxicity test period of 2–3 years before receiving approval for commercialisation.[9]

Conclusion

In summary, the substitution challenge remains in the use of materials offering the same benefits as those of bisphenol A, whilst offering satisfactory long-term health guarantees.

It is important to note that the question of bisphenol A relates to a wider issue for the food industry linked to the transfer of chemical substances into food. Other substances have also been identified by scientists as presenting risks to consumer health, such as phthalates. **It is estimated that around 100,000 substances present in packaging can transfer into food, and scientific knowledge on these substances is currently limited.** The topic remains an important point of vigilance for the food industry and an important source of innovation for new materials.

We can expect a reinforced public debate and regulations on health-related topics, as with bisphenol A. The most proactive groups on health-related issues will be amongst those best positioned to address sustainable development issues.

> BPA equates to a major problem for the food industry, linked to the migration of chemical substances in food.

(8) Judy Lakind, 2012, 'Can coatings for foods and beverages: issues and options', International Journal of Technology, Policy and Management, http://www.inderscience.com/www/pdf/2012ijtpm_lakind_openaccess.pdf. • (9) Lakind, 2012, Op. cit.

AFTER FUKUSHIMA: THE NUCLEAR QUESTION

Written 18/12/2012

On the 16th December 2012, the victory of the Liberal Democratic Party (LDP, Conservatives) in Japan re-launched speculation on the future of nuclear energy in the country. On the 14th September, the previous government (Japan's Democratic Party, centre-left) had unveiled a plan to end the Japan's reliance on nuclear power within the next thirty years,[1] in the wake of the Fukushima disaster. There is, however, uncertainty regarding this decision as the LDP has campaigned on the impossibility of a nuclear phase-out in the medium term.

To date, only two out of fifty reactors in Japan have been restarted since the Fukushima accident. The new government has pleaded for a security review of all installations over the next three years. This review is set to lead to a revival of a significant portion of the nuclear reactors in Japan, though it is still too early to determine what the exact position of the LDP will be in the longer term. It seems highly unlikely that the decision to pursue a nuclear phase-out will remain. However, the new government needs to take into account the new expectations of a population which has been strongly affected by the catastrophe.

What can be drawn from Fukushima in the nuclear energy debate?

As a consequence of the earthquake and tsunami that took place in March 2011, the Fukushima accident has been a contributor to the re-launch of the debate surrounding nuclear energy. Beyond the emotional impact linked to the disaster, there are numerous factors to be highlighted.

At first sight, the scale of the disaster may seem relatively small. The authorities say that not one single death has so far been linked to the nuclear disaster itself.[2] **To determine the full extent of the long-term health consequences will require significant continued efforts.**[3] In light of this challenge, the government launched an ambitious project to gather information from the Japanese population with a goal of identifying the 'medium to long-term' consequences of this accident, particularly as regards the development of cancer. The inquiries will involve tens of thousands of people over a period of 30 years.

To the above must be added the evacuation of around 80,000 people covering an area of 900 km² around the nuclear power station[4] due to radioactive contamination.

- 30% of this area is progressively being repopulated following decontamination efforts and infrastructure rehabilitation.
- 50% of this zone will require many years of rehabilitation work to be carried out.
- The remaining 20% will be left inhabitable for the foreseeable future.

> "At first sight, the scale of the disaster may seem relatively small. To determine the full extent of the long-term health consequences will require continued significant efforts.

It is difficult to estimate the compensation the victims of the disaster will receive, though it is said to be billions, even tens of billions of euros.

Adding to this compensation are numerous costs, such as those linked to:

- the several decades of work needed to dismantle the power station
- the capital loss of a non-operational power station
- updating the safety measures across the whole site, etc.

Tepco, the power station's operator, has subsequently been taken into state ownership to avoid bankruptcy.

(1) The previous government had announced that it would take into account recommendations from the 'Innovative Strategy for Energy and the Environment' report (http://www.npu.go.jp/en/policy/policy06/pdf/20121004/121004_en2.pdf) which mentions in particular a nuclear phase-out before 2030, but has not made this date official. The Minister of Economy and Industry, Yukio Edana clearly stated that this objective will not be achieved. • (2) The six deaths since the accident were due to the earthquake/tsunami or personal health issues. • (3) The debate is still ongoing regarding the death toll of the Chernobyl disaster in 1986. The WHO outlines the health consequences as 56 deaths and 4,000 thyroid cancer cases, in which more than 99% of those affected are still alive. Other studies led by NGOs suggest several hundred thousand deaths. • (4) The surface area equivalent to the entire city of London.

Beyond this assessment, we now know that the authorities had envisaged scenarios in which the consequences were much worse. If major radioactive emissions had reached Tokyo and its 35 million inhabitants, the consequences would have been devastating.

Such a scenario was only narrowly averted:
- It could have become a reality if water in the fuel ponds had completely evaporated (leaving fuel rods exposed to the open air), which would have happened had the members of staff been evacuated as initially planned by the power station's operator, leaving the ponds without cooling systems.
- If, for one reason or another, the employees had not been able to put water back into the ponds to ensure this cooling, it would have been a different story.

Serious consequences for the energy mix

The government's choices relating to nuclear energy will have serious consequences for the future of the country in terms of its energy use.
The evolution of Japan's energy mix since the disaster gives an insight into the challenges ahead.

Before the accident, Japan's electricity supply was mainly provided by:
- Gas (27%)
- Nuclear (27%)
- Coal (27%)
- Oil (9%)
- Hydroelectricity (7%)
- Other renewable energies (3%).

Japan has had to face a major challenge in providing the country with electricity as only two of the original fifty reactors have been restarted since the accident.

The previous government initially urged businesses and consumers to reduce their electricity consumption. However, this proved unsuccessful in that the decrease in consumption equated to a mere 5%, compared to an initial target of 15%.

As a result, in the absence of nuclear electricity, **Japan had to turn to fossil fuels in order to meet demand**. In the first quarter of 2012, fossil energy's contribution to the total electricity mix rose to 73%, which led to an increase of 21% of gas imports, almost 10% of coal imports and 5% of oil imports.

If this massive dependency on fossil energies is to be progressively reduced with the restarting of nuclear power stations, this first experience illustrates just how difficult it is to eliminate nuclear energy without resorting to an increased dependency on fossil fuels.

The previous government had, along with a nuclear phase-out, proposed a new strategy that focused on energy efficiency and the development of renewable energies.
The strategy notably included the strong development of solar energy. Hydraulic and wind energy have limited potential in Japan. Hydroelectricity (~7% of the current mix) already uses the core exploitable sites and Japan's dense population is holding back significant development opportunities for on-shore wind power. The depth of Japanese coastal waters also makes off-shore wind projects very difficult.

The success of the LDP in the elections has brought these objectives into question. If the new government is likely to be willing to develop energy efficiency and renewable energy, the level of ambition will be considerably less if nuclear is to remain an important part of the energy mix.

> Japan has had to face a major challenge in providing the country with electricity as only 2 of the original 50 reactors have been restarted since the accident.

A worldwide energy debate rekindled

What happened in Fukushima has been a harsh reminder, not only to Japan, but to the rest of the world, that zero risk simply does not exist and disasters much worse than Chernobyl can happen.
The debate is far from over. **Most of the energies that we use pose significant risks to humans.**

- **Coal** is responsible for thousands of deaths each year in the mining industry and leads to respiratory problems for people in the surrounding areas.

- **Construction of major hydroelectric dams** involves large-scale population displacements and has major impacts on biodiversity, etc.

As Fukushima has shown, nuclear energy creates specific security risks. It does remain, however, amongst the cheapest for producing electricity and has the advantage of zero greenhouse gas emissions.

Fukushima led to a change of course in terms of the energy mix for countries such as Germany, Switzerland and Japan. Nevertheless, numerous states such as the United States, France, Russia and China would like to keep using this technology, stating that **the Fukushima disaster will result in the strengthening of safety measures in power stations, and even justifies further investment into new reactor generations, without, however, calling into question the entire industry. The debate therefore remains open.**

> Most energies we use involve significant health risks to humans. There is no such thing as 'zero risk'.

THE ARCTIC:
THE NEW EL DORADO OIL FIELD ?

Written 08/11/2012

The Arctic has been known for decades for its oil production. The extraction of reserves is not a new concept for this region; in fact, onshore production began in the 1920s in Alaska and then, in the 1970s, still on American territory, offshore saw a rapid development in terms of prospecting and drilling. However, drilling projects have not seen a huge increase because the area has since been abandoned, as it is thought to be less viable than other geographical locations.

Increased operational costs as well as the cost and difficulty of transport were the main barriers to its development. Recent trends, though, have changed this view.

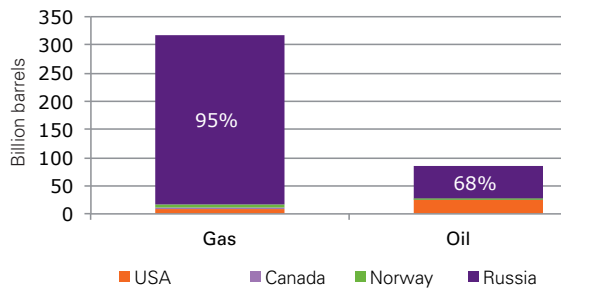
Advances made in hydraulic fracturing which enabled offshore deposits to be reached from on land, the emergence of new Asian energy-intensive markets, increased petrol prices, scarcity of oil resources and, ironically enough, ice melting, are all favourable levers surrounding the exploration of the Arctic.

Guaranteed hydrocarbon potential

If we consider its hydrocarbon potential, the Arctic is an interesting region. According to the study led by the USGS (2008):

- **oil:** the proven hydrocarbon reserves represent 13% of proven global reserves (90 billion barrels)
- **gas:** the proven reserves represent more than 30% of proven global reserves (more than 50,000 billion m^3), of which more than 80% is situated offshore.

These figures must be considered as orders of magnitude; some players[1] believe these estimates to be lower, given the lack of knowledge of the geology of numerous sedimentary basins in the region, uncertainties over the maximum exploitation costs and the likelihood of extraction success.



Source: Natixis Asset Management, IFP Energies Nouvelles, 2012

Proven hydrocarbon resources in the Arctic

Resources on the Arctic continent are mainly Russian; Russia has more than 95% of proven gas reserves and more than two-thirds of oil resources, mainly in Western Siberia (IFP, Energies Nouvelles, 2012).
While the geological potential, mainly in Russia, is there, the economic potential is yet to be proven.

Economic potential to be confirmed

There is still a question mark over the economic viability of Arctic projects. Recent events have shown that drilling development in the Arctic comes at a high price.

Total considers that the barrel price must be above $80 to justify a viable[2] investment in this region, therefore representing the least interesting oil resource along with shale oils (Total, 2011). Of course, this is an average price which, in reality, varies depending on the terrain, but it does serve to explain **the intrinsically high extraction, production and transporting costs, notably due to:**

- long distances between production and consumption sites requiring significant infrastructure investment (buildings, roads, oil pipelines, airports, industrial complexes, etc.) to evacuate hydrocarbons
- reinforced mobile offshore platforms linked to underwater drilling sites to prevent the risk of collision with floating icebergs
- materials to support extreme climatic conditions
- transport in extreme weather conditions (large waves, frequent storms, oil pipeline maintenance and channels navigable only with difficulty)

(1) Wood MackenZie, Central Bureau of Statistics and the Centre for Research on Norwegian climate • (2) Thus a rate of return greater than 10%.

- high environmental demands particularly linked to the risk of oil spills for exploration and oil production
- legal risk and the failure to respect deadlines.

Compared to exploration in Arctic waters, shale gas projects in North America, gases from Iran, Qatar and soon Mozambique and Brazil, as well as, to a lesser extent, Canadian oil sands, seem to carry less technical and organisational pitfalls.

A fragile social acceptance

Despite frequent setbacks, the major integrated oil companies as well as some local players still want to take a chance with the Arctic.

However, the industrial disappointments are numerous.

- In 2009, BP and Rosneft abandoned the Sakhaline-IV project due to a significant lack of reserves.
- This year, in light of the current gas surplus market,Total, Statoil and Gazprom decided to indefinitely postpone a huge Shtokman gas project, almost 25 years after its inception.
- ExxonMobil and Rosneft have serious doubts on the accessibility of resources in the Kara sea.

However, other players have not been disheartened by this difficult environment.

Shell and Eni are at an advanced stage in negotiations and sooner or later should start to open up drilling in Alaska and the Barents Sea, respectively.

Their success depends on social acceptance of the oil industry in the Arctic. Society in general, all the more vigilant in the current post-Macondo context, along with local populations (4 million inhabitants currently live in the Arctic) are unwilling to reduce their land and share their continent with new working populations, and would find it difficult to accept the slightest incident in the Arctic waters.

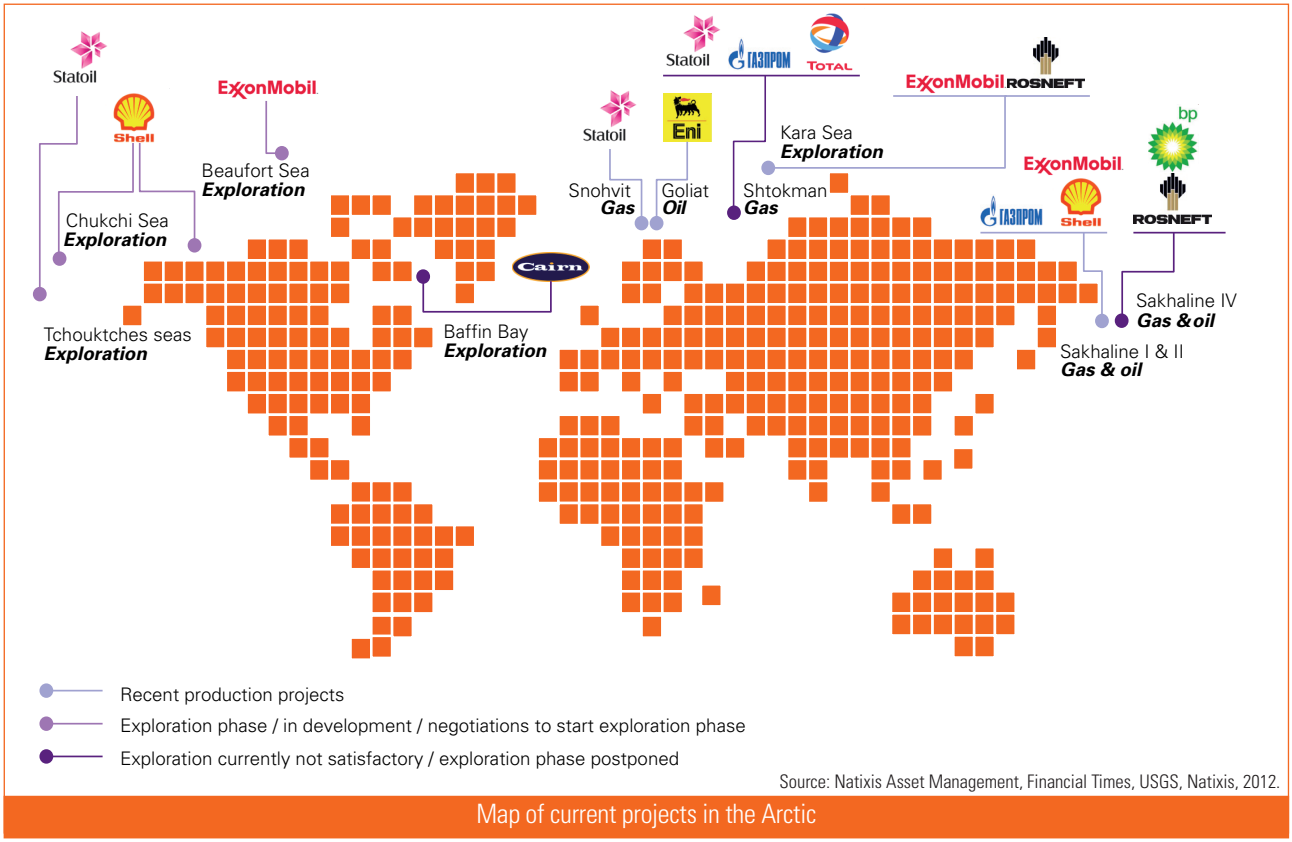
Risky Russian offshore gas exploitation

Numerous studies have analysed the social and environmental impact of oil drilling in the Arctic. Management of these risks is at the centre of oil projects in the region.

It is necessary to distinguish clearly between offshore and onshore when looking at the social and environmental challenges.

Compared to onshore, offshore drilling generally provides a considerable technological challenge. This is equally the case in the Arctic.

The technical complexity of offshore drilling inevitably means that the potential environmental risks are more significant. BP and Macondo, Chevron in Brazil and Total's Elgin platform in the North Sea all illustrate the difficulties the oil industry faces in operating offshore facilities with optimal safety conditions. 80% of proven resources in the Arctic are situated offshore.



Source: Natixis Asset Management, Financial Times, USGS, Natixis, 2012.

Map of current projects in the Arctic

There is no common legal system in the five Alaskan States, **making it difficult to establish a binding legal framework**. Numerous NGOs continue to underline the insufficient responses from the industry in light of the environmental risks related to Arctic drilling (Pew Group, 2010, Greenpeace, 2011).

Given the inexorable exploitation of Arctic resources, these NGOs are campaigning for the creation of an offshore oil exploration institution in the Arctic in charge of spreading good social and environmental practices to minimise operational risks.

Key players, such as Shell and Cairn, openly welcome the principle of a coherent approach but clearly specify that this decision remains that of the Arctic Council and its eight members (UK Parliament, 2012).

Another important differentiation: oil or gas? In the event of a hydrocarbon spill, oil is more harmful than gas to the local ecosystem.

Oil exploitation in the Arctic is thus extremely risky given the fragility of the surrounding biosphere and the difficulty in anticipating, detecting and rectifying any eventual oil spill in frozen waters. Oil recovery is an extremely complicated process on ice (UK Parliament, 2012).Total publicly voiced their opposition to offshore oil exploration in Arctic waters. According to its chief executive, the risk of an oil spill in such an ecologically sensitive area is quite simply too high. He told the Financial Times, 'A leak would do too much damage to the image of the company,' (Financial Times, 2012).

Still, with its 95% of proven gas resources, the majority of drilling will take place on Russian territory.
However, the laxity of Russian authorities regarding social and environmental issues means that this Russian predominance is not without its consequences. The legal framework in Russia, considered as being particularly permissive, does not lend itself to optimism (Chatham House, 2012). Note that Russia is the main global contributor of greenhouse gas emissions from burning gas associated with the oil fields, whilst the weak level of maintenance and replacement of Russian gas pipelines highlights once again the environmental advantage of gas compared to coal.

Additionally, they have a lack of experience in offshore operations, since less than 2% of Russian gas production comes from offshore mature fields (Associated Press, 2011). To further highlight this, Gazprom has just postponed the start of exploitation on the Prirazlomnoye field by one year due to safety concerns (Reuters, 2012).

Conclusion

Although gas is considered an interesting source of energy transfer, Arctic gas projects are unsatisfactory for the following reasons: the associated social and environmental risks, the passivity of Russian authorities on the topic, and the increasing risks in terms of the safety of offshore production.

Beyond our investigation on its adequacy with a limited long-term scenario of +2°C increase in 2035, the industrial development of the Arctic is questionable.
Oil producers repeatedly postpone dates and incur setbacks, increasing exploitation costs and therefore decreasing investment returns on projects.
Oil producers are going to have to revise downwards their Arctic ambitions for quite some time; perhaps for long enough to develop more viable renewable and decarbonised fields to attract massive investments from energy providers, oil producers included?

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THE INTEGRATED REPORTING INITIATIVE

Written 08/11/2012

In the context of the current combined economic, social and environmental crisis, it is now crucial to react as a responsible player and support businesses which provide solutions. The International Integrated Reporting Council (IIRC), which shares and supports this approach, is central to this, as it aims to respond to investors' need for adequate information to allow them to make responsible investment choices.

The second IIRC Pilot Programme conference since the launch of the initiative was held on 18th and 19th September 2012. It now seems relevant to look into this initiative and the theoretical and practical advances that have been made so far.

Summary of the Integrated Reporting Initiative <IR>

The IIRC, which was founded in 2010 by the Prince of Wales's Accounting for Sustainability project and others, **now works in collaboration with more than 100 organisations** (issuers, investors, auditors, NGOs, etc.) **with the aim of developing a new type of reporting capable of communicating the way in which organisations create value for shareholders and stakeholders alike**, whether it be in the short to medium or long term.

The IIRC is chaired by Professor Mervyn E. King, and Paul Druckman is CEO. The IIRC is made up of:

- The *Council*, a forum for senior representatives of the IIRC's member organisations, which advises on the mission, role and governance of the IIRC and provides thought leadership, intellectual contribution and strategic insights relating to the IIRC.
- The *Working Group*, external experts who provide practical guidance in developing positions and making recommendations in respect of the development of the international <IR> Framework, and promoting the initiative.
- The *Secretariat* ensures the planning, coordination and execution of initiatives, activities and interactions undertaken in support of the IIRC's mission and role.
- The *Board* oversees the coordination and interaction between the Council, the Working Group and the Secretariat, and between the subcommittees and task forces, as well as with external stakeholders and other parties.

Two network groups provide feedback on the business and investor perspectives on <IR> respectively.

Theoretical approach

Between 2010 and 2011, opinions on the fundamental principles of <IR> were gathered at successive round-tables and in response to a Discussion Paper. A working draft of the 'Prototype <IR> Framework' was published on the IIRC's website in September 2012, as a medium for companies to develop their own integrated report.

The <IR> Framework encourages companies to approach corporate reporting in a way that draws together all information (financial and non-financial) necessary to communicate the full range of factors that materially affect the ability of an organisation to create value over time.

The aim of an integrated report is to provide all material information necessary to communicate the way in which a company creates value including the economic, social and environmental context in which it operates and the short, medium and long-term strategies implemented to create value. <IR> should therefore benefit managements, investors and the companies' stakeholders alike.

> Integrated reporting encourages companies to adopt a reporting model which binds together all information, financial and non-financial, in order to highlight those factors which significantly affect the capacity of an enterprise to create value over time.

To assist companies in the preparation of their integrated report, the draft Prototype <IR> Framework establishes a specific nomenclature.

- **The capitals** – The draft Prototype <IR> Framework refers to the following types of capital: financial, manufactured, human, intellectual, natural and social and relationship. These capitals are the inputs to the organisation's business model and are increased, decreased or transformed through the value-adding activities of the organisation. The company's impact on these capitals will inform decisions about the extent to which the company creates value.

- **Seven content elements** are identified as being necessary for inclusion in an integrated report: organisational overview and operating context; risks and opportunities; strategy and resource allocation; governance; performance and outcomes; future outlook; business model.

- **The six guiding principles** are specific requirements to be met by the information contained in the integrated report. They are: strategic focus and future orientation; connectivity of information; stakeholder responsiveness; conciseness and materiality; reliability; comparability and consistency.

The approach of the business model through the capitals constitutes an interesting angle of attack to define a company's strengths and weaknesses, and the content elements appear to cover its different aspects.

In our opinion, the fundamental principles surrounding the quality of information provided in the integrated report seem to address the current needs for transparency and material, though we are still awaiting a more precise definition of the notion of materiality. Indeed, if the aim of this report is only to provide relevant data of significant importance, the notion of materiality is crucial, and largely depends on who the information is addressed to, the company's risk appetite, and the more or less long-term approach the company finds itself in.

As a responsible investor, Mirova defines the notion of materiality with regard to the interests of long-term investors and thus considers 'material' as being any activity that has a significant social or environmental impact.

Putting theory into practice

Organisations from around the world have joined the IIRC's Pilot Programme business and investor networks.

- **The 'Business Network' is made up of more than 80 organisations from the public and private sectors** which are evolving their own reporting and are contributing to the development of the International <IR> Framework.

- **The 'Investor Network' is a group of over 25 institutional investors** who regularly communicate, via conference calls, on the Draft Framework and the significance of <IR> for the investor community. They also provide feedback on integrated reports developed by members of the Business Network.

To date, a number of members of the Business Network and companies outside the IIRC's Pilot Programme have begun to prepare integrated reports. Extracts of some of these, providing practical examples of the implementation of the guiding principles and content elements from the draft Prototype <IR> Framework, can be found in the IIRC's database.[1]

The next steps

The IIRC will release for public consultation a draft International <IR> Framework in mid-2013 and, after this process, will publish v1.0 of the Framework.

The Pilot Programme has thus been extended to September 2014 to capture the experiences of those using v1.0 of the International <IR> Framework.
For this third year, the Council is also looking for a broad promotion campaign that is geared towards both companies, (encouraging them to use this new generation of report) and regulators. Indeed, the integrated report is based on the idea that adequate information for investors is information that integrates long-term financial and non-financial significant data. This represents a substantial philosophical change affecting regulatory information; therefore regulatory intervention seems necessary as a result to confirm the progress made by the IIRC.

Conclusion

Although the outcome of this long-term project will require many more years of work in terms of promotion and exchanges, as a responsible investor, Natixis AM is regularly confronted with the needs of transparent, adequate, material and full information.

The Integrated Reporting approach could represent a significant qualitative jump in terms of information. It is for this reason that Natixis Asset Management and Mirova, its responsible investment division, decided to support this initiative by joining the Investor Network in early 2012 and actively participating in collaborative work.

(1) Database of some examples of integrated reports: http://examples.theiirc.org/home.

Q&A – CEO Paul Druckman gives us an interesting insight into International Integrated Reporting Council

PAUL DRUCKMAN

Paul is Chief Executive Officer of the International Integrated Reporting Council (IIRC).

Following an entrepreneurial career in the software industry, Paul operated as a non-executive chairman and director for companies in a variety of sectors before taking over this post. Formerly a Director of the UK Financial Reporting Council, member of the City Takeover Panel, and President of the Institute of Chartered Accountants in England and Wales (ICAEW), his high profile work on sustainability matters has included chairing The Prince's Accounting for Sustainability Project (A4S) Executive Board and the FEE Sustainability Group.

What do you see as the main obstacles to the development of IIRC in the near future?

We have been fortunate over the last year in gaining the support of a broad coalition of very influential business leaders, investors, regulators, standard setters and NGOs. Maintaining this active engagement, particularly as we move towards publication of the Consultation Draft of the <IR> Framework in April 2013, is our biggest ongoing challenge.

Another significant challenge is market confusion around the many initiatives and organisations involved in corporate reporting reform. While we believe many of these initiatives represent stepping stones towards Integrated Reporting, businesses and investors need certainty. We therefore intend to play a significant role in helping to set out a road map towards Integrated Reporting, enabling a greater degree of coordination and consistency in this area.

What kind of effective drivers or leverage will lead the IIRC towards success?

Integrated Reporting is a market-led initiative, so the support of businesses and investors will be the critical drivers of our success. If we look at the capital markets today, there is a real sense that we can't go back to business as usual. Corporate reporting systems should underpin financial stability and encourage forward-looking decision making by investors and businesses.

What is really interesting is the degree to which stock exchanges and listing authorities are taking an interest in this debate, embracing the idea that better quality reporting can be attractive to inward investment and encourage economic growth. This trend is increasing.

What kind of added value can the investors expect from Integrated Reporting?

Integrated Reporting will offer investors greater visibility over a wide range of factors that contribute towards value creation over time. Critically, these factors will be integrated into the financials of the business to ensure a holistic representation of value creation. With its focus on providing more future-oriented information, mainstream investors will have a better underpinning for their decisions. Integrated Reporting also offers investors assurance that the company is properly joined up internally, that risks are better managed and that the Board has a clear sense of its strategy and how its business model delivers value.

To what extent can Integrated Reporting benefit companies in terms of management, corporate governance, and so on?

We are learning from the companies in our Pilot Programme. They are beginning to apply the principles of Integrated Reporting to their own reporting practices. We would expect the following early benefits to emerge:

- a better quality of engagement between the business and its investors, as the reporting process unlocks more investor-relevant information
- a better control of the company's message, which will be presented in a more coherent and consistent way, as a result of the breaking down of silos within the business
- Better quality decision making by those charged with the governance of the business; this is the result of integrated thinking, the process of working in a more cohesive way across the business to present a concise communication of value.

We recognise that the move to integrated reporting is a journey which will often take multiple reporting cycles to achieve. The involvement of company Boards and the leadership team has driven this journey most successfully in the businesses that have started to evolve their reporting practices.

WHAT CAN BE LEARNED FROM THE **KAY REVIEW?**

Written 08/11/2012

In August 2011, the English economist John Kay[1] was appointed to establish an Advisory Board. His role was to produce a complete report on the current short-termism seen in the English markets and the dysfunctional nature of agency relationships within the investment chain. The main finding of the Kay Review is rather alarming: the players in the investment chain have lost sight of their main mission in the equity markets, namely to know how to guarantee the performance of companies and to generate returns for savers. Also, markets are suffering from a lack of confidence which is preventing companies from meeting the expectations of shareholders and savers.

Why this report?

The Kay Review was a follow-up to the consultation proposed in October 2010 by the Department for Business Innovation & Skill entitled 'A long-term vision for British businesses'. This first consultation explored the issues of short-termism in the United Kingdom, as well as other corporate governance-related challenges, focusing particularly on executives' remuneration.
The responses received from this consultation revealed the extent to which **short-termism is prevalent in UK equity markets, and also the dysfunctional Agency relationships within the investment chain.**

As a result, Vince Cable commissioned the economist John Kay in August 2011 to establish an Advisory Board to produce a more detailed report on these issues, identifying the specificities and relevant areas of reflection on the matter. In addition to John Kay, the Advisory Board is made up of Sir John Rose (former Chief Executive of Rolls-Royce), James Anderson (Baillie Gifford associate and manager within the Scottish Mortgage Investment Trust), and Chris Hitchen (Chief executive of Railways Pension Trustee Company and president of Pensions Quality Mark). Throughout the writing of this review, the Board benefited from regular contributions from a group of experts.

Initially, the Advisory Board issued a consultation between September and November 2011. This 'call for evidence', which received more than 82 responses, led to a better understanding of the major issues to incorporate into the report. The intermediary report, which was published in February 2012, recapitulated the responses obtained following the consultation and outlined the preliminary conclusions to be discussed in more detail in the final report, published in July 2012.

Findings

➜ **Markets are disconnected from the economy and corporate finance.**

First of all, the review highlights one of the major flaws in the UK equity market.

An efficient market is supposed to improve corporate performance whilst generating revenues for savers. As the report suggests, **this long-term logic functions if the profits made by the best performing companies are the only source of revenue for savers who, in turn, invest in share ownership.**

And yet, the stock market has become a minor source of finance for corporate investments: the primary capital allocation system is carried out within the company; the main source of funds is the cash-flow generated by the company itself, and the use of these resources is determined by company management. This phenomenon has been developing over the last thirty years in Europe, and is thus relatively recent, which explains why savers no longer participate in the economy or corporate finance as they did before.

> « An efficient market is supposed to improve corporate performance whilst generating revenues for savers.

(1) John Kay is a British economist, a professor at the London School of Economics, and a regular contributor to the economic columns of the Financial Times. His latest work, entitled 'Obliquity – Why our goals are best achieved indirectly' came out in 2010.

Moreover, equity market fragmentation and the use of debt make direct engagement with companies relatively difficult. Therefore, encouraging engagement with institutional investors and favouring good corporate governance is crucial for the equity market. The efficiency of modern markets depends entirely on their capacity to promote these specific aims and thus defines a long-term logic necessary for the success of British companies.

> Equity market fragmentation and the use of debt make direct engagement with companies relatively difficult.

➜ Asset management, at the heart of the system

Next, the report deals with asset managers by underlining the importance of their contemporary role in the equity markets today, through their 'share ownership'.

The concept of 'ownership' is complex and raises several important questions:

- Whose name is on the share register?
- For whose benefit are the shares held?
- Who makes the decision to buy or sell a particular stock?
- Who determines how the votes associated with a shareholding should be cast?
- And finally, who holds the economic interest in the security?

The last two questions relate back to the fundamental shareholder rights that asset managers are now more and more willing to undertake.

As a result, we understand why **asset managers' activity needs to be controlled: as described earlier, they must ensure the effective functioning of the market.**

As the report states in its fifth chapter, **asset managers were traditionally promoters of a long-term vision, buying positions that they held for a long period thereafter.** Hedge funds, on the other hand, favour a short-term vision that many managers have tended to adopt as a result. This is why it is important to distinguish between those who are behaving as traders and those who are genuine investors within the asset management sector.

To Professor Kay, **public policies aiming to regulate the market should evaluate asset managers' activity** (particularly those who have the role of traders) in light of their potential to fulfil this double market objective of:

- fostering long-term decision-making on behalf of companies
- allowing savers to carry out financial operations in agreement with their objectives.

➜ Erosion of trust

To achieve these objectives, it is vital to establish a relationship of quality and trust amongst all players in the investment chain.

The report highlights how the trust placed in financial intermediaries has decreased over the last five years, not because of a negative perception on behalf of the public, but rather because of an actual breakdown of the system.

The short-termist culture favoured high-frequency transactions and anonymity, which led to a lack of understanding between asset managers and savers.

Add to this the fact that engagement is not encouraged: it represents, for example, an additional cost for asset managers, as they would need to commit resources to this kind of dialogue, while the profit from such an initiative would go beyond the limit of actions which would benefit the whole company.
All of the above-mentioned factors tend to encourage 'exit' rather than 'voice', to use the terminology of Albert O. Hirschman.[2]

> Within the asset management sector, it is important to distinguish between those who are behaving as traders and those who are genuine investors.

The structure and the regulation of the markets at the start of stewardship have become superficial and of poor quality, which is deplored by certain interlocutors approached during the writing of this report.

(2) Albert O. Hirschman, 1970, 'Exit, Voice, and loyalty'.

Recommendations

Among the 17 recommendations[3] mentioned in the report, those below seemed to us to be the most interesting:

➜ **Support the development of responsible share ownership that is not geared only towards corporate governance**

Stewardship is a crucial duty that asset managers have to undertake. However, as asset holders, their responsibility goes beyond governance-related issues.
The report issues an interesting first recommendation: the Stewardship Code needs to be strengthened in terms of an expansion of the asset holders' field of activity, in order to integrate strategic issues such as the company's key competences (the analysis of which can indirectly facilitate long-term decision-making).

> Asset managers should take greater responsibility with regard to engagement. As for asset holders, their responsibility goes beyond that of governance-related issues.

This code can be strengthened by the implementation of non-binding Good Practice Statements to which company directors, asset managers and asset holders could volontarily follow.
This could promote a more responsible attitude and encourage the players in the investment chain to comply with them. A model of principles for each professional category is thus proposed later on in this report.

➜ **Encourage group actions**

Encouraging collective initiatives would also represent a way of making players in the investment chain more responsible and more involved in the ownership of their assets.

However, regulatory obstacles often cause a hindrance to such collective engagement.
The report therefore recommends the establishment of an investors' forum, completely separate from the government, while advocating a certain flexibility regarding the format and terms of membership. Unfortunately, it does not provide any further details on the matter.

The British government, with the help of such an initiative, would show, not only that it authorises such collective actions, but, better still, that it encourages them.

With regard to the structure of this forum, it should remain very flexible so that it can easily react to major issues for investors in general, or for certain companies in particular.

➜ **Increase communication and transparency**

Several recommendations focus on the necessity for asset managers to reinforce their communication and transparency policies.
Amongst the most interesting suggestions, the eleventh one in particular deserves to be looked at in more detail.

The report considers that the information overload in the current slide in the market is the result of excessively heavy regulatory constraints.

Indeed, in response to the increasing demand to reinforce transparency, much information is aimlessly produced without there being any real interest in the evaluation of companies' long-term strategies. What is more, it is often the case that useful information is buried by the sheer volume of irrelevant data.
The report quotes the example of the Enron fraud, where the details were contained in regulatory filings, but these filings were so voluminous that the details went unnoticed.

Thus, a focus is required on information adapted to businesses' investment horizons. For example, the evolution of the building industry can only be appreciated in terms of a complete economic cycle. The same applies to banks, as the recent financial crisis has demonstrated.
Multiplying the quarterly reports or annual quantitative standards is not a good way of encouraging a long-term strategy. Obligatory quarterly reports should be removed while information transmitted to asset managers and shareholders should be qualitative instead of statistical, and should adopt a format specific to each company.

> Multiplying the quarterly reports or annual quantitative standards is not a good way of encouraging a long-term strategy.

Moreover, several recommendations touch on the content of what should be communicated. With regard to asset managers, they should make the whole of their management fees public, including those associated with an asset disposal strategy.

(3) Can be found via the following link: http://www.bis.gov.uk/assets/biscore/business-law/docs/k/12-917-kay-review-of-equity-markets-final-report.

More transparency on the issue of asset lending would be appreciated. The Investment Management Association (IMA) consultation on the matter, published on the 20th September 2012, was eagerly awaited. It revealed useful recommendations in terms of publications that should be added to European regulations.

An interesting area for reflection is proposed in the fifth recommendation, which encourages businesses to engage in a consultative dialogue with their principal shareholders, particularly regarding boards of directors. The above-mentioned shareholders' forum should facilitate the creation of such initiatives.

Unfortunately, the report does not dwell on the issue of remuneration discussed in the eleventh section of the report. In fact, the topic was already to a large extent tackled by the Business, Innovation and Skills Minister throughout a consultation on the strengthening of shareholders' voting rights launched in March 2012, which helped define the framework for reforms announced by Vince Cable on the 20th June.

Two recommendations are to be highlighted:

- The first concerns companies, in that incentive mechanisms must be aligned with the idea of the long-term performance of a business. Although long-term plans are being more and more put into place, their length is generally inappropriate because they stop at the end of executives' terms. Most strategic decisions have an impact which goes far beyond executive mandates.

- The second important recommendation is more related to asset managers' bonuses. Indeed, asset managers should align remuneration of their managers in the interests, and on the timescale, of their clients, in a way that does not associate remuneration with either fund or asset manager performance in the short term.

What can we expect from this report?

Few indications have been given as to what to expect from this report. Vince Cable stated that he would give a response after a closer reading of the full content.
One can only hope that, under the auspices of the Minister, this report will lead to new legislation on the themes discussed. Of course, **asset managers are encouraged to implement the various recommendations** presented as soon as possible, though in the absence of strong impetus from the government or from a British corporation, the chances of the situation evolving seem very slim.

What should be drawn from this?

The main observation is rather alarming: players in the investment chain appear to have lost sight of their main duty in the equity market, namely guaranteeing corporate performance and generating revenue for savers.

The markets are therefore suffering from a lack of confidence, stopping companies from satisfying the needs of their shareholders and savers.

In reiterating the necessity of making asset managers take responsibility for their actions, this report is comforting in that the idea of socially responsible investment is a way of rethinking the functioning of the market according to a long-term strategy. It also offers interesting avenues of reflection for asset management and highlights opportunities related to this profession today, to redirect the markets towards sustainable perspectives.

FINANCE WATCH:
ONE VISION, ONE PROJECT
INVESTING, NOT BETTING

Interview with Thierry Philipponnat
Head of Strategy, Advocacy, Output and Staff, Finance Watch

by Hervé Guez,
Head of Responsible investment research, Mirova

FINANCE WATCH: A VISION, A PROJECT INVESTING, NOT BETTING

THIERRY PHILIPONNAT

__Interview with Thierry Philipponnat,__ Head of Strategy, Advocacy, Output and Staff, Finance Watch __by Hervé Guez,__ Head of Responsible investment research, Mirova.

Thierry Philipponnat is in charge of Finance Watch's strategy, advocacy, output and staff.

Thierry started a career in finance in 1985. His 20+ years' experience ranges from trading to devising structured equity products. In 2006, Thierry crossed into the NGO world, campaigning and lobbying on behalf of Amnesty International, with a particular emphasis on the impact of the financial sector on human rights. He was later elected as an Executive Board member of Amnesty International, France. Thierry Philipponnat graduated in Economics from the Institut d'Études Politiques de Paris.

Can you explain briefly how and why Finance Watch was created?

Finance Watch was founded in June 2010 following a call for action from 22 Members of the European Parliament (MEPs), members of the Committee on Economic and Monetary Affairs. As the legislative body for matters of financial reform, this committee has great power. Its members felt, '*Every day we have the financial industry in our office lobbying their interests, it's normal, it's legitimate, and that's life. It's the economic system we're in. But for us, as MEPs, to do our job well, we need to hear a different version of the story – the same story but from the general interest perspective. The story needs, at the same time, to be told by an organisation that will be significantly representative of society and will also have a realistic, professional approach that will allow it to go beyond a general call for reform, in order to make concrete proposals.*'
So that was the call for action of June 2010, which was supported by 5 out of the 7 political groups present in the European Parliament. It was thus a multi-partisan call for action from MEPs from the right-wing, liberals, social democrats and environmentalists alike.
In just 3 months, the call united almost 200 MEPs from widely diverse political backgrounds, which, democratically speaking, gave significant impetus to the whole idea. In the autumn of 2010, a decision was made to try to turn this idea into a reality.

Finance Watch was registered on 30 June 2011 after a 6-month consultation period. In legal terms, it is a Belgian, non-profit, international association; an NGO with two types of member: organisations (such as consumer groups, trade unions, other NGOs, research centres and think tanks) and qualified members, in other words, experts in the financial field.
To become a member of Finance Watch, the sine qua non is that you do not work for the financial industry. This is not a value judgement, as the majority of us came from this industry; it is, rather, a prerequisite for good governance so that the 'boundaries' are clear. It avoids any suspicion of a conflict of interests.

Why was an NGO, an association, created as opposed to a body dependent on the Commission or the European Parliament?

I think the main reason is linked to freedom of speech. By definition, when one is a branch of an administrative or legislative authority, there tend to be constraints of an institutional nature that are both legitimate and comprehensible, but that are not entirely compatible with Finance Watch's mission.

> Our mission is to strengthen the voice of society in the reform of financial regulation by conducting advocacy and presenting public interest arguments to lawmakers and the public, as a counterweight to the private interest lobbying of the financial industry.

Since there are plenty of people with strong technical skills both in the financial industry and in the Commission or Parliament, Finance Watch has 3 goals.
Our goals are:

- to be strongly representative of society
- to have freedom of speech
- to have the technical expertise necessary to take the discussions forward, thanks to a large majority of members coming from a financial background.

Is it not surprising that political representatives in charge of general interest delegate this issue to an NGO?

> “The aim of finance is to bring capital to a productive economy.

They are not delegating the issue of general interest, but rather the work of analysis and expression that will develop their thoughts. It's a sign of maturity on behalf of the public entities in Europe, and it's to their credit that they say that, to be able to carry out their work, they need to have balanced and effective debate, with arguments from several sides. In this way, they can weigh the pros and cons and move forward in a balanced manner.
Let's not forget that the work of a lawmaker or a civil servant is terribly difficult: the issues are complex and there is considerable pressure from all sides. Encouraging debate from a general interest point of view is therefore very useful to them.

Which topics are you working on, or would you like to work on?

So far, our work has essentially been reactive, due to the extremely heavy nature of the agenda of European institutions regarding finance: CRD4,[1] UCITS,[2] rating agencies, shadow banking,[3] bank structures and banking unions.
For all the topics proposed to us, Finance Watch offers an analysis based on the general interest, in order to take a position that we will defend through our lobbying activities. For example, after announcing our position on the implementation of the Basel III Agreement, the CRD4 text, 5 of our 6 key recommendations were transformed into amendments, or propositions for amendments, after 2 weeks of intense discussion at the European Parliament – even if, 8 or 9 months later, much of them had disappeared. In future, we plan to be more proactive and work on fundamental themes that are not always necessarily taken into account by existing regulation or those under development.

What are the main themes that need further analysis?

In our opinion, one essential theme is: *investing*, not *betting*.
For us, the aim of finance is to bring capital to a productive economy and to society. We therefore have to promote a financial industry that allows us to invest, and not to bet. We will be developing this theme with a large number of possible regulations.

Could you explain the distinction you make between 'investment' and 'betting'?

Indeed, this is a very important point because, of course, behind the words one can include very different ideas. For us, 'investment' is an act that consists of bringing capital to a productive economy and creating a partnership between the investor and the underlying economic project. With regard to this notion of partnership, whether we win or whether we lose, we do it together. Thus, there is an economic meaning behind investment, which is what society needs.

• (1) The European Commission's legislative proposal of 20th July 2011, entitled CRD4, will integrate into European law the international reform, Basel 3 of 2010. It focuses particularly on demands in terms of banking solvency and on the surveillance of liquidity risk. This text revises the European Directive on the adequacy of own funds (CRD) that came into force in 2007 for the third time. • (2) UCITS: Undertakings for Collective Investment in Transferable Securities. • (3) Shadow financial systems are a series of financial entities such as hedge funds, capital investment firms, corporate banking, credit rating agencies, speculators on raw materials, clearing houses and off-balance-sheet companies.

'Betting' is a zero-sum game. If you and I were to bet on the change in the price of the pen you're holding over the next 10 minutes, one of us would win and the other would lose. Besides you and me, no one else would have been affected by our bet. That is an example of a zero-sum game.
You need to put things into perspective, though, because there is a part of speculation that has an economic and financial use in certain markets at a certain time and to a certain extent. Betting is something that has always existed, and our aim is not to get rid of it. Having said that, when we're in a financial system where this activity is becoming predominant (and there are examples to prove this) and when intellectual confusion is such that numerous 'betting-related' activities are considered as 'investment', then there is a problem. It's not a question of whether it's good or bad, but it is, nevertheless, useful and necessary to outline the conceptual difference between activities playing a role in the economy and activities of a different nature. As a result, the legislator will be more easily able to tell the difference between investment products and other types of products.

You seem to separate 'vanilla' assets (such as equities, bonds and real assets) from products based on derived instruments. Is this the case?

In general terms, yes. If we have only 20 seconds to summarise the position, it is exactly what you have just said. But we all know that there are obvious extreme cases and intermediate cases where the boundaries are more difficult to define.

Going back to the definition of assets; let's use the simplest one that everyone will understand, that is, holding shares on a secondary market. Would it be right to distinguish 'high-frequency trading' products from 'long-term holding' products? In other words, if I were to buy some equities on the secondary market, am I financing the real economy regardless of if I hold them for 3 days or 6 months, or am I doing what you consider as betting?

Clearly, on the secondary market, we know very well that the boundaries can sometimes be blurred. Having said that, in order to finance the economy, we need savers who put their savings in equities and bonds. I do not know a better solution than savings that invest in these asset classes.
Beyond that, what is the holding duration that determines when we move from a pure bet to an investment? We all know that it is not an exact science and I wouldn't pretend to be able to trace the line. One thing that is certain is that we are far from what we could call an investment when the investment horizon is reduced to milliseconds.

Are you referring there to high frequency trading?

Yes. I am convinced that a company has relatively long cycles, probably over some years. I know a lot of asset managers who find equities very frustrating because their expertise is based primarily on their capacity to find a company that can create value in 3 to 5 years.
And yet, though this is a bit of a caricature, we ask them every week if they have beaten their benchmark. This topic is part of a discussion launched by the European Commission on the concept of long-term investment. It's something that we, as well as the Kay Commission in Great Britain, are working on. There are obviously numerous issues but if, at the end of the day, capital flows are oriented towards equities and bonds (as opposed to products with relative values, secured capital, and so on), we would have won, at least in terms of economic logic.

> Giving investment an economic meaning is what society needs.

What do you feel about the Libor manipulations?

We've built a system with conflicts of interests at various levels. There have always been unscrupulous individuals, and there always will be, though I'm not sure that there are more in the finance industry than elsewhere. Today, the ideal solution would be to build a system that discourages this type of behaviour. Indeed, the system should be able to detect it to avoid being vulnerable to unscrupulous traders.
With regard to Libor, the trader is both judge and defendant; judge by stating, for example, that 'I think Libor is X' and, at the same time, defendant since, by determining a level X or Y, his profitability and his profit will be different.
A person who is extremely rigorous and very honest can easily handle these two roles, though it is obvious that the door is wide open to all kinds of manipulation.

Good governance should let no one be both judge and defendant; human beings are who they are, and it always ends up getting out of hand; it happens everywhere. There's a similar sort of situation with regard to the price of electricity, and it's common knowledge that the same applies to oil, gas and probably other indices, just like every time that a system is built on this double role of judge and defendant.

What is your position in the debate about credit rating agencies (creating a European agency, more strict regulations, and so on)?

For us, the creation of a specific agency is really not the answer. Nothing would change and the European authorities are fully aware of this. This project has therefore been put on hold because, apart from the fact that it's too expensive and a rating agency takes about 10 years before it is credible, it simply would not work. The problem with rating agencies is identical to that of the Libor: confusion of roles. Rating agencies must act as analysts and not judges! To have someone who carries out an analysis, and says, 'I think that...', is not just good, it's vital. And if an analyst's opinion is just something that we can choose whether to accept or ignore, the problem with rating agencies is that they are both 'analysts' and 'judges'.
In fact, as soon as an issuer sees its credit rating downgraded, asset managers (or some of them at least) will no longer be able to buy it because it is there in black and white, that the European Central Bank's rules on refinancing are linked to these rating agencies.

In short, then, would you say that the political authorities ought to 'deconsecrate' the role of credit rating agencies, rather than being outraged by their methods or the quality of their ratings?

Exactly! We commented on this issue during a hearing at the European Parliament and it's a topic that we feel very strongly about. *'Ladies and gentlemen, lawmakers and regulators, take the bull by the horns and start by removing all reference to rating agencies from financial regulations, the CRD[4] and others because, at the end of the day, you are the ones creating these pro-cyclical effects, you are the ones assigning them the role of "judges" when they should only issue opinions.'*

• (4) CRD: European Directive on the adequacy of owned funds, which entered into force as of 2007.

Where do you stand on the debate surrounding the role of agricultural derivatives? It's a recurring debate that comes up with every incident, as was recently the case with the severe drought period in the United States this summer.

We have done a lot of work on this topic. Our opinion is that a certain amount of speculation on the agricultural markets is useful (and what happened in America has reinforced this).
Indeed, for the farmer who wants cover for his production, there is a speculator who will take the opposite position. Studies, both empirical and theoretical, have shown that a level of speculation of 20–30% on the market is of real economic value.
The problem on the agricultural markets today is that the speculation ratio compared to other market uses (speculation or covering agricultural-related financial products) is around 70–80%. Such a level of speculation creates instances of price distortion that have considerable consequences. On these markets, contrary to equity or bond markets, it is the price of the future that will dictate the price of cash.

I can't remember the exact figure with regard to financing agricultural products, but I do know that the financing of commodities in general represents around 500 billion dollars globally. Technically speaking, in market terms, that makes 500 billion dollars of Delta One[5] products that create an upward pressure on commodities.

To come back to our opinion on *investing not betting*, we can clearly see that this money is not going into the productive agricultural economy. This relates to *betting*, not *investing*. A so called agricultural 'investment' product is not an investment, it's a bet.
What is unique about Finance Watch is that we advocate the banning of derivatives related to agriculture (index-based products, Exchange Traded Funds), as we are convinced that the consequences are too dramatic.

> "The problem with credit rating agencies is that they are both 'analysts' and 'judges' due to inadequate regulations.

In more general terms, why have derived products been developed to such an extent?

Regarding derivatives, there's an ongoing debate about whether they are good or not. For a relevant response, the question needs to be asked differently. Derivatives are effectively only a tool. In and of themselves, tools are neither 'good' nor 'bad'. It all depends on how we use them. The real question, therefore, is to find out why derivatives represent such massive investments around the globe. After having spent a long time devising structured products, I am convinced that the main reason is their low cost of production. The cost of devising these products is far too low. All the trading desks that structure derivatives obtain funding that is far too cheap.
The derivative market relies on an oligopoly of no more than 12 to15 large banks worldwide. The Liikanen[6] report reveals interesting figures, stating that BNP Paribas implicitly controls 50,000 billion Euros-worth of derivatives, Deutsche Bank 60,000, Société Générale 20,000 (and so on) for a notional underlying 700,000 billion dollars worldwide. I remember being in a trading desk that, like any other desks, regularly raised 40 or 50 billion Euros a day on the money market. That was before the crisis. These funds were raised at the rate of the money market (a few basis points above the Libor or Euribor). These activities normally generated 2 to 3 billion Euros of profit with a profitability of 2 to 4% of the amount of financing raised.
Who would have lent 40 or 50 billions to 400 traders, even if highly qualified and organised, if it were not for the name of a big bank behind them? Everyone was willing to lend 40 million Euros at the Libor rate because they knew that there was virtually no credit risk. If one were to lend the same sum to a bank that was not 'too big to fail', the cost of financing would have been 3–6% higher and, in

• (5) Delta One products are derived products whose price evolves in line with the underlying assets. • (6) The Liikanen Commission was established by the European Commission in February 2012 to examine the feasibility of structural reforms aiming to reinforce the stability and efficiency of the European Banking Industry.

this particular case, profitability of a large part of the more speculative activity would, without a doubt, have disappeared overnight.
I therefore believe that the best way to regulate derivatives would essentially be to make sure that entities that sell them finance themselves at a cost that is economically fair.

That brings us to the issue of banking structures. If I've understood correctly, in the debate on separating retail banks and market activities, in your opinion, we would separate 'investment-related' activities from 'betting-related' activities?
As such, the low cost of financing of the 'too big to fail' banks would be available to the real economy and investment. We would need to ensure that this advantage, with its high economic value, does not benefit betting-related activities that should be independent structures?

Yes, absolutely. A bank that's too big to fail benefits, de facto, from an implicit guarantee of the power of government and, therefore, of taxpayers. While it is conceivable that taxpayers and society could support activities that are in the general interest, activities of a different order should be practised freely without reliance on what is effectively a form of subsidy. When we hear it said that 'during the latest crisis, French banks did not cost the taxpayers anything, so a banking reform is not necessary', the reasoning is rather shallow.

In concrete terms, how would you define the boundary between 'investment' activities and 'betting-related' activities within banks?

The boundaries are not always that easy to define. However, I would say that there are basically two types of banking activities.
On the one hand, you have an activity that is directed towards financing liquidity for companies and individuals. On the other hand, you have the financing of assets. A banking business that finances economic flows usually does not create a speculative bubble. However, when money is directed at buying assets, there is always a risk that it contributes to the creation of a bubble, either in trading or in real estate.
Bubbles are a recurring issue that comes back each time credit is too abundant or when there's money creation destined for these activities. Any activity linked to buying assets should therefore be done on 'existing' money.
In asset management, for example, savings (funds) already exist, so there is no creation of money. In a similar fashion, a corporate or investment banking business should focus on money that already exists and not on money creation.
The problem with universal banks that have under their roof both retail and money-creation activities, is that the retail activity and the underlying money-creation activity are susceptible to being involved in the purchase of assets. And that creates economic bubbles.

> "Above all, we need to separate activities that are investments from those that are bets.

On this very topic, what do you think about the conclusions in the Liikanen report?

At the Liikanen Commission hearing, we argued in favour of the points I've just summarised. I think that the analysis of the Liikanen report, prior to the final proposal, is particularly lucid and relevant. They really go deep into the matter and they deserve a lot of credit for such a tough job.
Nevertheless, the proposals are not up to the same standard as the analysis, in our opinion. First of all, if the separation that they propose in terms of trading activities makes sense, setting the threshold for these activities (that could remain on the banks' balance sheets) at 15% or 25% is not the same thing. In Europe, the large majority of banks fall just under 25%. We therefore get the

impression that this threshold was set with a view to not affect too many people. Furthermore, the line drawn between the two banks seems to us inadequate. More exactly, we would have preferred that real estate loans move over to the other side of the fence, to the trading side.

Today, financial activity is the subject of much attention. After the Liikanen Report, came the recently published Kay Review.[7] What is your opinion on this last report?

Indeed, its analysis largely resembles the one I developed on the subject of investment versus speculation. Although expressed in a slightly different way, our rationales are comparable in that they consist in creating a form of 'partnership' between the investor and the underlying project.
In my opinion, the key point in the Kay Review is that it defends the idea that, in order to achieve the ideal pro-investment situation, one of the key elements, or the key element, is to have measures in place that take into account this idea of close relationships between investors and the project, and the duration of the partnership.
Then the question of the measure of market risk arises. Provided that this measure is a *Value at Risk*, we transform a long-term investment into a daily trading activity. A benchmark, in my opinion, is vital or at least useful, as we need to be judged on certain criteria. However, we need benchmarks to go beyond just weekly performances.
The issue of short-term / long-term measures and the adaptation of these measures is essential if we are to evolve into an asset management business that would give us enough time to do our work of detecting and selecting good projects.

> As long as the only way of measuring market risk is Value at Risk, we are turning investment into a daily trading activity.

Is there not a contradiction in the political thinking? On the one hand, indeed, there is a wish for a financial system that will be in the general interest, for the benefit of the real economy and steering savings towards the long term. On the other hand, are all the regulatory measures aiming to reduce risk. However, long-term finance to a certain extent is synonymous with additional risk, don't you think?

I couldn't agree more. During the discussions we have, whether with regulators, lawmakers or the Commission, we try to make them realise that these two objectives, realistically speaking, are not compatible. The stated objectives regarding financial regulation outlined by the elected representatives and the local government officers are, firstly, to finance the real economy and, secondly, to ensure savers do not take on risk.
In the end, you have to admit you've taken a risk, but one that is going to be put to good use for the economy. Put simply, buying shares and bonds responds to this logic. We can't always say, 'Finance the real economy, but don't take any risks.'

At a seminar organised by the European Commission that I went to three weeks ago, several stakeholders were consulted on this matter. I was asked to lead a session and I took the same stance as you, that is: what you're proposing is contradictory, so now you need to choose. I'll even go as far as to say that if you say to an equity fund manager that they have to have a daily liquidity, there are too many constraints. You have to break the taboos and tell yourself that if liquidity were slightly less, it would give portfolio managers the opportunity to take the time to choose assets and manage them in the long term.
But here we're up against huge opposition, even at a political level. I've heard MEPs from across the political spectrum say, 'Yes, but what about consumer protection?!' To which we respond that we need to stop treating consumers and investors like children. They are capable of dealing with the fact that an economic project is not fundamentally liquid and that, by the same logic, financial assets should not always be completely liquid.

• (7) The British economist, John Kay, was commissioned by the Secretary of State for the Department for Business Innovation & Skill to examine activities on the British equity markets and their impact on long-term performance and the governance of companies listed in the United Kingdom.

If there's a real virtue behind liquidity, we will recognise it, but we also need to find a balance and develop products that we'll have the courage to say will be less liquid because it's the only way to steer savings towards long-term investments.

That seems logical to me. We've talked a lot about finance and the real economy, but do you also have an opinion on whether or not finance should take external social and environmental factors into account?

> In order to promote investment and not speculation, we need measures in place that take into account the relationship between the investor and the financed project, as well as the duration of the partnership.

It's not something we have worked on, mainly because we don't have the internal resources to go beyond general statements on the matter. Nevertheless, on the fundamental topic of long-term investment, the first question is, 'How can we turn savings into long-term investments?' and the next step is, 'What is it that we wish to finance in the long term?'
This is where the external social and environmental factors would come in. There are a good number of organisations with real expertise in this matter. They have approached us and we have started working with them to try and pool our know-how. Our contribution concerns the regulatory aspect and the necessary conditions to encourage money to go towards investment, while theirs is to do with driving investment towards the energy transition, and so on.

Thierry Philipponnat, thank you for your time.

Interview conducted 02/11/2012

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Hervé Guez
Head of Responsible
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(1) The Infrastructure financing activity is managed by Mirova Environment and Infrastructure, a subsidiary of Natixis Asset Management.
(2) Impact investing: investments with a strong social and environmental impact.
(3) Source: Feri Lipper, based on assets under management as of 30/06/2012.
(4) Including €235m invested in infrastructure projects.
(5) ESG: Environmental, Social, Governance.
(6) PRI: Principles for Responsible Investment.
(7) ICGN: International Corporate Governance Network.

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