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Regulatory and economic instruments in order to reduce emissions of green house gases by 2050: financial impacts on industry?*

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Résumé

L'industrie européenne, y compris le secteur de la Défense, va être exposé à des régulations des émissions de gaz à effet de serre (GES) d'une force contraignante croissante. l'Union européenne conservera en effet à long terme des objectifs ambitieux de réduction de ses émissions de GES. Les incertitudes pesant sur la forme et l'ampleur d'une coopération internationale sur le climat ne devraient pas entamer ce volontarisme européen. La division par deux des émissions mondiales entre 1990 et 2050 impliquera une réduction d'un facteur 4 de celles des pays développés. Cependant, au regard de la difficulté de la réalisation d'un tel but pour le secteur diffus (ménage, agriculture, transport…), l'industrie européenne devra très probablement réduire ses rejets de GES d'un rapport de 5 à 6 fois. Malgré des conséquences futures d'importance, cet enjeu est pour l'instant sous-estimé par le secteur de la Défense.

Abstract

Industrial groups will be exposed to increasingly stringent regulation measures against GHG emissions. Uncertainties over the form and extent of international cooperation on climate change should not begin to weaken the European voluntarism otherwise than concerning the targets level of ambition. ***Therefore, the degree of restraint will remain strong.*** *Halving global emissions between 1990 and 2050 will involve a reduction by a factor of 4 of those in developed countries. However, given the difficulty of achieving such a goal in the diffuse sectors (households, agriculture, transport…), the European industry will most likely reduce its GHG emissions by a factor of 5 to 6.*

* Document drafted in 2011.

Introduction

Even as, for several decades, an environment-based economy (environmental taxation[1], environmental policies and their economic impacts[2]) has been developing, a greenhouse effect economy[3] emerged in the early 1990s. The range of economic instruments and tax measures to curb greenhouse gases emissions has continued to grow: carbon markets, climate-energy tax, carbon tax, emission caps or border adjustment mechanisms... In addition is added, at the expense of governments but also of businesses, the increasing weight of the presumed expectations of public opinion, those of the civil society.

Jean-Hervé Lorenzi[4], during a lecture delivered in February 2010 at the Paris Dauphine University, highlighted the huge effort implied in the reduction of greenhouse gas emissions by a "factor of 4"[5] by 2050. He warned against the absolute requirement of this break, in the absence of financial resources and appropriate innovation wherewithal. Is this goal attainable? Will it be done at the price of the competitiveness of industrialized countries enterprises? Is the defense sector preparing for it, and is it particularly exposed? These issues arise particularly for countries and companies in the European Union, which are almost alone for the time being to commit to a path of reducing emissions consistent with factor 4 – especially as climate controls are now suffering from relative volatility and lack of predictability.

1. Bureau Dominique, Godard Olivier, Hourcade Jean-Charles, Henry Claude, Lipietz Alain, *Fiscalité de l'environnement*, Paris, Conseil d'Analyse Economique, La Documentation française, 1998, 197 p.

2. Bureau Dominique, Mougeot Michel, *Politiques environnementales et compétitivité*, Paris, Conseil d'Analyse Economique, La Documentation française, 2004, 158 p.

3. Guesnerie Roger, *Kyoto et l'économie de l'effet de serre*, Paris, Conseil d'Analyse Economique, La Documentation française, 2003, 263 p.

4. Jean-Hervé Lorenzi is chairman of the « Cercle des économistes » and teaches at the Paris Dauphine University. On 23 February 2010, on the occasion of a convention whose theme was: "2010, Année des nouvelles régulations mondiales / 2010, The year of new global regulations".

5. The Factor 4 greenhouse effect gases issue aims to reach a 450ppm carbon dioxyde level (CO^2) by 2050 (550 ppm as far as all GHG are concerned), so as to contain global warming at +2°C. This means the halving of current worldwide emissions, i.e. a factor of 4 to 5 where industrialized countries are concerned. Factor 4 results from recommendations issued by German, U.S. and "Club de Rome" research centers in the late 1990s. See for example, Boissieu Christian's (pdt.) genealogy of factor 4, *Rapport du Groupe de travail "Division par quatre des émissions de gaz à effet de serre de la France à l'horizon 2050"*, 2006, 77p., available at this address : http://www.industrie.gouv.fr/energie/prospect/facteur4-rapport.pdf and Christian de Perthuis (pdt.), *Trajectoires 2020 - 2050 vers une économie sobre en carbone*, Paris, la Documentation Française, octobre 2011, 331p.

The climate conferences in Copenhagen[6] and Cancun, held in December 2009 and 2010, were far removed from the 1997 Kyoto Protocol binding objectives and architecture. The scope of future regulations of greenhouse gas (GHG) emissions is even more open and unpredictable, despite very high potential implications for all economic sectors and households. In addition, carbon regulations may occur suddenly, like the climate-energy tax, whose implementation was proposed in France on 1 January 2010. Between the launch of the Rocard[7] committee and the abandonment of that very measure in March 2010, less than one year has elapsed...

Throughout the developments, the term "emissions control", which includes various means for governments to act on greenhouse gases emissions, is the one we prefer. This regulation includes, either singly or jointly, economic instruments (taxation, certification...), regulations (mandatory standards) and incentives (subsidies ...). It also includes CO_2 markets and social norms, and the latter may be more stringent than the currently enforced regulations and still not be formally binding

While it is difficult to predict what the international and European climate architecture will look like in 2050, the basic orientations and structures that will shape it can be identified, before highlighting the potential financial impacts of such regulations on industry (with a focus on the Defense sector).

Public regulations for controlling emissions of greenhouse gases

➡ The process regarding the **international control of greenhouse gases emissions** is still immature. It is primarily based on an international treaty (the United Nations Framework Convention on Climate Change, 1992 – UNFCCC) that has soon proved ineffective, although it has laid the three founding principles of an international regime (in the legal sense) of climate change.

First, the Convention takes note of **the climate change, attributed directly or indirectly to man** (Article I). Adhering to the Convention therefore implies acknowledging that two-fold observation.

It then sets as its "ultimate objective" **to "stabilize (...) the concentrations of greenhouse gases in the atmosphere** at a level that would prevent dangerous anthropogenic interference with the climate system" (Article 2). The word

6. 15th Conference of the Stakeholders at the UN Framework Convention of the UN on Climate Change, 1992 – UNFCCC about global warming (1992).

"emissions mitigation" was used at a later date, on the occasion of the first Bonn Conference of Parties, in 1995.

Article 3 establishes an important principle based on equity: that of a **"common but differentiated responsibility" for global warming.** The implication of this foundation could have gone very far. Brazil had for example proposed to establish what amount of emissions each country has been responsible for since the industrial era. The reduction effort would then have been calculated directly based on past emissions. Though this viewpoint was not selected, developed countries have accepted the principle of differentiated reduction efforts. Thus, the UNFCCC contains a series of objectives that apply only to the industrialized countries listed in Annex 1 of the Convention. The negotiation (ongoing) at the climate conference in Durban (November-December 2011) was marked by India's obduracy on the implications of industrialized countries' historical responsibility for emissions.

The lack of a binding force imparted to the UNFCCC therefore appears as a symbol of its inefficiency and the main point for reform. Then, the main instrument for its implementation, the Kyoto Protocol (1997), created to overcome the main shortcomings of the 1992 Convention, still has no successor as of the year 2012.

Other issues will gradually emerge, with the intention of assigning emissions targets to each state with a historical responsibility for past GHG emissions, and with the determination to ensure they are duly controlled and sanctioned, if need be. On this point, the Kyoto Protocol marks a break in international relations, "*as it enshrines in international law a set of rules that restrict the free and unlimited use of the atmosphere by the human community. The Climate Convention articulated intentions. Kyoto requires binding commitments for the parties concerned*[8].

But the Climate Conferences in Copenhagen and Cancun (December 2009 and November/December 2010) did not yield the predictable and/or expected results. It led neither to an ambitious international agreement after 2012, nor to utter failure. The Copenhagen and Cancun agreements that ensued are disappointing on both form and substance.

The international climate change regime, in addition to regional agreements or national implementation, on a voluntary basis and with exemplary character, is also based on other negotiating bodies, like the Major Economies Forum on Energy Security and Climate Change (MEF) or the G8/G20.

➡ **The European Union** has positioned itself as a global model in terms of voluntarily mitigating emissions from its member states. The EU action on the matter is rich and complex and results from the observation, made in 2000, that the EU-15 would not achieve its goal of reducing greenhouse gases emissions by 8%, as set in Kyoto, between 1990 and 2008-2012.

In anticipation of negotiations on a post-Kyoto regime, the European Commission promoted an integrated management of climate and energy policies. It will then be responsible for implementing the three objectives (3x20) by 2020, adopted by the 27 member countries at the 8 and 9 March 2007 European Council (a 20% reduction in GHG emissions against 1990 and up to 30%, if an ambitious international agreement is reached; an increase of up to a 20% proportion of renewable energies in the total energy consumption and a 20% increase in energy efficiency).

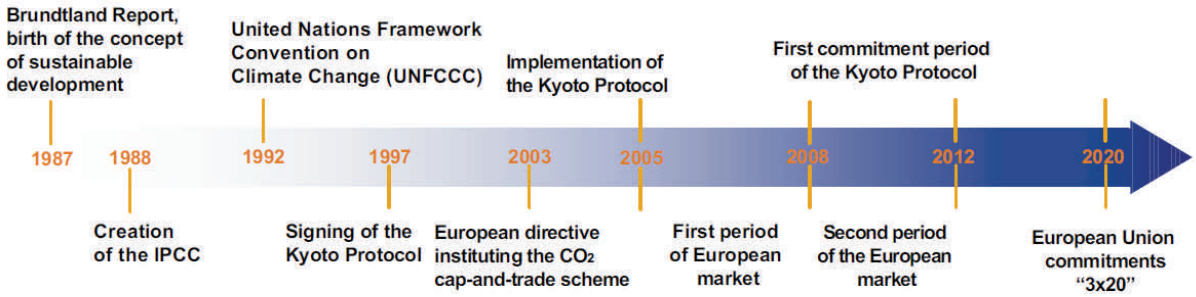
With a mandate to implement this triple objective, the Commission presented its Action Plan in 2008 (approved by the European Council in Brussels), which has since been called the "(Baroso) **Climate and Energy Package**." More specifically, the European Union has particularly committed itself to a 21% reduction in GHG emissions from its industries (between 2005 and 2020) via a mechanism of emission allowances allocation and auction. Also, by the same maturity date, non-industrial sectors (transport, housing, agriculture...) must reduce their emissions by 10%. The European Emission Trading Scheme (ETS or EU-ETS) is by far the most ambitious instrument within the more challenging markets of emissions allowances under the Kyoto Protocol. In 2007, Europe totaled 80% of the €47b carbon-asset transactions in the world[9].

7. A committee whose report was published on 28 July 2009: Rocard Michel (pdt.), *Rapport de la conférence des experts et de la table ronde sur la contribution Climat et Energie*, 28 July 2009, 83 p.

8. Leguet Benoît, Perthuis (de) Christian, "De la prise de conscience scientifique à l'action politique internationale", *Questions internationales*, Paris, la Documentation française, n°38, July-August 2009, pp. 37-48.

9. Gattet Philippe, *Le marché du CO_2 en France*, Xerfi, September 2008.

The Kyoto Protocol and the European CO2 Market[10]



➡ The **French government** took a leading role in the adoption of the Energy-Climate Package at the 12 December 2008 European Council, at the very end of the French European Union presidency. We thus find the logical national versions of European regulations, including through the adoption of a National Allocation Plan (NAP). The French climate change mitigation measures fall into action in the areas of energy, transport, agriculture, construction, waste treatment or awareness. These policies and actions have been reinforced by the publication in July 27, 2010 of the new *National Strategy for Sustainable Development (SNDD 2010-2013)*.

Emissions control of greenhouse gases by 2050

The political and economic means to take action

The most likely architecture of policies against climate change would build upon the Copenhagen and Cancun agreements regarding its international dimension (no binding agreement, voluntary reduction by states...) and upon carbon markets for its regional and national dimensions...

Three approaches synthesize the different possible actions. Each can have regional, domestic and industrial variations. They will probably be combined with each other:

⇒ "*Pledge and Review*". Popularized by the Bush administration, this approach relies on trusting national schemes to reduce emissions. States set their own goals. Their evaluation and effectiveness then become the main issue. The Copenhagen agreement is part of this approach, which, consequently, will structure the future architecture of global climate. China and the United States clashed on the issue of verifying national objectives. The text of the Agreement provides many verification procedures, either internal or international (depending on the type of action), but does not specify how to enforce their implementation. The extreme sensitivity of the BASIC countries to safeguarding their national sovereignty is likely to reduce the scope of the audit procedures. This opens the door to the withdrawal of either an emerging country, or indeed a developed one, for breach of the agreement.

⇒ *"Cap and Trade"*. This system is based on the distribution of emission allowances and transferable credits (unlike the Command and Control approach). The regulator sets a ceiling for emissions rights to be distributed, put up for sale at a fixed price or auctioned. Initiated in the 1960s (Ronald Coase and John Dales), Cap and Trade, when applied to the environment, can control the overall volume of emissions in the sectors it covers. As was mentioned above, the markets of tradable permits may apply at the regional, domestic or sector levels.

⇒ "*Command and control*". The prescription of standards stands at the heart of this approach. The public authority enacts and monitors compliance with regulations. Its first application to the environment is probably the U.S. 1970 Clean Air Act. This leads to sector regulations[11]. Jean Tirole[12] warns about the risk of the proliferation of

10. Caisse des Dépôts Consignments and Loans Fund) MEEDDEM, *Key figures on Climate. France and Worldwide. 2011 Edition*, January 2011, 44p.

11. About the limits of sectorial approaches, see Baron Richard, *Approches sectorielles et lutte contre le changement climatique*, in Tirole Jean, 2009, op. cit.

12. Tirole Jean, « Politique climatique : une nouvelle architecture mondiale », Les Rapports du Conseil d'analyse économique, n° 87, 2009, 358 p.

lobbies and exemptions. In addition, by imposing cuts without flexibility, the public authority could increase the costs of mitigation. In terms of international climate policy, the Command and Control approach could allow coordinating actions, at least in some sectors, particularly GES emitters (cement, metal...).

These policy responses will range within a mix of these three approaches, especially the first two (stacking individual objectives by State and sub-regional carbon markets). Even the prospective report[13] *Climate Futures, Responses to climate change in 2030*, a very interesting one on account of the variety of scenarios it imagines, does not provide for different modes of regulation from those mentioned above.

Towards a carbon tax?

Regulatory and economic Instruments

Resorting to these two types of instruments to control greenhouse gases emissions aims at the same goal: to create a signal / carbon price (and equivalent) to influence behaviors and practices, and eventually lead to a minimization of reduction costs.

Resorting to taxation is directly attractive as it is bound to impact both uses and consumption, without warranting their amplitude. Carbon valuation is protected from price volatility. Conversely, if a carbon market, with a well-defined emissions cap, is supposed to best ensure environmental integrity (by means of defining an emissions cap), its long-term incentive effect is more uncertain and will depend on the price of carbon and its predictable value at different time horizons. A tax indexed on recent carbon quotations (€19 to €7 between January 2010 and November 2011) might well prove no great incentive. According to the June 2010 Rocard report, the following is necessary for a price signal to be efficient in terms of energy-carbon Tax (ECT)

⇒ Long term predictabiliy;

⇒ The level of the ECT should increase over time;

⇒ Clearly identified (the ECT ought to come in addition to existing regulatory instruments, so as not to be confused with the latter);

⇒ The correlation of price with clear emissions reduction targets. The calculation of that price-signal should be detached from the yield of the tax (whose tax-base – GHG emissions – is gradually to be reduced).

A national and / or regional carbon valuation leads to sector distortions relatively to areas that have not implemented a carbon tax or market. The impact on competitiveness requires an overhaul of the mandatory levy tax burden to make their level constant.

The first potential effect is the "carbon drain", meaning the relocation of GHG emitting activities to areas not subject to emission reduction measures.

The second problem results from the difficult to establishing measures designed to correct such distortions. Among the possible hypotheses, a tax on carbon imported into the EU was mentioned several times. Such a mechanism seems impossible to implement in practical terms. For example, taxing a Chinese product would require perfect knowledge of its carbon footprint (and it might itself be an assembly of materials produced in several countries), as well as means to evaluate the effectiveness of emission reduction measures in the importing country. Beyond the prohibitive transaction costs of implementing a carbon tax at EU borders, this device would cause extreme trade tensions. Developing countries fear that the de-carbonization of Western economies could be the pretext for measures amounting to protectionism. Such a tax would, however, not be inconsistent with GATT / WTO rules. It could pertain to the exceptions therein provided for, regarding "the protection of people's life and health..." (GATT, Article XX-b), or to the "action designed for the conservation of exhaustible natural resources, if such measures are applied in conjunction with restrictions on domestic production or consumption" (GATT, Article XX-c). The atmosphere could thus be regarded as an exhaustible natural resource, but this interpretation would require a jurisprudence that is yet to be drawn up[14].

An added carbon tax?

Some researchers[15] recommend, to overcome this difference in treatment between "local" and imported products, by adopting a "European added carbon tax" (European ACT). Such a device, similar to the principle of VAT, would hit all goods in the same way, including imported

13. Forum for the Future, *Climate futures. Responses to climate change in 2030*, London, October 2008, 76 p.

14. On that theme, see: Institut de l'entreprise, *La taxe carbone : mythe ou réalité ? De la théorie à la pratique*, coll. Les Notes de l'Institut, July 2008, 64 p.

15. Laurent Eloi, Le Cacheux Jacques, *Une Union sans cesse moins carbonée ? Vers une meilleure fiscalité européenne contre le changement climatique*, Notre Europe, coll. Etudes et Recherches n°74, Nov. 2009, 73 p.

TABLE 2. PRICE OF A TON OF C02, IN 2008 EUROS[17], ADOPTED BY THE "QUINET" COMMISSION"

	2010	2020	2030	2050
Value recommended by the "Quinet" report » (2009)	32	56	100	200 (150-300)
Value adopted by the "Boiteux" report (2001)	32	43	58	104

ones. On each purchase, consumers would pay an amount equal to the total emitted carbon, from the manufacturing of the product to its distribution. Consumers would thereby be directly confronted with the carbon price signal, prompting changes in consumption practices. Amongst the four scenarios regarding a new EU tax on carbon developed by Eloi Laurent and Jacques Le Cacheux (op. cit.), the EU ACT is the one that results in the best eco-efficiency. However, this solution is the most difficult to implement. It would require, on the technical level first, to have perfect knowledge of each product carbon footprint throughout (production and distribution) chain.

Among the other scenarios considered by the two researchers, a stricter regulation[16] of the EU ETS would better ensure the effectiveness of the European carbon market. This would for example be done through more frequent interventions in the market (determination of a price ceiling, removal of excess amounts of carbon, speeding up auctioning permits...). But this solution will concern only 50% of EU emissions, with no effect on the diffuse sector. Two other scenarios, precisely to reach all sources of GHG emissions, provide the completion of the EU ETS with a two -fold tax: energy and carbon. Either the tax uniformly impacts the energy content of fuels and their carbon intensity in differentiated fashion ("Climate conversion scenario"); or it creates a differentiated taxation meant to evolve over time ("European green shift" scenario). To increase immediate efficiency, this energy / carbon hybrid system is meant to tax energy first. Then the carbon component of the tax gradually increases, while the energy share decreases. These systems limit the risk of a carbon-drain within the Union. Sweden has been applying this type of hybrid taxation since 1990.

The price of carbon: fluctuation and efficiency

How to decide on the worth of carbon?

Setting a price on carbon is expected to lead, in accordance with economic rationality, to the re-assessment of investments and consumptions per each family of emitters (industry, government, private individual...). Determining the per ton price of carbon is part of a cost / effectiveness approach, which focuses on achieving the objective of factor 4.

The determination of a carbon price directly depends on the lifestyle and the convergence of living standards among the various regional blocs. The generalization of the development style in industrialized countries, to be compatible with a concentration of greenhouse gases of 450 ppm would lead, for example, to valuation levels close to €450 per ton of CO2 in Europe by 2050. Such a high price does not mean it must be fully reflected in all sectors, for example by means of a tax. This is not an average cost reduction. It indicates a level of constraint likely to achieve the objective. In addition, a ton of CO2 at €350 in 2050 would result in doubling fuel prices in Europe, which seems proportionate to dividing emissions by 4[18].

Whether regarding an energy-carbon Tax or CO2 markets, the price hypotheses at different time horizons should be read with caution. Uncertainties are indeed numerous. Economic growth or the state of scientific knowledge are likely to get emissions reduction targets to vary. Still, the major uncertainty lies in some green technology innovations, which would achieve GHG emissions reduction levels with economic and social costs[19] that would be far lower than current forecasts.

The multiplication of national and regional carbon markets: what coordination and what risks?

Despite questions about the international carbon market, the number of domestic carbon markets

16. « Fiscalisation » in french.

17. Quinet Alain (dir.), 2009, op. cit.

18. C.I.R.E.D., ENERDATA, L.E.P. I.I et FONDDRI., *Etude « Scénarios sous Contrainte carbone. Scénarios « REF » et « F4 mimétique ». Résultats des simulations harmonisées Poles/Imaclim-R »*, April 2007, 53 p., http://www.epe-asso.org/pdf_rap/EpE_rapports_et_documents88.pdf

19. Gollierr Christian, *Incertitude et prix du carbone*, in Quinet Alain (dir.), *La valeur tutélaire du carbone*, Centre d'Analyse Stratégique, coll. Rapports et Documents, n° 16, 2009, pp. 93-111.

besides the EU ETS, already in operation or only planned, keeps increasing. Markets, albeit narrow, were created in the United Kingdom (2002), Norway (2005-2007) and Australia (New South Wales since 2005).

The multiplication of national and regional carbon markets: what coordination and what risks?

Despite questions about the international carbon market, the number of domestic carbon markets besides the EU ETS, already in operation or only planned, keeps increasing. Markets, albeit narrow, were created in the United Kingdom (2002), Norway (2005-2007) and Australia (New South Wales since 2005).

The multiplication of these internal initiatives (two in the United States), national ones (Japan, New Zealand, South Korea...) and regional ones (EU) could result is so many different carbon prices. The heterogeneity of carbon prices in different markets reflects the ambition of policies against climate change.

Several issues arise from the coexistence of these different carbon markets:

⇒ How to make sure that the level of quotations will remain incitative enough to bring about effective GHG emissions reductions?

⇒ Are these markets going to coordinate each other?

⇒ Can a world carbon price emerge from the multiplication of domestic carbon markets?

⇒ How to safeguard these markets from excessive price volatility (speculation, risk that some emission reduction certificates might be counted twice...)?

Thus, the likely non-renewal of the Kyoto Protocol may not affect the establishment and effective functioning of numerous domestic carbon markets.

The prospect of reconciliations or even mergers / takeovers between some of these markets is possible[20]. But the main link between these exchange systems until at least 2020 would be the Clean Development Mechanisms (CDM). If they still exist at that time, these mechanisms will contribute to bring together different carbon valuations[21], at least until 2020.

20. See Galharret Sophie, *Le marché carbone comme soutien à la transition ?*, Iddri, coll. Idées pour le débat, n°2, May 2010, 22 p.

21. Galharret Sophie, *Le marché carbone comme soutien à la transition ?*, Iddri, op. cit.

➡ Two points stand out from the different scenarios and uncertainties of the future emissions control.

First, whatever the ambition level of the implemented international policy, the Union will very likely always have a proactive and determined attitude on the issue of GHG emission reductions. However, the European carbon market (the European Union Emissions Trading Scheme, EU ETS) in its current form will not meet European targets for attenuation after 2020. An extension of the ETS, coupled with the introduction of a carbon tax targeting the isolated lots sector could be introduced after 2020.

Then, the enhancement of the tonne CO2 equivalent value would amount to at least $150 in 2050 (assuming that all countries in the world are taxed on the same basis so as not to exceed a 450-ppm GHG concentration). A belated implementation of international climate policy will lead to an even higher carbon valuation, to catch up with the carbon 450 ppm emissions trajectory. The tonne of carbon could therefore stand, for industrialized countries, at the high end of the Quinet[22] report, between €200 and €350.

The correlation of these two elements led to a high rise in the value of carbon in a growing number of sectors in the EU. This perspective remains valid even in case of total lack of international mitigation coordination, or non-involvement of emerging countries, if it is coupled with border adjustment measures. Fragmenting carbon markets and promoting regional protectionism could thus do the trick, while allowing emission reductions. However, these uncooperative developments will not reduce CO_2 levels to 450 ppm.

Impacts on industry (focus on defense sector) of the limitations of GHG emissions

Impacts of current regulations on Defense companies

Companies in the defense sector are relatively little exposed to existing carbon constraints. For example, a group with a €10m turnover only has 3 out of 130 of its sites that are submitted to FNAP2 (the second French National Allocation Plan) for 2008-2012, reflecting to what extent each country in the European Union does abide by the EU ETS). Moreover, the extension of the number of sites involved in the FNAP3 between 2013 and 2020 (namely sites with a power greater than or equal to 20 MW for PNAQ2 and 3 MW for FNAP3) is to bring the total to fewer

22. Quinet Alain (dir.), 2009, op. cit.

than ten. In addition, the balance of permits allocated to this group is positive, which should allow the resale of a portion of these allocations. The situation should remain the same during the PNAQ3 period.

In addition to holding permit credits, some groups valorize some Energy Savings Certificates (in France) with energy suppliers, on sites not subject to the EU ETS. The inclusion of air transport operators in the EU ETS as off 1 January 2012 requires them to compensate with new permits the equipment conveying transactions (all groups are involved).

Yet, the effects of EU ETS and of national energy saving measures should remain favorable for large groups until the end of FNAP3 (2020). The rapid adaptation of the sector to carbon constraints must be qualified, though. It reflects the GHG reduction margin at a low marginal cost enjoyed by these early actions. **Further declines of about 2 to 3% per year from 2020 to reach factor 4 by 2050, should represent an effort (implementation costs) that is incomparable with what is being done until 2020**. In addition, this at first sight rapid adaptation occurs without medium-term prospective about the double pressure imposed by more stringent carbon constraints (auctioning of permits will be the rule, and possibility of a tax on non-EU ETS sectors) and about a narrower margin regarding emissions reductions within groups.

Contrainsts resulting from future carbon regulations

The industrial stakes of an energy-climate Tax

For industrial groups, the domestic sector is both a safeguard and a risk. A 30% reduction in GHG emissions in the EU would lead to an enhancement of carbon in diffuse sectors (excluding EU ETS, i.e., households, buildings, transportation, agriculture and the tertiary sector) ranging between €138 and €188 per ton[23], depending on the economic recovery scenarios. This price level (escalation of fuel prices between 0.18 and 0.34 per liter) would prove far too heavy for households. But the incentive for households to achieve a 20% reduction in emissions by 2020 through fiscal measures would, anyway, still raise problems[24]:

First, the valorization level of carbon would remain too high for households (between €71.5 and €155.3 per ton of CO2 according to the level of the economic recovery)

It would then generate great distortions between the valorization of carbon in the framework of the EU ETS, and that of diffuse areas in the framework of a tax (with a ratio of about 2 to 3).

The actual risk lies in the determination of a single carbon price within the EU ETS and outside of it, which amounts to redefining effort-sharing between individuals and industrialists[25]. All the fossil fuels consumed in Europe could then be included in the EU ETS (as this would require importers of these raw materials to purchase emission rights on the European market). In this case, part of the reduction effort by households would be supported by the EU ETS sector: the carbon price in the European market would then be higher than it should be without this inclusion. **Achieving "factor 4" by 2050 in France actually requires a factor of 5 to 6 for industry[26].**

Thus, Europe, or failing that, several countries, could commit more to a tax increase of the consumed energy than to an energy -climate Tax, if the principle of a tax was adopted (unanimous vote is required by EU member countries). Especially since having a reliable carbon image of a product will remain difficult (especially in the case of components assembled from various geographical origins) and could generate transaction costs for the implementation of such a tax that could prove much higher than its expected returns. **Energy should therefore lie at the heart of the emissions reduction scheme in sectors outside the EU ETS**.

In this case, all defense related companies sites, except the few that fall within the scope of FNAP2 and 3 and out of exemption, would be likely to be affected by this tax. Energy consumption for infrastructures heating facilities, for production (outside EU ETS) and for staff -travel would pertain to its base.

The level of tax burden should depend for policy-makers on whether it is urgent or not to curb greenhouse gas emissions relatively to the risks of impaired competitiveness, on the progres-

23. CAS, "Les effets du Grenelle de l'Environnement. La France doit-elle réduire ses émissions de gaz à effet de serre de 30 % d'ici à 2020?", *La note de veille*, CAS, n° 175, May 2010, 10 p.

24. CAS, "Les effets du Grenelle de l'Environnement. La France doit-elle réduire ses émissions de gaz à effet de serre de 30 % d'ici à 2020?", *La note de veille*, CAS, n 175, May 2010, 10 p.

25. CAS, "Les effets du Grenelle de l'Environnement. La France doit-elle réduire ses émissions de gaz à effet de serre de 30 % d'ici à 2020?", *op. cit.*

26. Combet Emmanuel, Ghersi Frédéric, Hourcade Jean-Charles, Thubin Camille, *Economie d'une fiscalité carbone en France. Eléments de synthèse*, CIRED, 30 June 2009, 7 p.

Table 3: Evaluation of the potential impact, in millions of Euros, of adding various carbon regulations (Taxes,emissions rights market ...) on a great group in the Defense industry (with a turnover in the vicinity of €10b) on the basis of constant emissions (2008)[28]

	2010 / Téq.CO2 = €17	2010 / Téq.CO2 = €32	2020 / Téq.CO2 = €56	2030 / Téq.CO2 = €100	2050 / Téq.CO2 = €200
S1 : Market + Tax on energy consumptions (heating, pro-	7.6	14,4	25,2	45	90
S2 : S1 + taking into account the GHG emissions of base materials (used for production)	27	50,9	89,1	159,2	318,4
S3 : S2 + including the GHG emitted by subcontractors	42,1	79,3	138,7	247,7	495,5

siveness of its implementation and on the compensations which might accompany it. Tax cuts have benefited SMEs and individuals in British Columbia, while Finland preferred offsetting its taxation of energy by means of social contribution compensations.

In Denmark, the exclusive use of taxation to get the diffuse sector to achieve the objective set by the EU (-21% between 1990 and 2020) would lead to a carbon valuation of up to €180[27], and employers would be sure to highlight the risk of relocation. Until then, a tax of around €15 per ton for individuals (habitats, transportation) had no incentive effects on behavior.

Trying to achieve greater efficiency for such a tax on carbon or energy consumption could lead to the overhaul of tax exemptions on energy. Compensations are designed with a view to reducing emissions globally, which is more compatible with the determination of a single target for all sectors than random exemptions. Exemptions from TIPP (domestic duty on petroleum products) could be the first to be targeted.

The EU ETS: a limited scope to anticipate on the carbon issue

Uncertainties surrounding the EU ETS have to do with the extension of its scope of application, and with changes in the price of carbon on the European market.

The EU ETS, a pioneering instrument in the world in terms of commitment to a regional bloc, was supposed to be one of the main incarnations of European leadership on international climate negotiations. However, the European market for trading emission allowances proves to be particularly lacking in forecasting scope. The only landmark that has been set is the end of the third "trading period" in 2020. While it introduces the gradual auctioneering of quotas (partly allocated for free in previous periods), the third implementation phase of the EU ETS (2013-2020) will have necessarily to go through an extension of its scope. Yet, this reinforcement is still limited to the petrochemicals and aviation industries, which is expected to increase the scope of the EU ETS from 43 to 50% of GHG emissions in the EU[29]. The scope of the European carbon market

27. Keller Fabienne, *Rapport d'information sur la fiscalité environnementale, sur l'instauration d'une contribution climat-énergie, le fonctionnement et la régulation des marchés de quotas de CO2*, Paris, Sénat, Rapport d'information, n°543, 8 July 2009.

28. This only aim of that table is to give an indicative cost of not taking action and suggesting a measure to anticipate the carbon issue for a great Defense industrialist. These figures, however, ought to be taken with several reservations. Firt, these calculations have been made on the basis of constant emissions up to 2050, though it no longer is true and never will be.. EU ETSSubstitutes that do not emit GHG, which should appear beyond a certain valuation level of a ton of carbon, are not taken into account. In addition, the calculation of certain items emissions has significant margins of error (including subcontracts). Then there is the assumption that a tax (on energy consumption – S1 – and / or on materials carbon intensity – S2) would complement the EU ETS, at least temporarily, which is not currently the case. Moreover, the prices used for the carbon equivalent ton corespond, except for the first 2010 column, to an ideal carbon valuation allowing to reach factor 4 in 2050, in compliance with the Quinet report (CAS, 2009). A €17 carbon price, such as chosen for the first 2010 assessment, is the price chosen for the carbon tax expected to come into force in France on 1 January 2010, before it was scrapped in March 2010. Finally, the projected impacts of carbon regulations neither take into account the progressive implementation of these measures, nor the many improvements that could accompany them (exemptions from obligations, tax credits, free allocation of quotas, etc.).

29. Commission européenne, *Le système communautaire d'échange de quotas d'émission (SCQE)*, 2009 edition, 28 p.

will depend on the existence of a carbon tax and the tax base of the latter. But market and tax are two methods for reducing emissions, which in theory should not be combined. However, the specificity of the action on the diffuse sector, like the institutional characteristics of the EU on taxation, may contribute to get these two instruments to coexist and to change their respective fields of application.

For industries, the uncertainty as to the scope of these tools will mostly impact the schedule. The implementation of a national or European tax on energy and/or carbon might happen more quickly than expected an also more suddenly[30] than the extension of the scope of the European carbon market. The European commission presented a proposal to revise the Energy Directive in April 13, 2011. This project includes a tax with an energy part, and a Carbon part. In the short term (2020), the valuation of carbon by means of a tax or via the EU ETS might well be imminent.

The mirage of a "Green New Deal"?

Could the conversion of industrialized countries economies to reduce carbon intensity prove to be a major source of industrial and commercial opportunities for large groups in the defense sector?

This is the simple question that the prospective departments of the defense industry seem to be asking: what are the risks and opportunities of the fight against greenhouse gases emissions?

First, the risks relate both to the fear of underestimating the challenge, for example lagging behind technologically, which could prove hard to catch up with, and to the danger of overestimating it, at the risk of straining the company's competitiveness by launching into expensive emissions reduction programs or escalating the price of products.

Vulnerability to these risks is increased by the return on investment horizon, which rarely exceeds 5 to 7 years. The launch of projects is conditioned by that temporal barrier. Plans for photovoltaic power generation, which French Defense Industrial Groups had initiated until 2010, have all[31] been cancelled or postponed: their return on investment has been postponed on account of the buy-back price of electric power, less favorable to industrialists since January 2010. Indeed, great firms do not commit themselves to these projects over 15 to 20 years. The increase in carbon prices and a rising marginal cost of emissions reductions over the years[32] might contribute within 5 to 10 years to extending that horizon as regards renewable energies.

Secondly, potential opportunities raise as much weariness as interest. Caution stems from the mixed results of previous national policies meant to support green innovation. The example of Germany, which has supported the development of businesses in the former GDR in terms of solar electric power, is indeed bleak. Most companies have relocated their production, which has helped make China the world's largest producer of solar panels, though the research has been funded by a third country... The CAS (Centre for Strategic Analysis) pointed out in May 2010 that, to achieve a long-term impact on GDP and employment, the investments expected to initiate green growth must improve in productivity and competitiveness.

Add to this the uncertainty regarding intellectual property rights. Many countries, led by India, argue for ways of patent sharing schemes concerning all that has to do with reductions of GHG emissions and for facilitating adaptation.

The absence of specific requests from customers in the fight against greenhouse gases (otherwise than by savings in energy consumption) is not conducive either to encouraging the greening of investment and innovation.

Under these conditions, fiscal and regulatory pressures or the need to resort to carbon markets do not seem sufficient incentives for Defense manufacturers to gear more resolutely their production processes and products towards action against greenhouse gas emissions. Obstacles to the integration of the carbon challenge thus prove very numerous: an uncertain return on investment (and in the long-term, at best), uncertainties about the use of patents or then again a fluctuating demand for low carbon intensity products depending on the sector.

Conclusion

Industrial groups will be exposed to increasingly stringent regulation measures against GHG emissions. Uncertainties over the form and extent of international cooperation on climate change should not begin to weaken the European voluntarism otherwise than concerning the targets level of ambition. **Therefore, the**

30. Similarly to the debate on the implementation of a carbon tax in France, which, from first being suggested to the decision of its enforcement, later to be scrapped, lasted at least one year and a half.

31. Except for one particularly well exposed SNPE site.

32. Due to a reduction scope that is not so large within each company (while supposing the less costly have been undertaken first).

degree of restraint will remain strong. Halving global emissions between 1990 and 2050 will involve a reduction by a factor of 4 of those in developed countries. However, given the difficulty of achieving such a goal in the diffuse sectors (households, agriculture, transport…), the European industry will most likely reduce its GHG emissions by a factor of 5 to 6. Public actors must not fail to get involved in this effort, which will require exemplarity on the part of States, hence of the Ministry of Defense.

By 2050, the financial impact of the various carbon regulations (markets and/or climate-energy tax) on a company of the Defense sector (with a €10b turnover) would be in the range of €90m to €500m. An aggravation of climate changes would lead to even deeper cuts than those of the "factor 4", and additional costs would then be exponential.◊

Author

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