ENABLING PERFORMATIVITY IN 'SKUNK LABS': THE UNTOLD STORY OF CARBON MARKETS DESIGN

Mélodie Cartel, Franck Aggeri, Marine Agogué

ENABLING PERFORMATIVITY IN 'SKUNK LABS': THE UNTOLD STORY OF CARBON MARKETS DESIGN

Mélodie CARTEL
Franck AGGERI
Marine AGOGUE
Centre de Gestion Scientifique (CGS)
MINES ParisTech

28TH EGOS COLLOQUIUM, HELSINKI 2-7JULY 2012
TRACK: PERFORMATIVITY BY DESIGN

`

INTRODUCTION

Climate change has become in 20 years one of the greatest economic, environmental and social challenges of our modern society. A wide variety of organizations – NGOs, governments, business, international bodies, local communities, research think tanks – are working together to design and implement a low carbon society. In this particularly uncertain context, characterized by distributed, lacunar, messy and sometimes contradictory scientific knowledge, the actors fail to converge on a common project regarding the architecture of a low carbon society. Projects and visions vary among actors and over time. Nevertheless, it is commonly admitted among experts and economists that a carbon price that would be stable, predictable and fair could provide the long term coordination that is needed to drive the implementation of a low carbon society. "A price of carbon would solve any problem" said a French expert in a recent interview[1]. A 'right' price of carbon would diffuse in the economy and provide long term drive for technology breakthroughs and switch to low carbon products said another one[2]. Such a 'right' carbon price would then stir up the profound societal changes that are required. In Europe, these great expectations over a 'right' carbon price have aroused an on-going design activity that enables the existence of the European carbon market (EU-ETS).

The 'official' story of how carbon markets were designed and implemented, as it is told in economic handbooks and in the press, is well known and widely documented (e.g. Braun, 2009; Ellerman & al, 2010; Hourcade, 2002; Cass, 2005; Wetestad, 2005). According to this story, environmental economics is supposed to be particularly performative as it presents carbon markets as the output of thirty years of research program in environmental economics initiated in 1960 by Ronald Coase and his famous article, 'the problem of social costs'. This common representation tends to overlook three activities that enabled the concrete performation of theoretical economy; that is to say design, negotiation and revision.

We propose to adopt the perspective of (Callon 2009): "*How are the different knowledge and know-how transported, experience capitalized on, and evaluations conducted*?" We claim in this paper that in the case of carbon markets, the existence of design spaces that mediate between economics and economy (Guala, 2007) is

[1] Richard Armand. Conference : « l'entreprise dans un monde carbone fragmenté ». held in October 2011.
[2] Thierry Berthoud. Head of Energy and Climate, WBCSD. Conference: « l'entreprise dans un monde carbone
[2] Thierry Berthoud. Head of Energy and Climate, WBCSD. Conference: « l'entreprise dans un monde carbone fragmenté ». October 2011.

central to explain the performation of the EU-ETS. We define a design space (Hatchuel, Le Masson, & Weil, 2005), as a collective working space where designers can act in a way that enables them "to learn on what has to be learnt" (Hatchuel & al, 2005). Most of them are governed by visible actors (like the European Commission, scientific think tanks or NGO's): their activity is made public and has already been studied. We chose to focus here on a more unknown kind of 'design lab' governed by industrial actors. As the industry is not invited to participate to environmaental policy making, their engineering activity is quite discreet, even hidden, which makes it difficult to observe. The European electricity sector set up such a lab after the Kyoto protocol[3] to explore what carbon markets might be and since then has run experiments to test new parameters on carbon markets. From 1999 up to now, they have designed a range of experiments that have played a key role in the performation of carbon markets. Building on the notion of 'skunk work' proposed by Peters (1997), to designate processes of internal entrepreneurship that are informally developed within corporations, we propose to label those subterranean design spaces as 'skunk labs'.

Building on Muniesa and Callon (2007), we explore further the notion of platform, focusing on the experimental activity they support. How were such design spaces organized? How were the experimentations instrumented? How did their instrumentation evolve? What type of knowledge was produced? Using a design theory approach, we model knowledge dynamics to highlight the complexity of the design activity that is undertaken by actors.

COMMON KNOWLEDGE ON THE CONSTRUCTION OF THE EUROPEAN CARBON MARKET: PERFORMING THEORY

The 'official' story of how a low carbon future commitment drove the performation of theoretical environmental markets into the real economy is very well established among the climate community (scholars, governments, NGOs, business, etc.) and documented (e.g. Braun, 2009; de Perthuis & al, 2010; Hourcade, 2002; Cass, 2005; Wetestad, 2005).

[3] The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997. It is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

"In order to reach the Community's emissions reduction commitment of minus 8% compared to 1990 agreed to in the Kyoto Protocol the European Commission proposed the establishment of a European Union Emissions Trading Scheme (EU ETS) in the framework of its Post-Kyoto Strategy in June 1998 (European Commission, 1998). The proposal was followed by a Green Paper in March 2000 (European Commission, 2000), a draft directive of the European Commission in October 2001 (European Commission, 2001a), and a binding EU framework directive – the European Emissions Trading Directive – on 13 October 2003 (European Commission, 2003a). After having been implemented by all EU Member States, the EU ETS finally went into effect on 1 January 2005." (Braun, 2009).

The common knowledge on the construction of the EU-ETS emphasizes two aspects of the performation of theoretical carbon markets: (1) the European carbon market stems from Coase's theoretical framework that has been enriched by economic engineering; (2) the implementation of pure economics was hindered by the bargaining of stakeholders.

Building the European Carbon Market; Performing Theory

Initial theoretical research focused on the design of 'efficient' economic instruments to address negative externalities. The idea of using a market to manage industrial emissions can be traced to Coase (1960). In his seminal article – the problem of social costs – he showed that, in the absence of transaction costs, a clear definition of property rights would lead to an efficient allocation of resources. Crocker (1966), Dales (1968) and Montgomery (1972) further developed Coase's theoretical framework. The idea of delivering an emission price through a 'cap-and-trade' instrument, i.e. a regulated market, was initially formulated by Dales (1968) in his book *Markets in Pollution Rights*, for tackling pollution problems. Then, Montgomery (1972) introduced an emission cost function in the management settings of the firm, relating each level of emissions to its cost. The idea of emission trading gained traction, based on the belief that a TDP[4] system could help to achieve a better quality

[4] Transferable Discharge Permits

of air while at the same time using substantially less resources than classic instruments such as taxes[5].

Market-based instruments to control emissions remained the fantasy of academics and existed only in peer journals until the first concrete projects were set up in California in the mid-1970s. Between 1976 and the late 1980s, the attempts to implement market instruments were not particularly convincing; however, they did fuel further theoretical thoughts, which gave birth to a large normative literature (e.g. Hahn & Hester 1989; Tietenberg 1980; Hahn 1984a, Hahn 1984b) that focused on the optimal design[6] of environmental markets. From 1976 to 1979, different formulas such as netting, offsets, bubbles and banking were introduced and explored, principally by the EPA (Godard, 2000). In the early 1980s, the design features that optimize market efficiency were clearly identified, such as permit allocation (Hahn, 1984a), geographical scope, sectoral coverage, monitoring (Hahn, 1984b) and penalties.

In 1995, the EPA launched the first 'cap-and-trade' market instrument at a national level, which is often considered to be the direct ancestor of the EU-ETS (Damro & Mendez, 2003). It was a key development for carbon markets as policy instruments (Ellerman *et al.*, 2000).

Implementing a Second-best Instrument as a Consequence of Bargaining among Actors

Economists often highlight the gap between ideal 'cap-and-trade' systems as designed within economic theory and real carbon markets, as a consequence of bargaining among stakeholders.

From the Rio conference in 1992 to the Kyoto protocol in 1997, the debate among scholars crystallized on the selection of appropriate policy instruments. Some economic scholars argued that market-based instruments had the potential to achieve emissions reductions at lower cost than traditional command-and-control

[5] See for example Plott (C.), 1983, "Externalities and Corrective Policies in Experimental Markets," *Economic Journal*, Vol. 93, No. 369, pp. 106-127; Hahn (R.), 1983, "Designing Markets in Transferable Property Rights: A Practitioner's Guide." In Joeres, E. and M. David, eds., Buying a Better Environment: Cost Effective Regulation through Permit Trading. Madison: University of Wisconsin Press, 1983, 83-97;Tietenberg (T.), 1985, Emissions Trading: An Exercise in Reforming Pollution Policy. Washington, D.C.: Resources for the Future.

[6] Optimality laid on two criteria: economic efficiency (the minimizing of marginal costs), environmental efficiency (air quality restored to a given target)

.

instruments (Hahn, 1983; Plott, 1983; Tietenberg, 1985). Controversies remain about their ability to deliver the stable and predictable price of carbon that is necessary to provide long-term anticipations for ‘low carbon’ investments. This theoretical concern shaped the political debate, leaving policy makers with two main tasks: setting emission reduction goals, and selecting policy instruments to achieve them (Stavins, 1995). According to this story, both the implementation and design of the EU-ETS is a ‘second best’ policy instrument that resulted from the combination of three elements:

- First, the European Union unsuccessfully defended its position on “coordinated politics and measures” during the negotiation cycles, against the US “emissions trading” proposal promoted by US experts, OECD, AIE, (Braun, 2009), the US government (Hourcade, 2002), the Environmental Defense Fund (Dudeck & Leblanc, 1992) the US industry lobbies (Levy & Egan, 2003; Newell & Paterson, 1998) etc. An accumulation of misunderstandings and cultural ideological conditioning, reinforced by unclear negotiation strategies, distorted the debate and eventually led to an unexpected compromise: the Kyoto Protocol (Hourcade 2003). As a matter of fact, the EU ultimately accepted emissions trading as the price for securing US participation in the Kyoto Protocol (Cass, 2005).

- Second, the European Commission failed in its initiative to introduce a carbon energy tax at the domestic level. When the Commission proposed an EU-wide carbon energy tax in 1992, it mainly faced two opposing forces: the European principle ensuring the fiscal autonomy of member states (unanimity is required), and the pressure exerted by industry lobbies. This opposition led to the withdrawal of the carbon energy tax proposal in 1997 (Braun, 2009; Wettestad, 2005).

- Third, the design of the European carbon market was then bargained between stakeholders within the stakeholder meetings held by the European Commission in 2001.

The Untold Story of ‘Skunk Labs’

According to the story described above, the current design of the EU-ETS results from two activities: theory building on carbon markets and negotiating design parameters among stakeholders.

This axiomatic interpretation of what happens misses an important part of the story that is the collective sense-making that enabled to create knowledge and eventually to shape carbon markets (Braun, 2009). Such a collective sense-making involved experimental activities held in several distributed design spaces, characterized as laboratories and platforms (Muniesa and Callon, 2007). Such design spaces are ”located” at the frontier of multiple worlds and enable the circulation and materialization of concepts from one world to another. We know little about their organization and the way they support collective learning and concrete market practices.

One of these design spaces – which we called 'skunk lab' because its traces were erased for political reasons – was governed by the power sector and played a considerable role in the materialization of the EU-ETS. This design space was built around a specific instrument: the GETS (Greenhouse Gas and Electricity Trading Simulation), a collective experiment run by major electric suppliers in Europe within the Eurelectric industrial association. As we shall demonstrate, the GETS experiment played a key-role in organizing debates, enrolling new allies (including policy makers) and building collective expectations around carbon markets.

FROM A WORLD TO ANOTHER, EXPERIMENTATION DEVICES AS MEDIATING INSTRUMENTS

How the Notion of Performativity Opens a Space for reflection

The notion of performativity questions the relations between multiple constructed worlds – in particular, between the economy and economics (Callon, 2006). Ideas circulate; they are being transferred, reshaped, translated, materialised in these different worlds. Hand-crafted images such as models (algorithms, equations, physical models, , visions of the future (expectations, utopias, fictions) act as mediating instruments by linking actors and domains belonging to apparently separated worlds (Borup & al, 2006; Joly, 2010; MacKenzie & Millo, 2003; Miller & O'Leary, 2007; Nyberg & Wright, 2011).

Materiality is central in shaping the notion of performativity. The way scientific practices, technical instruments and experimentation produce objective reality has been explored within science anthropology (see e.g. Hacking, 1983; Galison, 1997). For instance, the intentional reorganization of sociotechnical arrangements to enable the performation of finance theory was explored in a pioneering study conducted by MacKenzie and Millo (MacKenzie and Millo, 2003; MacKenzie, 2003, 2006)

The Role of *in vitro* Experimentation: Laboratories and Platforms

Performation is a collective activity. It is a process within which socio-technical arrangements are being modified and redesigned to enable the existence and relevance of a new statement, concept, image, theory or model (Muniesa & Callon, 2008). The purposeful circulation of models from a world to another involves exploring and testing the conditions under which such images become true in the projected world; it involves a design activity. Building the vehicles of performation is a politic activity undertaken by purposeful actors through the recombination, reconfiguration, 'bricolage' and production of knowledge. Experimental activity plays a considerable role in this translation process (see e.g. Guala, 2007). Muniesa and Callon (2007) explore the notion of 'laboratories' and 'platforms' to refer to those spaces where experimental activities are led, at the junction between multiple worlds.

RESEARCH DESIGN: THE DYNAMICS OF KNOWLEDGE IN 'SKUNK LABS'

Drawing on the case study of the Greenhouse Gas and Electricity Trading Simulation (GETS) undertaken by Eurelectric from 1999 to 2001 we explore the dynamics of knowledge – its multiple sources, its construction through innovative experiments, and its bricolage – that supported the materialisation of carbon markets and its initial institutionalization within the EU-ETS. We describe the experimental activities that supported the conjoint process of design and performation of carbon markets through a double analytical framework. Using a design theory framework, we first map the knowledge dynamics and then we come back to the consequences of these knowledge dynamics on actors' relations.

Building on the GETS' case study, we then enrich the notion of experimental platform proposed by Muniesa and Callon (2007). The GETS' skun lab is indeed a good example of such an experimental configuration.

METHODOLOGY

Data Collection

We held a longitudinal qualitative case study analysis (Pettigrew, 1990). The data was collected during a two years in depth investigation, from December 2009 to December 2011.

The first interview with Jean-Yves Caneill, head of climate policy at Electricité de France (EDF), the European leader in the electricity sector, was held on Tuesday 15 December 2009 in Copenhagen at the 15th Conference of Parties on Climate Change. He filled us in with many details about how the European electricity sector historically engaged in the "backstage" of the construction process of the EU-ETS. He drew our attention to a point that appeared to be of major interest: before its institutionalization in 2003 the electricity sector had been designing a version of carbon markets that presented disturbing similarities with the pilot directive. This is how we came to acknowledge the existence of a wide subterranean knowledge building activity within the business sector.

Back home, we began investigating more the "GETS" case study. We held a set of 16 semi-directed interviews (Eisenhardt and Graebner, 2007) among the organisers and participants of the GETS. The primary data we used to cross back with the interviews are public archive documents (the GETS reports) as well as unpublished documents that relate to the experimentation and its evolution. We also had access to archive documents that relate the simulation and to the European Commission's stakeholder consultation summary reports.

Presentation of the Case Study

After Kyoto, the European electricity sector was facing three major challenges. First, it was difficult to imagine what carbon markets might look like and what would be the consequences of such mechanisms at the utility level. Second, the sector was facing fierce opposition regarding the desirability of a carbon market. Third, the recent Europe wide liberalization of the sector raised the problem of the compatibility of carbon trading with the new architecture the electricity market. From 1999 to 2001, Eurelectric[7] engaged in a wide collective experiment on *carbon trading*.

1997-1998. Gathering knowledge

In 1997, one member of Eurelectric organized a trip to the US to gather practical knowledge on emission trading from the utilities that were under the SO_2 scheme. They also met with members of the EPA that filled them in with some theoretical features and "learnings" regarding the SO_2 scheme.

[7] The Union of the electricity industry

1999. GETS 1: Designing a generic carbon market model

At the beginning of 1999, Eurelectric invited 'ParisBourse trading exchange' (an organization specialized in electronic trading for the Paris stock exchange) and the International Energy Agency to organize a sector wide simulation of carbon markets. The simulation was organized as follows:

"The simulation period lasted eight weeks, and covering the 2000-2012 time scale. Each week represented either one or two years of activity. Virtual companies could trade electricity and CO_2 once a week for two hours" (GETS1, 1999).

2000. GETS 2: Collective crafting on the generic model

Building on the feedbacks of GETS1, the second market model received a more sophisticated design. The generic model was made deliberately simple to enable fast learning. As we shall see further, the model used for the second simulation addressed the short comings of the generic model. It was also enriched by new actors entering the simulation that brought original knowledge on carbon trading. GETS 2 aimed at testing a more complex set of rules encompassing the investigation of diverse options for the European carbon market's architecture and justifying the selection of a particular one.

The management of the design space was re-organized. Six new industrial sectors[8] were invited to participate in three sets of simulations. "To enhance the results obtained, three successive simulations were organized (Gets2.1 in February/March, Gets2.2 in April, and Gets 2.3 in June), thus making it possible to test and/or improve various assumptions" (GETS 2, 2000). A Steering Committee was created to monitor the simulation and to 'theorize the output'; it included former organizers of GETS 1 and was chaired by the Eurelectric Working Group on Climate Change.

2001. Back to the Lab; Testing Parameters

A sensitivity analysis was held by Eurelectric in 2001 to test the effect of diverse parameters according to so-called economic efficiency criteria. For instance, multiple auctions formats, and their effects at both micro and macro levels were

[8] all of the sectors discussed in European Commission's green paper on greenhouse gas emissions trading

tested. This particular form of the GETS allowed the electricity sector to present new solid evidence to sustain their position.

Data Analysis: The Concept-Knowledge Theory Approach

Using design theory to model the emergence of the European Carbon market place

We aim at unveiling how this skunk lab has been a central design space (Hatchuel, Le Masson, & Weil, 2005) that gave birth to and shaped the European carbon market place. To model the series of interactions that led to build new knowledge on the matter and to explore different possible rules for managing and implementing a carbon market, we build on a framework provided by recent development in Concept-Knowledge design theory (C-K theory), which models design reasoning (Hatchuel & Weil, 2009; Le Masson, Weil, & Hatchuel, 2010; Shai, Reich, Hatchuel, & Subrahmanian, 2009). C-K design theory explains invention, creation, and discovery within a design framework and models creative reasoning. We propose to use this framework to model the different steps that led the GETS experimentation to shape the European carbon market place. We first present the structure of C-K theory and its principles. Then we explicit the three steps of the GETS experiment, that are (1) mapping the existing knowledge, (2) generating different conceptual models and the associate values and (3) converging on one design path.

C-K theory, framework and principles

The theory is based on several propositions that we present briefly; the proofs of these propositions are given in more detail in (Hatchuel & Weil, 2009).

C-K theory is a cognitive theory; it allows modeling the fundamental logic of innovation design reasoning. It is named « C-K theory » as its core proposition is the formal distinction between «Concepts » and « Knowledge ». C-K theory models the design process through interactions and expansions of the concept space (C-space) and the knowledge space (K-space). One space, defined as the Concept space (C-Space), is tree-structured and describes the progressive generation of alternatives, which are undecidable propositions, i.e. propositions that are ideas and not yet knowledge. The other space, defined as the Knowledge space (K space), is formed by the network of knowledge that is used for the generative process of the Concept space.

Using the principles of C-K design theory allow to model the creative process as the interrelated expansion of these two spaces. The C-space describes the stepwise exploration of 'desirable alternatives'. The list of attributes increases until the description of one of the potential design paths is so well defined that a 'conjunction' between the C-space and the K-space appears. A conjunction, i.e. a concept that develops into a piece of knowledge, can be then interpreted as 'a solution'. On the other hand, the knowledge involved in the process constitutes the K-space. C-K theory then sets the framework for a structured and manageable design process based on refining and expanding the initial concept by adding attributes stemming from the K-space or challenging it.

The development of C-K theory both offers good insights on how to reason in the unknown, and provides empirical guidelines on how to use those design formalisms to visualize design paths and design strategies (Hatchuel, Le Masson, & Weil, 2004). (Hatchuel & Weil, 2009) argue that C-K theory gives insights on how to fruitfully represent design reasoning, as interactions between the two spaces match the particular cognitive efforts that designers deploy during the design process.

Using a C-K diagram has been used in diverse cases to allow a representation of design reasoning (Gillier, Piat, Roussel, & Truchot, 2010; Hatchuel et al., 2004; Hooge, Agogué, & Gillier, 2012), either during and after the design process in order to support actors in the explanation of the design choices and the linkages between the concepts explored and the associated knowledge.

USING C-K THEORY TO MODEL THE STEPS OF THE GETS EXPERIMENTATION

We propose now to follow this line of work to model the GETS experimentation and unveil how this experimentation supported the design process of the European carbon market place.

Step 1: Mapping the existing knowledge: a first experimentation

This first step aimed at structuring and testing the existing knowledge. Using both models of existing emission trading schemes (in particular the US' SO_2 market) and economic theory, a generic carbon market model was designed. The GETS1 experiment was then conducted as follow:

Each player was provided with a virtual profile – energy mix and installed capacity – and an emission target (8% over the emissions of year 2000). A total of 16 Virtual companies had to comply with both national electricity demand and emission targets. To reach their objectives, they could choose between three options: electricity trading, carbon trading, and investing in clean technologies.

The market place for electricity and CO_2 was a trading platform, provided by Paris bourse.

This analysis of the existing solutions and the structuring of the available knowledge are therefore modeled with C-K theory as the explicitation of the relevant knowledge base regarding the existing design path (figure 1).

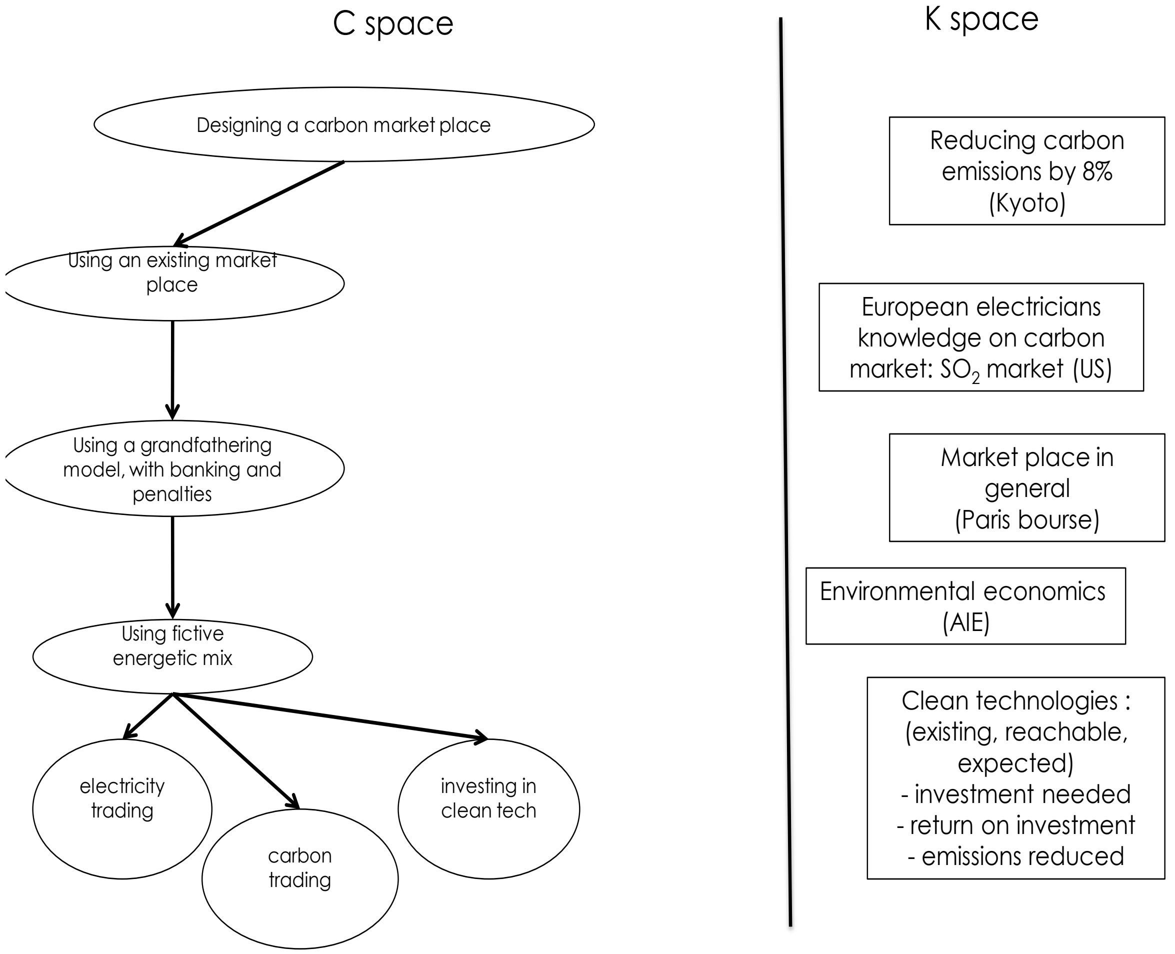

Figure 1 - C-K modeling of step 1, structuring the existing knowledge using a first experimentation to gather available expertise and to test existing market places

This first step led the European electricity sector to acquire and structure different types of knowledge.

First, GETS 1 produced knowledge regarding the impacts of carbon markets at the utility level. Rather than a constraint, carbon trading was now envisaged more as a "tool for compliance" (GETS1, 1999: p25). From a strategic point of view, the quick delivery of a carbon price signal by the market was seen as a crucial factor to elaborate a compliance strategy – i.e. clean tech investments vs. market strategies (GETS1, 1999: p1).

Second, GETS 1 provided interesting findings regarding the design of a carbon market and its rules. To elaborate long term strategies, companies relied a lot on the possibility of banking[9] allowances from one commitment period to the other. "In a sector like the power sector, the size of investment in new production is largely dependent on the chosen technology: investing in a new 300 MW combined-cycle gas turbine may deliver more low-emission generation than what the company needs to comply with its CO2 objective. Banking made it possible to benefit from these additional reductions, on top of the possibility to trade them immediately" (GETS1, 1999: p25). VCs relied also a lot on the grace period, so to say the possibility to buy or sell permits after the end of the commitment period. Such a grace period helps "handle the uncertainty related to normal business operations", that may affect compliance (GETS1, 1999: p26).

Third, GETS 1 revealed an unexpected property of carbon markets. As the emission objectives did not extend beyond 2012, companies had little or no incentive to build long term strategies. This leads companies to develop "uneconomic behaviors". The wall effect is then characterized by abnormal transactions, patterns and prices.

Step 2: Generating different conceptual models and the associate values

The second step aimed at exploring the diverse design paths for a new carbon market place, i.e. involving new actors and testing three different models (benchmark, auctions, grand fathering). Thus, the goal was to test diverse options for the European carbon market's architecture and to justify the selection of one particular model. The experimentation was therefore conducted not only in terms of testing economic theory but also to build the value criteria of each design path. This exploration of alternatives is modeled with C-K theory as the generation of new

[9] Banking means that the credits that are not used for compliance during a given period can be used for compliance the following period.

different design paths and as the acquisition of new knowledge to make sense of these design paths (figure 4).

To make the simulation more realistic and precise, the Steering Committee refined the mechanisms of the simulation: the platform enabled the trading of electricity both on spot and future markets; variations in primary energy prices were introduced; and carbon targets were defined beyond 2012.

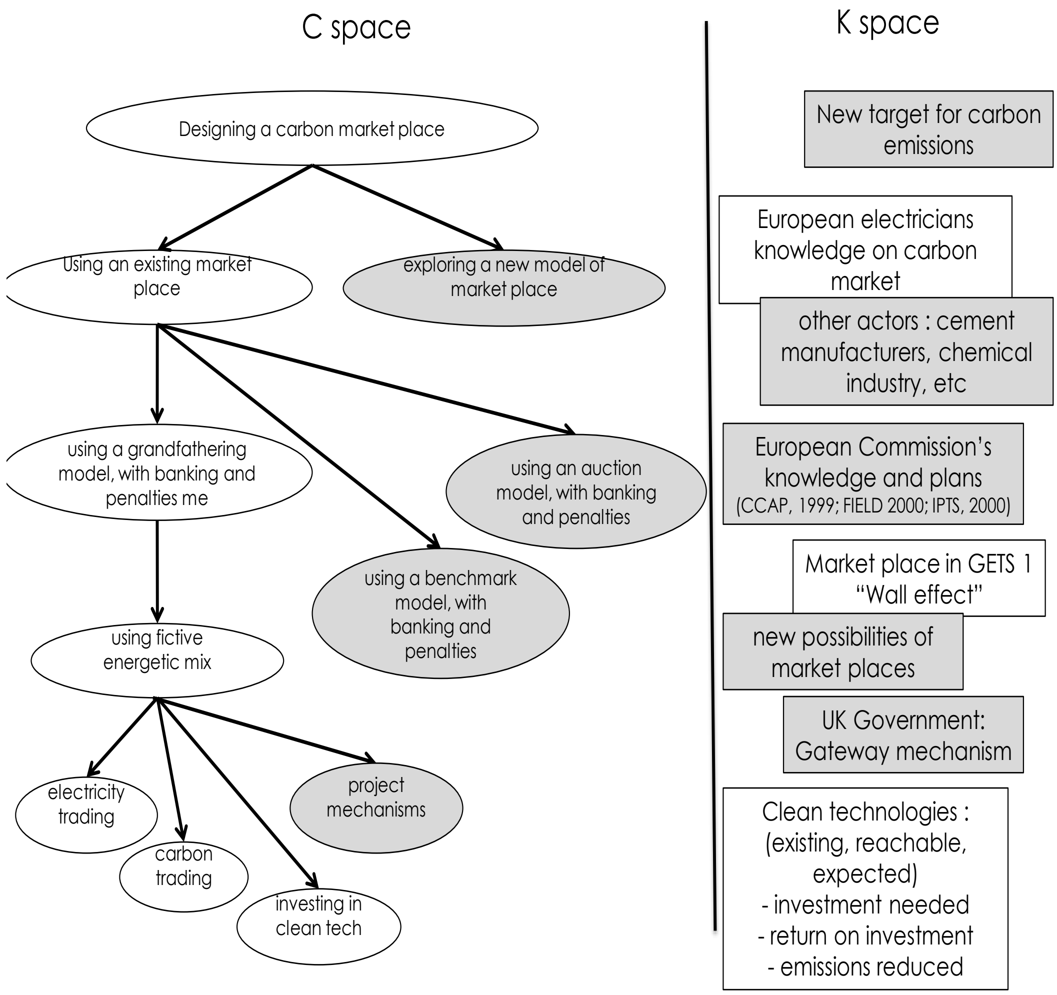

Figure 2- C-K modeling of step 2 – Different conceptual models for a European carbon market

This second step led to the exploration of different alternatives for a carbon market, and allowed to build value criteria in order to help decision-making to converge on a single path, and to select the more adequate model for a European carbon market.

Step 3 : Converging on a design path : the emergence of a new market place

The last step of the design process consisted in testing the model, i.e. converging from conceptual model to: clean tech, credit market, relocation of CO2 prod: hybridization of the European market with the global market.

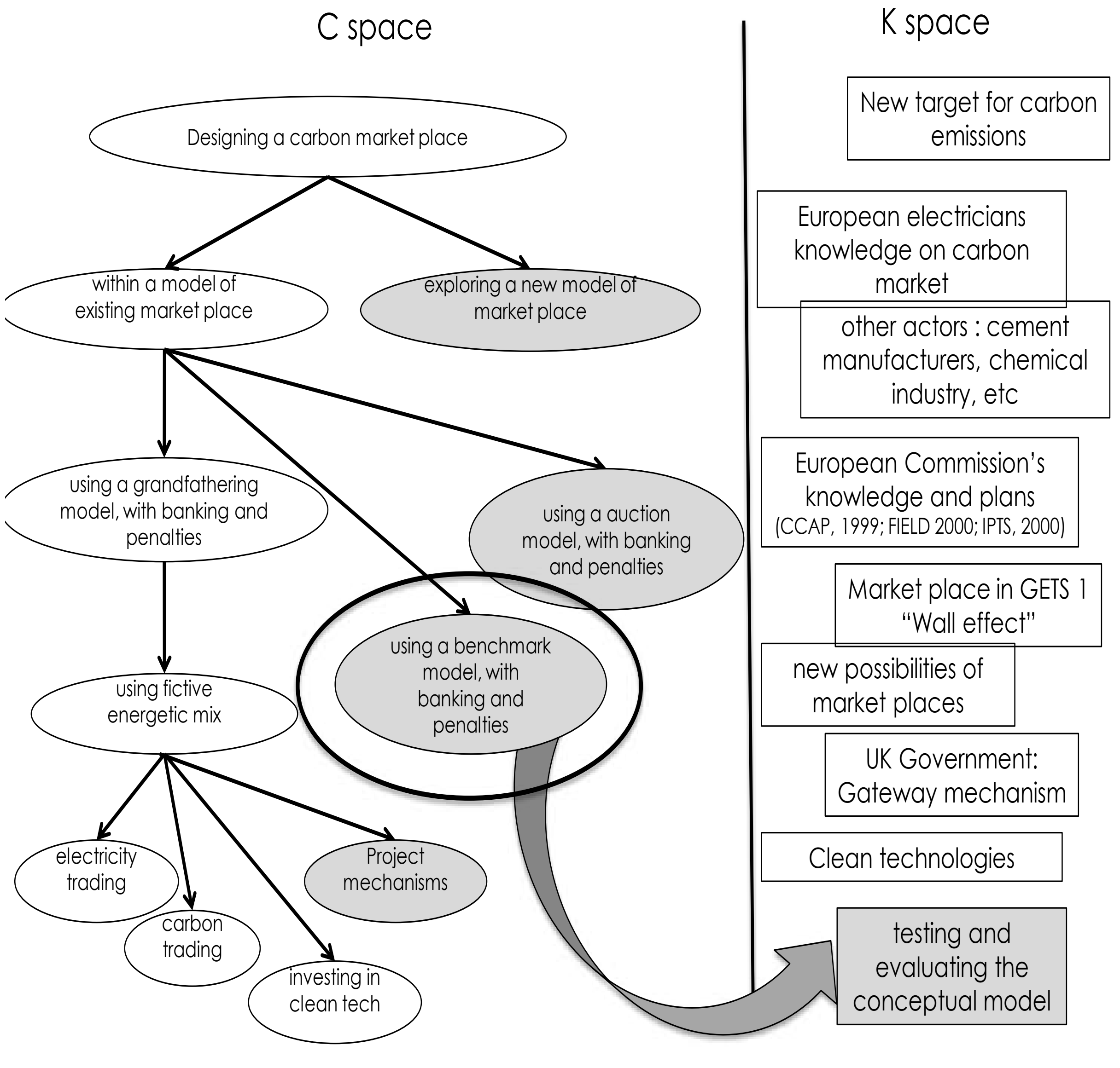

Figure 5- C-K modeling of step 3 – Converging on a design path

The modeling of the design process of the European carbon market with C-K theory allows us to understand the dynamics of knowledge and the exploration of different concepts for a carbon market.

THE EVOLUTION OF RELATIONS AMONG ACTORS IN LINE WITH THE GETS LEARNINGS

Before the GETS

In 1999, before the GETS began, the tax that the European Commission had been trying to introduce since 1992 as the corner stone of a European climate policy had failed (Braun, 2009). As one major reason, fierce lobbying from the industry sector undermined the Commission's efforts to introduce such a tax (Wettestad, 2005). Within the business sector, some members were reluctant to any form of constraint. In Germany, for example, the industry – and the power sector in particular – was working on voluntary agreements with the government and was mostly opposed to the idea of a mandatory scheme, whether it would be a tax or a market. Nevertheless, in other countries such as Denmark and the UK, the power sector had gathered in favor of an ETS and launched trials to put in place ETS pilots at the state level (Braun, 2009).

GETS 1: how it provided a common strategy for the European power sector

At the Power sector Level

As we show in the previous section, GETS1 provided Eurelectric with a basic practical understanding of the state of knowledge on carbon markets. Both Jean-Yves Caneill and John Scowcroft emphasize the role that GETS 1 played at switching visions within the power sector. The experiment made it clear for the sector that a market was much more desirable than a tax if a mandatory regulation was to come up: "The simulation clearly showed that trading could help participants to best manage their CO_2 emission objective together with their core activity" (GETS1, p25). The only actor that was still reluctant after GETS1 was the German power sector that saw the rise of carbon markets as a threat against the voluntary agreements it had been working on hardly (Wettestad, 2005). Nevertheless, at the end of GETS1, a consensus was reached among the power sector: a market was definitely more desirable than a tax, and further exploration of what such a market could be was of primary importance.

At the Regional Level

The presentation of this first experiment at COP 5[10] in Bonn in 1999 was well received and helped establishing a constructive dialogue with the European Commission (Caneill, 2011). This dialogue helped Eurelectric build the second GETS

[10] Fifth Meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change

rules consistently with the vision the EU had been developing: “[…] with the input of the European Commission, acceptable and effective rules have been defined for both, permits allocation and reporting procedures” (GETS 2, 2000).

GETS 2: how it enabled the construction of collective expectations

During the experiment

In GETS2, some other members of the industry (the sectors that were to be introduced in the Green Paper) were invited to participate to the simulation. The exploration of various alternatives within the C-space enabled new forms of collaboration among actors in the industry. The exploration status of the experiment proved fertile to collectively test alternatives and debate them. For example, when the Italian industry asked for the implementation of DSM project, it raised concerned among the members that it would cause double counting issues. The status of the experimentation nevertheless enabled to collectively test, assess and reject this alternative. In line with the model they had been working on with their government, the UK power plants asked for a gateway that would enable the coexistence of both relative and absolute targets. The value of this proposition was also assessed by the market test. Eventually, very few actors used intensity targets and the results were not convincing. GETS 2 provided the industry with a collective expectation: a price of carbon that would be clear and “right” is needed to induce private compliance strategies. At the end of GETS 2, the actors had converged on a model for the carbon market, which is the one of GETS 2.2, and a “conjunction” was made.

During the stakeholder meetings

The stakeholder consultation, organized by the European Commission, supported “an intense process of collective sense making” (Peter Zapfel, 2011). It is important to notice that GETS is not the only experiment that fueled the stakeholder meetings. According to Peter Zapfel, BP and the UK government were being particularly constructive and transparent in their contributions to the consultation. Eurelectric presented the findings of GETS 2 as “political weapons” within the stakeholders’ consultation” (Scowcroft, 2010). The “solution” also provided a basis for further elaboration within the different working groups, as a common language regarding this model was made possible thanks to the collective exploration.

Within the international negotiation process

The Commission invited Eurelectric to present the results of GETS2 as an official European Side event at COP 6 in The Hague in december 2000. “I remember the European Commission’s room was full of people. The presentation of GETS 2 was attended as one of the most important side events of the Conference” (Caneill, 2010). This presentation of the first carbon market pilots in front of the international community by Eurelectric was not neutral. It supported the collective learning process that was taking place around carbon markets.

CONCLUSION AND DISCUSSION: THE ROLE OF EXPERIMENTAL PLATFORMS

Using the C-K theory formalism (Hatchuel & Weil, 2009), we attempted to restore the complexity of the design activity that supported the performation of carbon markets. The nature of the design of the GETS device – collective crafting – enabled to structure common interests among the power sector, the industry and then, the main stakeholders. The creation of shared interests through collective design is key to understand the performation of carbon markets.

Experimentation plays a crucial role in the conjoint process of designing and performing carbon markets. Here, economic experimentation consists in constructing an economic object and comparing the values associated to its different forms. Such experiments take place in concrete design spaces that have been classified in three categories by Muniesa and Callon (2007). According to this classification, laboratories refer to confined spaces which access is restricted to a few actors. There is a physical separation between the outside and the inside. Economic objects have to be transferred from the real world to the laboratory world to be studied. In contrast, in vivo experimentation breaks this distinction between the inside and the outside as the experimentation site is the real economy. The list of actors that might be involved is not defined a priori and is likely to evolve during the experiment. The design space the GETS experiment took place in seem to look like what Muniesa and Callon (2007) name platform. The platform configuration refers to a space that is more open than the laboratory and enables the participation of a great variety of actors. These actors that are defined by the platform manager and constitute a community of knowledge (Gets2, 2000) are likely to evolve along the experimentation process.

Whereas *in vivo* experiments and laboratories have already received considerable attention by scholars, experimental platforms are still under described. An industrial platform is described in the literature as a modular architecture of relations, structured around a "core" (Gawer and Cusumano, 2002; Hatchuel, Lemasson and Weil, 2010). Such a core can be either a product as a car or a camera, or a component, as a microprocessor in the case of Intel and the high tech industry described by Gawer and Cusumano (2002). According to Ciborra (1996), a platform is a meta-organization which structure can take any form, from the matrix to the network. In this representation, a platform is a confused organization which strength lies in its ability to generate quickly any type of organizational structure – by reordering people and resources – to adapt to a changing context.

Building on this previous work and on what we observed with the GETS, we can propose a first characterization of experimental platforms.

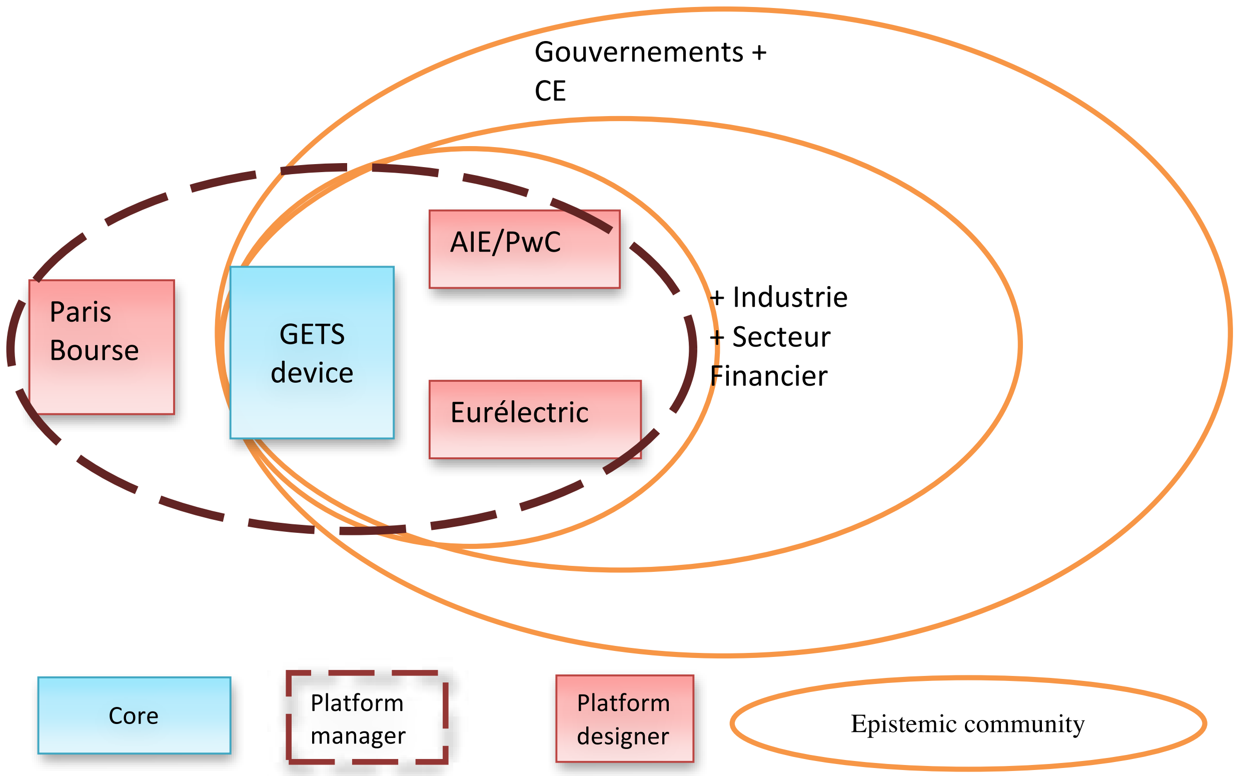

Figure 4- The GETS experimental platform

Experimental Platforms are design spaces that support collaborative relations between an evolving set of actors. They are organized around an instrumental core – here, the Gets device – that is being permanently experimented on and redesigned by the community of knowledge. Such a configuration enables the hybridization of different sources and forms of knowledge. It also supports the confrontation of individual interests and the construction of a collective project. Experimental platforms are design spaces where knowledge can be shared, built and managed by epistemic communities (Amin and Cohendet, 2004). In the context of climate change, or sustainable development in general, knowledge on both scientific issues and regulatory frameworks is particularly distributed among a wide variety of actors. It is lacunar and often contradictory (Adant, Godard et Hommel, 2005). In such conditions, the construction of collective knowledge as a common good is essential to support the construction of institutional and innovation fields. They call for further description and analysis. Their design and their management are key variables that need to be addressed in order to better design sustainable development frameworks.

REFERENCES

Adant, I., Godard, O., Hommel, T. 2005. Expertise scientifique et gestion de la contestabilité sociale en présence d'acteurs à visées stratégiques. Cahiers de Recherche n°5 Ecole Polytechnique.

Aggeri, F., & Labatut, J. 2011. Looking at management through its instruments. A genealogical analysis of instrument-based approaches***, CGS working paper series,*** 2011-01.

Amin, A., & P. Cohendet. 2004. *Architectures of Knowledge: Firms, Capabilities, and Communities.* Oxford: Oxford University Press.

Braun, M. 2009. The evolution of emissions trading in the European Union –The role of policy networks, knowledge and policy entrepreneurs. ***Accounting, Organizations and Society****.* 34: 469–487

Borup, M., Brown, N., Konrad, K. & Van Lente, H. 2006. The sociology of expectations in science and technology. ***Technology Analysis & Strategic Management.*** 18(3/4) : 285–298.

Callon, M. 2003. Laboratoires, réseaux et collectifs de recherche. In Mustar, P. & Penan, H. (Eds), ***Encyclopédie de l'Innovation*** : 693-722. Paris, Economica.

Callon, M. 2006. La performativité de l'économie. ***Le libellio d'AEGIS***. Propos recueillis par Hervé Dumez.

Callon, M. 2009. Civilizing markets: Carbon trading between in vitro and in vivo experiments. ***Accounting, Organizations and Society***. 34(3-4) : 535-548

Cass, L. 2005. "Norm entrapment and preference change: The evolution of the European union position on international emissions trading", ***Global Environmental Politics*** 5(2): 38-60. The MIT Press.

Ciborra, C.U. 1996. The platform organization: Recombining Strategies, structures, and surprises. ***Organization Science*** 7(2): 103 – 118.

Coase, R. 1960. The problem of social cost. ***Journal of Law and Economics*** 3(1): 1–44.

Crocker, T.D. 1966. The structuring of atmospheric pollution control systems. In Wolozin, H. (ed.) ***The economics of air pollution***. 61-86 New-York, WW Norton

Dales, J.H. 1968. ***Pollution, property and prices***. Toronto University of Toronto Press.

Damro, C. & Mendes, P. 2003. Emissions trading at Kyoto: from EU resistance to Union innovation, ***Environmental Politics***, 12(2): 71-94.

Ellerman, D., Convery, F.J., de Perthuis, C. 2010. **Pricing Carbon. The European Emission Trading Scheme**. Cambridge

Dumez, H. & Jeunemaître, A. 2010. Quand l'économie échoue à être performative. In Akrich, M., Barthe, Y., Muniesa, F. & Mustar, P. (Eds) ***Débordements. Mélanges offerts à Michel Callon*** (pp. 129-141), Presse des Mines.

Galison, P. 1997. ***Image and logic: a material culture of microphysics***. University of Chicago Press.

Gawer, A., & Cusumano, M.A. 2002. Platform leadership: How Intel, icrosoft and Cisco drive industry innovation. Harvard Business School Press.

Guala, F. 2007. How to do things with experimental economics? In D. McKenzie, F. Muniesa, & L Siu (Eds.), ***Do economists make markets? On the performativity of economics****:* 128-162. Princeton University Press.

Hacking, I. 1983.***Representing and intervening : introductory topics in the philosophy of natural science***. Cambrige University press.

Hahn, R. 1984. Market Power and Transferable Property Rights. ***The Quarterly Journal of Economics***, Vol. 99, No. 4, pp. 753-765

Hahn, R., Hester, G. 1989. Marketable Permits: Lessons for Theory and Practice. ***Ecology Law Quarterly***, 16: 361-406.

Hatchuel, A., & Weil, B. (2009). C-K design theory: An advanced formulation. *Research in Engineering Design*, *19*, 181-192.

Hatchuel, A., Le Masson, P., & Weil, B. (2004). C-K Theory in Practice: Lessons from Industrial Applications. In D. Marjanovic (Ed.), *8th International Design Conference* Vol 1: 245-257. Dubrovnik, 18th-21st May 2004.

Hatchuel, A., Le Masson, P., & Weil, B. (2005). The Development of Science-Based Products: Managing by Design Spaces. ***Creativity and Innovation Management***, 14(4): 345-354.

Hatchuel, A., Le Masson, P., & Weil, B. (2010). Platforms for the design of platforms: Collaborating in the unknown. In, A. Gawer, (Ed) ***Platforms, Market and Innovation***: 274 – 315.

Hourcade, J-C. 2002. Dans le labyrinthe de verre: la négociation sur l'effet de serre, Critique internationale No.15

Joly, P.B. 2010. On the economics of techno-scientific promises. In Ackrich,M., Barthes, Y., Muniesa, F., M. Mustar, P. (Eds) ***Débordements, Mélanges offerts à Michel Callon***: 203-221.

Le Masson, P., Weil, B., & Hatchuel, A. (2010). *Strategic Management of Design and Innovation*. Cambridge: Cambridge University Press.

MacKenzie, D. & Millo, Y. 2003. Constructing a market, Performing theory: The historical sociology of a financial derivatives exchange. American Journal of Sociology 109(1): 107-145.

MacKenzie, D. 2003. An equation and its worlds: Bricolage, exemplars, disunity and performativity in financial economics. ***Social Studies of Science***. 33(6): 831-868.

MacKenzie, D. 2006. ***An engine, not a camera: How financial models shape markets***. Cambridge, MIT Press.

Miller, P. & O'Leary, T. 2007. Mediating instruments and making markets: Capital budgeting, science and the economy. ***Accounting, Organizations and Society***, vol. 32, n° 7-8, p. 701-734.

Muniesa, F. & Callon, M. 2007. Economic Experiments and the Construction of Markets. In D. McKenzie, F. Muniesa, & L Siu (Eds.), ***Do economists make***

***markets? On the performativity of economics**: 163-189. Princeton University Press.*

Muniesa, F. & Callon, M. 2008. La performativité des sciences économiques. ***CSI Working Papers Series***.

Montgommery, W. 1972. Markets in licenses and efficient pollution control program. ***Journal of Economic Theory***, 5: 395-418.

Nyberg, D. & Wright, C. 2011. Prevention, pre-emption and preparedness : Corporate responses to climate change as a logic of risk. ***Ashridge International Research Conference** - "The Sustainability Challenge: Organisational Change and Transformational Vision"*. Ashridge, United Kingdom.

Peters, T.J. 1997. A Skunk work tale. In Katz R. (1997): ***The human side of managing innovation***: 347-355. Oxford University Press.

Tietenberg, T. 1980. Transferable Discharge Permits and the Control of Stationary Source Air Pollution: A Survey and Synthesis. ***Land Economics*** 56(4): 391-416.

Shai, O., Reich, Y., Hatchuel, A., & Subrahmanian, E. (2009). Creativity Theories and Scientific Discovery: a Study of C-K Theory and Infused Design. *International Conference on Engineering Design, ICED'09*. 24-27 August 2009, Stanford CA.

Wettestad, J. 2005. The making of the 2003 EU Emissions Trading Directive: An ultra-quick process due to entrepreneurial proficiency? ***Global Environmental Politics*** 5:1.

List of nterviews

Caneill, J.Y. 2011. Interview