CREATING INCENTIVES FOR TECHNOLOGICAL CHANGE: INNOVATION MANAGEMENT AND THE EU REGULATION OF ENERGY EFFICIENCY

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Abstract: *Technological innovations and change in highly regulated sectors such as the energy sector depend on decisions made by political actors in what is called a 'joint decision system'. Such systems comprise divergently constituted actors, varying from electoral bodies to expert committees to industry representatives. The problem with decisions made in joint decisions system is that they depend more often than not on the unilateral agreement between all the participant is the decisions. The presence of veto players in areas of divergent interests creates a 'joint decision trap': situation where suboptimal decisions are taken. This explains why even in areas such as energy efficiency where preferences among decision makers do not vary so much as in other areas, the EU regulation, creating incentives for technological change develops rather slow.*

Introduction

Energy efficiency has a key place among the measures of the EU energy policy . Higher energy efficiency means more competitive European economy, greater energy security and less impact on the environment. Energy efficiency plays a key part of the EU 20-20-20 by 2020 Action Plan that provides for the reduction of greenhouse gas emissions by 20 % compared to 1990, 20% share of renewables in energy consumption and 20 % reduction in primary energy consumption achieved by increasing energy efficiency. The policy has the following components:

- The establishment of minimum standards for „eco-design" of the 19 groups of products (Directive 2005/32/EC);
- The establishment of standards for energy efficiency of buildings (Directive 2002/91/EC and 2010/31/EU)
- The establishment of standards in the industry and transport (Directive 1994/94/EC, Directive 1999/94/EC).

In October 2006, the Commission adopted an Action Plan for Energy Efficiency, which was operational for a period of 6 years: from 2007 to 2012 (COM (2006) 545). Its purpose was to set in motion the process to achieve the 20 % reduction in energy consumption, as this identifies six priority areas:

- Requirement for dynamic energy consumption of products, buildings and services;
- Energy Conversion;
- Transport;
- Funding , economic incentives and pricing;
- Energy efficient and energy saving behavior of energy consumers ;
- International cooperation.

Directives 2009/125/EC and 2010/30/EU further amended Directive 2005/32/EC establishing requirements for ecodesign for energy-related products and standards for labeling and product information concerning energy consumption. Finally, in October 2012, the EU adopted the Directive 2012/27/EU on energy efficiency which creates binding measures for energy efficiency in the public sector including energy audits, policy roadmaps, targets for renovation and energy efficiency in buildings, incentives for investments in heating, insulation and general energy neutrality.

Regulatory frameworks for technological change

a. Technology and sociotechnical change

Viewing technology as activities through which resources are transformed into output (Perrow 1970) is convenient if we wish to think about actors in the energy sector trying to optimize their performance in the settings of the regulatory regime. Energy producers decrease cost by investment in new generation technologies and buying cheapest energy resources. Industry wants cheap energy for greater competitiveness. Policy actors try to enact efficient rules to increase support and stay in power.

Users of technology and their environment create stable interdependencies distinguished as 'sociotechnical systems'. In sociotechnical systems technology becomes a symbol, an important part of the material landscape (Lemonnier 1993). It becomes part of everyday life and important asset to the community. Thus we see the energy plants and wind turbine plants, for example, as important landmarks all over the world.

Sociotechnical systems underline the importance of technology and technological change. Technology is vital to societies' transformations. In Lewis Mumford's view, it is not an external driver of these transformations, but an integral part of them (Mumford 1967). Current world challenges such as climate change, depletion and increasing costs of petrol, energy prices and the security of energy supply are all intrinsically linked to technology. The technologies of the industrial revolution used coal to supply energy to the industry; burning fossil fuels led to the ever increasing of carbon dioxide and other greenhouse emissions in the atmosphere. Now, technology is viewed as the key factor in the mitigation of climate change impact on the planet and provision of cheap, reliable and secure energy.

Energy efficiency stays at the center of the global energy issues. First, it helps fight global warming by emitting less greenhouse gasses. Second, it adds to the competitiveness of the economy by decreasing the amount of energy consumed for a unit of production. Third, it limits the dependence on energy imports thus increasing economic and political freedom. Therefore, energy efficiency technologies are important in the same sense as the steam engine, the locomotive, the automobile, the computer: they are a key to a transformation of the whole sociotechnical system.

b. Technological and policy regimes

Sociotechnical systems operate within the rules and institutions of the society. These rules constrain human behavior, shape interactions between economic and policy actors, reduce uncertainty and create incentives for development and growth (North 1990). Within the institutional settings the sociotechnical systems create stable forms of interactions defined as 'technological regimes' (Kemp et al. 1994). Technological regimes define the rules, standards and practices of production processes, industry standards for the use of technology and development of innovations. The 'efficiency' of the regime: the way incentives are embedded in rules and practices, determines the quality and quantity of the innovations that are created and adopted in the society. Thus, it is important that these regimes are 'efficient' enough so that they contain enough incentives for creation and adoption of innovations.

Policy regimes, on the other hand, consist of formal and informal networks of interdependent policy actors negotiating and agreeing on decisions, often in forms of 'package deals' which include several different issues at once so that deals and concessions are more easily made. In such regimes (the European council is a prime example) bargaining power and the level of conflict often determine the outcome of the negotiations and the form and matter of the decisions made. Thus, as with technological regimes, the 'efficiency of the policy regime is important for the outcome of the bargaining, decisions and outcomes for both policies and technology.

The most important feature of these regimes is the self-interest of the parties involved. Industries and policy actors operate in competitive environment where the rules of economic and political markets dictate what actions are feasible and what not for survival and growth. Thus participation in technological and policy regimes is voluntary and any actor may choose to exit and act unilaterally if his self-interest dictates so. Violations of industry standards and norms of political behavior occur often even within the highly developed setting of the western world. Globalization creates even more pressure for violation of the rules and standards as industries' exit options are ever more cheap and available.

Good example for such pressures is the carbon leakage: the incentives for the industry to move production away from strict regulation on emissions and energy use to places where energy is cheap and regulation is not so strict. Carbon leakage not only negates the efforts for emission reductions, it creates a state of affairs where old technologies are still used for the benefit of lower cost even if they are harmful for the environment and may lead to unwanted economic and social consequences in the countries the industry is move from. Thus the creation of an 'efficient' incentives structure within technological regimes that lead to creation, adoption and diffusion of technology is important for solving problems, development and growth.

Innovation management as a cooperative game

Can the interaction between industry and policy actors be represented using the analytic tools of game theory? When participants in a decision making system take their decisions sequentially the interaction between them can be represented as a continuous game. Its analysis, then, requires finding Nash equilibria for each sub- game and will be complicated if, for each sub- game to more than one such equilibrium. The biggest problem of this analysis, however, would be to ignore the specific circumstances of the players in the representation of energy policy which not only interact with each other but also have some control over the environment in which they interact.

Possibility of recurrence of the interactions and subsequent changes in the behavior of the players could in principle lead to an efficient result in games such as prison dilemma and , indeed, of all collective dilemmas. The Folk theorem (Folk Theorem) gives an evidence of such cooperative behavior, although this has not been formally proven. What changes the behavior of the players furthermore, is the possibility of "intelligent design" of the institutional setting in the a series of interactions take place. If the political actors are involved in a non-cooperative game, they would have the opportunity through 'mechanism design' to coordinate their actions towards achieving a collective goal (Hurwicz 1973). Such coordination is a game in itself, and different strategies are themselves rules by which the game is played at least one of the participants in the game. Allocation of limited resources is a typical example of mechanism design and the tendering - for example for telecommunication frequencies (Binmore, Klemperer, 2002) . The problem with this conceptual possibility , however, is the inability for the individual preferences to be ordered as a meaningful group preferences as shown by the Arrow's impossibility theorem (Arrow 1951). Thus, for various classes of interactions - from elections to markets - the aggregation of the preferences of the participants is not a realistic outcome.

But what can be said if the participants in a game can form coalitions? First, the negotiation process is usually accompanied by transaction costs, which are the greater, the more different are the preferences of the participants. They can be minimized, however, if the negotiators reach preliminary agreements on the implementation of commitments and of the production and the distributive dimensions of the agreement (Scharpf 1997 , 117-119) . In the first case, this means that the participants have to fulfill their obligations even if their failure to do so do not incur direct loss for them (for example, if the benefits to a participant does not depend directly on its contribution) . In the second, it means an acceptable distribution of costs and benefits of the agreement. What immediately stands out here is the fact that the institutional environment is the key to how the players will address these problems. If the institutional environment has the means to enforce the sanctions for any breach of the agreement, this could deter a self-interested player who wishes to unilaterally escape from fulfilling the obligation. In addition, there may be mechanisms to compensate those affected by a decision or possibly negotiation process include package deals whose elements are meant to offset the high cost absorbed in a particular sphere. In such a situation, an agreement between the political actors with different preferences is possible . But the provision of such institutional capacity in the first place is a legitimate goal for the participants in the negotiation process, or at least some of them.

Going back to the energy efficiency regulation and taking into account the above considerations, we can see how the creation of the institutional regime reflects the desire to achieve a 'mechanism design' to ensure achievement of the desired collective objectives: cheap and secure energy and economic prosperity. In addition , it could be said that the regulatory regime reflects the specific preferences of the leading Member States - France and Germany (Garett 1992). Establishment of the internal market, launched in mid 80s of last century occurs in the shadow of the collective need to increase economic growth. This led to the increase of the role of the Commission which was authorized to monitor compliance with rules of the internal market.

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One important note is in order here. Intentional mechanism design does not fully reflect the historical development of the regulatory regime because in practice the creation of the common energy policy did not fully reflect the preferences of the Member States that participate in it. This development is a rather unexpected consequence of the construction of the 'mechanism' of the Internal market of the EU, because it is through this mechanism that building the overall energy market began. So perhaps to illustrate this process the more flexible metaphor 'intelligent design' is in order, which in this context simply illustrates a particular institutional environment for the status, the rights and obligations for the participants in a given regime, and from the moment of its creation it began to live its own life and form its own look.

Conclusion

Technological innovations and change in highly regulated sectors such as the energy sector depend on decisions made by political actors in what is called a 'joint decision system'. Such systems comprise divergently constituted actors, varying from electoral bodies to expert committees to industry representatives. When such actors join in finding a cooperative solution for common problems? The above analysis shows that some preconditions are important. First, there must be serious problems that affect all participants. Second, the institutional setting in which interaction take place and regulatory regimes are created must favor cooperative solutions. Thus, there must be incentives for cooperative behavior even before the bargaining begins. Third, the self-interest of the economic and political actors must be compatible enough so that the negotiations would not break up easily.

In the case of the energy efficiency regulation all three conditions are in order, thus setting the stage for the creation of incentives for energy savings and more efficient generation, transmission and distribution of energy. Energy saving technology now is a familiar sight in world landscape with house insulation, energy use labels, energy saving light and heating devices all over. Such change could not occur if all decision makers: from industry giants to single households were left to their own devices. It happened through the process of intentional creation of incentives by economic and policy actors involved in cooperative bargaining that can be represented as

a cooperative game. This game, furthermore, could not yield an efficient solution without the favorable institutional setting of the European Union, where the Commission acts as agenda setter and the European court – as guardian of the agreements.

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