Markets vs. regulation: A role for indicative energy planning

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When there is no vision, people perish (Proverbs, 29:18)

Abstract

The energy sector worldwide is facing the enormous challenge of finding a path of economic, environmental, and social sustainability. This paper argues that, although markets are adequate instruments to achieve an efficient allocation of resources and to promote private initiative, the resolution of the sustainability challenge cannot be left only to market forces, but requires other complementary instruments, among which we highlight indicative energy planning. We discuss the role of indicative energy planning in the future of liberalized energy markets, and propose a general methodology for its implementation, as well as the identification of the major issues to be addressed.

1 Introduction

It is a great satisfaction for the authors of this paper to participate in this special issue of the Energy Journal in honor of David Newbery, since he has been a source of knowledge and inspiration for many of our activities as professionals in the energy sector. The relationship of the first author of the paper with David dates from almost 15 years ago, at the time where novel regulatory approaches to electricity regulation were discussed in numerous forums and Professor Newbery's insights and sharp analysis were deeply illuminating and influential. David's curiosity and interest in any regulatory problem were contagious. Luckily this frequent interaction and the participation in the activities of the Cambridge MIT Institute and David's Electricity Policy Research Group developed into a long lasting friendship. We particularly appreciate David's contribution to the activities that we have organized in the context of the Madrid Forum on Energy and Sustainability, where his presence and interventions have meant so much to the success of the meetings. When writing this paper we have thought many times of striking the right balance between competitive markets and regulatory intervention, private initiative and indicative or even mandatory planning and what David would think of our proposal. We hope he approves it.

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The major concern of public authorities dealing with the energy sector in Europe, which may very well reflect the general interest, can be summarized as achieving a reasonably reliable energy supply at an affordable price, and with an acceptable environmental impact, over the long term.

In practice, however, both legislation and regulators have focused primarily on the reliability and efficiency of the energy system in the short term. This paper argues that, although reliability and short-term prices are legitimate concerns, a comprehensive approach to the energy problem should not be limited to a short-term and local perspective. A realistic and thoughtful approach to the energy issue also has to consider the reliability of supply for future generations, has to be aware of the consequences of the environmental impact of energy production and consumption, and must realize that a third of the world population lacks electricity or any other advanced energy supply. This paper also argues that, although the market is an adequate instrument to achieve an efficient allocation of resources and to promote private initiative, the resolution of the serious issues above mentioned cannot be left just to market forces, because of practical, political-economy shortcomings of the classic instruments when addressing market failures or behavioral issues, and therefore requires other complementary instruments, among which indicative energy planning should be highlighted. This is not a new idea, but our understanding is that, as we will argue, its role will grow more relevant in the future electricity sector.

1.1 An unsustainable energy model

Several studies, using different approaches, and from different perspectives, carried out by reliable institutions (IEA, 2007; UNDP, 2000; IPCC, 2007) share the conclusion that the current world energy model – and particularly the one of developed countries – is unsustainable in economic, social and environmental terms. It does not seem possible, with the current energy model, to satisfy the energy needs of the world population in a way compatible with the current economic growth rate, equality in access to energy, or an acceptable environmental impact. There is a broad consensus on the sustainability challenges of the current energy model, and on the general strategies required to face these challenges. The major problems of the current energy model are:

- Access to modern energy services in a continued manner with affordable prices is an essential requisite for the maintenance and development of our civilization. Its absence condemns people to underdevelopment.
- Economic development is still excessively coupled to growth in energy demand, with a reduced level of use of the existing potential for energy efficiency and savings.
- The massive use of fossil fuels for energy is the major source of anthropogenic greenhouse gases, whose strong and sustained increase is a major driver of climate change, with potentially adverse economic, social and environmental effects.
- The growing dependence on energy imports threatens security of supply in Europe. This is added to the uncertainty over the availability of long-lasting, reliable and cheap energy resources.

The complexity of, and mutual inter-relationships among, these problems shows the impossibility of carrying out a long-term analysis of the energy sector in Europe without jointly accounting for all of them, from a global perspective.

2 The need for indicative planning

2.1 The limitations of energy markets

Europe, as well as many other regions of the world, has experienced a restructuring and liberalization process of its energy sector, the outcome of which is a market-oriented model, to a large extent opposed to the previous paradigm of vertically-integrated companies and central energy planning.

The advantages of markets – when the appropriate conditions hold – for the efficient allocation of resources are well known. Indeed, some of the energy activities and sectors seem well suited for markets. And now that a reasonable time has passed since most reforms were implemented, well-grounded opinions can be formed about their success or failure. We may summarize them by stating that energy markets have been successful when the sector structure was the right one, and when they have been allowed to work without interferences. However, reality has shown that the design, implementation and monitoring of markets are much more complex tasks than initially envisaged (Sioshansi, 2006).

The histories of successes – quite limited in fact – should not make us forget the diversity of failures in the implementation of energy markets, whose implications are amplified at the present time, when energy has become a critical matter. While the regulatory trend during the last two decades has been towards a stronger presence of energy markets, the capability of markets to face some of the major future regulatory challenges is now subject to close scrutiny. The debate about the limitation of energy markets is multifold:

- First, we need to distinguish between generation and retailing activities – well suited to a competitive setting – and those related to the transmission and distribution of electricity in networks, which have natural monopoly features and where competition may only be introduced marginally (through incentives to improve the performance of firms or the quality of service). The failure of the proposed USA Standard Market Design in this respect, and the very few electricity lines that have been built worldwide under merchant conditions, are notorious.

- Within the energy sector – electricity generation in particular – the debate which has resulted in more controversy and publications concerns whether the market model suffices to provide an adequate level of investment for a reliable supply or not. Should it be left entirely to the market to decide the investment levels in production infrastructure, or should the regulator intervene to guarantee a satisfactory level of security of supply? In addition to adequacy of generation investment, the regulator may also intervene in prescribing the security level of operating margins or in establishing incentives to enhance the availability of existing generation capacity.

- Markets have difficulties in taking into consideration uncertain future events such as the long-term availability of energy resources – both concerning their eventual depletion, price and reliability of supply – as well as the implications for the energy dependency level of any considered region of the diversification of its energy sources. This is mostly due to the well known fact that complete markets for all contingencies in all future periods do not exist (Arrow, 1986) and therefore there is a need to correct this market failure by some means. The issue of concern regarding security of supply here is not dependency by itself, but the vulnerability which might result from that dependency.

- Because of this short-sightedness, it is also difficult for energy markets to promote the development of those technologies that are most suitable under a long-term strategic perspective. Due to several reasons (which mostly have to do with political acceptability, but also with imperfect information), current energy prices fall short of internalizing the total actual incurred costs of the different technologies. As the most

representative case, climate change will require a radical transition towards a low-carbon economy, probably even more demanding than the official storyline, even that of truly concerned organizations (Pielke et al, 2008). However, the agents of an energy market will not undertake costly investments in new technologies – typically with useful economic lives of at least 30 or 40 years – in a highly uncertain regulatory, technical and economic context. Investors, quite understandably, are not convinced that governments will internalize externalities to their full extent and that they will provide a sufficient regulatory long-term commitment. Investments in renewables, clean coal or nuclear are particularly salient in this respect.

Thus, to summarize, the current market paradigm relying only on the correction of market failures through internalization is not robust enough, because of political unacceptability issues, regulatory failure, and also because of the inability of most governments to provide sufficient long-term regulatory commitment. Therefore, it seems necessary to provide the market with some kind of long-term vision, so that, while minimizing the interference with the efficiency of the allocation mechanisms of markets, market agents receive additional signals to steer them in the right direction.

2.2 The Spanish case example

The Spanish case is a good example of the energy challenge that many other countries are facing. Spain is a country with a very large energy dependency – higher than 90% in primary energy, whereas the European average is 50% – but in spite of that achievements in energy efficiency have been very scarce. The growth in electricity consumption is clearly higher than the European average, although consumption levels are average. Energy intensity is growing, contrary to what has happened in most of Europe. Spain is also far from meeting its prescribed Kyoto goals on reduction of greenhouse gases. The potential for large hydro facilities has already been mostly exploited; the use of national coal is decreasing, due to several economic, social and environmental issues; nuclear energy – which produces a fifth of the total electricity in Spain – faces strong opposition from the public; and there are abundant renewable resources in biomass, solar and wind energy, which are being developed rapidly – although unevenly – with a feed-in tariff system. 80% of primary energy is met with fossil fuels. And the expenditure on oil imports in 2006 surpassed 4% of the GDP.

The effort in long-term R&D in the energy sector has been very small and decreasing, similarly to what has happened in the rest of Europe and elsewhere during the last 20 years. A profound social debate on the more appropriate energy model has not taken place yet, although the Spanish government and some institutions have started some prospective studies recently.

The Spanish economy has grown in recent years well above the average level of the European Union. The sectors with a higher energy consumption growth – also the ones where it is most difficult to modify the existing patterns of consumption – are buildings and transport. The building sector in Spain accounts for 22% of the primary energy consumption – 29% if we add the construction phase – and transport accounts for 38%, of which 81% corresponds to road transport.

According to the burden sharing agreement of the European Union for the Kyoto Protocol, Spain should not increase its emissions more than 15% compared to 1990 levels during the 2008-2010 period. However, currently the Spanish GHG emissions have increased more than 50%. It is true that the Spanish economy and population have increased more than the average European level, but it is also a fact that the effort on energy efficiency and savings has been very poor so far, although this is starting to change. In Spain, 78% of GHG emissions come from the energy sector. The

CO_2 per capita emissions are 9.6 tCO_2-eq, while the European average is 10.6 tCO_2-eq.

The general policy recommendations for Spain probably will not differ much from those for any other developed country, when trying to improve the sustainability of the energy model. In the absence of a rigorous planning exercise, the following guidelines appear to be sound: start by recognizing the lack of sustainability of the current energy model and the urgency of setting up measures to change it; a significant role for renewable energy; a real culture of energy efficiency and savings, with much stronger measures than those adopted till now, and with a particular emphasis on buildings and transport; the use of electricity and gas markets to obtain appropriate signals of energy prices; a positive intervention of regulators to guarantee permanently an adequate reserve margin; the support to R&D in advanced, cleaner and more efficient energy technologies; caution in the transition towards this more sustainable model, since administrative and regulatory decisions may determine the future of existing technologies; a flexible and open approach towards all available technologies, although clearly establishing priorities among them based on their long-term implications in the broad sense that is contemplated here, and not just in terms of economic costs and benefits; the fulfillment of international agreements, particularly those related to climate change; the provision of universal and equitable access to modern energy sources in developing countries in ways that are consistent with this global energy strategy; the translation of these objectives to the corresponding economic, social and regulatory measures; and finally, a special effort to educate and make people conscious of the relevance of these issues, so that they may become a help, and not a hindrance, for the recognition of the problem and for the definition of the actions required for its solution, which will necessarily change their lifestyles and consumption practices.

2.3 The role of indicative energy planning

The strategic appraisal of electricity supply in Europe requires a long-term comprehensive analysis, integrated in a global energy context. This analysis should take into account the current availability and the foreseeable evolution of generation technologies and their environmental and economic consequences; the implications of the current liberalization of energy markets; the environmental restrictions; the capacity of demand to respond and to implement energy efficiency and savings measures; geopolitical considerations; the consequences of the different strategies of security of supply; the capacity of interconnections; the price of electricity and the competitiveness of industries and services; always taking into account the perception of the public about the energy issue.

As we have argued in the previous sections, the market by itself will not adequately address the shortcomings that have been detected in the energy model and redirect it towards a more sustainable path. We need to provide somehow the following additional elements: a) the basic criteria to be met by a future sustainable energy model; b) a specification of the targets to be achieved, such as CO_2 emission levels, energy efficiency, penetration of renewables or minimum requirements of diversification in primary energy sources; a nuclear energy policy; and c) a definition of the regulatory instruments that will make all this possible, while minimizing the interference with the functioning of the energy markets. Indicative planning, as proposed in this paper, comprises all these three aspects.

Indicative planning as such is not a new idea. It has been around for long, mainly applied to broader economic issues (Black, 1968). Nevertheless, its application to energy has not yet been materialized, except for the electricity sector in some Latin American countries (Rudnick, 1996), at least. As indicated above, indicative energy planning comprises the characterization of the relevant features of a future energy model, the

identification of the major required strategic measures; and the definition of the regulatory instruments that will make all this possible. “Indicative” may be considered as a misnomer, since some of the instruments and measures arising from this exercise will have a mandatory character. However, it is still indicative in the sense that it is compatible with the free activities of investment and operation on the part of the economic agents that participate in the market, although now subject to some incentives and constraints.

Some national laws (in Spain, the Electricity Sector and Hydrocarbon Acts) provide States with indicative planning as an instrument to set up this energy strategy. However, this indicative planning must reach much further than just the network infrastructure plans, which receive as external data the estimations of demand growth and the new generation investments envisaged.

The UK government White Paper “Our energy future. Creating a low carbon economy” (HM Government, 2003) begins by stating in the introduction that “This white paper is a milestone in energy policy. It is based on the four pillars of the environment, energy reliability, affordable energy for the poorest, and competitive markets for our businesses, industries and households. This white paper sets out a strategy for the long term, to give industry the confidence to invest to help us deliver our goals - a truly sustainable energy policy”. The UK government, as other European governments, has examined the options available to move towards a more sustainable energy model. The French government commissioned a similar document (CAS, 2008), which among its conclusions includes: “It is necessary to undertake without delay actions allowing us to be in 2020 on a virtuous trajectory to face the different long-term scenarios (2050 and further)…It is also required in parallel to become prepared for the long-term challenges, by devising from this very moment structural policies which will only bear fruit in the long term…This being a long-term perspective, it is evidently good policy to envisage very ambitious, even extremely ambitious objectives”.

Indicative energy planning should provide the integral vision for all stakeholders, plus the constraints to be respected, the targets to be met and the incentives to achieve both. We must insist that this indicative planning should not curtail the freedom of installation for electricity and gas utilities, which would continue operating in a free market environment. But indicative planning should provide the framing conditions that should be known by all agents that may be affected, and should set up goals and well-determined resources for everything that is regulated: targets for renewable energy penetration and the corresponding support schemes; the real possibilities for integration of intermittent energy sources for a predetermined level of reliability, which may also be modified dynamically as more flexible mechanisms for generation and demand response are found; energy efficiency and savings targets and how to achieve them, which should include as a priority a public education program; the required margin for electricity demand; the development of gas and electricity infrastructures, including interconnections; priorities and resources for R&D in energy; carbon allowance allocations; the strategies for fulfilling international commitments; the volume and technological approach for international cooperation in the energy field; the guidelines resulting from public opinion on the future of nuclear energy; the coordination of all these instruments to achieve the expected goals at the lowest possible cost; and finally, an estimation of the additional cost and its implications on demand and competitiveness.

Indicative planning is more than just prospective energy analysis. Rather than estimating what might happen we should envision the basic traits of what should happen to achieve a sustainable energy model. In order to establish correct guidelines now, we need to assess the volume of effort required to invest in renewables, the level of improvement in energy

efficiency and savings, the needs for energy R&D, the potential contribution from nuclear energy, or the limits for emissions from coal or gas. Therefore the objective is not to carry out a prospective energy analysis – to find what could happen – but a normative one – to identify what has to happen to achieve a desirable future with some prescribed characteristics (Smil, 2005). The time horizon for normative analysis in energy, in particular when climate change is concerned, should contemplate 25 years, 50 years and even longer. The implications, however, should be immediate, because of the long maturation periods of energy investments and the large inertia of this sector, with lengthy deployment rates of new technologies.

3 Indicative planning methodologies

We present in this section a possible conceptual approach to indicative planning in the energy sector. It is just a general framework that may result in very diverse specific implementations. It is assumed from the outset, in agreement with the European and Spanish legislation, that the core of the energy model is a competitive market, both in generation and retailing, where agents are free to choose any technology for their investments and to select their trading partners and commercial arrangements.

The indicative planning exercise would start by identifying a set of future scenarios for the energy sector that are acceptable – i.e., meet the minimum desirable requirements set by the regulator – and which feature a number of characteristics which make them preferable to the rest of the possible scenarios. Selecting the best scenario will not be straightforward, so a number of options may be examined to be later presented to the regulatory authorities.

The formulation of the conceptual model for indicative energy planning requires the use of a precise terminology. Here we adopt the structure and classic terminology of an optimization problem, although the specific planning method should not necessarily follow this approach. A scenario will be defined in terms of its attributes, of the parameters that are external to the decision making process and that the planner cannot control, and of the values of the decision variables. The definition of these three concepts follows.

The *attributes* of a scenario are a set of indicators which allow its qualitative or quantitative evaluation on the basis of the different criteria presented before; in particular, its economic, social and environmental sustainability. These indicators will determine whether a future scenario is acceptable or not, and whether it is better or not than other scenarios. An obvious indicator is the cost of energy for the consumer. Another is the level of GHG emissions or some reliability measure of electricity supply. The quality of supply or the environmental impact of a scenario may be expressed either as constraints or, once the minimum requirements have been achieved, as attributes. Sustainability concerns also require the incorporation of other aspects, for which adequate attributes have to be defined for their precise quantification: long-lasting and reliable access to energy sources at a reasonable price; adequate capacity of infrastructures and security of supply; an environmental impact which does not exceed the carrying capacity of the natural environment and which allows the development of its inhabiting species; compatibility with an adequate economic development (which does not need to be unlimited); and universal and reasonably equitable access to modern forms of energy.

In such a complex context as the one of energy planning, a key issue is to avoid reducing its multiple dimensions to a supposedly common monetary unit, with the subsequent lack of information. Instead, these dimensions should be thoroughly discussed when making decisions, so that it will be society, through its values, which establishes a hierarchy to evaluate the relevance of the several dimensions (Sagoff, 2004).

The external parameters are another component in the definition of a scenario, although they are partly or totally beyond the control of the planners. Typical examples include the growth in the demand of energy services, the price of fuels, or the availability and cost of new technologies.

Finally, to complete the specification of the scenario we must make explicit the *decision variables*, that is, the framing conditions which the planner may use to exercise his influence on the market behavior. Some of these conditions may be imposed externally – such as an international agreement on GHG emissions reduction – although the planner may still try to make them more stringent. Here the decision variables under the control of the regulatory authorities are classified as quotas or incentives (or quantity or price instruments as in Weitzman, 1974), and cross-cutting measures. Although quotas or incentives may be considered as equivalent under certain conditions, uncertainty and asymmetric information make it necessary to use them both.

Quotas are requirements to achieve some targets or objectives or not to exceed some limits, which may be freely set by the regulator or may be imposed externally: e.g., maximum acceptable levels of environmental impact, be them global (GHG) or local (particulate emissions); minimum levels of penetration of renewable energy; minimum levels of energy efficiency improvements; minimum levels of security of supply and reliability; minimum diversification or maximum energy dependency; minimum progress regarding universal access to modern energy sources; or minimum use of domestic energy sources. These quotas may be implemented as tradable quotas or as standards, depending on the case.

Incentives are price signals meant to guide the development or the functioning of the energy sector in a desirable direction, while avoiding imposing constraints and minimizing interferences with the competitive market. Incentives frequently try to transfer to the final consumer the right economic signals (be it energy market prices or regulated tariffs) that partly or totally internalize long-term or sustainability considerations. As, for instance, mechanisms to facilitate demand response; energy taxes; support systems for renewable energies; removal of barriers for specific technologies (high penetration of intermittent energy sources in electricity networks, or high regulatory risk of nuclear); or regulatory procedures or guarantees that make it possible to invest in the required infrastructures.

Finally, by *cross-cutting measures* we refer to other broader more institutional regulatory instruments, which can help achieve satisfactory values of the attributes of any given scenario by addressing other externalities or market barriers related to innovation, education, networks or institutions. Characteristic examples are: public support of R&D in energy, public education for a change in consumption patterns; implementation of advanced metering and communication systems; better knowledge and utilization of demand response possibilities; improvements of energy regulation and market design at the European and national level; international cooperation with developing countries and environmental diplomacy actions to achieve regional or global agreements such as those for climate change mitigation or adaptation.

Once the nature of the scenarios has been defined, the specification of an indicative planning approach is completed with the formal description of the procedure to generate scenarios and to search for better ones. It exceeds the scope of this paper to attempt here a thorough presentation of the existing research on energy planning methods and models. An attractive and simple approach, albeit a crude one, would just consist of generating manually the scenarios, based on experts' information using as inputs the several measures that could be applied, with a prescribed volume or intensity. One interesting example of this method is the "wedges" study developed by Pacala and Socolow (2004), which can be improved by considering, at least, the interactions among the different measures to be

implemented, by means of some physical model of the energy flows and transformations. A second approach would be the random generation of many scenarios, then using advanced data mining systems to retrieve the relevant information from them (Lempert, 2003). A third one would make use of well-known optimization techniques to search for the optimal scenario or for a family of non-dominated scenarios in a multi-dimensional attribute space. There are good reviews of these in Huntington and Weyant (2004) on large-scale, energy-economy-environment models; in Linares (2002) on electricity planning methods; in Ventosa et al (2005) on electricity market simulation models; or in Dyner and Larsen (2001) on the need for new decision methods adapted to new frameworks.

4 Making planning and markets compatible

Once indicative planning has provided the long-term view that is required for the definition of sensible energy policies, this has to be made compatible with the already existing energy markets. The main issue here is to assess, for each type of infrastructure, the right amount and kind of regulatory intervention so that the investment that takes place is compatible with the long-term sustainability requirements that have been identified in the indicative planning exercise. What is the borderline that the regulator should not cross? Perhaps too naively, at the beginning of the liberalization process it was believed the all kinds of investment decisions should be "left to the market". Now, the more recent realization of the serious shortcomings of our energy model, or the too-common regulatory failures when addressing market failures, demands a shift in paradigm. Indicative planning will help here in the identification of the objectives. Then, orthodox principles of microeconomics and regulation should be employed to determine the nature and intensity of the regulatory measures (quotas, incentives, or cross-cutting policies), if any, to be applied in each case.

Motivated by the pressing needs of finding solutions to security of supply risks and climate change, the EU is trying an approach along these lines, which mixes centralized global objectives with policies and measures at Member State level. Long-term targets (such as CO_2 emission reductions or penetration levels of renewables) are set at EU level, while leaving to subsidiarity of the Member States and to ad hoc global markets associated with each target (like the EU emission trading scheme or green certificates markets) how to meet these commitments.

Markets should be used as much as possible, with the prices of energy, emissions and green or white certificates sending the correct economic signals for investment in adequate technologies or consumption. These prices would be set through incentives, quotas, or contracts. However, while the long-term and sustainability implications of the energy model are not duly internalized in these prices (for reasons already explained), market instruments will need to be supplemented by other measures, such as R&D support, and also, especially in those sectors such as energy efficiency and savings where externalities are more difficult to internalize fully and behavioral issues are more prevalent (Metcalf, 1994), by more traditional "command and control" measures such as standards.

Some specific interesting ideas should be mentioned here, such as the "regulation by contracts" paradigm (e.g., Gómez-Ibáñez, 2003), or the contracts for low-carbon electricity that are proposed by Grubb and Newbery (2008), for example, which basically reflect the need for this type of energy source from the social point of view, and provide political certainty to the market. Rivier et al. (2008) also follow the same approach for renewable electricity generation. A discussion on regulatory mechanisms to enhance security of supply in electric power systems can be found in Pérez-Arriaga (2007).

In the next section we pay attention to the specific regulatory environment where indicative planning will have to take place: the Member

State level within the European context. Energy planning must be set in a legal framework which allows and promotes the development of a long-term energy policy, since it is an instrument for its definition.

5 Moving in the right direction: the future of electricity policy

5.1 Towards a European energy policy

It is quite paradoxical that, in spite of the strong energy dimension of the first European Treaties, and of the relevance of energy for the European economy, until very recently it has been difficult to identify a European common energy policy (Sierra, 2006). Energy is not explicitly mentioned in the Treaties, so there is no clear legal basis on which to produce regulation on energy policy. Therefore, any formal action from the European Union on energy issues should be framed in other policies, which may have other priorities and collateral implications that may even be ill advised for other energy objectives. According to the European Treaties and regarding energy, Member States reserve exclusive rights to the definition of the use of their natural resources, of the choice of supply sources, and of the general supply structure. Therefore, Member States are the ones to decide their energy mix.

European Treaties do envisage, however, the adoption of exceptional measures in case of a supply crisis. This is therefore applicable to energy security of supply, but only in exceptional moments, so it is not useful to define preventive policies on energy security.

Several factors contribute to making a common European energy policy particularly difficult. There is a conflict between economic efficiency – which has led to the creation of common European gas and electricity markets – and national sovereignty – which makes Member States reluctant to leave their security of supply in others' hands. Another conflict is the one arising because of "national champions" policies. It is difficult to reach a consensus on these highly political issues. Nuclear energy is one of them. Until recently most of the measures adopted at European level have lacked an integral vision: usually policies have focused on a particular aspect, fuel or technology, ignoring the rest. The outcome has been an unbalanced, non-harmonized development of the different energy aspects, which harms effectiveness and perdurability (Sierra, 2006).

Although the formal legal situation for the adoption of a common European energy policy has not changed in any significant way during the last decade, during the last few years another more pragmatic approach has been adopted, which is guided by sound sustainability principles, has a vision and a long-term strategy behind, as proposed in this paper, and is already achieving some practical results.

The European Commission opened a first in-depth debate on the sustainability of its energy model with the Green Paper "Towards a European strategy on energy security of supply" in 2000, and concluded that it is in the consumption area where the largest potential exists for an effective action strategy. This has been reinforced in a second Green Paper "Doing more with less" in 2005, where the target of reducing European energy consumption by at least 20% is tentatively introduced. More recently, the "third package" of measures that has been proposed in September 2007 and January 2008 by the European Commission on "an energy strategy for Europe" constitutes a first comprehensive attempt – albeit still insufficient – at a European energy policy. This package contains measures to reinforce the energy markets while, at the same time, establishes targets for GHG emissions, renewables and energy efficiency. Given the current prices of electricity and the estimations for the future, and the current lack of internalization of externalities and uncertainties already mentioned, energy or environmental standards or "regulation by contract" measures may have to be introduced to supplement the economic signals

from the market in order to promote the introduction of new clean technologies and to achieve the prescribed long-term targets.

It is expected that improved and more transparent tools of indicative planning will be used at European level to refine and justify better the long-term goals and to assess the regulatory measures that will be needed to achieve them. The outcome of indicative energy planning at the European level will also create the framing conditions to repeat the exercise, now at Member State level.

5.2 Future actions for Spain

As mentioned before, Spain is a good example of a State very much in need of an indicative planning exercise, so that the decisions that are made now and that will strongly condition the Spanish future energy model for many years, are adopted with a sound technical, legal and economic basis. This is even truer when one notices that in some areas – like electricity generation, for instance – most of the options are already subject to a large degree of regulation, and that there is very little left for the market other than the efficient implementation of policy instruments. For instance, nuclear expansion will not take off without a hypothetical political commitment to reduce the risks derived from the long period of construction, the generalized opposition of public opinion, the accident insurance costs or the long-term treatment of the nuclear waste; clean coal technologies such as carbon capture and sequestration will also need regulatory support, at least until the price of CO_2 stabilizes at a high enough level, as happens with most of the renewable technologies. Even the investment in gas generation units (particularly peaker plants) may strongly depend on the specific regulation on security of supply. Therefore, the coordinated vision and strategy argued for in this paper seems particularly necessary.

The White Paper on the Spanish electricity sector (Pérez Arriaga, 2005) strongly recommended a long-term evaluation of the energy model in Spain along the guidelines presented here, based on a specific application of indicative energy planning, which should provide the guidelines to establish and to justify long-term objectives and any associated regulatory measures. Only partial analyses were available, considering only a fragment of the problem at a time, like energy efficiency or renewables. Finally, as in other European countries and at EU level, some activity has recently started in this direction. In September 2006, the Spanish government launched a study on “Prospective on the energy sector in Spain for 2030”, which should be the basis for strategic decision-making in the following years. The objective of this study is to “investigate the possibilities and define the strategic guidelines for Spain to achieve in 2030 the maximum attainable level of energy self-supply with renewable energies, guaranteeing at the same time the reliability and quality of supply, all of it within a sustainable economic framework which contributes to the welfare of society… This prospective study will allow putting forward and comparing different future energy scenarios, thereby facilitating the planning of appropriate energy policies, which minimize the impacts of high energy prices, of the global supply insecurity, and of the unsustainable growth of carbon emissions”. Hopefully this initiative gives finally the long-awaited answer to the need for a strategic vision for the Spanish energy future. Other organizations, like the Nuclear Forum or the Spanish Association of Electric Utilities (UNESA) have followed suit and are announcing their long-term prospective energy analysis.

6 Conclusions

The strategy of electricity supply in Europe requires a long-term analysis, integrated in a global energy context. This analysis should take into account the current availability and the foreseeable evolution of

generation technologies and their environmental and economic consequences; the implications of the current liberalization of energy markets; the environmental constraints; the capacity of demand to respond and to implement energy efficiency and savings measures; geopolitical considerations; the consequences of the different strategies of security of supply; the capacity of interconnections; the price of electricity and the competitiveness of industries and services; always integrating the perception of the public about the energy issue.

Indicative planning, as considered in some national laws, may be the instrument that will provide the integral vision required to address adequately the above mentioned issues. Indicative planning, which in principle should not interfere with the freedom to invest of energy firms or the functioning of the energy markets, should show the road to follow and the available alternatives, in order to achieve a sustainable energy model in the long term. Indicative planning should also make explicit these alternatives, with their pros and cons, so that the public and the relevant institutions have enough information on the available options and are able to adopt fundamental decisions.

Indicative planning, as a support instrument to a consistent energy strategy, should provide the guidelines which allow us to achieve, co-ordinatedly and in the best possible way, any prescribed objectives, and to justify the decisions adopted in that regard. The plan should establish the framing conditions which should be known by all economic agents which might be affected, and should set precise goals for everything to be regulated, at least for some time: renewable energy penetration and the corresponding support schemes; energy efficiency and savings targets and how to achieve them; any support schemes to improve the security of electricity and gas supply; the development of gas and electricity network infrastructures; priorities and resources for R&D in energy; carbon allowance allocations; and the practical implementation of any guidelines resulting from the public opinion on the future of nuclear energy.

The leadership to determine the national energy policy should come from governments, while complying with any European common energy strategy, and avoiding any direct interference with the companies' decisions. The role of governments should be limited to provide any necessary regulatory measures to energy markets that will make possible the achievement of the agreed long-term energy policies. Tensions and ambiguities will always exist regarding the fuzzy borderline between markets and regulation. But in the energy sector, they must be seen not as opposite but complementary forces.

References

Arrow, K.J. (1986). "Rationality of self and others in an economic system" *The Journal of Business*, 59: S385-S399.

Black, J. (1968). "The theory of indicative planning", *Oxford Economic Papers* 20: 303-319.

CAS (2008). "Perspectives énergétiques de la France à l'horizon 2020-2050". Centre d'Analyse Stratégique. Rapport de la Comission d' Énergie presidée par Jean Syrota.

Dyner, I., E.R. Larsen (2001). "From Planning to Strategy in the Electricity Industry", *Energy Policy* 29: 1145-54.

European Commission (2008). "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – 20 20 by 2020 – Europe's climate change opportunity." COM(2008) 30 final.

Gómez-Ibáñez, J. A. (2003). *Regulating Infrastructure. Monopoly, Contracts, and Discretion*. Cambridge, MA. Harvard University Press.

Grubb, M., and D.M. Newbery (2008). "Pricing carbon for electricity generation: national and international dimensions". In Grubb, M., T. Jamasb, and M.G. Pollitt (eds.) *Delivering a Low Carbon Electricity System: Technologies, Economics and Policy* Cambridge, Cambridge University Press.

HM Government (2003). *Our energy future. Creating a low carbon economy: White Paper* Cm5761. London, The Stationery Office.

Huntington, H.G., J.P. Weyant (2004). "Modeling energy markets and climate change policy" in Cleveland, C.J. et al. *Encyclopedia of Energy*, Academic Press / Elsevier Science.

IEA (2007), "World Energy Outlook 2007", International Energy Agency.
IPCC (2007), Intergovernmental Panel on Climate Change, “Fourth Assessment Report”, http://www.ipcc.ch/.
Lempert, R.J., Popper, S.W., Bankes, S.C. (2003) “Shaping the next one hundred years”, Rand.
Linares, P. (2002). “Multiple criteria decision making and risk analysis as risk management tools for power systems planning” *IEEE Transactions on Power Systems* 17: 895-900.
Metcalf, G.E. (1994). “Economics and rational conservation policy,” *Energy Policy* 22: 819-825.
Pacala, S., and R. Socolow (2004), “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies”, *Science* 13 August 2004: 305(5686): 968 – 972.
Pérez-Arriaga, J.I. (2005), “Libro Blanco sobre la reforma del marco regulatorio de la generación eléctrica en España”, [White paper on the reform of the regulated market for electricity generation in Spain] prepared for the Ministerio de Industria, Turismo y Comercio, July 2005, http://www6.mityc.es/energia/archivos/LibroBlanco.pdf.
Pérez-Arriaga, J.I. (2007), “Security of electricity supply in Europe in a short, medium and long-term perspective”, *European Review of Energy Markets*, 2(2):
Pielke, R., T. Wigley, and C. Green (2008). “Dangerous assumptions,” *Nature* 452: 531-532.
Rivier, J., R. Passey, I. Macgill, and H. Outhred, (2008). “Contracts for differences. A possible new role in supporting renewable energy generation”. IEEE Transactions on Power Systems, submitted. IIT Working Paper.
Rudnick, H. (1996). “Planning in a deregulated environment in developing countries: Bolivia, Chile and Peru,” *IEEE Power Engineering Review*, July 1996.
Sagoff, M. (2004). *Price, principle and the environment*, Cambridge: Cambridge University Press.
Sierra, J. (2006), “La energía: Encrucijada y retos”, *Industria y minería*, 363:10-20.
Sioshansi, F. P. and W. Pfaffenberger (2006), *Electricity Market Reform: An International Perspective*, Elsevier.
Smil, V. (2005). *Energy at the crossroads: Global perspectives and uncertainties* Cambridge, MA.: The MIT Press.
UNDP (2000), “World Energy Assessment”, a report of the United Nations Development Program, United Nations Department of Economic and Social Affairs (UNDESA) and World Energy Council (World Energy Council, WEC), 2000.
Ventosa, M., A. Baillo, A. Ramos, M. Rivier (2005). “Electricity Market Modelling Trends,” *Energy Policy* 33: 897-213.
Weitzman, M.L. (1974). “Prices versus quantities,” *The Review of Economic Studies*, 41: 477-491.