Energy efficiency vs. economic efficiency - balance or pressure?

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Synopsis

The paper discusses the consequences to the promotion of energy efficient use of the present trend to emphasise economic efficiency in electric energy markets.

Abstract

More than 20 years have passed since a great awareness to energy and environment related issues has emerged in developed countries. Several energy policy transformations have taken place during this period. Regulation has played an important role in the promotion of energy efficiency, to a large extent unquestioned up to the mid-eighties. Meanwhile, evolution of background economic policies in the most developed countries determined transformations in energy policies in general. Unbundling and deregulation have lately struck many electric utilities, most of the times at the expense of previously successful DSM programs. Economic efficiency, presented as the main objective of utilities restructuring and also as the panacea for the eventual dissatisfaction of their customers, has been the driving force behind recent transformations. Yet, in Europe there are many different realities in what concerns promotion of efficient use of energy, either by utilities or other entities. In many cases, DSM policies either do not yet exist or are incipient. Different natures of ownership exist for utilities with also different management orientations and different states of development of distribution networks and different levels of access of citizens to electric energy. The paper discusses the degree of fitness to the European reality of the present trend to emphasise economic efficiency as a universally applicable recipe. Particular emphasis is given to the consequences of such orientation in what concerns the efficiency of energy use. Portugal is used as a case-study country to discuss the role of regulation in the context of the recent restructuring of the electricity market.

1. Introduction

Until some time ago a reasonably stable approach has been in use by utilities to deal with the problem of economic operation of electric power systems. This problem is easily stated as the minimisation of a cost function dependent on the power output of generating groups, subject to constraints of power balance within the system and of physical limits to power output. Unit commitment and optimal dispatch problems have been solved by means of different methods and represent essential steps not only in operations management but also in power systems planning. Other constraints are also observed, that deal with security of supply — seeking to avoid supply interruptions — and quality of service to consumers — dealing with the control of variables such as system frequency or voltage magnitudes.

In recent years, both planning and operation of power systems have also been influenced by environmental concerns, most of the times guided by new legislation that followed social pressure for environment conservation. Integrating these new concerns in the usual procedures followed by utilities led to many methodological contributions. Some of them still using a single objective approach to the basic problem, thence adding new constraints, others using multiobjective approaches where cost minimisation is to be compromised with other goals related to environmental impacts of electrical energy production (Clímaco et al. 1995).

Also, demand-side resources became increasingly important in the electric industry business, at least in some

countries. Influencing the way electric energy is used has become an effective means of complementing supply-side options with the purpose of increasing overall systems efficiency. Determining the appropriate mix of supply-side and demand-side resources became the goal of the so-called integrated resource planning (IRP), allegedly leading to a global least-cost approach (Schweppe, Merrill, Burke 1989). Several difficulties had to be tackled with to solve the problem of cost-benefit evaluation of demand-side options. A standard approach has been designed for the purpose (CPUC and CEC 1987), which has only recently been adapted to the european specificities through an initiative of the European Commission (The European Commission 1996). Demand-side management (DSM) has been recognised as an ally to environment conservation as it leads normally to lower overall consumption growth and contributes to using available resources in a more rational way — the portfolio of DSM even includes fuel replacement options. Huge savings, both financial, energetic and environmental have been claimed, namely in the USA (Sioshansi 1996), as due to the massive adoption of DSM programs by utilities, bounded by strict regulatory constraints.

A common background is identifiable in the approaches referred. In fact, the decision variables used in the classical models, as for example the power outputs of generating units, show a unified approach to systems planning or operation, only viable in the context of a monopolistic management structure. Theoretically, this could lead to an overall rationality of the use of the resources available, thus maximising efficiency, provided that both state-owned utilities (SOU) and investor-owned utilities (IOU) are subject to regulation. Eventually, from a societal perspective, implemented through appropriate regulation, efficiency would not only be economical but also environmental, through some kind of compromise dictated by society's preferences.

However, claims and some evidences have arisen showing some distance of actual management to this potential rationality. Management decisions have not always been in the consumers interest, either when utilities were IOU or SOU. Economic efficiency improvement showed to be necessary, as some decisions — e.g. concerning capacity expansion — seemed to be inadequate from the point of view of consumers — thence of the economy and of society. Competition has been proposed as the road to improve economic efficiency of utilities, hopefully providing consumers with lower energy prices resulting from the fact that it would become possible to shop around electricity. Market laws would dictate better economic supply conditions to consumers. Besides, revoking the concept of natural monopoly traditionally associated to the electricity industry has been accompanied by the splitting of vertically integrated utilities into smaller companies, usually dedicated to segments of the former overall business — generation, transport and distribution.

In the generation side, energy conversion efficiency became a major goal, as it is the corner stone of competitiveness. This has a definite influence on choices of fuel and of power generation technologies — leading in many cases, for example, to the construction of gas-fired combined-cycle units, which have better efficiency and less negative environmental impact than, say, coal-based units.

The new paradigm of the "free" market ruling the business essentials within the electricity industry came up irrespectively of the previous existence of DSM activities. DSM has been identified since the infancy of the concept as a privileged tool for utilities to contribute to the societal goal of environment protection — besides being profitable on its own in many cases. In view of this advantage, in some countries regulations have been issued and accompanying procedures implemented that sought to maintain economic advantage for the utilities while promoting energy efficiency on the demand side. Losses of revenues had to be compensated in some way, which is not possible, in strict economic terms, in a competitive environment.

Hence, the question: which efficiency improvement should be pursued — energy or economic? Ideally, both, one can say, as long as society may receive a large part of the economic benefits, and not only utilities. Is this possible? How do the answers to these questions vary with different points of departure as regards to previous commitment of utilities to DSM or to electricity efficient use (EEU) activities?

2. Different Points of Departure

The european internal energy market, whose implementation is under way to become effective by the end of the century, forces namely third-party access to the networks in order to improve competition among suppliers in the European Union (EU). Allegedly, this will improve economic efficiency and allow lower prices of energy to consumers.

There are countries in Europe, like e.g. Denmark, where environmental concerns have been dictating energy policy (Danish Ministry of Energy 1990), much in a way similar to a top-down approach where energy efficiency is seen as a natural instrument for environment conservation. In these cases, one may say that there is an environment policy, assumed as a societal commitment, and that economic goals have to take this longer term commitment into consideration. Energy efficiency promotion is usually bounded by regulations that aim at influencing market behaviour, through prices, taxes and consumer information, and also at forcing codes of practice, namely for design, operation and maintenance of plants, buildings and equipment. Supply-side and demand-side equipments are both targets of efficiency improvements in order to improve overall energy systems performance. Cost-benefit analysis have a long-term perspective which is not compatible with the short-term profit needs of utilities in a highly competitive environment.

On the other hand, in other countries. like e.g. Portugal, DSM or EEU promotion have never influenced utilities' planning or management activities (Martins and Jorge 1995). Though engaged in initiatives which have EU support, mainly through SAVE program, there is no commitment at the administration level to the issues of EEU or DSM. Hence, though a certain amount of work has been carried out in these areas, it has been more a consequence of some persons initiatives in some utility departments than the result of an assumed corporate policy. This situation does not avoid a great visibility of the utility's commitment to energy efficiency, as seen mostly by big customers. The „SYMBOL 104 \f „Symbol“ awar d“ has registered a growing adhesion from industrial customers from edition to edition. Load research activities, naturally previous to DSM initiatives, have only recently begun.

Additionally, the utility's structure has been changed recently, through unbundling of the previously vertically integrated SOU into various utilities in charge of generation, transmission network, regional distribution (four regional distribution utilities — RDU). Presently, privatisation is under way, from the holding company to the RDUs. An office for regulation — much like the UK's OFFER — is presently operating in a preliminary phase, preparing regulations for the new market operating conditions following privatisation. As a matter of fact, the bulk generation business is already partly privately owned.

The present situation is, regarding supply-demand balance, tending to a high reserve margin in the bulk generation side. As a matter of fact, several important investments in new generation capacity are presently under way, despite the fact that energy demand has raised only at an average of 2%/year between 1991 and 1994, and peak power demand raised a global modest 1,4% during the same period (Martins and Jorge 1995). Also in this four year period, generation capacity increased 13% while between 1987 and 1991 the increase has been 7,6%. If, added to this, one observes that only co-generators accounted for around 7% of energy supplied in 1995, while independent power producers in general represented only 0,3% of supply in 1991, it is easy to recognise a situation of growing excess capacity, with negative effects in stranded costs.

Excess generation capacity is, in general, a factor which is counterproductive towards EEU promotion, be it in a situation with SOU, vertically integrated, or with market oriented organisation of electricity supply. Only, in the former case it is easy to mandate strategic load growth programs (Gellings 1985), thus promoting EEU anyway.

In other countries, such as e.g. United Kingdom, a much debated case-study, option has been made for the free market approach, now with almost fully implemented third party access(Löfstedt 1993). Several imperfections have been pointed out, namely as regards to the supply sector (Thomas 1994), acting as an actual duopoly, thus motivating several headaches to OFFER and forcing it to more than abundant interventions on the market. One undeniable effect of reforms in UK has been the tremendous enrichment of RDU's owners and the total abandonment of DSM practice in the first years following restructuring (Flavin and Lenssen 1994).

Of the three examples referred, only in the former exists some stability in the perspectives of steadily promoting DSM and EEU. And it is in the former that the concepts of natural monopoly, DSM, IRP still have broad acceptance, and where third party access to the network is seen as a negative factor possibly affecting EEU when the internal energy market comes to scene (ELSAM and ELKRAFT 1993).

3. DSM: a Virtuous Fellow?

In those countries where DSM had a great impact, namely in the USA, the present trend to liberalise the energy market has strengthened some old reserved opinions and emphasised some controversial issues that had been in debate, though most of the time in an inconspicuous form. Themes such as cross-subsidies, hidden taxation of customers, etc., connected to the problem of lost revenue recovery by utilities that had engaged in DSM programs mandated by regulatory bodies, began to assume high importance in the debate. Why? Third-party access, or wheeling (Schweppe 1988), as the key-issue to competition among suppliers, means death to the franchise markets, abolition of the concept of natural monopoly and, hence, the impossibility of recovering lost revenues through any regulatory-driven scheme. Even some half-humorous expressions such as the „reverse Robin Hood problem“ (Sioshansi 1996) have been created to refer to the alleged perverse effects of revenue reconciliation procedures on non-participating customers, some claiming that the most penalised by rate adjustments were exactly the less wealthy.

Strictly, DSM may be profitable on its own, apart from lost revenue recovery, simply because there are situations where cost-benefit analysis shows that total costs incurred without DSM would be higher than with DSM. Apart from strategic load growth (SLG) (Gellings 1985), all other options require that the utility's system is under pressure and requires either capacity expansion or load relief. Cost-benefit analysis will dictate which options to adopt. But it should be noted that when these are demand-side options, it can not be taken for granted that costs are recovered in the desired time span — namely because estimates may be wrong, either relative to customer participation, occurrence of free-riders, unexpected behaviour of participants, or programs' imperfections, etc. Hence some claims have been made that the true costs of saved energy are not so lower as stated than making investments in new capacity — in many cases they would have shown to be actually higher. In what concerns SLG, it will be cost-effective when previous supply-side investments need recovery conditions which are not likely to exist without promoting electricity consumption growth. But this promotion will assume SLG nature only if regulations impose it. Otherwise there will be plain load growth, eventually with some free-riders adopting conservative measures.

The trend towards highly regulated DSM and IRP in the USA, actually forcing utilities to adopt certain decisions though with the guarantee of financial compensation, shows in itself that these instruments have been considered of high societal value. The initial formulation of DSM (Gellings 1985) did not contain any requirement on regulation support. Implicitly, it relied on market forces to have success. But as a background there was a „natural“ monopolistic structure of the electricity industry, which allowed for a particular kind of relation between utilities and franchise customers. And one may well reasonably tend to think that the potential of DSM has not been fulfilled in the previous context of the presently changing market structure (Gellings 1996).

4. Market and Regulation

The restructuring of the portuguese electricity industry is a good example of a systematic approach to unbundling and privatisation. It has specific aspects, as any other, but it is conducted according to the typical goal, publicly announced, of increasing economic efficiency of the resulting companies when compared to the previous vertically integrated utility.

Some particular aspects are worth noticing, however. The first phase of restructuring has been unbundling. The second, to follow soon, will be privatisation.

The previous nation-wide utility has been considered, prior to unbundling, a financially sound company, having

improved a great deal the quality of its relations with the customers, providing a reliable supply of electricity and a set of services in the customers' interest. Among them, monthly bills with average expenditure information, prior to actual collection of payment, fast response maintenance services, toll-free lines for various aspects of customer assistance, etc. Assets have an estimated high value, due to more than fifteen years of investment in electrification, technical staff is generally considered of very good standard, profits have been raising every year in the last years. One may ask where is the margin for management improvement with such a good record and whether such a company should be sold to private investors in the first place. There are strong reasons to do so. First of all, state owned monopolies are not compliant with EU prevailing economic options. Second, to be able to comply with strict economic convergence criteria defined for joining the first group of EU countries adherent to the „euro", the government needs to collect much more money than taxes can provide — selling profitable companies allows killing two birds with one stone.

Planning decisions have been taken, namely in the generation sector, according to a plan where natural gas plays an important role. The gas network infrastructure, representing a huge investment partly financed by the EU, will be used in the first phase principally to feed a new combined-cycle plant near completion. This plant will be responsible for the majority of gas consumption, its operating cycle being inevitably determined by the need to begin recovering the gas network investment. It is still to be demonstrated that this is a sound economic advantage in the short-term. Claims are presented that the gas investment represents a big effort to diversify primary energy options available — the country depends on oil well above 80% — and this forces the consideration of longer-term economic judgements.

Orientations on electricity rates, though to be established by the office for regulation, are well defined already in terms of strategic trends, in order to prevent big customers from shopping around energy and power, outside the traditional RDU franchise areas, when the internal energy market becomes effective. It is curious to note that in this particular case there is no evident claim that competition is welcome as a means of providing customers the possibility of obtaining energy at lower prices.

It is not clear enough whether franchise areas will go on existing, supported by regulation, at least for smaller customers — as for the big ones third party access will be mandatory across the EU. In the near future there will also be a high bulk capacity reserve, reinforced by a high rate of construction of new generating facilities by independent power producers (IPP) and by an increasing number of co-generating facilities (for which aggressive marketing by the emerging gas industry is already evident) that make a great number of big customers partly or totally self-sufficient in electricity supply.

It seems reasonable to say that the country's energy market is presently being much influenced by political decisions and orientations and thus represents a somewhat particular model of de-regulation — people responsible for the sector prefer to talk about re-regulation and publicly insist that it is very different from de-regulation.

5. How Much Room for Energy Efficiency and DSM?

Under the circumstances described, there is apparently not much room for utilities' initiatives towards energy efficiency at the demand-side. In the portuguese case, namely, competition will most probably be allowed also among the RDUs that resulted from the unbundling process. As these RDU are not strictly distributors, having assets on the generation side also, their competitive capabilities are different and probably big customers will be able to choose not only abroad, within the EU, but also inside the country.

At present, the office for regulation has no clear — or, for the time being, known —blueprint for promoting demand-side initiatives leading to higher efficiency of energy systems. Nor does this issue seem to be near the top of the list of priorities. Besides, there is a big cultural gap on the side of consumers as regards to the need of using energy efficiently. This is particularly evident at the residential sector and frequently frightening at the service sector. Industry is where the most important part of the efforts have been invested in the past and also where administrations are more aware of the importance of energy costs in the business competitiveness. Hence, what is the room left for actual energy efficiency improvement?

If one looks at the issue from the utility's point of view, there are two main situations where it is recommendable to face demand-side strategies.

One of them corresponds to the need to retain big customers — if possible not only industrial customers — in the context of competition. Providing technical assistance, together with promoting electrotechnologies, advising and financing customers' efficiency upgrades, redefining rate structures by fitting them to the particular customer's needs, as e.g. establishing specific end-use prices, all consist of energy services of great value to customers as they contribute to lower energy bills, to improve business competitiveness and to face eventual environmental regulations (Swinden 1995). The move to this type of strategy will force utilities to develop new technical and commercial skills or to create separate entities for the purpose — in either case complementing internal skills with consultancy — thus broadening the traditional fields of intervention on the market. Some opinions even say this is the way to *survive*in a competitive market (DA&DSM Monitor 1996). Of course, this attitude must be explained to the target customers, to whom transparency of procedures will be a key issue in evaluating the utility's quality of service and trustworthiness.

The other situation arises whenever capacity reveals scarce in view of demand evolution — mainly in distribution, for the nearest years to come. In these cases DSM should always be evaluated in equal footing with capacity investments through cost-benefit analysis. The impact of these particular cases in overall efficiency improvement is of course limited and difficult to predict.

6. Market Uncertainties

Competition in the electricity industry and the removal of the natural monopoly concept is still feeding much debate. Lack of experience somehow restrains certain enthusiasms for strict market-driven proposals.

The California Energy Commission admits e.g. that distribution utilities retain some franchise market shares — some energy services are simply not possible to alienate by utilities in the present conditions(California Energy Commission 1995).

DSM program funding has been cut dramatically in California — the two biggest utilities, PG&E and SCE alone planned to reduce $174 million in total — since the issue of de--regulation appeared to be of inevitable implementation, the estimate being of $1 000 million of losses of long-term benefits. Research and development (R&D) in this area has been one of the most penalised activities by this cut back in expenditures.

Evolution of energy prices is one example of an uncertain effect of de-regulation, being still scarce the information available on ongoing market transformations world-wide. In UK, according to (Hoch 1995) residential consumers, for instance, saw on average a 3,2% reduction in prices between 1989/90 and 1993/94, and other consumer classes different other reductions. Only very large consumers saw a price increase of about 2,7%. But, according to (Bunn 1994), 1993 prices are about 30% above what they might be if privatisation had not taken place and trends in fuel prices and efficiency had continued. In (California Energy Commission 1995) it is admitted that consumers' bills will rise if they are not allowed to reduce the level of services they get. The concept of energy service unbundling is used to define a certain number of services that only traditional utilities can provide from those others providable by other agents, solely or in co-operation with utilities, and also to establish which services can be provided at a lower quality level (read reliability of supply). In this perspective, it is assumed more important to maximise consumer value, i.e. what consumers are willing to pay the most, than to maintain or exceed the forecasts on global energy efficiency improvement under the previous market organisation. Optimism is one concept broadly explicit in (California Energy Commission 1995) when prospected difficulties with energy efficiency are identified, hope being the preferred weapon to face a considerable uncertainty of the results of the present transformations.

7. Conclusions

It seems that much is to learn from the future course of energy market evolution, namely to find out whether advantages such as increase of disperse generation importance, or friendly customer retaining strategies implemented by utilities, will outweigh the present retraction of energy efficiency improvement efforts.

Certainly, the future will reveal more or less clearly where traditional DSM actions and programs have been less effective, either strictly in economic terms, or in global energy efficiency improvement. In some countries there seems to be likely that previous methods will go on being applied to the possible extent, which will allow for comparisons.

The fact that the present philosophy of transformation of electric energy markets is being applied according to purely economic motivations becomes more apparent in those cases where DSM and energy efficiency promotion have not been part of the usual portfolio of services and activities of utilities. Hence, concerns about the future of DSM and arguments in favour of great advantages to energy efficiency improvement from the new market-driven approaches, very hardly will reveal cause-effect relationship between these approaches and those concerns. That is to say, environmental goals and policies do not seem to have been exactly the driving force for market-driven approaches.

In those cases/countries where there has not been DSM involvement, the adoption of the presently dominating orientation towards liberalising the electricity business brings an accrued responsibility to governments in two main issues: appropriate regulation, and consumer education through key information delivery.

In view of the question raised in the title, one tends, with the information available, to reply that pressure of economic short-term efficiency seems at present more important than attempts to achieve balance between it and long-term strategies for environment protection through improvement of energy efficiency. Future will tell.

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