

Electricity market and hydropower in transitional countries: the example of Croatia

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Introduction

The process of power system restructuring and electricity market opening in transitional European countries (former socialist countries and the countries formed after the disintegration of those) has been developing quite intensively for the last few years, following the Western European trends.

Relationships in electricity industry in all European transitional countries before the starting of deregulation and privatisation processes were very simple: a full state owned power system utility with absolute monopoly in generation, transmission, distribution, and supply. The basic common characteristics of such utilities were (and in most of them still are):

- Low level of work efficiency, as well as a large number of employees.
- Relatively good power system security level (generation and transmission part).
- Electricity prices are quite below the real level (price regulated by the state, with tariff system which is structured in the way to subsidize households).
- Sometimes small share of industrial consumers.
- Major political influence on power system utilities.
- Technically well versed employees, but low level of organizational and managerial knowledge on all management levels.
- Unstable general economic conditions, and in some countries even the political instability.

The topic of this paper is an impact of power system restructuring, electricity market introducing, and privatisation of state owned utilities on hydropower sector in transitional countries, examined on the example of Croatia. A short review of common characteristics of deregulation process in transitional countries is presented in the text, as well as the detailed description of the situation in Croatia. The analysis of possible variants of market relations establishing and development is made, as well as of the corresponding repercussions on short-term and long-term hydropower operations and development. Also, the problem of privatisation of hydroelectric sector is examined. Hydroelectric sector often represents a marginal aspect of privatisation in transitional European countries because of a small contribution of hydropower, but not necessarily always. In countries like Croatia, with an average 50% of electric energy production from hydropower, the privatisation mode of hydroelectric assets is very important. Moreover, it is probably the key part of power system restructuring and privatisation process in such countries.

1. Electricity market, restructuring of power system utilities, and privatisation in transitional countries

From the beginning of 1990s through today, the energy utility sectors around the world have undergone dramatic change. Three of the principal drivers of change have been:

1. Restructuring of vertically-integrated monopolistic organisations into disaggregated and sometimes competitive companies.
2. Privatisation of state-owned power system utilities, introducing private ownership to these businesses.
3. Electricity market introducing in generation and supply business.

The process of electricity sector restructuring and privatisation is large in scope and complex, needing a combination of significant legal, economic, technical, and other efforts, and it leads to a large number of individual policy decisions and implementation actions. The political and the social importance of the electricity sector contributes to make the task of restructuring, market introducing and privatisation very challenging. Today, there is substantial international experience regarding the process of restructuring and privatisation in the utility sector, as

well as the models of electricity market organisation. This experience has been gained from the many successes in different countries undergoing these processes, as well as from the disappointments where such efforts have failed to reach the hoped-for success. Surely, almost all of the experiences in this area are situation specific.

Although it can be said that the basic motive for the electricity market opening in transitional countries is the same as in developed Western European countries, two important characteristics should be emphasised:

1. The electricity market opening is strongly connected with the privatisation, i.e. with the frozen capital activation in state owned utilities, and with the starting of new investment cycle. Therefore, observing from the wider public perspective, in the foreground there are regularly economic, political, social, and other repercussions relating to the process of privatisation, while the question of restructuring is secondary. For example, the social aspect can be divided in two main parts: the problem of surplus employees and the problem of politically regulated (low) electricity price. In many transitional countries the quoted social aspects represent main obstacles to faster opening of electricity market and privatisation of power system utilities.
2. The satisfying of the Directive EC 96/92 for transitional countries very often represents an obligation which these countries have to approach in a more responsible way than the countries members of the European Union. Although this may result contradictory at first sight, the fact is that all transitional countries experience the Western European integration joining as a necessary condition of development, as well as of the great priority, so that they are forced to co-ordinate their legal regulations, no matter if they are able or not to carry them out in practice. Namely, their starting points are drastically different, so it is often questioned how much, when, and to which extent changes are necessary, taking into consideration potential negative effects.

Potential negative effects in power system sector are possible on several levels. On the social level they are connected with the unavoidable electricity prices rise (which is not the case in Western European countries), and which, finally, is not the direct consequence of market restructuring and opening, but of the necessary social politics change in which the social peace is maintained by electricity prices, which happens to be the characteristics of almost all former socialist countries. On the wider economic level, in relation to the connection of electricity market opening with the privatisation of power system utilities in transitional countries, the question about consequences on the economy on the whole is unavoidably imposed. This happens primarily because of a possible replacement of the domestic government monopoly with the foreign private monopoly. At the end, the question about reflection on the operation and the development of all parts of power system in new circumstances is asked, mainly because of the inadequate technological, organizational, personnel, and other assumptions, or, more exactly, starting points, in which transitional countries are on the average very far from the Western European ones.

The question about the privatisation models of power system utilities in transitional countries is not the scope of this work, but it cannot be avoided because of its decisive influence on at least three key segments in the process of restructuring, which are of major importance for the hydropower sector.

The first question concerns the way of carrying out the utilities unbundling, which has a vital influence on the possible privatisation models. The vertical and horizontal unbundling on the ownership basis, from which the privatisation on separate parts results, is surely the solution that will induce the market development in the best way. However, that kind of solution in transitional countries can lead to numerous unwanted consequences, and therefore it is mostly avoided.

The second question concerns the basic prerequisite for electricity market opening: competition in production. Practically, the only way of ensuring the real competition in production is the privatisation of power plants, in at least several groups with different owners (the unbundling problem again!).

The third and also the most important question for hydropower sector is whether to privatise hydroelectric power plants at all, and, if the answer is yes, in which way it should be done, especially in relation to questions such as:

- rights for water usage as a natural resource and adequate compensation,
- the level of regulatory influence on the future incomes of the privatised hydroelectric power plants,
- wider regulatory frame connected on one hand with the hydroelectric production, which in future must operate under the conditions of the decentralised market mechanism, and on the other hand limited preferably by the centralised decision making water resource management for multipurpose river systems and the related environmental and other externalities.

The basic variants with the horizontal unbundling of the generation sector are:

- no unbundling, i.e., all power plants remain in the property of one company
- unbundling of thermal and hydro sector
- further unbundling of thermal and hydro sector in a few companies, i.e. every plant (or group of cascaded hydro plants on the same river) becomes a separate company.

Observing it only on one-side, the complete horizontal unbundling of the hydro sector is a variant which is often preferred by foreign consultants with the preliminary quoted basic argument for providing as better as possible conditions for electricity market development. However, on one hand such a variant considerably reduces the total value of hydroelectric power plants in the privatisation process, but it also leads to weakening of position, i.e. to

competitiveness of small generation companies in the domestic as well as in wider electricity market. The typical example of such a model is already accepted proposal of privatisation in Bosnia and Herzegovina, where the horizontal unbundling of the hydropower sector is planning to be carried out on the level of groups of hydro plants on the same river. On the contrary, the Croatian model of restructuring includes the complete vertical unbundling on legal basis (in the ownership of one holding company), but not the horizontal unbundling in the generation sector: all hydro and thermal plants remain in one subsidiary company. Also, the current privatisation model provides only the minority privatisation of the holding company. The basic argument against such a solution, connected with the providing of competition in the production on electricity market, can be partly contested by asking a question what is meant by electricity market in the period of globalisation and efforts to open the complete European electricity market. In other words, can the area of a small country with the annual electricity production of 12TWh, which corresponds to the production of one nuclear power plant, be called the electricity market? And moreover, how can such an argument be justified taking into consideration the horizontal integration of large Western European power system companies and the growing of the same by purchasing small companies in the Eastern Europe?

2. Croatian power sector restructuring and HEP unbundling

The process of power system restructuring in Croatia started by passing new Energy laws in July 2001, by which it was established the basic law frame for electricity market and regulation of energy activities [1]. The quoted laws were created in keeping with the Western European practice, and they prescribe electricity market opening for eligible customers (with the annual consumption higher than 40 GWh), establishing of Independent System and Market Operator (ISMO), as well as the Energy Regulatory Council (ERC) as a regulator body for all energy activities. According to the law, tariff customers supply remains under the provision of public service obligation, which is entirely within the jurisdiction of Hrvatska elektroprivreda (HEP) – the Croatian power system utility, under the control of ISMO and ERC. The law on electricity market also provides for the category of eligible producers (cogeneration plants and plants that use waste or renewable energy resources), frame rules concerning regulations and the construction of network infrastructure (transmission and distribution network), as well as for the basic relations among subjects on electricity market. This relates first of all to the necessity of unbundling of HEP, but without stating the way in which it will be done.

The main problem of the laws mentioned is the shortage of the appropriate superstructure. Basic law frame requires numerous additional sub law acts by which some open questions should be defined more precisely, such as:

- Transmission and distribution Grid code
- Market code,
- Network and system costs,
- Treatment of stranded costs, etc.

Besides, it also lacks the detailed technical regulation, which has to define the operative procedures of power system operation in the newly created conditions.

Also, the way of restructuring of HEP and its adaptation to the newly created conditions is of vital importance, because by its means the space for new subjects on electricity market will be opened. On the other side, the question of the appropriateness of formal forming and opening of market is asked, which in reality does not exist. Namely, the limit of 40 GWh gives in total 10% of eligible customers in Croatia, while the competition in production is none at the moment: all power plants are property of HEP. The unbundling of HEP was carried out on formal-legal base in July 2002, in the way that from the existing joint stock company was formed the HEP Group holding with a few subsidiary companies, organised as profit, income, and investment centres. HEP Production Ltd, HEP Transmission Ltd, HEP Distribution Ltd, and HEP Supply Ltd are holders of the basic activity of the HEP Group (core business). The basic structure of the HEP Group holding is shown in Figure 1.

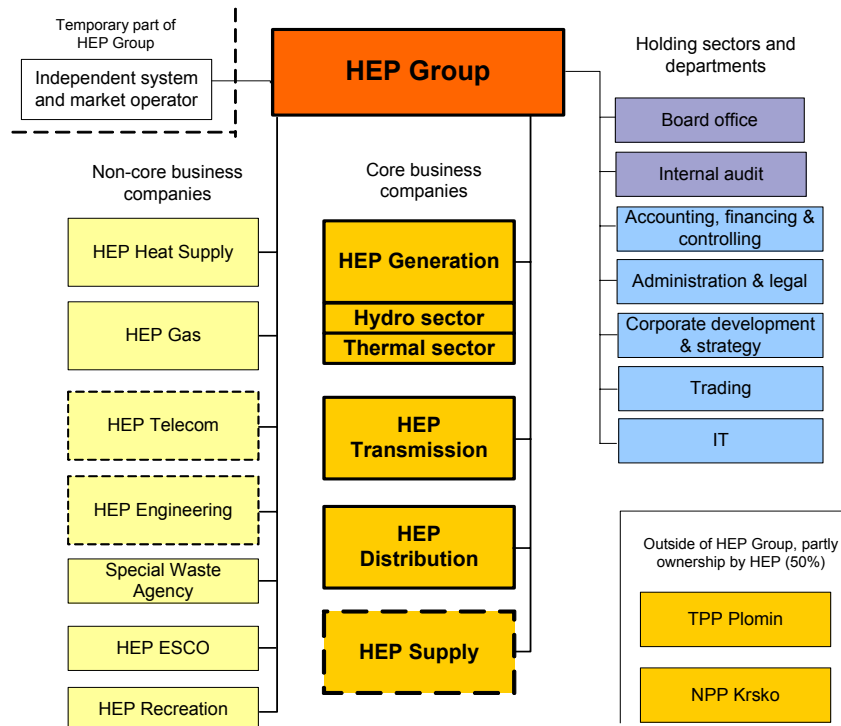


Fig. 1. Organizational structure of HEP Group

Different aspects of deregulation and restructuring process have significant repercussions on power system operations and regulations, which is well documented [2,3]. We can also speak of several years of practical experience in this field [4-6]. Surely, the point is mostly about experiences of developed countries with well-organised market economies and clearly defined ownership rights, where electricity supply industry is most often in the private property.

Power system operations and regulations in Croatia in the new structure of relations mainly result from the way of solving of HEP unbundling, and partially from the way of operation of ISMO. Namely, it is far more difficult to realise the system with ISMO in the present technical and organizational conditions in relation to the more acceptable system with Transmission system operator (TSO), which integrates the complete operation of transmission network and system operations in an independent organisation. Therefore, the following questions are also being asked:

- In which way costs of transmission network, balancing energy, and ancillary services can be transparently separated into market part (eligible customers and their suppliers) and non-market part (tariff customers and their suppliers), taking into consideration that the portion of the first one is only 10%.
- Which model of electricity market organisation should be applied in the case of limited market, and in that case which is the function of ISMO in the domain of electricity market organisation.
- In which way the production for eligible customers and tariff customers could be distributed, is it necessary at all, and in which way the regulator will control possible cross-subsidies between regulated and eligible market parts.
- Etc.

Besides the above, numerous questions are being asked in the domain of the operation of individual parts of power system, as well as of the power system on the whole, basis to which is how to maintain the necessary level of system security and reliability in the new relations, especially in the transitional period.

3. Hydropower sector in Croatia

Hydroelectric power plants make 54% of the totally installed capacity of power plants on the territory of Croatia, or 43% considering also the power plants in the neighbouring countries in the property of the HEP Group (problems with property and price of electricity from these power plants are only partly solved). The total installed capacity of hydroelectric power plants in Croatia is 2063MW, out of which 1683MW is installed capacity of storage, and 381MW of run-of-rivers and small hydro plants. Among the storage hydro plants there is also counted a pumped-

storage plant with the installed capacity of 276/-240MW. All hydro plants in Croatia are property of the HEP Group besides one small hydro plant with the power of 1,5MW. In the structure of satisfying needs for the electricity during the last few years thermal plants have been participating with 34%, hydro power plants with 43%, and the rest of 21 % has been imported. In the next years the electricity import reduction can be expected, but the amount of hydro plants production in the average hydrological year will remain on approximately the same level, i.e. around 5900GWh. The average annual utilization level of the installed capacity of hydro plants in Croatia is between 50-55% for run-of-river plants, and 25-30% for storage plants.

The majority of hydro plants were constructed during the '60s and the '70s of the last century, while the last hydro plants were constructed in the late '80s. For the last 15 years mostly partial actions of refurbishment of the older hydro plants have been done, which in some cases mean the increase of the installed capacity, the turbine efficiency, and similar.

Relatively large share of hydro plants, especially the storage ones, provides for cheap energy and good regulation possibilities on all time levels. In spite of relatively bad daily load diagram, hydro plants cover the most of variable part of the daily load, while the peak load completely. The surplus of peak power and energy is also frequent, so that there is a great possibility of their placement on foreign electricity markets. This is made possible by:

- Two reservoirs for seasonal and annual water regulation,
- Two reservoirs for monthly water regulation,
- Nine reservoirs for weekly and daily water regulation.

On the other hand, there is a large outstanding variation of monthly inflows, as well as the uneven disposal of inflows during the year, which is well compensated with reservoirs for seasonal and annual regulation, except in very bad hydrological conditions. Maximal net water energy value of these reservoirs is theoretically around 1500GWh, and because of the practical reasons (infiltration and evaporation losses in Busko Blato reservoir) it amounts to around 1000GWh, which corresponds to the average bimonthly inflow to all hydro plants in Croatia. The variation of monthly inflows is shown in Figure 2, through the span of the average value of the net energy values of monthly inflows (all hydro plants in Croatia). The highest and the lowest inflows relate to hydrological variants, which correspond to probability of 5%. On the annual level, energy value of the water inflow variations are in the limits from 4300GWh to 7800GWh (both with probability of 5%).

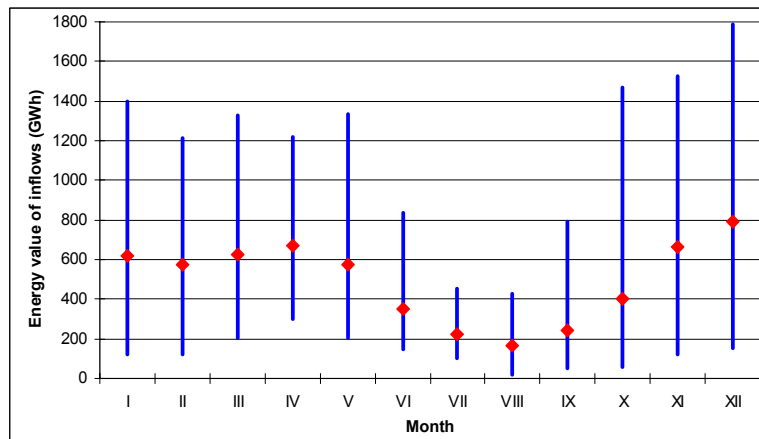


Fig. 2. Variation of monthly energy value of inflows

The possibilities of constructing new hydro plants in Croatia are very limited. In the smaller or greater readiness there have been conducted researches and the documentation for nearly 750MW of new hydro plants, including the two bigger reservoirs for monthly and seasonal water regulation. In the average hydrological year, production of the new hydro plants could be around 1700GWh. This also represents, with numerous small hydro plants (100-150GWh possible annual production), maximally usable new hydro potential in Croatia. Surely, these are mainly projects that require large investments (up to 1500 EUR/kW), which is, with the ecological limitations, the main obstacle to their construction.

4. Implications of electricity market opening on operation and development of hydropower sector in Croatia

Numerous questions which are being asked in hydropower sector, relating to the processes of restructuring, privatisation, and implementation of electricity market, are mostly well-known and documented, and they are common for the developed industrial countries, as well as for those which plan to become such. The key questions and problems are in relation to:

- Management of hydrological risks, i.e. the ways of insuring against the possible bad hydrological circumstances which disable long-term contracts and stable revenue stream (of course, gambling is always possible).
- Management of regulatory risks in the conditions of frequent legislative and regulatory changes, as well as the changes of industry structure, the loss of monopolistic position and the fixed selling prices, etc.
- Restrictions connected with the environmental impacts, and the increased social sensitivities, especially within the limits of local community.
- And finally, maybe the most important problem is related to the further development, i.e. the construction of new hydro plants as projects which on the short-term level cannot be competitive and cannot provide fast pay back of the capital invested, which in the conditions of an open electricity market (and previously given problems of hydro plants) very often repulses private investors.

Transitional countries with the significant share of hydropower surely have additional specifics, which, again, depend on the concrete conditions in which hydropower sector exists (legal and regulatory framework, organisation of electricity industry, structure of the electricity market, conditions in transitional period, privatisation model impacts, etc.). Besides, numerous aspects of hydropower sector in market conditions, including the problematic transitional period of the partly open market, are closely connected with the remaining components of power system and with the way of its restructuring. Therefore, it is practically not possible to give the common section of specifics for all transitional countries, but to indicate some problems as examples, as well as to designate the possible way of solving them for the current situation in Croatia (briefly described in previous chapters), i.e. for some current and open questions.

1. In the transitional period, during the time of the partly open market in which the production for tariff customers dominates (regulated prices), who is responsible for hydrological risks? For example, previously given variation of inflows in Croatia can influence significantly the incomes of the HEP Group. In extremely bad hydrological conditions the loss can amount even to $60 \cdot 10^6$ EUR, which amounts around 8% of the total annual income of the HEP Group. Surely, possible solutions are obvious. One way is the state intervention (guarantee) because of the Government being responsible that the regulated prices for tariff customers cover their supply expenses. The other solution is leaving it to the HEP Group to take care of the appropriate insurance instruments.
2. The usual way of examining the values of the produced electricity from hydro plants through the thermal plants avoided costs is unavoidably changed. The process of planning and scheduling of hydro plants in market conditions is based on the water value concept and on the clear differentiation of all products which hydro plants deliver on the electricity market. Maybe of the biggest importance is the position of storage hydro plants on daily balancing energy market: technical advantages provide to storage hydro plants almost perfect competitiveness in relation to other power plants. In systems with the significant share of hydro plants, which are all in the property of one company, it can be observed as a very serious obstacle to the electricity market development. However, that problem, with good regulatory solutions, can even be transformed into the stimulus of market development. By avoiding market power with good price regulation, price of balancing energy can be provided for on the level that will satisfy hydro plants, and it will also be acceptable enough not to demotivate the eligible customers entrance to an open market. Surely, this practically means that in the first stage of electricity market opening, in the described circumstances, the balancing energy market should not be opened.
3. As practically for all hydro plants in Croatia the investment costs have been paid off, meaning that these generate only operating&maintenance costs (and occasionally costs connected with the refurbishment), the production costs are on average much lower than thermal plants costs (about twice) or, than, for example, the average price on the neighbouring electricity markets. Up till now that difference has been used for “solidarity” covering of production costs of more expensive thermal plants, bringing thus the average electricity prices on the relatively low level, which has also given good support for maintaining low electricity price. With the electricity market opening this practice can continue, but primarily because of providing competitiveness and profit increase.
4. Previously given item can be connected with the problem of new hydro plants construction. Namely, the overcoming financial problems connected with the new hydro plants construction in partly market conditions, and in the same time with a relatively low electricity price for tariff customers, is simply not possible at the moment. The solution with private and public partnership in the way that the reservoirs and the dam of multipurpose hydro systems are financed from the public funds and the hydro plants from the private capital is accepted in the world as a very reasonable option [7]. However, in Croatia, as well as in other transitional countries, such options are in fact very difficult to be carried out at the moment, primarily because of the numerous infrastructural buildings that have priority in investment from the public funds. Therefore, as an interesting option, which could be taken into consideration, can be proposed a purpose restricted setting aside of the part of the present hydro plants income for the construction of the new ones. The approximate evaluations show that the difference in hydro plants production costs in Croatia in relation to the real value, which such a production has on an open electricity market, would be enough for the next 15 to 20 years financing of the total unused hydro potential.

5. Of other remaining numerous open questions, there can be indicated some dilemmas in relation to the organisation of the HEP Group holding, which relates to hydropower sector:
- Whether the property of hydro plants should be transferred to the subsidiary company HEP Generation, or should it be left in holding?
 - Whether the HEP Generation should function as the real profit centre with the full responsibility for its costs and incomes, or should it be decided for the operating company model in which the HEP Generation is responsible for only costs management?
 - Whether the functions of planning and scheduling within the limits of the HEP Generation should be left as they are, or whether to choose some other option, for example a particular sector on the level of holding, or should it be taken over by the separate trading company within the holding?
 - Whether to make an additional step in horizontal unbundling, i.e. whether to separate hydro and thermal sector in separate companies?

5. Conclusion

The life of hydropower sector in the era of competition is dramatically changing. New economic mechanisms and the legal and regulatory framework in electricity sector is being established in practically all countries in the world, as well as in former European socialist countries. The inherited conditions and work specifics require not only very careful analysis of the current experiences in the more developed industrial countries, but also an avoidable adaptation in the interest of preserving competitiveness and providing for the future development of hydropower sector, as well as for generally wider social interests, which result from the usage of natural water resources for electricity production. Unfortunately, according to the opinion of the authors of this article, in Croatia there is being paid so little attention to the influence of the reform of power system industry on hydropower sector, whose annual output, calculated on the basis of the average European electricity prices, amounts to circa 1,5% of Croatia GDP. Whether it is the result of the closeness of the sector, political will, or something else, it is difficult to answer. In any case, we should hope that hydropower sector would however remain the winner at the end of the transitional period, and that the market conditions, because of all real technological and economic advantages of hydro plants, will however contribute to its further development.

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