# Implementation and Perspectives of Electricity Market

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ORIGINAL SCIENTIFIC PAPER

**More than ten years have passed since the introduction of market relations in the electricity sector in Europe. Bearing in mind the fact that reform of electricity sector was initiated with practically no previous experience and without prior understanding of all the problems that could be encountered in the process, it will be interesting to see which goals and to what extent were realized, what are the accompanying results and total perspectives for further reform in this capitally-intensive sector, important for the economy of any country. The paper aims to show in an objective manner both positive and absent segments in the development of the electricity market in Europe and to present some open issues, which will significantly determine further development of the electricity sector.**

*Key words:* electricity, market, goals, achievements, experiences, perspectives

## 1. INTRODUCTION

In view of the fact that some ten years have passed since the introduction of market relations in the electricity sector in Europe, it is time to recapitulate the achievements and define the perspectives of electricity market. Historically, Chile is the first country in the world which initiated the market liberalization process in the energy sector and opening of electricity market in 1978. The reform of electricity sector in New Zealand began in 1987. England and Wales made the first step in deregulation in Europe by adopting the Electricity Law in 1989, which was followed by Argentina (1989), Norway (1990), Australia and Peru (1993.), California, Bolivia and Colombia (1994), etc.

In the EU reform formally began in 1996 by announcement of the first liberalization package, which referred to electricity and natural gas. The package included Directive 96/92/ EC concerning common rules for the internal electricity market, which became effective on February 19, 1997. The second liberalization package followed in 2004, which included electricity, natural gas and security of supply, i.e. Directive 2003/54/EC concerning common rules for the internal electricity market (applicable since April 1, 2004), Regulation 1228/2003 on conditions for access to the network for cross-border exchange in electricity (applicable since July 1, 2004) and Directive 2005/89/EZ concerning measures to safeguard security of electricity supply (applicable since February 24, 2008). Proposal of the third liberalization package was prepared in 2007 and is currently under discussion.

Almost all countries in Europe are today at the end of the unbundling of activities and complete market opening process. However, since the reform was initiated practically without any previous experience and prior understanding of all the problems that could be

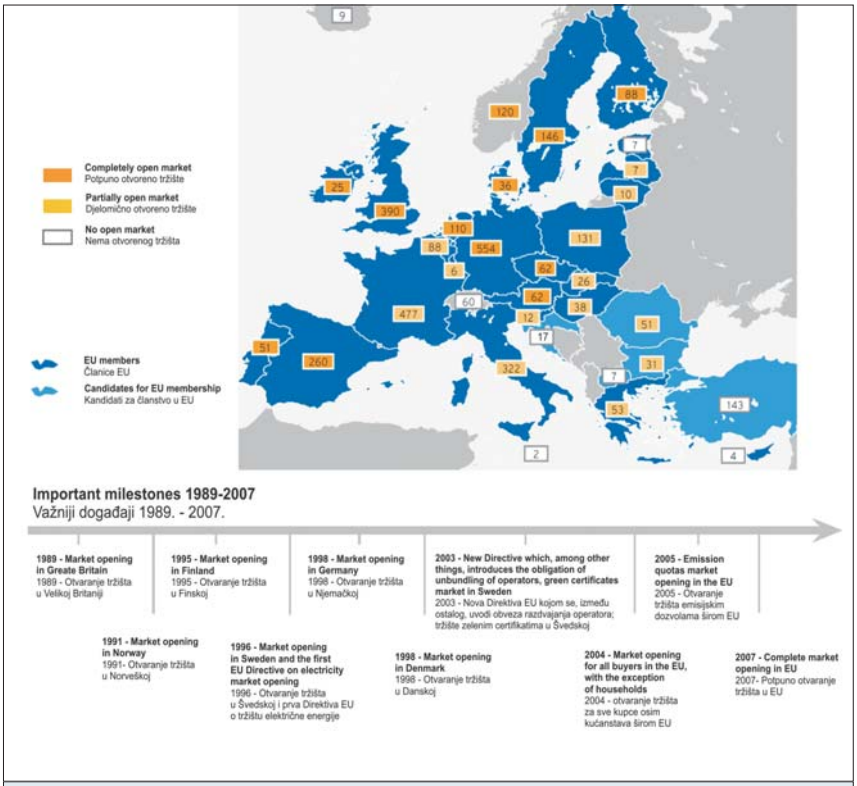


**Fig. 1. Important milestones in electricity sector in Europe in the 1989 – 2007 period**
Sl. 1. Važniji događaji u europskom elektroenergetskom sektoru u razdoblju od 1989. do 2007.

**Table 1. The main aspects of transformation of a monopoly into open competition[6]**

| Monopoly | → | Open market |
|---|---|---|
| Oriented towards supply conditions | → | Oriented towards consumer |
| Provides energy at best possible security | → | Maintains network stability and maximizes profits |
| Starts from costs and moves to full price, including ensuring of profits | → | Starts from market price and goes downwards, risking to lose profits |
| Vertical structure and state control | → | Several competitors and new private key players in competition |
| One supplier | → | Free access for third parties |
| National supplier | → | International supply business |
| Engineering | → | Finances |
| Network maintenance | → | Network optimization |
| Active network development | → | Reactive network development |
| Integrated system development | → | Individual activities development |
| Costs | → | Turnover and revenues |
| Consumers of known behaviors | → | New consumers |
| Approval of tariffs | → | Market-based price determination |
| Opposition to risks | → | Risk management (Price/Size/Predictions/Loan) |
| One year plan (transparent) | → | Production life costs (without clear transparency) |
| Budget | → | Profit |
| Human resources management | → | Property management |

encountered in the process, after a ten year experience it will be interesting to see which goals and to what extent were realized, what are the accompanying results and total perspectives for further reform in this capitally-intensive sector, important for the economy of any country. The following figure chronologically lists some important milestones in the electricity sector in Europe in the 1989 – 2007 period (total consumption of electricity (TWh) in 2007 by country is shown in squares).

## 2. WHAT WILL THE ELECTRICITY MARKET BRING?

Transformation of a monopoly into an open market implies a change in many business principles in the electricity sector. The following table briefly describes the main changes that accompany it.

During formation of electricity market design, differentiation should be made between market structure and organization. Market structure includes market characteristics, such as: technological characteristics in production and transmission, ownership relations, level of regulation, cost structure... Market organization includes "submarkets" and their defined and hidden connections. Organization of an individual market should be adjusted to its structure. At present markets can be divided according to three criteria: time for delivery of goods (prompt and futures market), manner of trade (bilateral market and exchange), manner of delivery of goods (physical and financial). In addition to electricity market design, new environment implies appearance of other accompanying markets: ancillary services market, energy balancing services market, green certificates market, emission quotas market, etc.

## 3. REASONS FOR IMPLEMENTATION OF ELECTRICITY MARKET

The initial reasons for introduction of the market implied:

1. higher power quality,
2. lowering of prices,
3. introduction of new technologies,
4. higher system efficiency,
5. system sustain ability.

Almost 10 years have passed since the implementation of electricity market in Europe, which is too short to be able to reach final conclusions, but quite sufficient to observe the first results of market implementation.

**The first reason for market implementation** is higher power quality. Generally speaking, higher quality of delivered electricity can be obtained under market conditions, but at considerably higher price. Accordingly, it can be said that the market did not initially increase the quality of delivered electricity, but enabled the purchase of higher quality of delivery.

**The second reason for market opening** is lowering of electricity prices, which was achieved. Detailed analyses indicate that in the 1995-2005 period average electricity prices in the EU-15 countries were by as much as 15% lower in real value in comparison with other energy sources (Figure 2).[13] More specifically, in the 1995-2001 period prices in electricity sector fell by 21% on average in real value, i.e. by 13% in nominal value, which implies equal nominal value of average prices in 1995 and 2004 in spite of by 4 - 11% higher taxes and other dues. In other words, in the period under review inflation was considerably higher than increase in electricity prices. After review of prices by country it can be concluded that

in the price period under review the prices in Europe converged towards a uniform amount.

**The third reason for market opening** - introduction of new technologies as a consequence of the market is completely absent. Namely, in view of introduction of competition, all energy undertakings try to maximize the utilization of existing capacities, but due to market dynamics and long time of return on investments, all investments, particularly into new technologies, without experiential results are becoming more risky.

If the first reason for market opening was absent (higher quality of electricity), **the fourth reason** – higher system efficiency, e. operation of electricity undertakings, was undoubtedly achieved, in technical sense (lower losses, more efficient management of capacities, development based on technical and economic criteria, etc.), in organizational sense (outsourcing of secondary activities, unbundling of activities, redefinition of individual organizational units, etc.), as well as in staffing sense (optimization of employee numbers in individual organizational units, higher responsibility at all levels, ongoing staff training, etc.). It is confirmed by real lowering of average electricity prices in spite of higher prices for other energy sources. Moreover, in spite of the mentioned real general decrease in electricity prices, accompanied by increasing prices for other energy sources, all large electricity companies in Europe earned record profits in the preceding period (Figure 2).[2]

**The fifth reason** – system sustain ability cannot yet be evaluated in full due to relatively short period since market opening. However, it is evident that it is a key reason and ultimate goal for introduction of market relations in electricity sector.

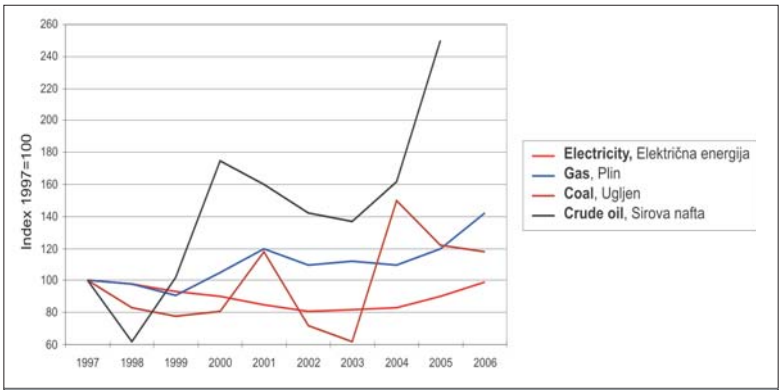


**Fig. 2. Fluctuation of average prices for energy sources in the EU-15 in the 1997-2006 period**
Sl. 2. Kretanje prosječnih cijena energenata u EU-15 u razdoblju od 1997. do 2006. godine

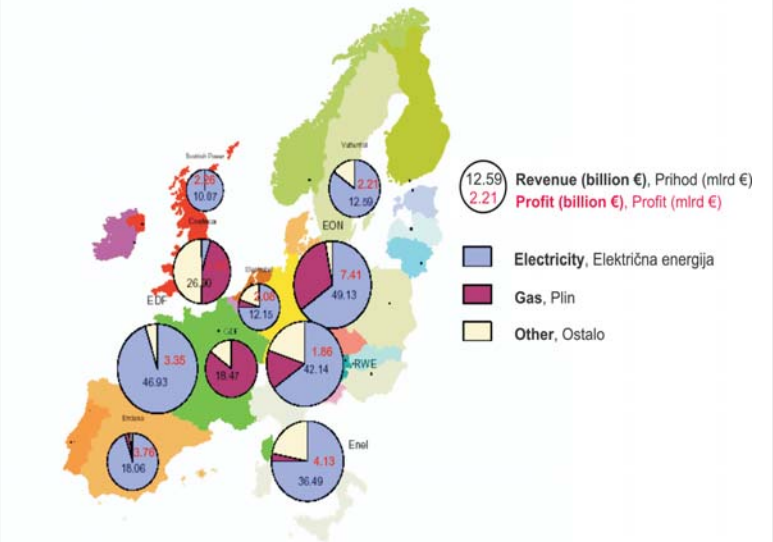


**Fig. 3. Revenues and profits of electricity undertakings in 2005 in billion €**
Sl. 3. Prihodi i profiti elektroenergetskih tvrtki u 2005. godini u milijardama €

## 4. MAIN CHARACTERISTICS OF ELECTRICITY MARKET

The main characteristics of electricity market will be illustrated though a function of transmission system operator (TSO) as the key subject for realization of market conditions. The following applies in a monopolistic environment:

1. Centralized monitoring and control of all electricity system elements by TSO, let's call it a *„sum of optimums"*;
2. Production, transmission, distribution and supply are vertically integrated and coordinated:
   a) knows the production cost in advance;
   b) defines the engagement of electrical power plants;
   c) supply of electricity is centralized and predictable for;
   d) TSO contracts cross-border exchanges;
   e) actively participates in the selection of locations and capacities of new power plants.

On the other hand, in the new market environment:

1. TSO does not define the engagement of electrical power plants;
2. TSO does not know the price offered for engagement;
3. TSO does not contract cross-border exchanges;
4. TSO does not monitor the supply;
5. TSO does not select the location and capacities for construction of new power plants;
6. TSO guarantees non-discriminating access to the network, system security and reliability, at limited (regulated) funds.

Therefore, in market environment applies a principle that generation, transmission, distribution and supply are unbundled and have individual optimums:

1. Producers are independent and want to sell energy at high price,
2. Suppliers are independent and want to buy energy at low price,
3. Traders are independent and want to make profit on resale,
4. Buyers are interested in cheap and high-quality energy,
5. System operator must:
   a) ensure a non-discriminating combination of all aspects – "*sum of optimums*",
   b) ensure security and reliability of the system,
   c) at limited (regulated) funds.

It is evident that introduction of market relations significantly complicates the role of transmission system operator and general functioning of the system. Besides, it is accompanied by a whole series of other opposing requirements which appear after the introduction of market relations in electricity sector, such as:

1. minimizing of costs → maximizing of profits (total profit vs. unprofitable investments, for example in rural areas);
2. daily (hourly) market → long-term construction process;
3. energy balance → eligible customers and commercial contracts;
4. laws and state boundaries (of operators) # rules and market boundaries;
5. open market → treatment of losses and network utilization fee (*post stamp*);
6. cost of delivered energy vs cost of undelivered energy;
7. cross-border exchange with differing methods for allocation of capacities;
8. higher security (larger number of subjects) or lower security (higher risks);
9. system growth → higher security requirements;
10. newly established regulators vs. powerful companies.

The electricity system is an exceptionally complicated technological system. As in almost no other technological system we encounter a whole range of complex requirements, necessary for normal functioning of the system and for high-quality electricity supply. Namely, electricity cannot be stored in any considerable amount, consumption of electricity within the system varies every moment, and production and consumption capacities must be balanced at all times. If we add to it specific requirements for functional form of frequency and voltage, it is obvious that electricity system management represents a complex series of activities. It is evident that the market in such environment cannot be compared with the market of standard goods and services.

Having in mind that in an open market each participant has his own goal function, we can generally say that open market in electricity as a goal function has „benefit to the society". Opinions often vary when the term benefit to the society is defined. It is usual in economy to define this term as a sum of total benefits for all participants on the market. Let us use c for cost of electricity and W as amount of electricity. Producer's benefit is calculated as a difference between sales revenue and electricity production costs:

$$DP = c_{market} \cdot W_g - c_{production} \cdot W_g$$

where:

$c_{market}$ - electricity market price
$W_g$ - amount of produced electricity
$c_{production}$ - electricity production cost

By the same analogy, benefit to the consumer (buyer) is calculated as a difference between revenues from utilization of electricity $W_p$ and costs for supply of electricity:

$$DK = c_{utilization} \cdot W_p - c_{market} \cdot W_p$$

where:

$c_{utilization}$ - revenue from utilization of electricity,
$W_p = W_g - W_{losses}$ - amount of received (used) electricity is the amount of produced electricity minus losses.

Consequently, total benefit on the market, i.e. benefit to the society (*ODK*) is equal to the sum of all benefits:

$$ODK = \sum_i DP_i + \sum_j DK_j = \sum_i (c_{market} \cdot W_g - c_{production} \cdot W_g)_i + \\ + \sum_j (c_{utilization} \cdot W_p - c_{market} \cdot W_p)_j$$

The previous relation written differently looks like this:

$$ODK = \sum_j (c_{utilization} \cdot W_p)_j + c_{market} \cdot \left[ \sum_j W_p - \sum_i W_g \right] - \\ - \sum_i (c_{production} \cdot W_g)_i$$

If we introduce further simplifications:

- electricity losses in the system are disregarded:
$W_p = W_g - W_{losses} = W_g - 0 = W_g$

-
$$c_p(W) = \sum_j (c_{utilization} \cdot W_p)_j$$
$$c_g(W) = \sum_i (c_{production} \cdot W_g)_i$$

where:

$c_p(W)$ – total benefit for all buyers (total consumption),
$c_g(W)$ – total benefit for all producers (total production).

we obtain a simple expression for goal function, i.e. benefit to the society:

$$ODK = c_p(W) - c_g(W)$$

Determination of this function's maximum requires the calculation of derivation $c_p(W)$ and $c_g(W)$.

$mc_p(W) = \mathrm{d}c_p(W)/\mathrm{d}W$ is marginal benefit for buyers, which shows how much benefit for buyers has increased per unit increase of load, and $mc_g(W) = \mathrm{d}c_g(W)/\mathrm{d}W$ is marginal benefit for producers, which shows the extent of increase of benefits for producers per unit increase of production.

Therefore, total benefit on the market can be calculated as:

$$ODK = \int_0^W mc_p(x)dx - \int_0^W mc_g(x)dx$$

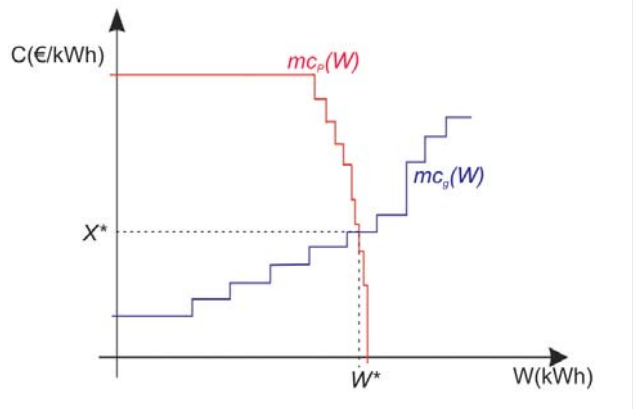


**Fig. 4. Determination of maximum point of total benefit to the society on electricity market**
Sl. 4. Određivanje točke maksimalne ukupne društvene vrijednosti na tržištu električne energije

It is obvious that with the increase of value $x$ in the upper integral, the value of function benefit to the society increases as long as $mc_p > mc_g$. After the function maximum is achieved in point $x^*$ it follows that $mc_p < mc_g$, and the function of benefit to the society begins decreasing, as shown in the following figure.

As mentioned earlier, disagreements about definition of the term benefit to the society can be used here to dispute such definition of the most favorable point for electricity market functioning. Since it is frequently not very simple to evaluate other aspects of wider benefits to the society (for example protection of the environment, preservation of work posts, strategic interests, etc.), only the function directly measurable by money on the market is accepted here as benefit to the society, while above described disregarded issues are willingly accepted.

Electricity, which had so far been available to everybody at all times, now becomes a market product. At the same time, legislators are obviously introducing special requirements for market functioning, which restrict a fully open market by preserving the following specific characteristics of electricity, which are at the same time the main (but not all) imperfections of the electricity market:

1. limited transmission capacity,
2. necessary security of supply,
3. obligation to provide a public service,
4. simultaneous production and consumption (balancing),
5. intermittent nature of some sources and higher ratio of certain types of sources,
6. trade restrictions,
7. market power,
8. possibility for manipulation in case of congestion,
9. treatment of losses,
10. ineffective participants on the market,
11. inherited costs.

Due to prescribed length of this paper, the problem of limited transmission capacity will be described briefly.

### 4.1. Limited transmission capacity

So far electricity systems in European countries were mostly constructed on the basis of self-sufficiency, and connections between states were used to ensure security and stability of operation, in case of intervention assistance and for limited exchange of electricity. We can estimate at present that they are insufficient for a fully open market, which results in congestion. Having in mind that transmission activity is regulated, i.e. that it is financed by consumers in the country, the problem arises with regard to financing of connections between the states, which are mostly used for realization of transactions of third countries. The example of the most developed European markets shown in the following figure makes it possible to conclude to what extent transmission capacities between the states allow import, i.e. restrict possibilities for development of electricity markets.

### 4.2. Security of electricity supply

In spite of market opening, every state must continue to take care to regulate electricity supply in such a manner to protect certain public interests and public goods. For example, it is necessary to guarantee supply of electricity of certain quality to all households at reasonable prices, since in spite of market implementation, life without electricity cannot be imagined. Therefore, it is in the public interest that all inhabitants have available electricity (in difference from others, previously regulated but nowadays market sectors: telecommunications, transport, etc.). Naturally, it additionally impairs „openness“ of the market, but guarantees security of supply. For the first time Directive 2003/54/EC introduces a notion of „universal service“, which implies the right to be supplied with electricity of a specified quality within a specified territory, at reasonable, easily and clearly comparable and transparent prices. The universal service is provided to households and, when the EU member state considers it necessary, also to the category of small enterprises. The term „supply of last resort“ is also introduced for the first time, implying supply to those customers who have not selected their supplier on the market, or whose supplier stopped operating. In that manner absence of electricity supply due to formal lack of supplier is prevented. Consequently, although electricity market is introduced, special attention is directed at security of supply of the most vulnerable, but also most numerous categories of consumers which cannot follow market activities and react in due time, which can represent a certain deviation from a theoretically ideal market.

### 4.3. Obligation to provide a public service

Obligation to provide a public service implies the provision of certain services of public interest in the electricity sector. It is obvious that such services need not be necessarily provided only on the basis of market mechanisms and in the interest of general public the State may assign (impose) certain services on the market to individual undertakings. Obviously, a public service can include a large part of the market and a question is justifiably raised to what extent and how public service has to be prescribed. Definition and manner of assignment of public service is prescribed in European directives and ac-

cepted by all member states, which is in a way a deviation from an ideal market.

### 4.4. Simultaneous production and consumption of electricity

Electricity cannot be efficiently stored in any significant amount. In other words, electrical system is one of the most technologically complex systems and requires simultaneous production and consumption at all times. If we add other specific physical characteristics and requirements for the quality of supplied electricity (voltage, frequency, dynamic and transient system stability, etc.), it becomes evident that due to physical reasons electricity can be treated neither as a standard market good nor as service.

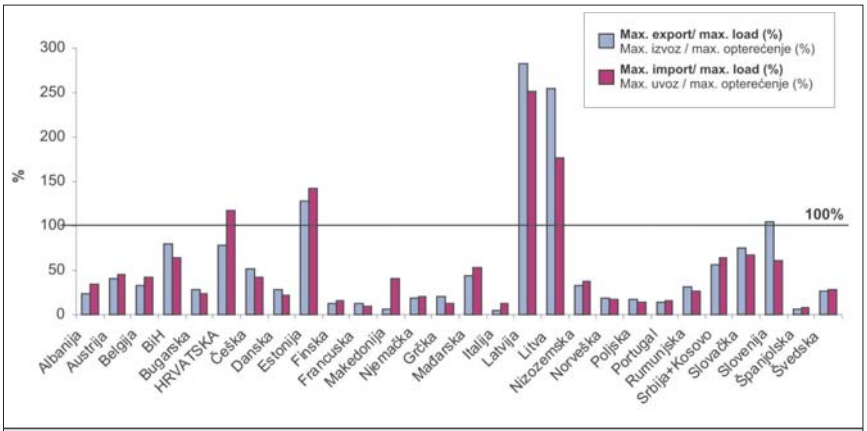


**Fig. 5. The ratio between available cross-border transmission capacities and peak loads in some European countries**
Sl. 5. Omjer raspoloživoga prekograničnog prijenosnog kapaciteta i vršnog opterećenja po pojedinim europskim zemljama

### 4.5. Eligibility of some electricity producers

An important element which restricts a completely free market is the role of renewable energy sources and efficient cogeneration. Namely, the European directives on renewable energy and cogeneration prescribe, and the national legislation adopt, that all producers using renewable energy sources and efficient cogeneration, have a status of eligible producers which can convey their production into the network before other conventional producers. In other words, eligible producers have not only priority in engagement, but can convey all their energy into the system. Regardless of the initial reasons for introduction of such solution, and regardless of the relatively small ratio of renewable sources at present, such condition may considerably affect market activities. If we add to it the official European Commission plans on 20% percentage of renewable sources in production of electricity with regard to total consumption in Europe in 2020, as well as intermittent nature of such sources, it is clear that eligibility of renewable sources and efficient cogeneration represents a major blow to the completely free market.

### 4.6. Restrictions in electricity trade

Implementation of bilateral electricity market implies that all buyers on the market do not have a possibility to find their own supplier individually, which is an obvious deviation from an ideal free market. Besides, examples of setting a maximum permitted price cap also represents a certain restriction of an ideal market. The main justification for such approach is supervision and control of market power misuse, which will be discussed later. Additionally, due to exceptional importance of electricity sector for any country, by this mechanism the State (or its representative – a regulatory agency) controls the market price, which is certainly a restriction and deviation from an ideal market. Namely, if the set price cap is lower than the market price, the market will not reach an equilibrium where maximum benefit to the society is achieved.

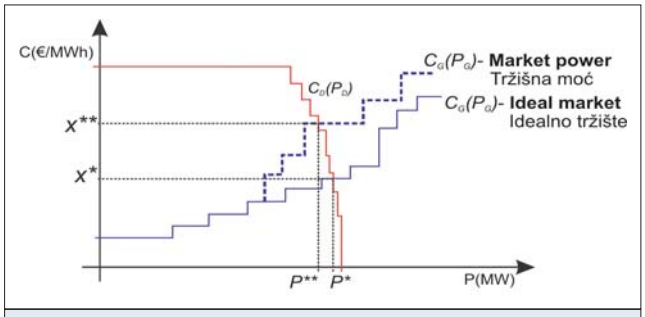


**Fig. 6. Influence of market power on market price formation**
Sl. 6. Utjecaj tržišne moći na formiranje tržišne cijene

### 4.7. Market power

Considering the inherited organizational structure of electricity sector from the time of vertically integrated companies and in view of globalization process, only several large companies dominate the electricity market. The term market power is generally defined as a status of market participant (most often producers, but consumers as well) which due to their market share can directly influence market price formation in such measure which is sufficient to increase their profit at the expense of total benefit to the society.

Reduction of delivered electricity P**<P* eliminates other competitive producers, which would realize certain profit on an ideal market, and at the same time market price increases x**>x*.

### 4.8. Possibility for manipulation in case of congestion

For some undertakings possibility for manipulation when congestion occurs implies realization of additional profit earned due to such congestion. The simplest example of competitive market and influence of congestion is shown in the following figure.

Let us examine characteristic values in two situations: 1) power flows and electricity price without congestion in

connecting line and 2) power lows and electricity price with occurrence of congestion in the connecting line (transmission limited to 50 MW).

In the first case the two cheapest generators (A and C) will convey their total production, as shown on the following table. However, with appearance of congestion, i.e. limitation of transmission to 50 MW, allocation of production units considerably changes, resulting in change of electricity price. Let's take a theoretical example: when congestion occurs, the level of consumption is infinitesimally higher than the sum of maximum allowed productions of the two cheapest generating units, i.e. 50 MW allowed due to limitations in transmission from electrical power plant A and total production of 150 MW from electrical power plant C; because of that, it is necessary to minimally engage the most expensive electrical power plant (P(B)=0+). Due to such minimal engagement of the most expensive electrical power plant, marginal (market) price will be defined as production cost of the most expensive engaged electrical power plant (50 €/MWh), regardless whether this power plant produces 0.01 MW or 1000 MW.

This basic example illustrates two seemingly illogical phenomena, which are directly at the expense of the consumer. First, it is obvious that in the case of congestion with minimum engagement of the most expensive power plant (P(B)=0+ MW) the consumers must pay for all energy at the price of the most expensive power plant ($c_B$=50 €/MWh), although the remaining part of energy is available at twice lower price ($c_C$=25 €/MWh). Second, total costs for consumers in case of congestion are several times higher than the relevant production costs.

Therefore, in case of congestion marginal market price results in costs for consumers which are significantly higher than production costs. Furthermore, it is obvious from this example that due to congestion production costs increase only by 50 €/h (from 7 300 €/h to 7 350 €/h), while the costs for consumers at the same time increase by as much as 5 000 €/h (from 7 500 €/h to 12 500 €/h), or 100 times more. In other words, consumers pay about 100 times higher price than is the cost of relevant problem's solution. This illustrates how a significant deviation from an ideal market can result from network congestion.

## 4.9. Treatment of losses

As almost on no other market, on its way from the producer to the consumer electricity travels through a technologically complex common monopolistic infra -structure (electrical network), where it is technically very complicated to define exact paths of individual transactions. Because of that, it is difficult to define the amount of losses caused by individual transactions. Concrete treatment of electricity losses in the network would imply that every participant on the market should cover a part of losses caused by his transaction. Physical laws are such that even when we know the producer's and buyer's node and the amount of analyzed transaction, it would be very difficult to determine accurately the amount of electricity losses caused by the relevant transaction. Besides their nonlinear nature, losses assigned to transaction under review are considerably affected by

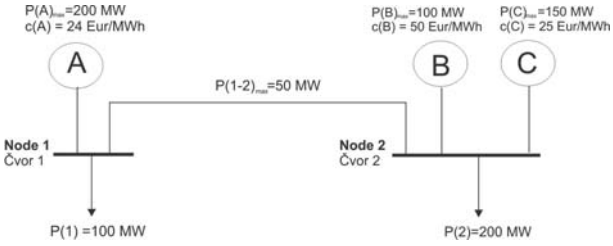


**Fig. 7. Example of electricity system with two consumers, three competitive producers and limitations in transmission network**
Sl. 7. Primjer elektroenergetskog sustava s dva potrošača, tri konkurentna proizvođača i ograničenjem u prijenosnoj mreži

other transactions as well. In proportion with the losses, it should be determined to what extent a particular participant uses the electricity network, and what should be his participation in coverage of other losses for network utilization. Such approach leads us to marginal costs of the location, different for each node, by which the incurred costs are allocated more justly and send better signals for economically justifiable investments in the construction of new facilities, but at the same time results in absence of construction and development in areas with unfavorable marginal prices of the location, causing absence of development in other branches of economy in these areas. Introduction of marginal prices of the location for electricity is the best illustration of the clash between market-based and social concept of electricity.

## 4.10. Inefficient participants on the market

Inefficient participants on the market also represent a deviation from an ideal market. They include those participants who intentionally fail to maximize their profit (for example, at the time when increase of prices is expected on the market, accumulation hydroelectric power plants generate electricity instead of accumulating water, or for example buyers who due to inertness and other subjective reasons do not choose the most favorable supplier). By inadequate maintenance methods and system development even monopolies (for transmission and distribution of electricity) can become inefficient participants on the market, which is the gravest form of market influence. Although such participants represent a relatively small share on the market, they have to be mentioned. Under certain circumstances they can significantly contribute to characteristics of electricity market which are far from ideal.

## 4.11. Stranded costs

Inherited costs or stranded costs affect those public companies that will not be able to achieve return on investment (investment, contractual and other costs) due to changed operating conditions after opening of electricity market. Previous conditions for operation of electricity sector included monopoly in production, transmission

**Table 2. Costs in the system under review with and without congestion**

| | Production (MW) | | | Production cost (€/h) | | | Producer's costs (€/h) |
|---|---|---|---|---|---|---|---|
| | A | B | C | | Node 1 | Node 2 | |
| | $c_A$=24 €/MWh | $c_C$=25 €/MWh | $c_B$=50 €/MWh | | $P_1$=100 MW | $P_2$=200 MW | |
| **Without congestion** | 200 | 100 | 0 | 7300 | 25 | 25 | 7500 |
| **Limitation to 50 MW** | 150 | 150 | 0+ | 7350 | 25 | 50 | 12 500 |

and supply of electricity on the territory of a country or region. In return, electricity companies had the obligation to supply electricity to all consumers on the territory and implement a policy of energy development prescribed by the state administration. In that sense, electricity companies had to make certain investments that they would not have made in case of operation under market conditions. However, all costs incurred by public companies cannot be considered as stranded costs after transition to operation under market conditions. For example, costs of mistakes in planning of new capacities, inefficient operation, disputes between the management and workers, bad financial planning, etc. should not be classified into this category. An additional problem is the fact that electricity sector is a capitally-intense activity with long periods of return on investments and long production life of equipment (it is estimated that in Europe investments in electricity sector up to 2030 will reach 1 000 billion €).

## 5. ELECTRICITY MARKET ACHIEVEMENTS

Although in Europe the process of electricity market opening officially began in 1997, it is clear that it has not been completed after more than 10 years.[3,4,5,10] Moreover, it is quite clear now that at the beginning of this unavoidable and irreversible process its originators had no clear understanding of the results and relevant time scales. In other words, lack of clear and uniform vision on final form of market functioning is a significant problem observed during development of market relations in the European electricity sector. More specifically, after several years of monitoring and analyzing the European electricity sector activity in the previous period, when implementation of electricity market was attempted by issuing a large number of directives and through large investments, we can draw the following conclusions:

1. Electricity system has many specific characteristics, which prevent the implementation of an ideal open electricity market;
2. There is no single vision for development of electricity market in the EU with sufficiently strong mechanisms for its implementation. The strategy for introduction of a single electricity market in several steps did not achieve the expected results; a new phase was suggested in answer to the problems of market implementation, but it was not applied in full, and sanctions for non-implementation have been practically absent so far;
3. Contrary to the set goals, national monopolies were replaced by new private mega-monopolies – oligopolies;
4. Countries in transition in East and South East Europe have most often implemented three processes simultaneously: restructuring, market opening and privatization. The realized privatization price of distributing companies ranged from 80-250 €/by measuring point (buyer) (as an illustration, such price is lower than the connection fee for supply of only 1 kW to a new consumer in Croatia);
5. A large majority of buyers do not take advantage of their right to select another supplier (cumulatively since market opening, less than 20% of all buyers on average by country have changed their supplier). The most frequent reasons are:
   a) lack of interest due to relatively low electricity costs (on average 20-39 €/month in the EU), and
   b) absence of real competition in supply activity.[1] This throws into doubt the point of competition and market implementation;
6. In 2005 the share of foreign suppliers on national markets amounted to less than 20%, and exchange of electricity between countries was only about 8% of total produced electricity;[2]
7. Differences in organization and operation of markets between member countries are significant, and functioning of a single European market is still unrealistic;
8. EU wants to implement a single open electricity market in the conditions when institutional relations between member countries are still unresolved;
9. So far EU has not taken as a problem the ownership relations and their impact on final market development, although it is evident that as a rule unclear ownership relations result in negative impacts on the market;
10. The question of supply security has not been raised seriously until recently;
11. There is a big discrepancy between long periods of return on investments in the system and dependence of project profitability on everyday market risks. The

result is absence of necessary activities and delay in construction of minimally required transmission and production capacities, which jeopardizes security of supply;

12. More extensive integration of renewable sources into the system (20% planned by 2020) through a system of incentives jeopardizes market foundations by favoring one group of market participants;
13. Introduction of greenhouse gases emission quotas reduces the possibility for market development, i.e. for production of electricity to satisfy the demand in other countries. Markets for trade in emission quotas are developing sporadically in some countries and integrated approach is again absent.

It has to be particularly emphasized that today almost no EU member country has fulfilled the requirements of the second liberalization package from 2004 in full and within the prescribed time frame. The European Commission in 2006 initiated court proceedings against 20 member countries, most often for the following reasons:

- Appearance of market power, access to the network for a third party,
- Vertical integration (all activities from the producer to the buyer are under the same ownership, organizational and management structure),
- Insufficient market integration,
- Insufficient transparency,
- Problems encountered during change of supplier.

Agreement on establishment of energy community, by which 9 countries from the region together with EU member countries formed a single regulatory energy region has been in force since 2006. By this Agreement countries from the region accepted the EU *acqui communitaire* in the sphere of electricity, natural gas and renewable energy sources, protection of the environment and market competition, which represents a legal frame for establishment of market relations and integration of the region into European energy market. However, in the South East European region electricity is still a social category, which implies low tariffs and problems in collection of payments. If we supplement it by lack of domestic production (high imports) in most countries in the region, it is clear that market implementation in the region will be a demanding job. In addition, main problems related to market implementation are:

- Regulations are not harmonized → non-uniform market,
- Insufficient unbundling of regulated and commercial activities,
- Transmission system operators in almost all countries are independent entities, but still operate as before unbundling,
- Discriminating approach for access of third parties to the network,
- Problems encountered during change of supplier,
- Insufficient authority and independence of regulators, particularly with regard to tariffs for access to the network, etc.

Finally, based on all above considerations it is obvious that measures undertaken to date, expressed through legal, financial and technical framework, have only partly created the preconditions for open electricity market development in Europe. These measures can be considered necessary, but insufficient for open market implementation and for establishment of necessary security of supply and uniform responsibility. Disruptions in supply and disintegration of the system result in economic, safety and political consequences. Implementation of the open market, most often as a possibility rather than a realistic option, progressed slowly so far and was accompanied by strong opposition of the main participants.

Based on all above considerations and on practical applicability of the market, it seems that in the course of electricity sector development the basic issue remained unresolved:

*Is introduction of electricity market a goal or means for realization of economic and energy policy goals?*

Analysis of the activities and experiences to date[8,9,12] clearly indicates that implementation of the market has so far been treated as a goal, and not as means. Moreover, dissatisfaction with achieved results in the EU was solved by enactment of new directives, while nonobservance of existing directives did not result in adequate and quick sanctions. In addition, the European Union has not implemented neither economic nor energy (nor political) integration, since the common market was not replaced by a single market. Without integrated production and development resources the EU quite certainly will not be able to parry globally the USA, Russia, and very soon China and India. Consequently, another important question is frequently raised:

*Will an open market solve all the problems or maybe open markets do not bring anything new but reduce security of supply?*

According to current experience it can be concluded that the concept of an open energy market can satisfy some goals, such as: reasonable price, possibility of choice and efficiency of operation, but other goals, such as higher quality of electricity, higher security of supply and introduction of new technologies cannot definitely be achieved by market alone, but must be under the competence and responsibility of countries.

## 6. PERSPECTIVES OF ELECTRICITY MARKET

It is quite clear that opening of electricity market is an irreversible process without alternative. Competition is the best motif for higher efficiency and guarantees electricity sector sustain ability.

But, in many ways the speed of market development in the EU will depend on resolution of mutual institutional relations. The following can be expected in the process:

- Total ownership unbundling of activities, unbundling of supply and production from the network;
- Higher transparency at the level of transmission and distribution system operators;

- Considerable efforts for maintenance of supply security and assignment of uniform responsibility;
- Narrowing of a wide gap between long period of return on investments in the system and dependability of the project on everyday market risks;
- Significant integration of renewable sources into the system (planned 20% by 2020) through a system of incentives (which is on the other hand contrary to ideal market);
- Regulation of the greenhouse gases system, which reduces market development, i.e. production for requirements of third countries;
- Bigger authority and independence of regulatory agencies;
- Stronger mechanisms for cooperation between regulators and between operators;
- A series of new court proceedings of the European Commission against member countries, especially through competition rules; a new series of privatization processes and continued emergence of oligopolies.

Perspectives of EU electricity market will considerably depend on the final version of the 3rd liberalization package of rules, whose proposal from January 2007[7] states that:

1. Ownership unbundling of is a rule, and independent system operator (ISO) is an exception;
2. If this requirement is not observed, the European Commission may appoint an for a period of 5 years;
3. The same model applies to electricity and natural gas transmission systems;
4. The current unbundling model remains applicable for;
5. Open possibility for establishment of supranational.

In 2007 France and Germany, alongside with Austria, Bulgaria, Greece, Lithuania, Latvia and Slovakia opposed the initial proposal and prepared an alternative one under the name "Third path", which allows TSOs to remain under the ownership of a vertically integrated company. However, in April 2008 the European Parliament's ITRE Committee refused the ISO model and "Third path", and the only option, which will be submitted for parliamentary procedure, is ownership unbundling of TSOs from other energy activities. Perspective for development of electricity market can be evaluated on the example of a case from 2008 when E.ON as the largest electricity company in Europe agreed to sell the transmission network and 20% of production capacities in exchange for termination of anti-trust investigation conducted against E.ON by the European Commission. A similar proceeding is now announced for RWE.

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