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AN ANALYSIS OF THE SOUTH EAST EUROPE ELECTRICITY MARKET

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ABSTRACT
South East European (SEE) power system has never been connected in unified parallel operation until October 2004. Untill 1995 Hungary, Slovakia, Czech Republic and Poland (CENTREL) as well as Romania and Bulgaria were not part of the UCTE grid. Due to war damages in the region in 1991, Serbian, Montenegrin, part of Bosnian, FYR Macedonian, Albanian and Greek power systems, in addition to Romanian and Bulgarian, were separated from UCTE and in island operation (2nd synchronous UCTE zone). In October 2004 UCTE reconnection was done and power system conditions in SEE dramatically changed. At the same time power utilities in the region enter deregulation and privatization process. Due to post-socialistic collapse of industrial consumption, SEE is characterized by surplus of installed generation capacities. Relatively cheap electricity from SEE became a great market opportunity. In that sense it is interesting to analyze creation of the energy market in SEE region. The paper gives an overview of electricity market in the region and it discusses advantages/disadvantages of regional market, gives some results of the long term generation and transmission development planning study for the SEE region (GIS study) and analyse influence on regional security of supply.

KEY WORDS
Power Market Regulation, Security of Supply, SE Europe

1. Introduction

Since October 10, 2004 at 10:00 hours, when UCTE grid reconnection was completed, for the first time in history all of continental Europe has become a single synchronous electricity area with 450 million people in 22 countries, and annual consumption of electricity of approx. 2.300 TWh, being one of the two biggest areas in the world. In parallel with UCTE reconnection, after decade of political and economical turbulence regional countries in SEE agreed to create a stable common regulatory and market framework capable of attracting investment in gas networks, power generation and transmission networks, so that all countries have access to the stable and continuous gas and electricity supply that is essential for economic development and social stability. Due to numerous discrepancies in energy sectors among the countries, the mission of common regional energy market is facing lot of challenges.

2. Energy Community

The SEE Energy Regulatory Process was launched by the signature of the Memorandum of Understanding on the Regional Electricity Market in South East Europe and its Integration into the European Union Internal Electricity Market [1]. As a result the Internal Market for Network Energy (electricity and natural gas) will be extended into the Balkan Peninsula as a whole.

Improving the balance between energy supply and demand is crucial to boost and sustain economic development in SEE. It also means that countries should be prepared to draw fully on the substantial gains which can result from energy trading among themselves and with their neighbours. This requires a strong commitment by the countries of the region towards market oriented reforms in order to: improve overall energy conservation and efficiency, reduce an excessively high energy intensity of production compared to international standards, strengthen national institutional capacities and adapt legislation and regulation to EU norms and practices.

Energy Community includes territories of the Republic of Albania, the Republic of Bulgaria, Bosnia and Herzegovina, the Republic of Croatia, the former Yugoslav Republic of Macedonia, Serbia, Montenegro, Romania, and the United Nations Interim Administration Mission in Kosovo (UNMIK) pursuant to the United Nations Security Council Resolution 1244. Austria, Italy, Hungary and Slovenia as neighbouring and influenced countries to this region have a status of Participant. Turkey is still in negotiation process. Moldova and Norway have a status of Observer. Development of the Regional Energy Market is coordinated by the European Commission.

The task of the Energy Community is to organise the relations between the countries in the region and create a legal and economic framework in relation to Network Energy in order to:

(a) create a stable regulatory and market framework capable of attracting investment in gas networks, power generation, and transmission and distribution networks, so that all parties have access to the stable and continuous energy supply that is essential for economic development and social stability,
(b) create a single regulatory space for trade in Network Energy that is necessary to match the geographic extent of the concerned product markets,
(c) enhance the security of supply of the single regulatory space by providing a stable investment climate in which connections to Caspian, North African and Middle East gas reserves can be developed, and indigenous sources of energy such as natural gas, coal and hydropower can be exploited,
(d) improve the environmental situation in relation to Network Energy and related energy efficiency, foster the use of renewable energy, and set out the conditions for energy trade in the single regulatory space,
(e) develop Network Energy market competition on a broader geographic scale and exploit economies of scale.

3. Brief Description of the Relevant Countries

This paper deals only with power system issues.

3.1 General Data

SEE is a diverse region of about 60 million people. Average income per capita has a wide range going from US$ 590 in Moldova to US$ 5350 in Croatia [2]. Since the end of the Kosovo conflict in 1999, however, there has been considerable improvement. Civil unrest has been overcome and a political balance has been found that has allowed a return to economic growth and closer regional cooperation. For the SEE region as a whole economic growth has been close to an annual value of 5 percent since 2000. Today average GDP/capita in the region is more than 7 times lower than EU-15 average. The following table presents characteristic country and power system specifics that prove large mutual differences.

Table 1: GDP and Electricity Intensity in the Region

2003 Data / Country	GDP per Capita [US$]*	Demand per Capita [kWh]**
Albania	1740	1.66
Bulgaria	2130	5.44
Bosnia and Herzegovina	1852	2.19
Croatia	5350	3.33
FYR Macedonia	1710	3.61
Moldova	590	0.76
Serbia-Montenegro	1910	4.33
Romania	2310	2.30
UNMIK	750	1.98

* World Bank 2003
** Energy Regulatory Regional Association ERRA 2004

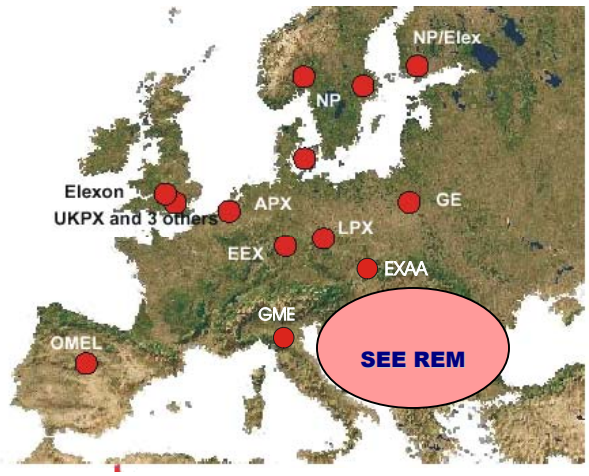

Fig. 1 Existing electricity markets in Europe and future SEE REM

Table 2: Peak Load and Consumption in the Region

2003 Data / Country	Peak Load* [MW]	Demand** [TWh]
Albania	1254	5.7
Bulgaria	6468	36.5
Bosnia -Herzegovina***	1800	8.8
Croatia***	2760	15.5
FYR Macedonia	1417	7.2
Moldova***	1200	4.2
Serbia	6067	34.4
Montenegro	668	4.4
Romania	7542	49.4
UNMIK	590	3.9

* Annual Report Southeastern European Power Utilities 2003, EKC
***National Energy Reports – 2003

GDP per capita in the region differs for 9 times (Croatia/Moldova) between the countries. Excluding Moldova this share drops to 3 times (Croatia/Albania). These values present significantly different national economies that can (not) easily withstand all necessary changes in power sector such as market opening, real tariffs, absence of state support to power companies etc. in the same timeframe. This is obvious disadvantage of unified steps to regional electricity market. Differences in electricity consumption per capita are not so significant. Peak loads are within wide range due to different country areas.

3.2 Installed Capacities and Generation

The region is characterized by 18711 MW of installed hydro generation capacities, 29086 MW of thermal and 4753 MW of installed nuclear capacities which gives total amount of 52550 MW. Country's share in total regional installed thermal capacity is dominantly defined by each power system size. Thermal power plants in the region are dominantly based on old technologies with high generation prices. If we include constant growth of

primary energy source prices (fuel, gas, coal), the role of hydro production is supposed to be even more important.

Table 3: Installed Generation Capacities in SEE Region

Country	HPP [MW]	NPP [MW]	TPP [MW]
Albania	1445	0	119
Bulgaria	2863	3760	6566
Bosnia and Herzegovina	2390	0	1912
Croatia	2063	338	1589
FYR Macedonia	440	0	943
Moldova*	60	0	970
Serbia	2831	0	5524
Montenegro	649	0	210
Romania	5970	655	9775
UNMIK	0	35	1478
TOTAL	18711	4753	29086
Peak Load = 52550 MW			

Source: Annual Report SEE Power Utilities 2003, EKC, Austrian Energy Agency

Table 4: Power Generation in SEE Region

Country	HPP [TWh]	NPP [TWh]	TPP [TWh]
Albania	4.7	0	0.08
Bulgaria	3.3	17.3	22.0
Bosnia and Herzegovina	6.3	0	3.8
Croatia	4.9	1.6*	8.3
FYR Macedonia	1.3	0	4.9
Moldova	0.1	0	3.3
Serbia	9.2	0	24.3
Montenegro	1.5	0	1.1
Romania	13.0	4.6	33.9
UNMIK	0.08	0	2.0
TOTAL	30.08	4.6	77.8
Grand Total = 112.5 TWh			

Source: Annual Report SEE Power Utilities 2003, EKC, Moldova Energy Overview, World Bank Report

* half of NPP Krško

3.3 Transmission System

Several projects on the regional transmission system have been realized recently [3]. The studies have shown that the regional electric transmission system in 2005 fully interconnected to UCTE. with and without Turkey and without any of the 12 proposed new interconnection candidate lines. is robust and capable of serving projected 2005 demands plus all long term contracted exchanges plus an additional 600 – 1500 MW bulk power exchange (depending on the exchange scenario).

The European Council agreed on a target for the level of interconnection between EU Member States corresponding to 10% of installed generation capacity in each Member State in order to improve security of supply and facilitate competition. Generally, this request is satisfied in South East Europe. Currently the system limitations aren't on interconnections. but in internal networks [3]. Since there were no this kind of study coordination in the past there is a need for further tight cooperation between power experts from region especially in the field of the power transit margins. Planned interconnections observed as single elements in the network do not increase transit margins significantly. In other words, transmission system is capable of supporting market opening in the region. while generation capacities data and new investment plans give us a basis for exchange possibilities within the region as well as between East and West.

3.4 Organisation of the Regional Electricity Market

There is no clear idea on the organization of the future SEE electricity market. Until now there are several proposals:

1. single regional system operator and few national transmission companies. This option is not possible in the short-term;
2. Seven, eight or nine electricity markets with the same number of system operators and transmission companies (similar to existing European practice);
3. Forming of import/export/transit agreement between the countries. This option does not support market development;
4. Forming of single regional independent system operator (ISO) that is supposed to coordinate dispatching activities of local TSOs. This option is not real in the short-term.

National electricity markets are at the very early stage of the opening (except Bulgaria and Romania). Countries declare some level of the market opening. while real level of competition is significantly lower. Generally, internal market opening in the region is expected to rise significantly in next few years along with coordinated process of common regional market.

3.5 Electricity Prices

While speaking of future common electricity market it is interesting to analyze existing electricity prices in region as shown in Figure 3 [4]. Average residential electricity prices in the region in 2004 (including Turkey) vary between 3.8 USc/kWh (Bulgaria) and 9 USc/kWh (Romania) with average value of 6.4 USc/kWh.

Obvious significant differences in existing electricity prices present good basis for market development. Consequently, organized electricity market will support higher level of electricity exchange in the region.

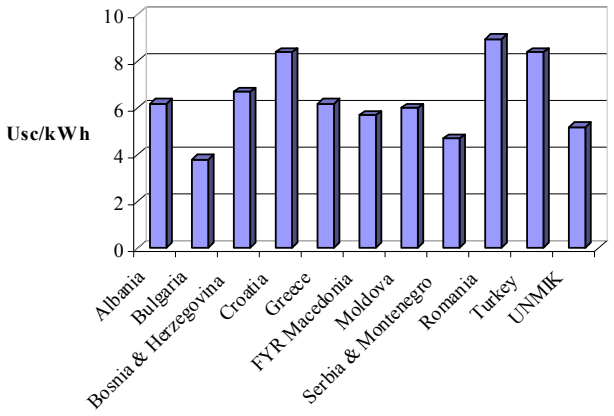

Figure 3 Average residential electricity price in 2004

4. Restructuring and Privatisation of the Power Sector in SEE

Simultaneous process of market opening, power system restructuring and privatization is taking place in SEE Europe.

After decades of non-changing environment in power sector, last few years are extremely dynamic. In Romania, Bulgaria, FYR Macedonia, Moldova and Serbia and UNMIK independent TSO is (will be) established. out of former vertically integrated company. TSOs own and operate transmission system. In Bosnia and Herzegovina ISO model is established. ISO operates but does not own transmission grid. In Croatia TSO is part of vertically integrated company, while in Albania the unbundling process has started recently.

Privatization of the power sector in the countries with economy in transition starts with distribution business, while generation capacities follow. Transmission companies are mostly excluded from privatization. Some countries started privatization before restructuring was done (e.g. Bulgaria).
Inert consumer reaction on market eligibility is the main reason for distribution company acquisition. While buying distribution companies investors are indeed buying supply business (i.e. become incumbent supplier having significant market share). Similar reasons are valid for acquisition of generation facilities. Another reason for the acquisition of old power plants is the right to use the construction site. Under strict environmental framework it is almost impossible. expensive and time-consuming to receive all licenses for a brand new location for a power plant.
Bulgaria and Romania face the most advanced stage of privatization. Privatization in Bulgaria started in 2002 with small hydro power plants. In 2003 there was first big foreign investment in electricity sector. in thermal power plant Maritsa East 3. In 2004 all six distribution companies were sold (66% of ownership) to foreign investors (CEZ. E.ON. EVN). In 2005 the process is continued in generation with 2300 MW of installed capacity offered through international privatization tender.
In Romania four out of eight distribution companies were privatized in 2004 (investors ENEL. E.ON and CEZ). Partial privatization of Transmission Company is under discussion and preparation in Romania. In Moldova three of five distribution companies were also privatized by Union Fenosa.
In Macedonia first call for privatization of generation and distribution companies is also announced. In other countries in the region there were no significant power sector privatization activities.

5. Investment Opportunities

In this chapter some results from the Generation Investment Study – GIS [5] are given. in which the authors were partly involved. The GIS brings together both the demand and the supply side of the electricity sector. It combines demand forecasting with least cost investment planning. assessing whether incremental demand should be met through rehabilitation or the addition of new generation and/or regional transmission capacity. Such investment decisions are based on fuel. operating and capital costs. Results of two alternative generation expansion scenarios are presented:

- The first scenario (Scenario A) consists of individual least cost plans for generating capacity expansion plans in each power system. i.e. utilities in each jurisdiction. without the benefits of regional cooperation;
- The second scenario (Scenario B) is an unconstrained least cost development plan for capacity expansion for all power systems participating in the REM operating as a completely integrated regional power system. The second scenario corresponds to an ideal case in which no transmission or other system operation constraints limit an optimal generation dispatch in meeting the regional demand.

The forecast demand for electricity is a key driver in planning the amount of generation capacity that may be required by an electricity system in the future. In broad terms. SEE jurisdictions' economic growth will remain at levels higher than the 2-3% likely for EC countries. as these economies converge on the average EC levels of economic output in the long term. This infers average economic growth rates of 3-5% in SEE. The model developed to forecast the SEE electricity demand to 2020 adopts a top-down approach. which assesses electricity demand based on an analysis of key macro level drivers. The central case forecasts a +2.3% regional electricity demand average growth to 2020.

The WASP model was used to develop long-term expansion plans of all the individual power systems in regional scenarios. A planning period of 1 January 2005 to 31 December 2020 was chosen. All costs were set to a January 2005 base price level and excluded general inflation. A basic real discount rate of 10% was assumed. discounted to January 2005.

Currently, power imports and exports within the SEE region and with surrounding jurisdictions are based on short-term transactions, except for a few cases of sharing power plant between jurisdictions. Historical import/export data show large variations from year to year. UCTE reconnection has increased the potential for major power transactions. but there is no indication at this time of the timing and magnitude of these transactions. No outside imports into the SEE region or exports from the SEE region to outside countries were considered.

The results of Scenario A illustrate the investment requirements based on the current plans of utilities looking at the electricity system within their own jurisdiction. Key findings from considering the jurisdictions individually are:

- 15.5GW of new capacity would be required in the individual jurisdictions by 2020;
- 11.6GW of rehabilitated plant is planned over the period to 2020;
- The NPV of all construction and fuel costs would be €37bn;
- Construction cost of new capacity would be €12bn (in constant 2005 Euros); and
- Total construction cost would be €18bn.

Scenario B was analyzed to develop an unconstrained regional expansion plan. Looking at an unconstrained regional scenario suggested that:

- 11.0GW of new capacity would be required across the region;
- 11.5GW of rehabilitated plans is planned over the period to 2020. 60% in the period up to 2010 and 40% between 2010 and 2015;
- The NPV of all construction and fuel costs would be €34.1bn for the "regional reference case". a saving of €3bn on Scenario A;
- Construction cost of new capacity would be €9.5bn (in constant 2005 Euros) while total construction cost would be €15.4bn.

It is clear from all scenarios that investment in power generation is required in SEE. Without investment in plant refurbishment and in new capacity across the region, it is clear that the SEE power grid will not be able to meet the system reserve specifications of the UCTE operating requirements by 2010 (or earlier. depending on the timing of the decline in available capacity or on higher than forecast demand).

The GTMax and PSE/E models were also run for various cases. to analyze the adequacy of the regional network and the need for new investment. In general, the expected network topology for 2010 is sufficient to meet the generation and load patterns for year 2010 under the medium load forecast. except in South Serbia and Belgrade areas. Building the 400kV corridor Nis-Leskovac-Vranje-Skopje would help resolve identified system operation problems. There are also a number of critical network elements in Romania that are overloaded. More detailed investigations and system operating studies are required to develop solutions and it is likely that additional transformer capacity in the sub-transmission system would be required.

It should be noted that the GIS did not include an analysis of all the needs for reinforcement, upgrade and expansion of major transmission lines and substations within each jurisdiction. Neither did it address investment needs at distribution levels. Over the next 10 years, it is likely that the total required investments would be greater than those discussed above which only relate to the operation of a regional electricity system.

6. Security of Supply Issues

Control of critical energy infrastructures is in turn highly dependent on the security and reliability of the monitoring and controlling interconnection infrastructures. To deal with this uncertainty, network operators adopt rules to ensure that the network has enough capacity so that the grid can be operated safely in a variety of extreme circumstances. In this sense there is no experience in SEE Europe. Rules and standards in data exchange, procedure adoption as well as adequate software platforms are to be taken and adopted from EU experience. Expert education can significantly influence supply security on electricity market in the region. Big effort has to be done to prepare staff for completely new working environment that consists of network performance standards and balancing supply and demand. Importance of this issue is proven by European Commission [6]. Apart from network operation standards and supply and demand balance, the most important aspect for supply security level is the construction of new lines. Since transmission system is regulated monopoly network reinforcements should be strictly and clearly defined. The network must not be limiting factor to market activities. At the same time, the consumers must not pay additional price for network overinvestment.

Accordingly, steady-state analysis and security (n-1) analysis of regional transmission network operation, as predicted to exist in 2010 and 2015, under market conditions with generators economically engaged on regional level, were performed in [3]. Several scenarios dependent on hydrological conditions (normal, dry and wet hydrology), load growth rate (referent, extra high

rate) and system balance (balanced region, import from UCTE and Ukraine) were analyzed. GTMax software was used for market simulations and generators engagement while PSS/E (Siemens PTI) was used for transmission network analyses.

Load flows through transmission network, including new interconnection lines which are under construction or preparation right now, shows that lines and transformers will be loaded under permitted ratings in year 2010 if all branches are in operation. Some transformers (Romania, Albania) and 220 kV lines (Serbia) are overloaded in fully available network 2015. For both time horizons there will be some overloaded 110 kV lines in each southeast European country but mostly in Serbia.

The majority of interconnection lines and internal branches are loaded less than 50 % of their thermal ratings observing both analyzed time horizons. Voltage profile during peak load conditions in the network is considered as satisfactory in 2010, while voltage stability problems may appear in Albania and southern Serbia in 2015. Construction of interconnection lines between Serbia and Macedonia, and Albania and UNMIK has positive impact on voltage stability.

Observing (n-1) security criterion under generators market engagement one may notice that congestions might appear in Romanian, Serbian and Albanian networks. Other areas are not congested in examined scenarios. Interconnection lines are not congested and all insecure operating conditions appear due to bottlenecks in internal networks.

Not simultaneous losses of 400/220 kV transformers in Romania (Mintia, Bucuresti Sud), 400/110 kV transformers in Romania and Serbia (Brasov, Dirste, Nis), some 400 kV lines in Romania and 220 kV lines in Serbia and Albania, may lead to insecure operation in 2010. The majority of insecure states may be solved by re-dispatching actions or network sectioning.

7. Conclusion

The main disadvantages in regional energy market establishing are differences in: levels of economy, production/consumption structure, energy prices, purchasing power parity, energy sector organization, transmission bottlenecks, power plant ageing, low efficiency and problem in environmental protection. The main advantages should cover lower total development expense and system operation as well as higher supply security. This kind of study analysis [5] has never been performed before for EU. Also, the importance of this study for regional supply security in EU is one of the main motives for regional market establishment [7,8], and its connection to gas sources in the East, North Africa. Supply security of Greece and Italy as border EU countries as well as other EU/SEE countries Austria, Slovenia, Hungary is making a great area for new investment and privatization.

Overall, the results of the simulations demonstrate that there are significant benefits in considering investments on a regional basis in SEE. The transmission investments to support the transfer of electricity between jurisdictions provide additional benefits from a trading perspective. Implementing common expansion planning and operating practices could save up to €6.7bn over the period 2005-2020. The capacity expansion scenarios developed show a mix between gas-fired combined cycle and lignite power plant for new capacity. It is important to note that the current level of reserve margins across the region as a whole is very high. This means that new capacity is not required until 2010 except for the units that are already committed or under construction.

Regional development plans should be reviewed and revised on a two-year cycle. Any revision should take account of the actions that have been taken in the intervening period (e.g. detailed feasibility studies for new and plant planned for rehabilitation. project contracts. new candidate projects where appropriate). The demand forecast should be also updated on a two-year cycle. recognizing that it will be less detailed than forecasts undertaken for specific jurisdictions.

Regional market opening actualized many questions on supply security under new conditions. Number of market subjects dramatically increased. responsibilities are decentralized and consumer requests are significantly increased. Accordingly, the main market design task comprises optimal solution of supply security problem under new conditions between subjects with contradictorily targets. Simultaneously, all power sectors in the region are going through turbulent processes of restructuring, market opening and privatization at the same time with no experience of interconnected synchronous operation in whole region.

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