ELECTRICITY RESTRUCTURING IN ROMANIA: THE SEARCH FOR COMPETITION IN GENERATION

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Abstract

Following the example of some other European countries and the EU Directives on Electricity, Romania is in the process of restructuring its electricity sector. Up to this point the generation, transmission, and distribution sectors have been separated from each other, several regional distribution companies have been created, and the process of creating independent generation companies has begun. However, while one of the goals of restructuring, in Romania and elsewhere, is to create competition among generation companies, in practice this has proved to be sometimes very difficult. In this paper we make a first attempt at examining the likely competitive structure of these markets. Our results suggest the strong possibility of the presence of market power in the restructured Romanian wholesale electricity market and emphasize the importance of certain institutional details of restructuring, especially regarding hydroelectric generation. The results emphasize the importance of the development of broader regional electricity markets under the SEEREM regulatory framework.

Keywords: electricity, restructuring, competition, generation, vertical separation
JEL classification: L22, L43, L51, L94, P23

* The views expressed are not those of the U.S. Department of Justice.

1. INTRODUCTION

Romania is well along in the process of restructuring its electricity industry in compliance with European Union directives (Binig, *et al*., 2000; Oprescu, *et al*., 2002). Over the 1998-2000 period the vertically integrated, state-owned monopoly was divided into five separate state-owned enterprises: one each for nuclear generation (Nuclearelectrica), hydro generation (Hidroelectrica), thermal generation (Termoelectrica), transmission (Transelectrica), and distribution (Electrica). Since then the distribution function has been further divided into eight regional companies, with four of these privatized to foreign buyers (Electrica Oltenia to CEZ, Electrica Moldova to E.ON, and Electrica Banat and Electrica Dobrogea to Enel) and privatization of the four others in the works.

One of the most important rationales for this "vertical separation" of the electricity industry – in the European Union generally and in Romania in particular – is to increase efficiency by creating a competitive generation sector. However, as the experience worldwide has made clear by now, creating competition in electricity generation is not an easy task. Some of the same characteristics of electricity markets that make them fundamentally different from other markets – especially the nonstorability of the product, flow externalities across the transmission grid, demand that may be unresponsive to price on a real-time basis, and supply that becomes increasingly inelastic as capacity is approached – also make them vulnerable to the exercise of market power, even when the market is structured in such a way that it appears unconcentrated (Borenstein and Bushnell, 1999; Joskow, 2001 and 2005; Hogan, 2002).

The danger of restructuring the electricity industry in such a way that the generation sector is controlled by a small number of enterprises is especially troubling in transition and developing countries like Romania, because electricity is an unusually complex industry that requires great sophistication on the part of regulators (Newbery, 2003). Indeed one of the most important tasks facing designers of electricity markets in such countries is to take account of the weak legal and regulatory institutional structures present there, and to structure the new markets in such a way that the demands on these fragile institutions are not beyond their capabilities (Wolak, 2000; Pittman, 2003a).

In this paper we examine the structure of the future electricity generation sector in Romania according to the government's announced plans for restructuring. Although there is much that remains uncertain, especially regarding both thermal and hydroelectric generation, we find a disturbingly high likelihood of the possession of market power by a small number of generation companies, especially during the winter season that is the time of peak demand in Romania. We suggest some ways to mitigate the problems that we foresee, but many of these are long-term rather than short-term solutions.

2. THE RESTRUCTURING PLAN

Romania's electricity generation capacity is comprised of about 10 percent nuclear, 25 to 30 percent hydro, and the remainder thermal generation. Nuclear's share will increase a good deal with the expected completion of the second (and eventually third) reactor at Cernovada, and hydro's share varies to some degree by season. Most hydro production is from dams with storage ponds, so that electricity generation may vary according to price signals as well as water flow if that policy choice is made and appropriate institutions are in place. Thermal capacity is a bit less than two-thirds coal and a bit more than one-third gas, with a small amount of oil. A good deal of the thermal capacity, including coal, gas, and oil plants, is made up of combined heat and power (CHP) plants.

The details of the restructuring plan for the generation sector are not completely clear. Certainly Nuclearelectrica will remain undivided and in state hands. There has been some discussion of dividing Hidroelectrica into separate enterprises, but it appears now that this will remain a single, government-owned enterprise, with private investors invited to build new hydro plants that would remain independent. More uncertainty remains regarding how to ensure that consumers benefit from the low costs of most hydro generation in a liberalized market, as we discuss below.

It is in thermal generation that the most uncertainty remains. The government has announced plans to privatize the large generation complexes at Turceni, Rovinari, and Craiova, though whether these are all three to be privatized *separately* – from each other and from other generation capacity – is unclear. A number of somewhat smaller thermal plants have been separated from Termoelectrica and are now under the administration of the local and *judeţ*-level authorities, including Bacau, Onesti, Iasi, Suceava, Brasov, Pitesti, Timisoara, Oradea, Arad, Brazi, Boicesti, Botosani, Focsani, and Bistrita. Some of these were unsuccessfully put up for bids from private investors, and are continuing to seek private participation in investment projects.

However, the larger vision for the thermal sector seems to be a work in progress. An analysis of plans for electricity restructuring commissioned by the regulator ANRE and performed by PricewaterhouseCoopers in 2001-2002 was directed "to assume an appropriate sector structure is in place to provide a sound basis for competition," and its authors proceeded to suggest that "three or four balanced thermal generating companies would be an appropriate split, providing a basis for competition yet a degree of financial strength." A World Bank study in 2004 spoke approvingly of a policy of creating five subsidiaries of Termoelectrica, including generation complexes at Turceni, Rovinari, Deva, and Bucharest (with the disappearance of Craiova from the list something of a mystery) – subsidiaries that would eventually be spun off. More recently, a conference presentation by ANRE director general Maria Manicuta described an eventual market structure including "7 Major thermal producers", Hidroelectrica, Nuclearelectrica, and "14 municipal CoGen producers and other IPP [independent power producers] and selfproducers".[1]

Even without final policy decisions in these areas, however, we may examine what we already know about electricity generation in Romania and reach certain conclusions about what factors may determine how smoothly and competitively these newly constructed wholesale markets operate.

3. WORKING ASSUMPTIONS

We begin with the assumption that the country of Romania will constitute a single "geographic market", as competition law enforcers and regulators use that term, for wholesale electricity. The presence of significant transmission bottlenecks within the country could, theoretically or in the future, lead to the presence of "load pockets" – i.e. regions where wholesale prices might increase in response to increases in demand when supplies from outside were unavailable – and these in turn would likely constitute geographic markets of regional or even local dimensions; however, it appears that such bottlenecks are not present currently, or at expected levels of demand in the

[1] Interestingly, the 14 municipal producers are not named, but the 7 major thermal producers include not only Turceni, Rovinari, and Craiova, but also Deva, Bucharest, Galati, and "Te".

near future.[2] Similarly, the presence of significant flows of power into Romania from other countries might lead one to define geographic markets at the level of regions larger than the country of Romania, and this indeed seems likely to occur in the future as demand increases, further investments are made in cross-border transmission lines, and the SEEREM process advances. However, for the present, cross-border transmission capacity is limited in many areas, and Romania is a net exporter of electricity.

We next assume that in Romania, as in all other electricity markets, certain technologies will be primarily "baseload"; that is, their low marginal cost and high adjustment costs render them generally unresponsive to fluctuations in wholesale prices. Nuclear energy is a classic baseload technology, and coal-fired generation, while not so inflexible as nuclear, is usually also treated as baseload.[3] Finally, hydroelectric plants that lack storage ponds – so-called "run of river" plants – are also not flexible in response to price signals: they generate electricity when the streams are flowing, and sit idle (or generate less) when they are not (or are flowing at lower levels).

On the other hand, generation plants powered by natural gas and oil generally have higher marginal production costs and are generally more flexible than nuclear, coal-fired, and run-of-river hydro plants, so they are brought into production when wholesale prices rise to high enough levels to make them profitable. In addition, the operators of hydro plants with storage ponds may allow water to build up in the ponds during periods of low wholesale electricity prices and then release the water to generate electricity when wholesale prices are higher. (Other factors complicate hydro scheduling decisions, however, including irrigation demands, environmental restrictions, and, related to these two, the ability to forecast future rainfall and stream flows.) Thus hydro plants with storage ponds often may be counted as non-baseload, flexible sources of generation.

More broadly, the distinction between baseload and non-baseload generation capacity is important because for the most part only plants using the latter make significant changes to their output levels in response to price signals. A generation market that appears competitive because of the presence of a large number of independent generation companies may not be so if so much of the generation is baseload that only a few companies vary output according to wholesale price, and therefore determine the price that reigns in a wholesale market. This is one of the lessons of the failed electricity restructuring experiment in California (Blumstein, *et al*., 2002).

Finally, we assume that the newly designed wholesale electricity markets in Romania will, as in most countries, pay all generators whose output is not under contract the price of the marginal electricity generated during each period of wholesale price bidding. (Under current policy plans – to be discussed presently – this may not be true for hydro generation, but it will be true for all other generation that is not sold through long-term contracts.) To the degree that Termoelectrica is eventually restructured into multiplant generation companies that have both baseload and non-baseload generation plants, this is likely to give an incentive to these companies to withhold output on some occasions when their non-baseload plant is the marginal generator in the market, since in that case their baseload plants will earn the inframarginal rents resulting from any increase in the wholesale price. This problem of anticompetitive incentives is of course not

[2] Wolak [2000], for example, points out that transmission volumes remain considerably below their communist-era levels, and that congestion on the grid is therefore rare. PricewaterhouseCoopers (2004) reports that both its baseline forecast and that of the Romanian government suggest that Romanian electricity demand will not return to its 1989 level of 65,000 GWh until about 2016.
[3] See, for example, the interesting analysis in Parry (2005).

unique to Romania, but it will be one challenge of market liberalization for the Competition Council and the regulatory agency for the energy sector, ANRE.

4. BUT WHAT ASSUMPTIONS FOR HYDRO?

In countries such as Romania where hydro plants play an important role in satisfying energy demands, the question of whether and how these plants respond to wholesale price signals – a particularly difficult one to answer if the plants remain state-owned – becomes crucial in analyzing the likely market outcomes of electricity restructuring.[4] Indeed the significant share of hydro in Romanian electricity generation capacity brings several issues to the fore.

The first, already mentioned, is whether generation sector restructuring will include breaking up the current monolithic hydro generation enterprise, Hidroelectrica, and either creating multiple hydro generation companies or, as some have suggested, allocating this low-cost hydro capacity among different newly formed, higher cost thermal generation companies in an attempt to reduce the average costs of the latter. The principal advantage of maintaining the monolithic Hidroelectrica probably relates to one policy option – widely discussed until recently – to pay hydro generators only a regulated (cost-based) price for wholesale electricity even if reigning prices in a liberalized wholesale market are much higher, and to allocate the difference between the market and regulated prices in such a way as to keep down the prices paid by final users.

The second issue is the degree to which a hydro generation enterprise or enterprises vary their electricity production in response to wholesale price signals. As noted above, hydro generation schedulers are generally operating subject to multiple constraints, including both irrigation demands and environmental concerns, but if they are profit-maximizing subject to these constraints – or indeed if they are government bodies that prefer more revenues to less, as most government bodies do – they may be expected to store water in holding ponds when wholesale prices are low and release water for generation when wholesale prices are high, all else equal, and, of course, subject to holding pond storage capacity.

Is this a good thing? Should public policy and restructuring decisions encourage it? Most economists would say so. To the degree that private costs reflect social costs, hydro generator behavior that causes power to be produced at times when rising wholesale prices would otherwise call high cost gas- and oil-fired generation capacity into operation seems unambiguously welfare enhancing. And yet there are dissenting voices to this view.

In particular, a recent study of Russian electricity restructuring by the International Energy Agency (2005) seems to argue that a post-reform, government-controlled hydro generation enterprise should take into account demands for water for irrigation and environmental amenities but should not schedule electricity generation in response to wholesale price signals. Why not? The authors fear that a government-controlled enterprise could use such a strategy to appropriate the quasi-rents of new private investors in thermal generation, artificially shaving demand peaks and thus tamping down wholesale prices relative to what they would be with a non-strategic hydro sector. We would argue that this would be a strategy of expropriation only if the government announced one policy but then pursued the other, but the issue remains one of controversy.

A final issue is the degree to which one or many hydro generation enterprises that are responsive to prices respond in a manner that is welfare-maximizing or – where these differ – profit-

[4] See, e.g., Arellano (2003) and Atkinson and Halabi (2005).

maximizing. This in turn depends in part on whether the hydro enterprise or enterprises have structural market power in generation markets. A hydro enterprise with wholesale market power in particular circumstances may – like any other enterprise with market power – withhold output in order to increase market price. (If there were corruption in the system, it could be paid to do so by other generators.) As with enterprises owning thermal generation capacity, Hidroelectrica or its successor companies would have special incentives to close some plants strategically if they maintained output levels at others and reaped the resulting higher wholesale prices.

Again, in a country like Romania where hydro accounts for an important segment of generation capacity, the particular restructuring policy choices that determine the rules and incentives of hydro generators will play a critical role in determining the degree to which the restructured industry achieves its potential in contributing to Romanian economic welfare.

5. WHOLESALE GENERATION MARKETS IN ROMANIA

Let us consider now the likely structure of wholesale generation markets in Romania. Table 1 divides the principal nuclear, coal-fired, hydro, gas-fired, and oil-fired generation capacity into broad categories of baseload and non-baseload, using net output figures for the most recent year available as a proxy for capacity, since the available capacity data are not consistently reliable. The large coal generation complexes at Turceni, Rovinari, and Craiova account for about 10, 10, and almost 7 percent of production, respectively, and the nuclear plant at Cernovada adds another 10 percent. Adding several smaller coal-fired plants and that portion of hydro that is run-of-river – in particular the large capacity along the Olt River – yields a baseload share of almost exactly half the market.

In non-baseload generation – the portion of the generation sector that will actively determine outcomes in the wholesale market – two facts immediately stand out. First, over 20 percent of non-baseload generation – over 10 percent of all Romanian electricity generation – comes from the 7 generation plants controlled by Electrocentrale Bucuresti. That enterprise, then – to the extent that it is participating in the wholesale market rather than simply passively meeting customer demands in Bucharest – may have a significant level of market power, and may – depending on how much marginal costs vary among the plants – have incentives to withhold output in order to earn inframarginal rents on the lower cost capacity. (Such incentives would be all the stronger if the reorganization led to a single enterprise controlling these plants and baseload plants – such as one of the 3 large coal complexes – as well.)

Second, almost half of the non-baseload generation is accounted for by hydro plants with holding ponds, and over half of this half – i.e., 14 percent of total Romanian production – is accounted for by the giant hydro plants on the border of Romania and Serbia, the “Iron Gates” (Portile de Fier) plants.

This makes quite clear the crucial future role of Hidroelectrica in the performance of Romanian wholesale generation markets, if we continue the assumption that Hidroelectrica will maintain control of most or all of the existing hydro plants. We do not yet have cost information at the level of individual generation plants. Still it seems clear that this flexible hydro capacity, about 24 percent of total Romanian generation capacity, will have lower marginal generation costs than the thermal non-baseload capacity – probably far lower. This leads to at least four conclusions:

First, on an average, non-winter day – we will discuss seasonal issues in a moment – Hidroelectrica or one of its successor companies will hold the marginal generation capacity – and

so have the most direct incentive to affect the wholesale price – only when demand is low, below 75 percent of capacity.

Second, if marginal generation costs set wholesale prices, then on this average day there is likely to be a large, discontinuous jump in price as non-baseload hydro capacity is exhausted and non-baseload thermal capacity is called into production.

Third, this means that a profit-maximizing hydro generation enterprise could have incentives near this discontinuous margin to withhold capacity, in order to earn inframarginal rents on the capacity that remains active.

Fourth, on this average day, as demand moves into the range that calls thermal non-hydro capacity into production, the ordering of costs of this capacity becomes quite important, as does the ownership of non-marginal capacity by the owners of marginal plants. In particular, if, as suggested by advisors such as PricewaterhouseCoopers, baseload coal plants like Turceni, Rovinari, and Craiova are placed in the same enterprises with higher cost gas- and oil-fired plants, the owners of these enterprises may have strong incentives to restrict the output of their non-baseload plants at the margin.

6. WHOLESALE GENERATION MARKETS IN ROMANIA AT TIMES OF PEAK DEMAND

It is clear, then, that under current restructuring plans the Romanian electricity system is in general at some risk of the appearance and exercise of market power at the wholesale level. The situation does not improve when we focus on the winter season, the season of peak electricity demand in Romania. The critical factor here – as in Russia (Pittman, 2005) and other transition economies especially – is that a large percentage of the thermal generation capacity that is generally non-peakload is accounted for by plants that generate both heat and electricity in the winter – so-called CHP (combined heat and power) plants. In Romania as well as other transition economies, these plants are relied upon by the urban populations especially for affordable heating during the winter, and they are not likely to be switched off even if electricity demand were to fall, so that wholesale electricity prices fell.[5]

In the winter, in other words, the gas- and oil-fired CHP plants that had been non-baseload in other seasons become baseload plants. As shown in Table 2, the effect on the structure of wholesale electricity markets is dramatic. If our assumptions are correct, fully 70 percent of Romanian generation capacity becomes baseload in the winter. Furthermore, the remaining non-baseload capacity is almost entirely hydro. In fact, according to the information available to us, there are only three generation plants in Romania that are not either nuclear, coal-fired, hydro, or CHP: the large gas-fired plant at Iernut that is a part of Electrocentrale Bucuresti, the smaller gas- and oil-fired plant at Braila, and the small gas- and oil-fired plant at Borzesti.

Two sets of conclusions seem to follow here. First, as in the "average year" analysis, the behavior and incentives of the hydro generation enterprise or enterprises will be crucial. A profit-maximizing or revenue-maximizing Hidroelectrica would have strong incentives to withhold marginal output in order to earn inframarginal rents (to the extent that this capacity is indeed flexible during the winter).

[5] "District heating systems are major suppliers of heat to Romania's urban population. District heating in Romania features a penetration of 31% of the heat market. In cities and towns the district heating market share is more than 57%." (Maly, et al., 2002)

Second, the ownership of the three non-CHP, non-coal hydro plants becomes crucial as well. If this analysis is correct, then on almost any cold winter day a generation enterprise that owned coal or CHP plants in addition to one of these three would have strong incentives to withhold output to raise the wholesale price.

7. DISCUSSION

This examination and analysis of the structure of wholesale electricity markets in Romania under current assumptions and reform plans suggests that there may be real problems with both the presence of market power among generation companies and incentives for the companies to exercise that market power. Indeed the entire broad exercise raises a fundamental question: if baseload generation accounts for fully half of Romanian generation capacity – more during the winter, and more in the future as Cernovada-2 and Cernovada-3 come into production – and if low cost hydro generation accounts for another quarter, how much is likely to be gained from the creation of wholesale generation markets? This question seems especially relevant in light of a) the danger of new wholesale markets creating problems of the exercise of market power (as emphasized by Pittman, 2003b) and b) the very high costs involved in creating the complex institutional structure of such a market (as emphasized by Wolak, 2000).

But if we add to earlier assumptions the assumption that this reform train has already left the station, there remain a number of policy decisions with the potential to determine whether and how much Romanian electricity customers suffer from the exercise of market power in the generation sector.

The first and most obvious policy decision concerns the continued development of regional generation markets within the SEEREM framework. As we noted at the beginning of the paper, our analysis has been based on the assumption of Romania as the relevant geographic market for the analysis of generation market structure. To the degree that internal and external transmission linkages are strengthened and wholesale electricity imports and exports become much more important components of Romanian electricity transactions, the structure of an artificially small geographic "market" is no longer of interest. Stated another way: attempts by Romanian generation companies to restrict output in order to increase wholesale prices would be defeated by imports – and thus the Romanian companies would give up on such attempts.

A second decision, or set of decisions, concerns the treatment of hydro generation in the restructured wholesale sector within Romania. Romanian policy makers have debated ways to insure that the public benefits from the low marginal costs of hydro generation. One solution might be to auction off ownership of the existing hydro plants and then allow the new owners to participate without special regulation in wholesale markets; a fair and competitive auction process should insure that the Romanian public treasury receives the discounted present value of the quasi-rents available. However, this market-oriented solution seems not to have been seriously considered. (There are reports that Hidroelectrica is currently selling the majority of its output at unregulated prices, thereby either pocketing the profits itself or favoring certain customers with cheap power. This seems the worst of both worlds from a reform standpoint.) One alternative apparently still on the table, as mentioned above, is the inclusion of hydro plants in the mix of generation plants separated from Termoelectrica and privatized, in order to lower the average cost of generation for the new generation enterprises; unfortunately, it is not clear why lowering average cost would affect the marginal costs and marginal incentives of these new market players.

The policy option apparently in the ascendancy until recently was to regulate the wholesale price of hydro generation – using some form of rate-of-return regulation or price caps based on current low marginal costs of generation – and then to divide this low-priced hydro power among the eight regional electricity distribution companies in order to lower *their* average costs and hence their (regulated) prices. Though this was obviously a highly "regulatory" solution, it did have the advantage of apparently removing any incentives for Hidroelectrica or successor companies to exercise market power in the generation sector. On the other hand, as markets for final users are gradually opened to competition and deregulated, the continued role of this regulatory solution would be unclear.

A third important policy issue concerns long-term contracts between generators and final customers (and/or supply companies). Long-term contracts have the potential to alleviate or remove the incentives for anticompetitive behavior by generation companies, because to the degree that prices are set by the contracts, a generator does not benefit on that portion of its output from any increases in wholesale prices. Thus in general electricity market reformers have encouraged the use of long-term contracts between, for example, individual generators and large industrial and commercial customers.

However, there is a downside to this strategy (beyond the reliance on the *enforcement* of long-term contracts in a country where the court system continues to recover from its communist past): too many long-term contracts can so reduce the liquidity of short-term wholesale markets that they can no longer serve as the basis of market operation. This has reportedly been a problem in the UK, where the combination of long-term contracts and vertical re-integration (between generation companies and supply companies) has left spot markets with very little capacity to allocate. According to the Romanian electricity market operator OPCOM, there are currently no long term contracts on the Romanian power market, but this could become an important issue as the market develops.

Our results suggest a dangerous probability of the appearance of market power in Romanian wholesale electricity markets under current restructuring plans. Unless these plans are revised, it is difficult to overstate the importance of both a) strong enforcement by ANRE and the Competition Council, and b) continued development of regional, multi-country geographic markets for wholesale electricity under the SEEREM process.

Table 1. Structure of Romanian Generation Sector

POWER STATION	NET OUTPUT	NET OUTPUT SHARE(%)	TECHNOLOGY	COGENERATION (Electricity and Heat)	CUMULATIVE NET OUTPUT SHARE(%)
			Base-load group		
TURCENI	5297923	10.25	brown coal	NO	10.25
ROVINARI	5245301	10.15	brown coal	NO	20.41
SNN	5142397	9.95	uranium	NO	30.36
OLT	2696000	5.22	other hydro		35.58
ISALNITA	2677667	5.18	brown coal	NO	40.76
RAAN	1367142	2.65	brown coal	YES	43.41
CRAIOVA II	748805	1.45	brown coal	YES	44.86
OTHERS	678000	1.31	other hydro		46.17
GOVORA	581091	1.12	brown coal, nat gas, black oil	YES	47.29
SIRET	423000	0.82	other hydro		48.11
ARAD	297311	0.58	brown coal	YES	48.69
ORADEA	265850	0.51	brown coal	YES	49.20
BACAU	215059	0.42	brown coal	YES	49.62
DOICESTI	194920	0.38	brown coal	NO	49.99
BRASOV	191023	0.37	brown coal	YES	50.36
PRUT	70000	0.14	other hydro		50.50
JIU	49000	0.09	other hydro		50.59
			Non-base-load group		
PF I	5692000	11.02	hydro with holding ponds		61.61
DEVA	3317992	6.42	pit oil	YES	68.03
BUCURESTI (LUDOS IERNUT,MURES)	2055694	3.98	nat gas	NO	72.01
BUCURESTI (SUD)	1543069	2.99	nat gas+black oil	YES	75.00
PF II + GOGOSU	1501000	2.91	hydro with holding ponds		77.90
LOTRU	933000	1.81	hydro with holding ponds		79.71
GALATI	853894	1.65	nat gas+black oil	YES	81.36
BUCURESTI (VEST)	827925	1.60	nat gas+black oil	YES	82.96
BISTRITA	775000	1.50	hydro with holding ponds		84.46
ARGES	715000	1.38	hydro with holding ponds		85.85
BRAILA	681508	1.32	nat gas+black oil	NO	87.17
SOMES	648000	1.25	hydro with holding ponds		88.42
PLOIESTI	553902	1.07	nat gas+ black oil	YES	89.49
IASI	547943	1.06	brown coal, nat gas, black oil	YES	90.55
SEBES	526000	1.02	hydro with holding ponds		91.57
RAUL MARE	512000	0.99	hydro with holding ponds		92.56
BUCURESTI (PROGRESUL)	456391	0.88	nat gas+black oil	YES	93.45
DRAGAN	420000	0.81	hydro with holding ponds		94.26
CERNA	373000	0.72	hydro with holding ponds		94.98
BUCURESTI (PALAS, CONSTANTA)	329233	0.64	nat gas+black oil	YES	95.62
SNP-PETROBRAZI	327233	0.63	natural gas	YES	96.25
BUCURESTI (GROZAVESTI)	293154	0.57	nat gas+black oil	YES	96.82
PITESTI	270292	0.52	nat gas+ black oil	YES	97.34
ONESTI	238805	0.46	nat gas	YES	97.80
BORZESTI - K	237814	0.46	nat gas+black oil	NO	98.26
SUCEAVA	220055	0.43	pit oil	YES	98.69
PAROSENI	192803	0.37	pit oil	YES	99.06
BISTRA	148000	0.29	hydro with holding ponds		99.35
BUZAU	141000	0.27	hydro with holding ponds		99.62
GIURGIU	90332	0.17	pit oil	YES	99.80
DAMBOVITA	59000	0.11	hydro with holding ponds		99.91
RAUL TARGULUI	31000	0.06	hydro with holding ponds		99.97
BUCURESTI (TITAN)	14269	0.03	nat gas+black oil	YES	100.00

Table 2. Structure of Romanian Generation Sector in Winter, when CHP Plants Become Baseload

POWER STATION	NET OUTPUT	NET OUTPUT SHARE(%)	TECHNOLOGY	COGENERATION (Electricity and Heat)	CUMULATIVE NET OUTPUT SHARE(%)
			Base-load group		
TURCENI	5297923	10.25	brown coal	NO	10.25
ROVINARI	5245301	10.15	brown coal	NO	20.41
SNN	5142397	9.95	uranium	NO	30.36
DEVA	3317992	6.42	pit oil	YES	36.78
OLT	2696000	5.22	other hydro		42.00
ISALNITA	2677667	5.18	brown coal	NO	47.18
BUCURESTI (SUD)	1543069	2.99	nat gas+black oil	YES	50.17
RAAN	1367142	2.65	brown coal	YES	52.81
GALATI	853894	1.65	nat gas+black oil	YES	54.47
BUCURESTI (VEST)	827925	1.60	nat gas+black oil	YES	56.07
CRAIOVA II	748805	1.45	brown coal	YES	57.52
OTHERS	678000	1.31	other hydro		58.83
GOVORA	581091	1.12	brown coal, nat gas, black oil	YES	59.96
PLOIESTI	553902	1.07	nat gas+ black oil	YES	61.03
IASI	547943	1.06	brown coal, nat gas, black oil	YES	62.09
BUCURESTI (PROGRESUL)	456391	0.88	nat gas+black oil	YES	62.97
SIRET	423000	0.82	other hydro		63.79
BUCURESTI (PALAS, CONSTANTA)	329233	0.64	nat gas+black oil	YES	64.43
SNP-PETROBRAZI	327233	0.63	natural gas	YES	65.06
ARAD	297311	0.58	brown coal	YES	65.64
BUCURESTI (GROZAVESTI)	293154	0.57	nat gas+black oil	YES	66.20
PITESTI	270292	0.52	nat gas+ black oil	YES	66.73
ORADEA	265850	0.51	brown coal	YES	67.24
ONESTI	238805	0.46	nat gas	YES	67.70
SUCEAVA	220055	0.43	pit oil	YES	68.13
BACAU	215059	0.42	brown coal	YES	68.55
DOICESTI	194920	0.38	brown coal	NO	68.92
PAROSENI	192803	0.37	pit oil	YES	69.30
BRASOV	191023	0.37	brown coal	YES	69.67
GIURGIU	90332	0.17	pit oil	YES	69.84
PRUT	70000	0.14	other hydro		69.98
JIU	49000	0.09	other hydro		70.07
BUCURESTI (TITAN)	14269	0.03	nat gas+black oil	YES	70.10
			Non-base-load group		
PF I	5692000	11.02	hydro with holding ponds		81.12
BUCURESTI (LUDOS IERNUT, MURES)	2055694	3.98	nat gas	NO	85.09
PF II + GOGOSU	1501000	2.91	hydro with holding ponds		88.00
LOTRU	933000	1.81	hydro with holding ponds		89.81
BISTRITA	775000	1.50	hydro with holding ponds		91.31
ARGES	715000	1.38	hydro with holding ponds		92.69
BRAILA	681508	1.32	nat gas+black oil	NO	94.01
SOMES	648000	1.25	hydro with holding ponds		95.26
SEBES	526000	1.02	hydro with holding ponds		96.28
RAUL MARE	512000	0.99	hydro with holding ponds		97.27
DRAGAN	420000	0.81	hydro with holding ponds		98.08
CERNA	373000	0.72	hydro with holding ponds		98.81
BORZESTI – K	237814	0.46	nat gas+black oil	NO	99.27
BISTRA	148000	0.29	hydro with holding ponds		99.55
BUZAU	141000	0.27	hydro with holding ponds		99.83
DAMBOVITA	59000	0.11	hydro with holding ponds		99.94
RAUL TARGULUI	31000	0.06	hydro with holding ponds		100.00

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