



DIW Berlin

German Institute
for Economic Research



Ensuring EU Electricity Enlargement – *Benchmarking the Reforms of the Electricity Sector in the New Member States*

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Joint Work Based on SESSA WP 5 Working Papers

www.sessa.eu.com

Haas, Reinhard, et al. (2005): Medium- and Long-Term Effects of EU-Electricity Enlargement.

Hirschhausen and Zachmann (2005): Perspectives and Challenges of EU Electricity Enlargement.

Kaderjak, Peter (2005): A Comparison of CENTREL National Experiences.

Zachmann, Georg (2005): Convergence of European Wholesale Electricity Spot Market Prices?

Agenda

- 1. Introduction**
- 2. Issues**
- 3. Benchmarking Indicators**
- 4. Conclusions**

Survey of the Region: The Electricity Sector in the New Member Countries



Overview of the East European Economies and Electricity Sectors

	Population 2002 in Mill.	GDP 2004 per Capita in €	Electricity Consumption 2004 in GWh	Net installed capacity 2003 in MW	Electricity Production 2004 in GWh
Czech Republ. (CZ)	10.2	5000	68,596	17332	84,312
Estonia (EE)	1.4	3500	8,553	2165	10,347
Hungary (HU)	10.2	4700	41,309	8708	33,134
Latvia (LV)	2.3	2800	6,620	2155	4,676
Lithuania (LT)	3.5	2300	11,712	6568	18,906
Poland (PL)	38.2	3900	144,741	31407	154,033
Slovakia (SK)	5.4	3900	14,594	2979	15,385
Slovenia (SLO)	2.0	10700	27,317	8302	30,350
Bulgaria (BG)	8.0	1500	35,635	11997	41,512
Romania (RO)	22.3	1500	55,826	19369	57,037
Sum CEECs	103.5	3400	414,903	110982	449,692
Germany (D)	82.5	25500	585,495	124669	588,134

Sources: Eurelectric (2004), Eurostat

Introduction: New Member States, Old Issues

Countries covered: EU Accession Countries (May 2004) +

- UCTE: Poland, Czech Republic, Hungary, Slovakia, Slovenia, Croatia
- Synchronous with 2nd UCTE-region: Romania, Bulgaria, South-East Europe
- UES: Lithuania, Latvia, Estonia
- New neighbours (not covered): Russia, Ukraine, Belarus

State of EU-Integration

- Technical integration succeeded in 1995 already (Centre/UCTE)
- Economic and institutional integration still in progress, but „Acquis communautaire“, mainly Directive 2003/54 far from being fulfilled (cf. EU Benchmarking Report)

„Traditional“ and new critical issues in Eastern Europe:

- Price adaptation, privatization
- Fuel diversification, security of (fuel) supply, efficient electricity trading
- Moving towards an internal electricity market, stated otherwise:

Stated Otherwise: Most of the „Priorities“ defined by Glachant and Levêque (2005) are Applicable to the New Member States

Priority Actions

1. Ensuring better access to, and improvement of, balancing services
2. Ensuring access to competitive gas supply long-term contracts
3. Improving the efficiency of the management of interconnections
- ...
5. Encouraging the negotiation of reinforced regional cooperation agreements between TSOs
6. ... Europe's interest in grid interconnection

Secondary Actions

1. Terminating vested contracts
2. Improving the link between the operation of Power Exchanges and grids
3. Setting incentive pricing of domestic congestion
4. - 11. Facilitating harmonization ...

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Issues (1): Prices

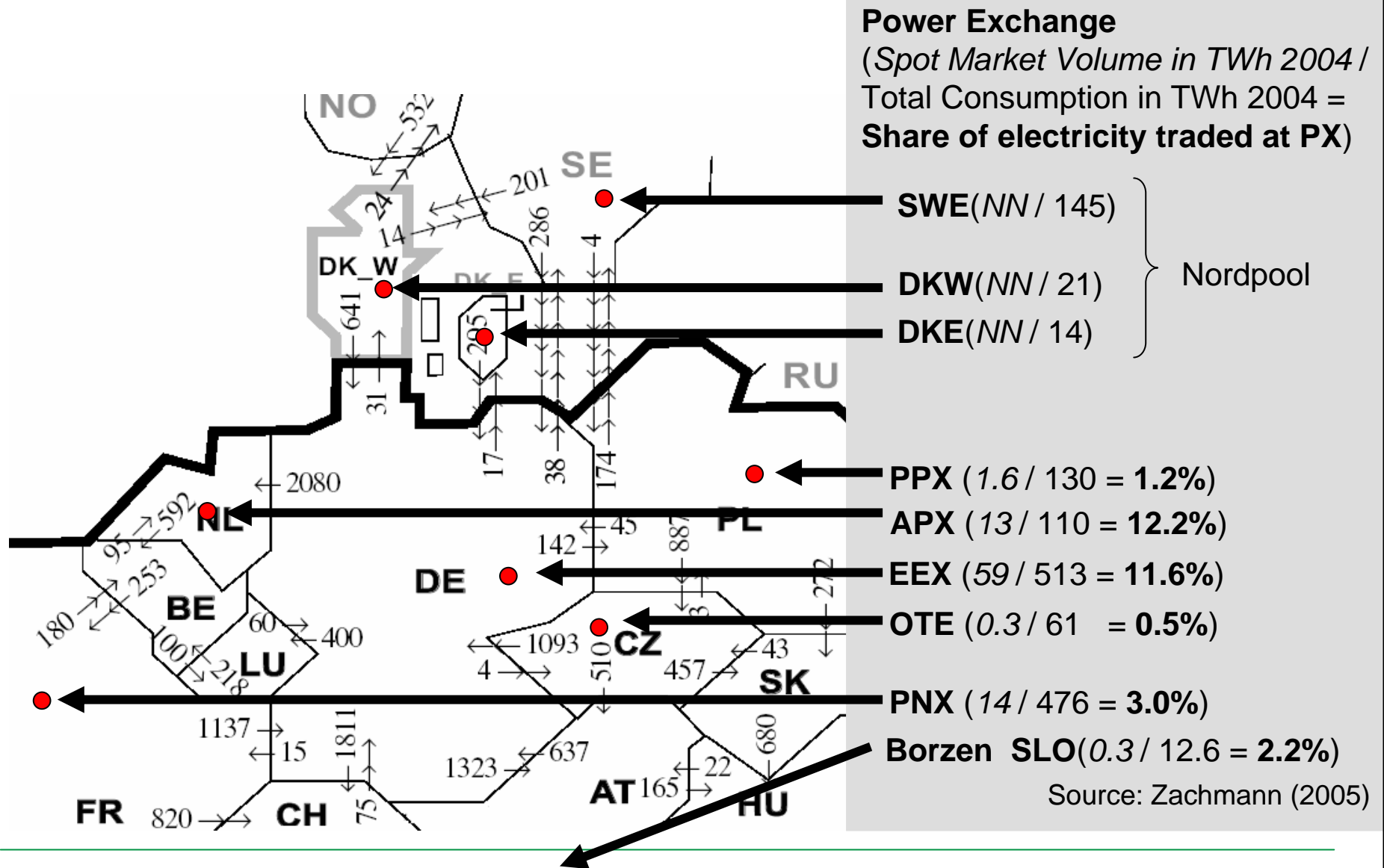
Electricity prices to big industrial, small commercial and household consumers without taxes (in EUR/MWh)

	24GWh per year	50 MWh per year	3.5 MWh per year
Czech R	41	60	68
Estonia	39	53	58
Latvia	35	68	58
Lithuania	45	70	54
Hungary	55	166	84
Poland	42	81	65
Slovenia	45	97	86
Slovakia	67	93	105
Romania	47	68	
Bulgaria	37	49	51
Germany	63	149	128

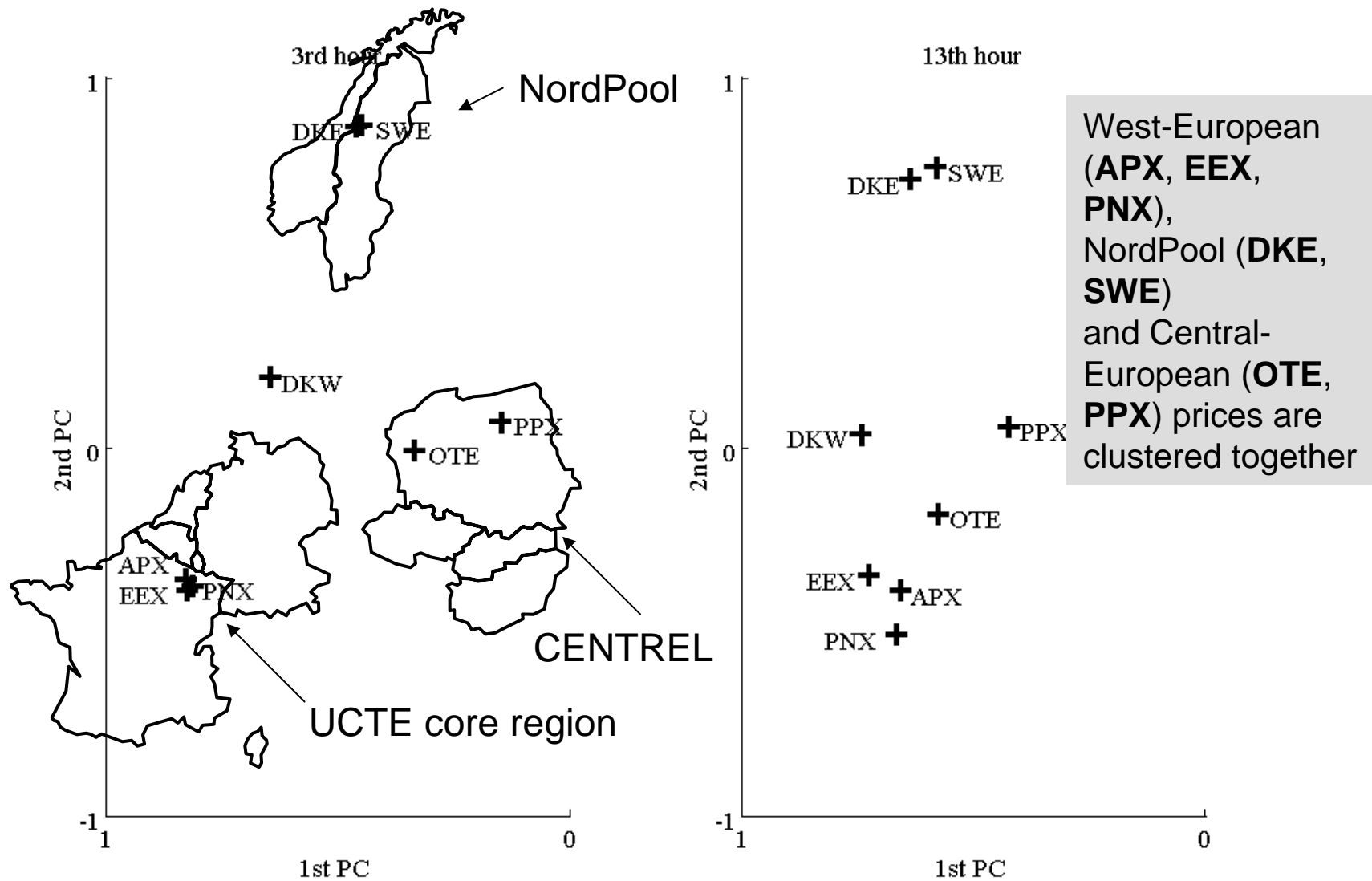
Source: Eurostat 2005

Issues (2): Markets

Liquidity of European Power Exchanges



Correlation of wholesale spot prices with their first and second common component



Source: Zachmann (2005)

Trade and Interconnection

Central Europe:

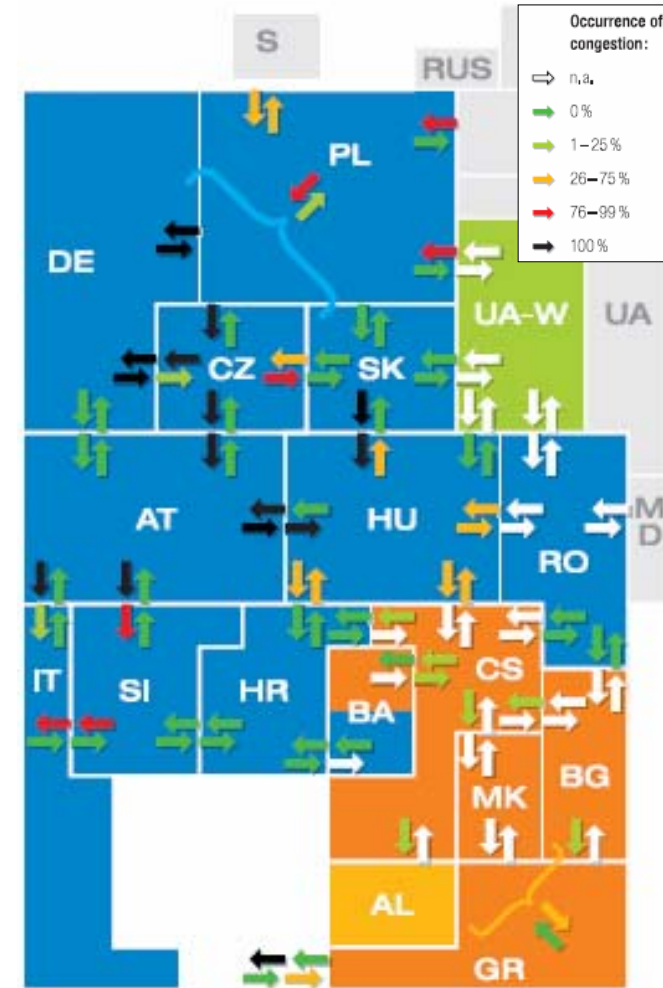
- Slovakia mainly trades from north to south. But there is an insufficient link for the profitable exports to Hungary
- The CR has strong interconnections with the neighboring countries and significant cheap surplus capacities after the full commissioning of NPP Temelin
- Hungary imports power from Slovakia and Ukraine. Export mainly goes to Croatia, where the fluctuating hydro capacities often result in good prices for transit or even for expensive Hungarian electricity
- Poland is not interested in imports of electricity. Because of its production overcapacity.

Baltic States:

- Lithuania, Latvia, Estonia: Baltic electricity network is technically well developed with strong interconnections between the three countries and eastern neighbours.

Balkan:

- Slovenia: congestion on the borders with Austria and Italy.
- Romania: plans to become a large regional electricity exporter by targeting neighboring countries; possible markets include Greece, Turkey, and Italy.
- Bulgaria: Interconnection with Albania, FYROM, Turkey and Greece is under development.



Source: UCTE System Adequacy Retrospect (2004)

Planned Grid Extensions*

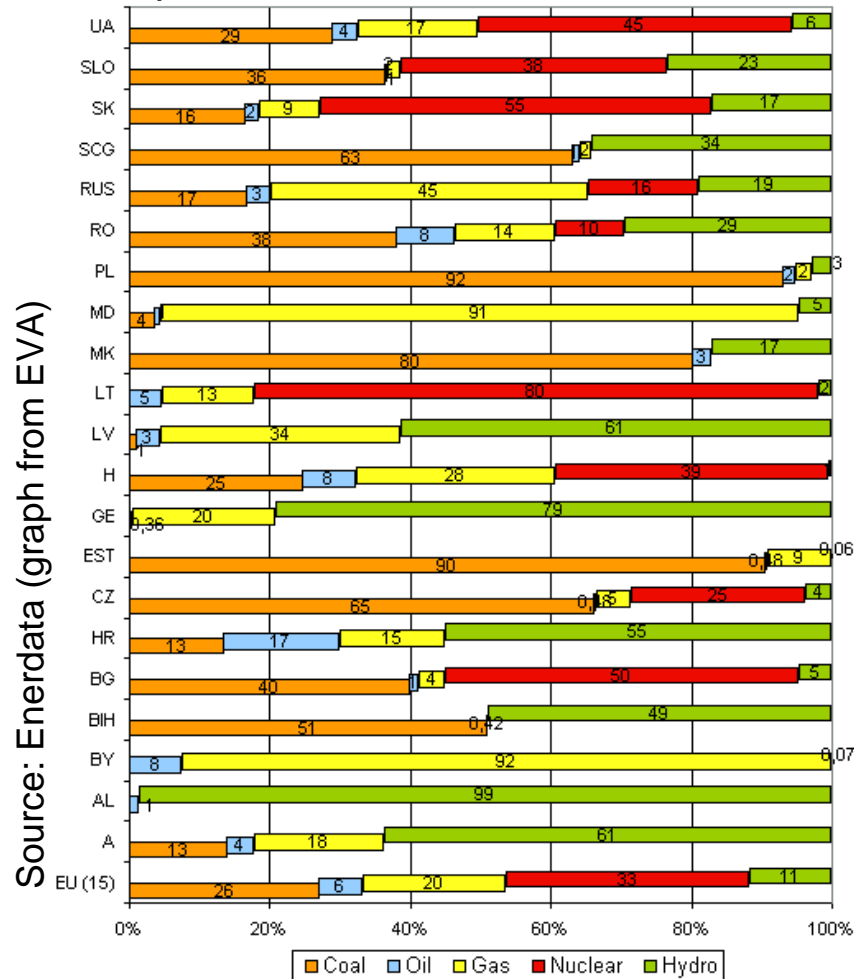
Line or equipment	Voltage level	Date of commissioning	Cross-border
PST Hagenwerder - Mikulowa		>2010	D - PL
2nd line Slavetice - Durnrohr	400 kV	2006	CZ - A
2x400 kV Okroglo - Udine	400 kV	2011	SLO - I
Cirkovce – Pince Line	400 kV	2010	SLO - H
OHL Nadab –Bekescsaba	400 kV	2007	RO -H
Single line	400 kV	2010	SCG - H
Stip-Cervena Mogila	400kV	2005	FYROM – BG
OHL Suceava – Balti	400 kV	2009	RO - MD
Nadab - Bekescsaba	400 kV	2007	H-HR
Line Ernestinovo - Pecs	400 kV	2007 - 2008	HR-H

Links between old & new member states	*clearly identified main developments developments on international interconnections over the period from 2005 to 2015.
Links between new member states	

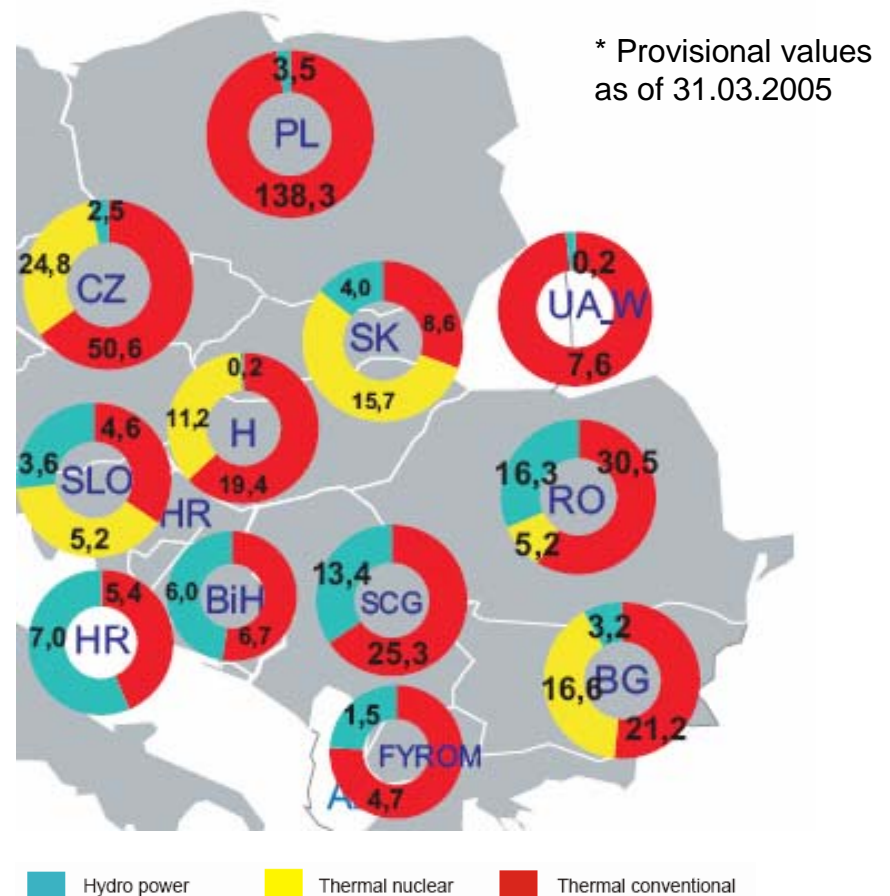
Source: UCTE (2005)

Issues (3): Fuel Mix and Sustainability

Production of Electricity According to Energy Sources in Central and Eastern Europe, and the EU15



Net production 2004 in TWh*

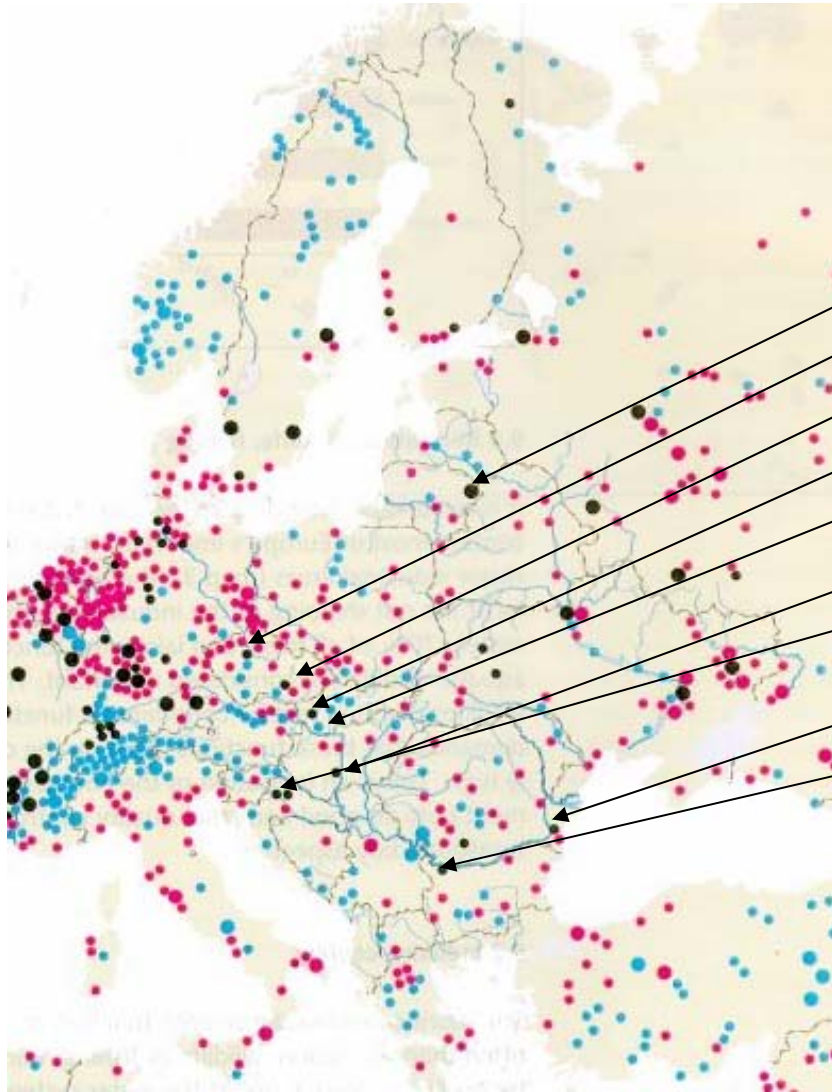


Primary energy share of electricity production in 2005

	BG	CZ	EE	HU	LV	LT	PL	RO	SI	SK
Nuclear	39%	33%	0%	39%	0%	63%	0%	9%	38%	55%
Conventional thermal	54%	64%	98%	61%	40%	28%	97%	61%	35%	29%
Coal	11%	10%	82%	25%	0%	0%	53%	9%	34%	9%
Brown coal	36%	49%	0%		0%	9%	40%	29%	0%	7%
Oil	3%	0%	1%	6%	6%	19%	0%	17%	1%	1%
Natural gas	4%	2%	16%	30%	33%	0%	4%	5%	1%	12%
Derived gas	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%
Conventional hydro	6%	2%	0%	0%	58%	4%	2%	30%	27%	15%
Hydro pumped	1%	1%	0%	0%	0%	4%	1%	0%	0%	1%
Other renewables	0%	1%	2%	0%	2%	1%	0%	0%	0%	1%

Source: Eurelectric (2004)

Nuclear Power Plants in Eastern Europe

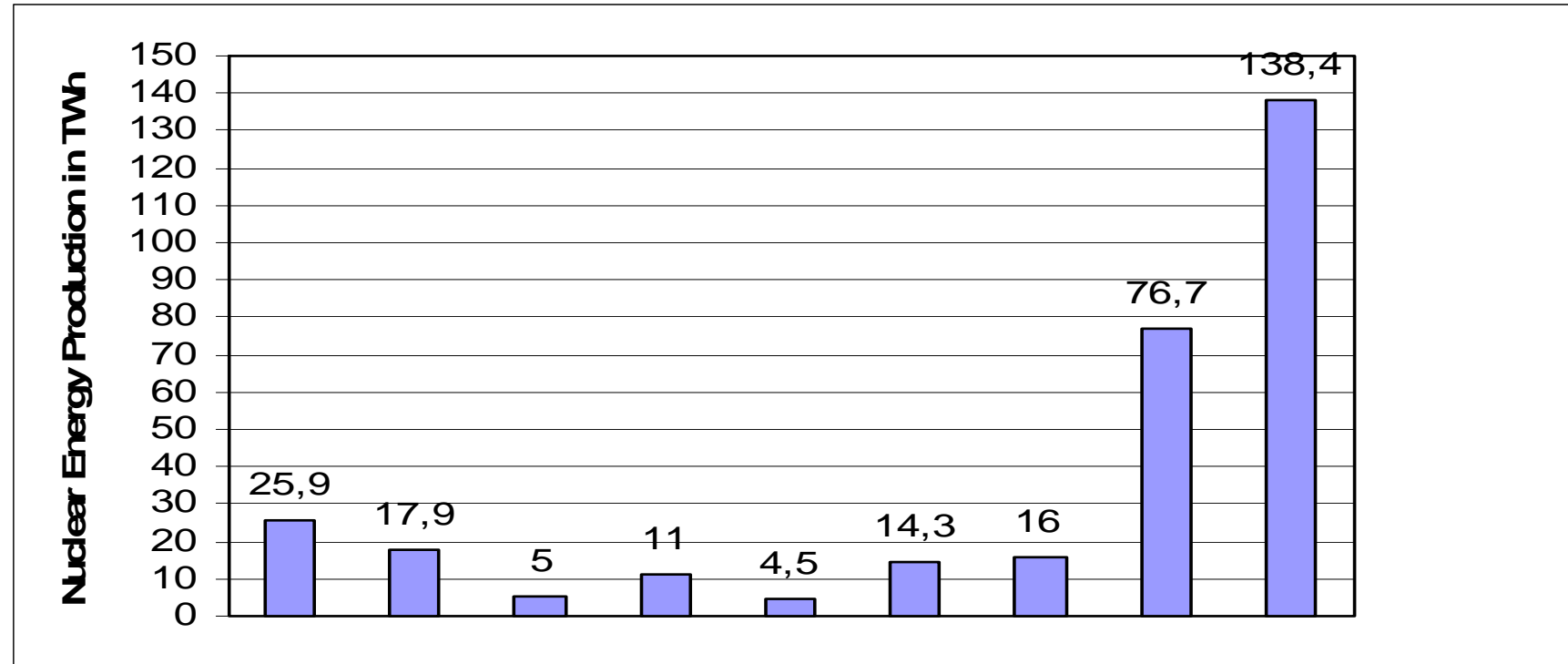


Country	Location
Lithuania	Ignalina
Czech Republic	Temelin Dukovany
Slovakia	Bohunice Mochovce
Hungary	Paks
Slovenia	Krsko
Romania	Cernavoda
Bulgaria	Kosloduy
Russia	10 locations
Ukraine	4 locations

- Traditional Power Plant
- Hydro Power Plant
- Nuclear Power Plant

<http://maps.unomaha.edu/Peterson/funda/MapLinks/EuropeOverview/tfsv1map4.jpg>

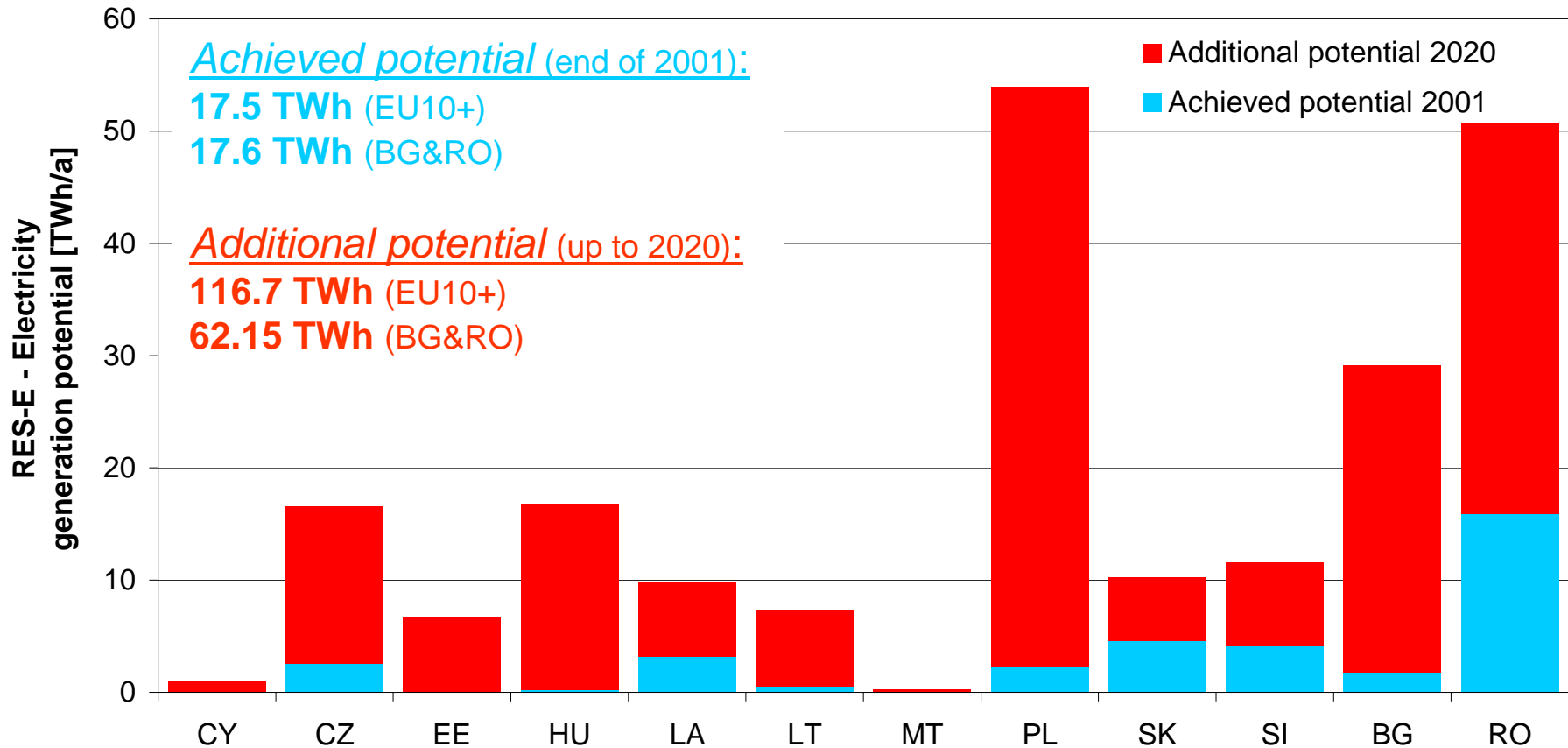
Share of Nuclear Energy (2003)



Country	CZ	SK	SLO	H	RO	LT	BG	UA	RUS
Nucl. Power Prod. in TWh	25,9	17,9	5	11	4,5	14,3	16	76,7	138,4
Total Power Prod. in TWh	83,2	31,1	12,3	33,7	48,6	17,9	42,5	167	836,9
Share in %	31,1	57,6	40,7	32,6	9,3	79,9	37,6	45,9	16,5

Source: <http://www.iaea.org/programmes/a2/index.html>

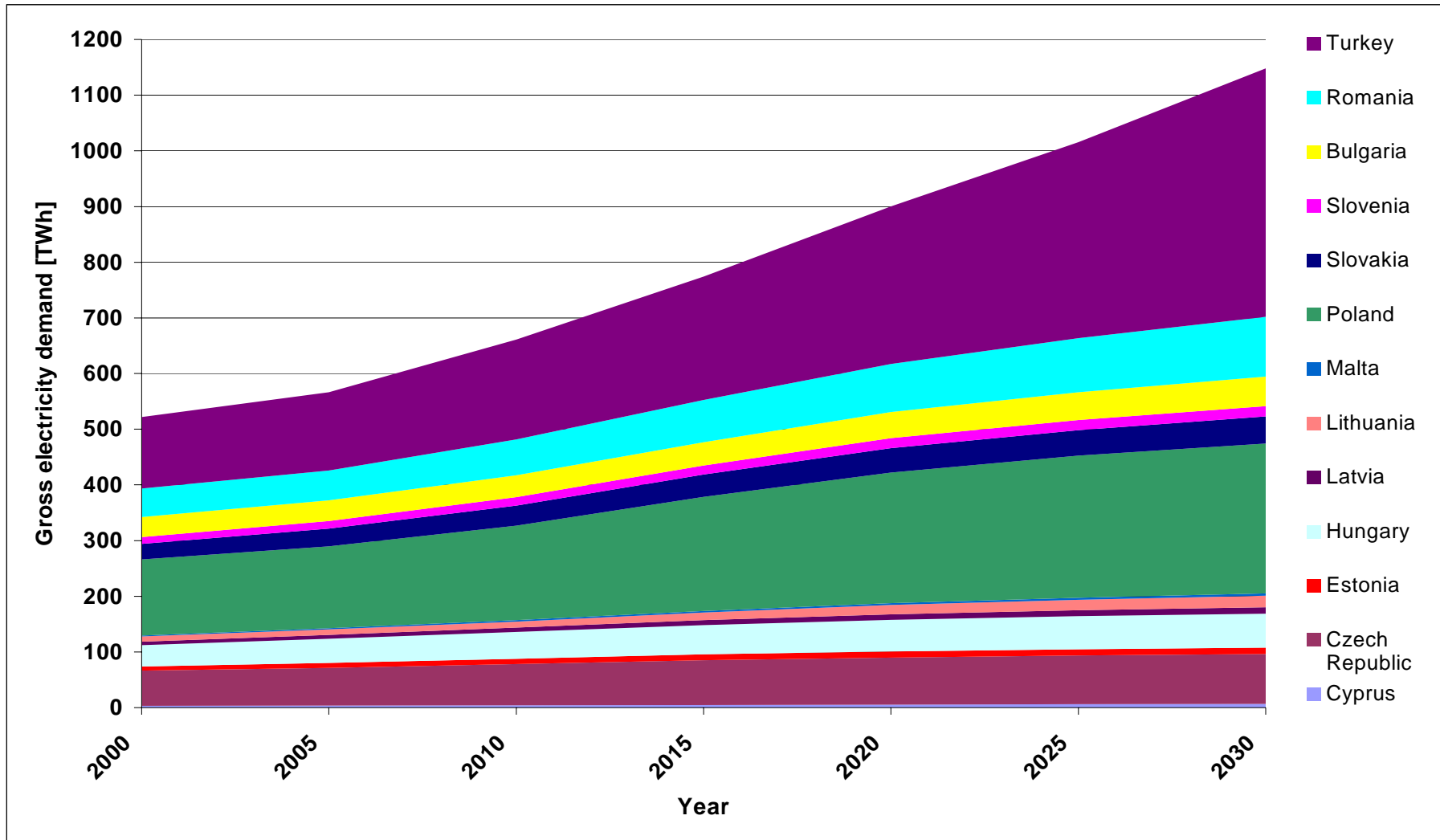
Achieved & additional realisable potential of Electricity Generation from Renewables (up to 2020) in EU-10 + CC



Source: FORRES 2020, Haas (2004)

Issues (4): Generation Adequacy

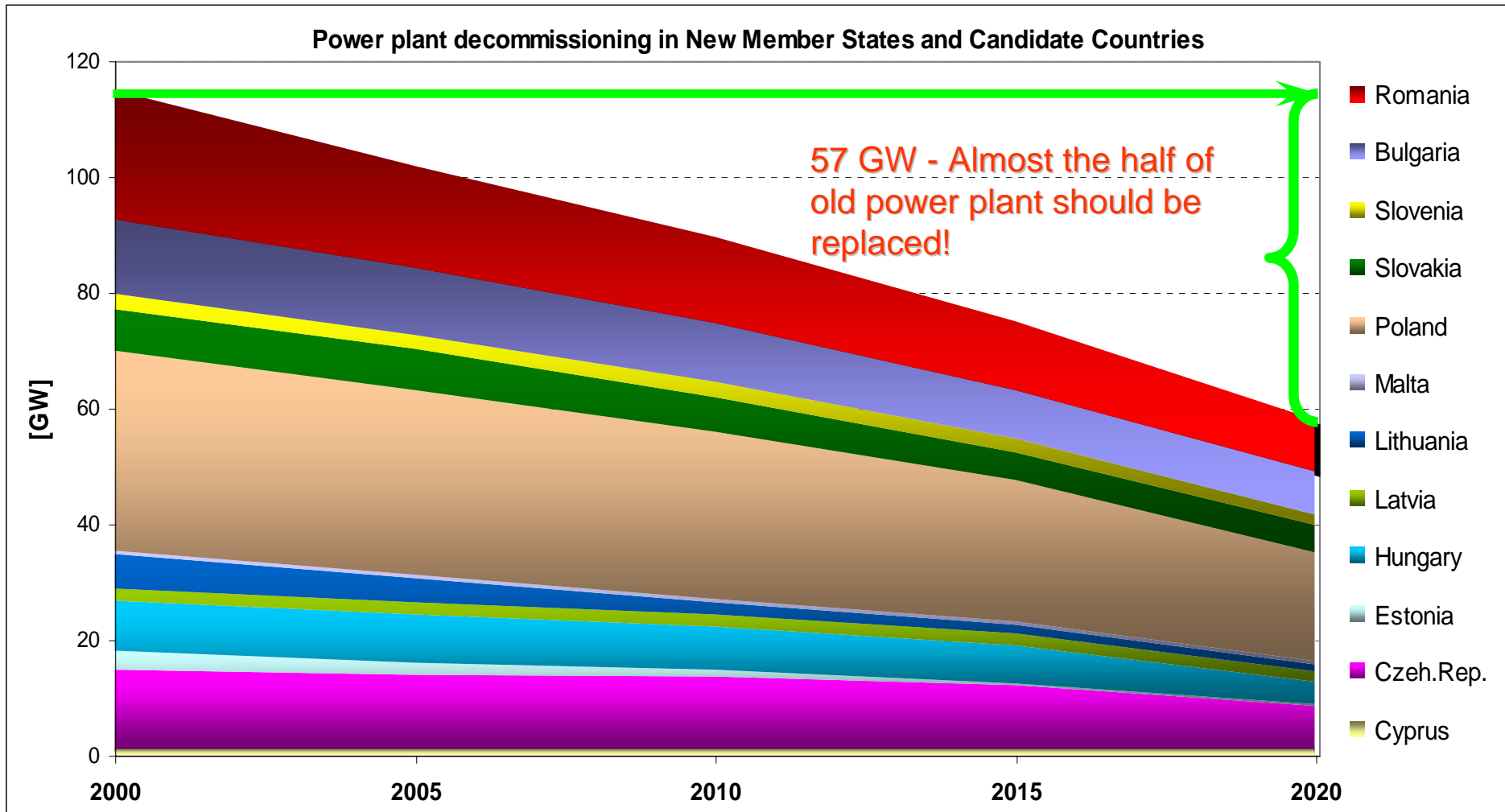
Gross electricity demand development in EU-10 + CC till 2030 (Haas, 2004)



Source: EU (2003), Haas (2004)

Decommissioning in EU-10+ and Candidate Countries

Growing need for investments in new capacity ! (Haas, 2004)



Source: Haas (2004)

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4.1 Summary of the 4th EU benchmarking report (2005) on electricity sector reform in the new member countries

	Declared market opening (%)	Unbundling : transmission system operator /owner	Unbundling: Distribution system operator
Czech R.	47	Legal	Accounts
Estonia	10	Legal	Legal
Hungary	67	Legal	Accounts
Lativa	76	Accounts	Accounts
Lithuania	n.k.	Legal	Legal
Poland	52	Legal	Accounts
Slovakia	66	Legal	Management
Slovenia	75	Legal	Accounts
Bulgaria	22	Accounts	Accounts
Romania	33	Legal	Management
Germany	100	Legal	Accounts
UK	100	Ownership	Legal

Source: European Communities (2005)

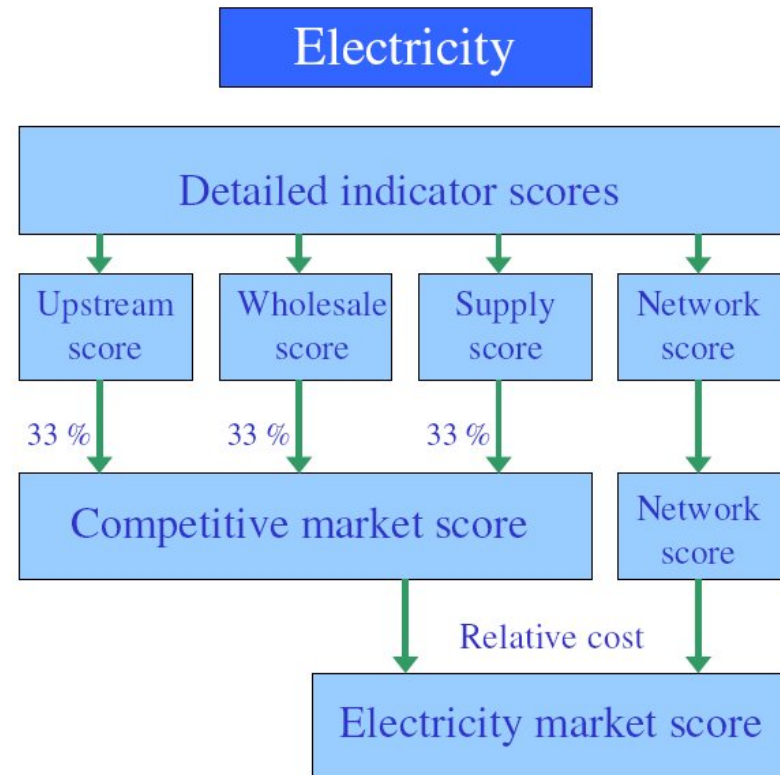
4.1 Summary of the 4th EU benchmarking report (2005) on electricity sector reform in the new member countries

	Biggest generator's share of capacity (%)	Biggest 3 generators' share of capacity (%)	Companies with at least 5% share of installed capacity	Import capacity (as % of installed capacity)
Czech R.	65	75	1	23%
Estonia	90	100	2	66%
Hungary	30	65	6	38%
Latvia	95	100	1	100%
Lithuania	50	80	3	50%
Poland	15	35	8	10%
Slovakia	75	85	1	37%
Slovenia	70	95	3	68%
Bulgaria	n.k.	n.k.	7	20%
Romania	n.k.	n.k.	7	16%

Sources: European Communities (2005)

OXERA-Based DIW-TUD Benchmarking

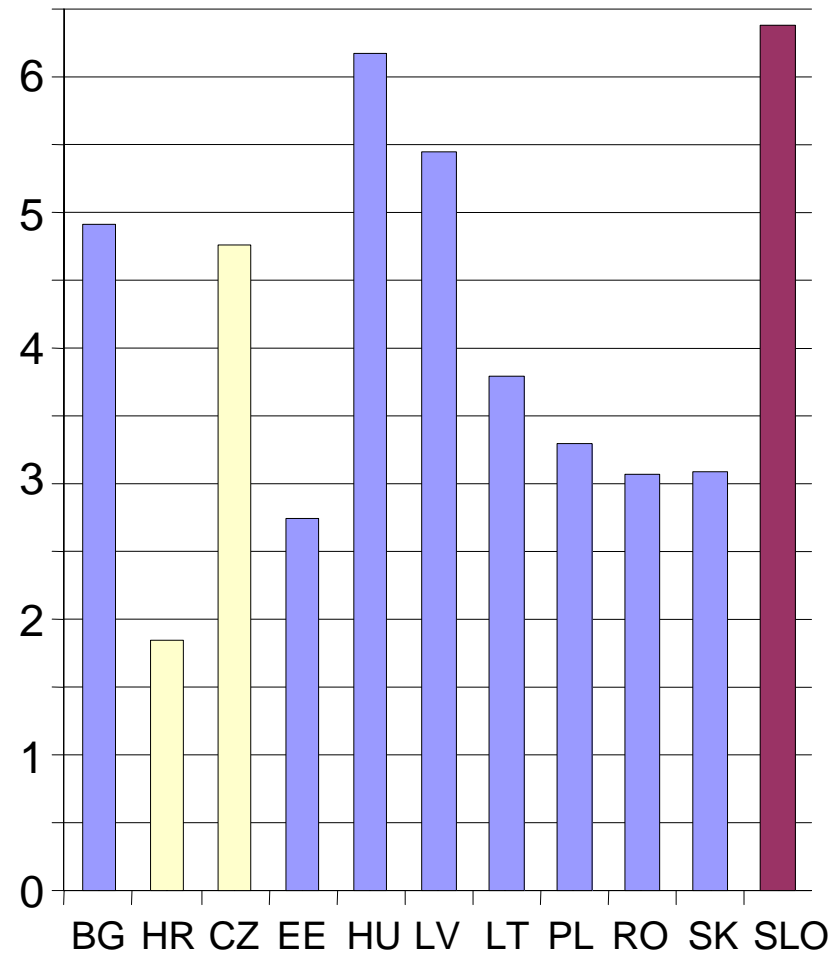
- According to the Oxera scheme liberalisation is measured by the competitive market score and the network score
- The competitive market score consists of the upstream score, the wholesale score and the supply score being weighted equally
- For the final score, the competitive market score is weighted with 0,7 and the network score with 0,3
- The initial filtering that was done by Oxera was not taken over



source:(Oxera,Energy Market competition in the EU and the G7, September 2003, p. 4)

Divergence Concerning Liberalization Between the Countries

- Slovenia achieves a level comparable to Western European countries
- Overall modest results concerning the OXERA-score
- Reforms are seemingly independent from geographical position and size



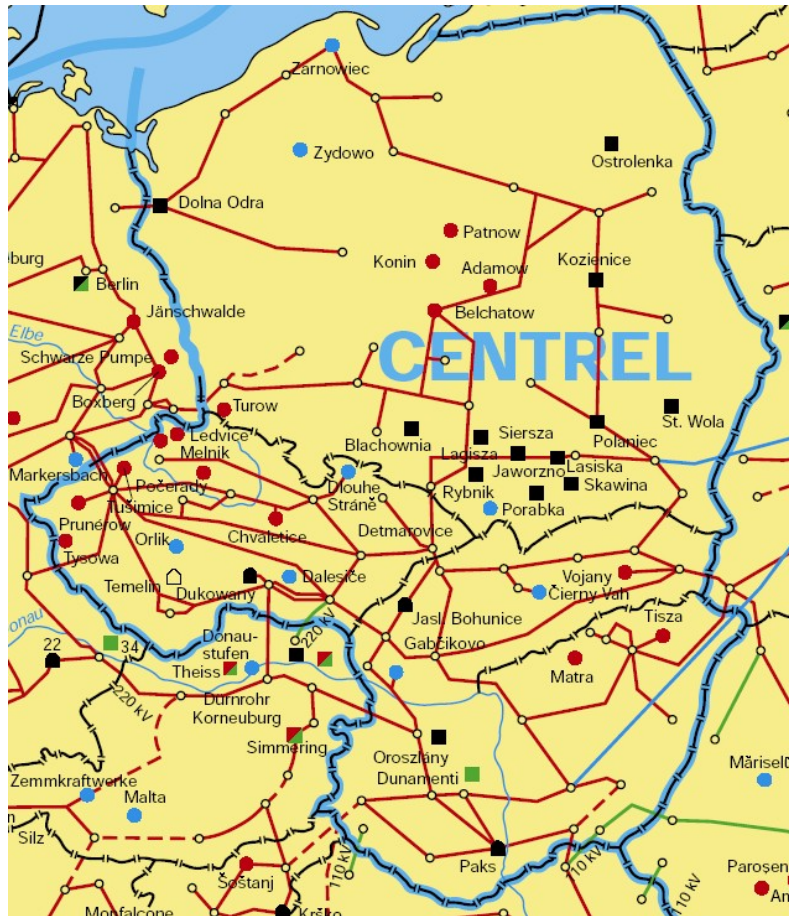
Synthesis: Useful Benchmarks to Consider in the New Member Countries (Green, et al., 2005)

- 1. Overcapacity and fuel mix: fuel mix evolution; *proportion of capacity to retire in the next decade; indicator of opening and closing plant (in MW)***
- 2. ...**
- 3. ...**
- 4. Uneconomic price structure: *ratio of domestic to industrial tariffs; ratio of tariff revenue to costs***
- 5. Small and isolated markets by lack of transport capacities; *absolute level of cross-border capacity; level of capacity available on the open market; correlation between the net export position of the countries and of competitive retailers***
- 6. Presence of longer term contracts in transmission lines and in generation: *proportion of cross-border transmission capacity sold under long-term contracts; proportion of electricity generation sold under long-term contracts***
- 7. Most local market structure dominated by a dominant player: *size of the dominant wholesaler; Herfindahl and Lerner Indexes***
- 8. ...**
- 9. Undeveloped market mechanisms: *size of the wholesale spot market / power exchange; ease of access to balancing services showed by the number of balancing services providers***
- 10. ...**

5. Conclusions

- The transition from socialist power systems to market-oriented electricity sectors has not proceeded as planned, but some progress has been made: all new member countries are still away from having efficient market structures and functioning markets**
- Three regional markets (Baltic, Balkan, CENTREL) are developing in CEEC's; infrastructure, congestion and market structure factors are preventing the development of an integrated market; however, successful technical integration into the UCTE**
- New member states are unlikely to become forerunners of a sustainable energy future: focus on coal and nuclear energy, potential of renewables to be activated**
- If anything, the new member states show that efforts to move towards an internal market all the more necessary**

Survey of the Region: The Electricity Sector in the New Member Countries



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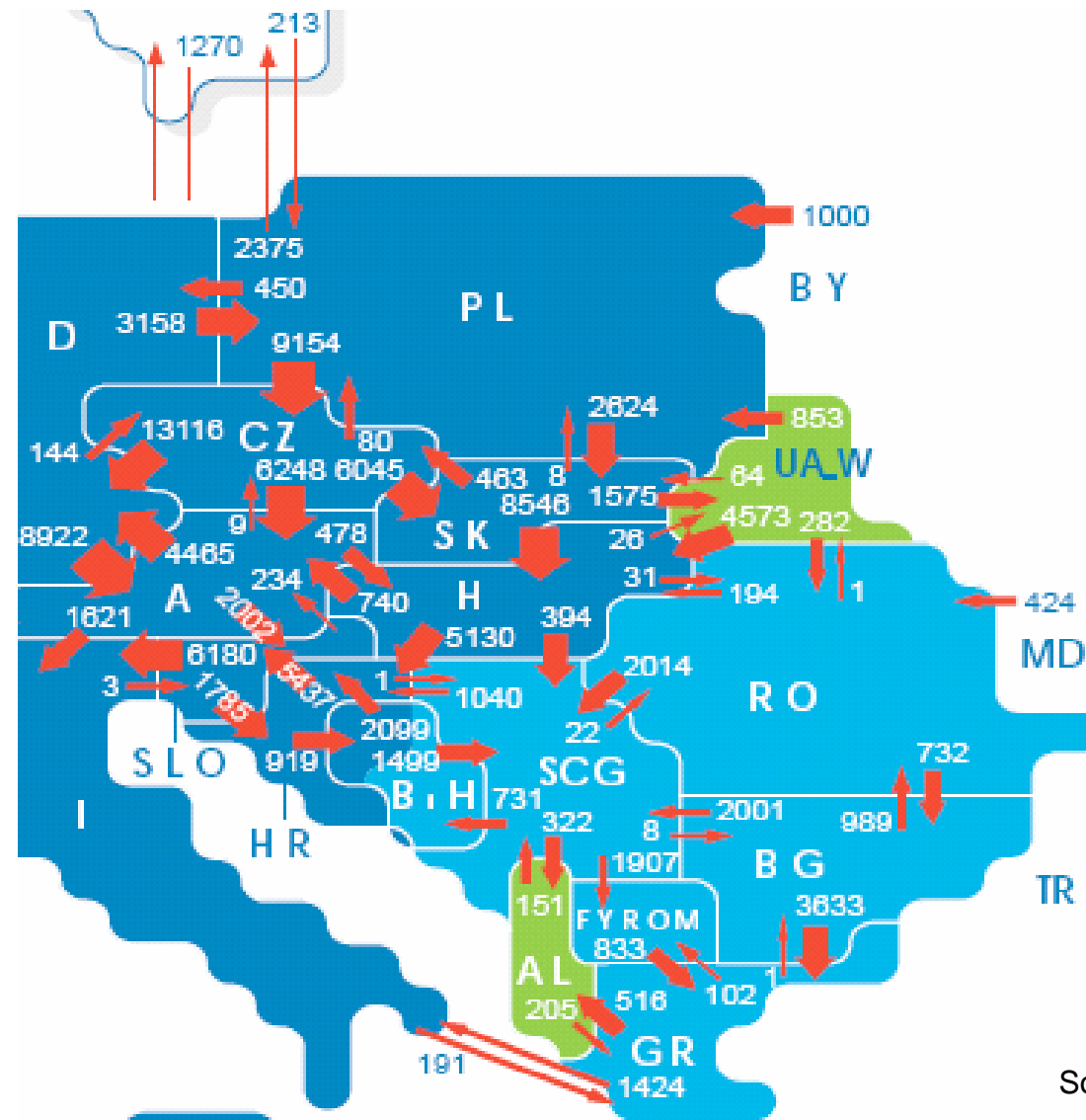
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Survey of the Region: Physical Electricity Exchanges in CEE Countries 2004 in GWh



Source:UCTE (2005)

Technical Description I

	Location	Type of Reactor	Capacity (MW/net)	Legal Status	Technical Status
CZ	Temelin	DWR, WWER 1000 DWR, WWER 1000	1 x 981 1 x 981	- -	- -
	Dukovany	DWR, WWER 440/213	4 x 417	-	modernization program
SK	Bohunice	DWR, WWER 440/230 DWR, WWER 440/213	2 x 408 2 x 408	closure in 2006 closure in 2008	improvements in safety, 1996 started program of incremental reconstruction → life time increase
	Mochovce	DWR, WWER 440/213 DWR, WWER 440/213	2 x 408 2 x 408	- under construction	
H	Paks	DWR, WWER 440/213	4 x 430	closure > 2020	recent problems of block 2 resolved
SLO	Krsko*	Westinghouse DWR	1 x 632	closure in 2023	modernization took place
RO	Cernavoda	Canadian Deuterium-Uranium-Reactor, CANDU 600	1 x 630 1 x 630 3 x 630	- under construction 1 block completion 2006 2 blocks completion 2010	safety improvements
LT	Ignalina	RBMK 1500, water cooling, graphite moderator	2 x 1185	1 block closure in 2007 1 block closure in 2008	adjustment: 1300MW gross, improvements
BG	Kosloduy	DWR, WWER 440/230 DWR, WWER 440/230 DWR, WWER 1000	2 x 408 2 x 408 2 x 953	closed in 2003 closure in 2006 modernization	improvements in control technology/cooling/radiation- & fire protection completion unrealistic
	Belene	DWR, WWER 1000	2 x 953	construction stop in 1990	

Sources: Jahrbuch der Atomwirtschaft 2001;
<http://www.eia.doe.gov/emeu/international/electric.html#IntlCapacity>;
<http://www.iaea.org/programmes/a2/index.html>

DWR: Druckwasserreaktor → Pressurized Water Reactor
 * 50 % Property of Croatia

Technical Description II

	Location	Type of Reactor	Capacity (MW/net)	Legal Status	Technical Status
UA	Rowno	DWR, WWER 440	2 x 370	-	-
	Rowno	DWR, WWER 1000	2 x 950	-	1 just finished 10/04
	South-Ukraine	DWR, WWER 1000	3 x 950	-	-
	Kmelnitzki	DWR, WWER 1000	2 x 950	-	1 just finished 08/04
	Kmelnitzki	DWR, WWER 1000	2 x 950	under construction	-
	Saporoschje	DWR, WWER 1000	6 x 950	-	-
RUS	Bilibinsk	LWGR	4 x 11	-	total capacity of nuclear power plants increases → 2010 about 170 TWh per year
	Nowo Woronesch	DWR, WWER	2 x 385	-	
	Nowo Woronesch	DWR, WWER 1000	1 x 953	-	
	Kola	DWR, WWER 440	4 x 410	-	
	Belojarsk	SNR, FBR BN 600	1 x 560	-	
	Kursk	LWGR, RBMK 1000	4 x 925	-	
	Kursk	LWGR, RBMK 1000	1 x 925	under construction	
	Sosnowi Bor	LWGR, RBMK 1000	4 x 925	-	
	Smolensk	LWGR, RBMK 1000	3 x 925	-	
	Kalinin	DWR, WWER 1000	2 x 953	-	
	Kalinin	DWR, WWER 1000	1 x 953	under construction	
	Balachowo	DWR, WWER 1000	4 x 953	-	
	Balachowo	DWR, WWER 1000	1 x 953	under construction	
	Rostow	DWR, WWER 1000	1 x 953	-	
Rostow	DWR, WWER 1000	1 x 953	under construction		

DWR = Druckwasserreaktor → Pressurized Water Reactor

SNR = Schneller Brüter → Fast-Breeder Reactor

GLWR = Graphite Moderator

LWGR = Water Cooling, Graphite Moderator

Sources: <http://www.eia.doe.gov/emeu/international/electric.html#IntlCapacity>, <http://www.iaea.org/programmes/a2/index.html>;

Jahrbuch der Atomwirtschaft 2001

Electricity: Security of Supply

Supply Demand Position				
	Amount of reserve generation capacity GW	As % of generation capacity	Import capacity (% generation capacity)	% p.a. increase in peak load
Estonia	n.k.	100	75	0.5
Lativa	n.k.	60	>100	1.5
Lithuania	n.k.	100	50	3.0
Poland	5.4	12	10	1.3
Czech R.	2.4	16	23	3.0
Slovakia	0.4	5	44	1.5
Hungary	0.4	5	22	1.5
Slovenia	0.2	8	53	3.0
Romania	1.7	11	6	4.0
Bulgaria	2.2	20	10	1.0
Germany	5.2	5	14	1.9
UK	n.k.	5-10	3	5.3

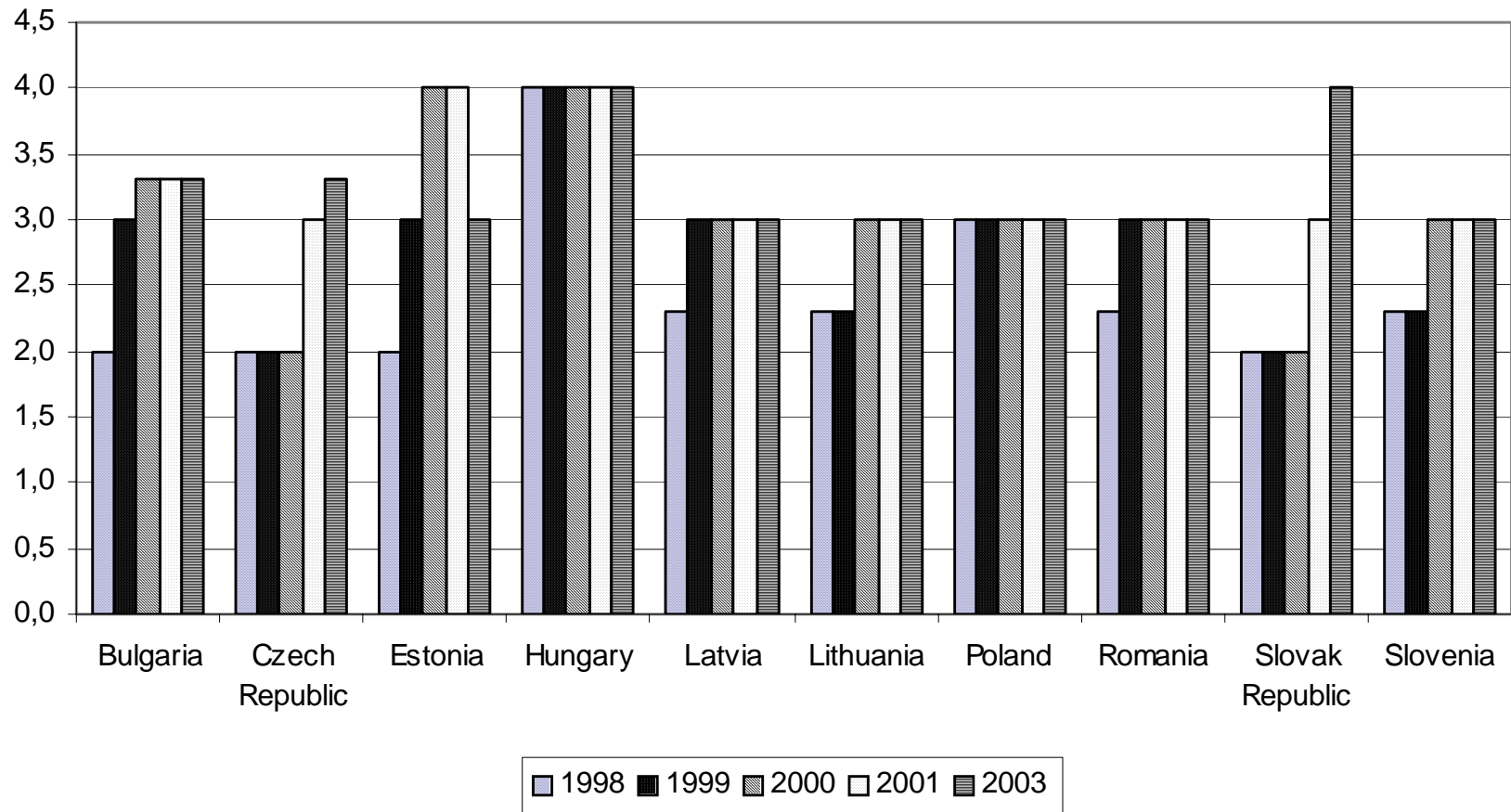
Source: Commission of the European Communities (2004), 20.

Market Structure in Import and Production of Gas

								Security of Supply Position 2003			
	% of gas from dom. Prod	% of gas from imp (no. of srcs)	Comp. with at least 5% share of avail. Gas	% of avail. gas controll ed by largest comp.	Gas release prog.	Cr. border pipeline cap. as % of cons.	LNG import capacity as % of consumption	Cons (bcm)	Amount of local prod.	Import cap.	Incr. in consu. 2002 vs 2001 (% p.a.)
Estonia	0	100 (1)	1	100	No	0	0	n.k.	n.k.	n.k.	n.k.
Lativa	0	100 (1)	1	100	no	0	0	1.5	0.0	1.5	+1.0
Lithuania	0	100 (1)	4	43	no	0	0	2.6	0.0	6.0	+1.5
Poland	34	66(3)	1	100	no	>100	0	12.4	4.0	7.8	-1.5
Czech R.	1	99 (2)	1	99	no	>100	0	9.6	0.1	12.0	-3.0
Slovakia	3	97 (1)	1	97	no	>100	0	7.5	0.2	7.3	+5.4
Hungary	25	75 (2)	1	100	no	10	0	12.8	3.1	13.3	+0.0
Slovenia	0	100 (3)	1	100	no	>100	0	1.0	0.0	3.5	-3.6
Romania	80	20 (1)	7	n.k.	no	0	0	15.0	12.0	12.0	-0.6
Bulgaria	1	99 (1)	1	100	yes	>100	0	3.0	0.0	6.0	-9.0
Germany	18	82 (5)	9	c. 50	yes	>100	15	98.4	20.2	87.0	+0.5
UK	90	10	6	c.25	compl.	10	0	94.0	112.0	9.5	-4.0

Source: Commission of the European Communities (2004), 32 and 34.

EBRD electricity sector reform indicators for Eastern Europe (1998-2003)



Issues: Market Structure Ownership and Concentration

All CEE countries still away from the unbundled and competitive benchmark case !



Hungary	} mainly privatised generation, fully privatised distribution, but integration of TSO and state owned generator
Czech R	} Partially privatised generation, partly privatised distribution
Slovakia	
Poland	
Romania	} State owned generation, partly privatised distribution
Bulgaria	
Lithuania	
Slovenia	} Unbundled state owned generation and distribution
Estonia	} Vertically integrated state owned monopolies
Croatia	
Latvia	