



Energy sector overview and case studies for NEEDS: Hungary

János Osán

**KFKI Atomic Energy Research Institute
P.O. Box 49, H-1525 Budapest, Hungary**

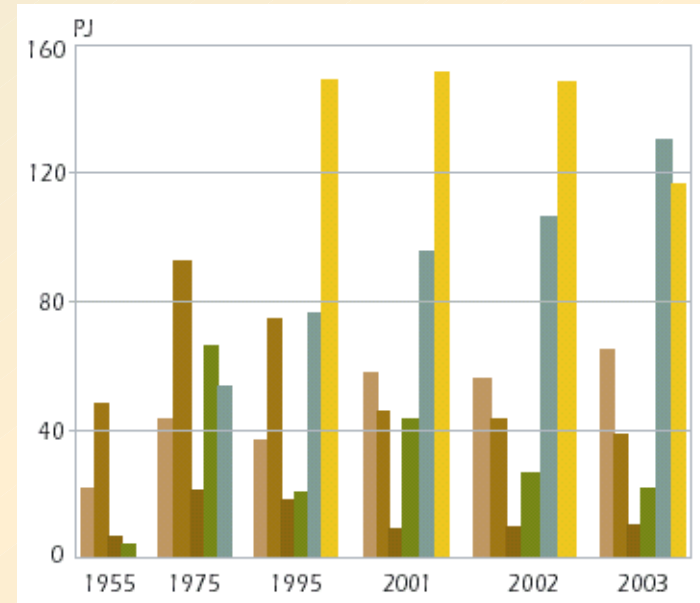
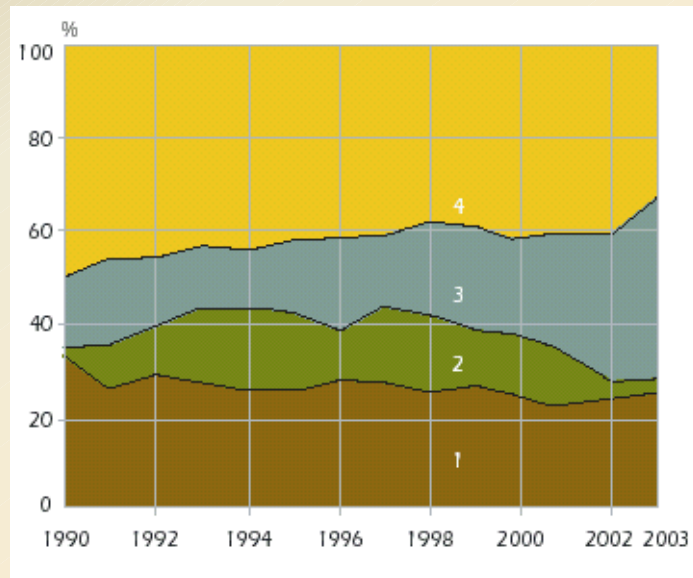
Power plants in Hungary



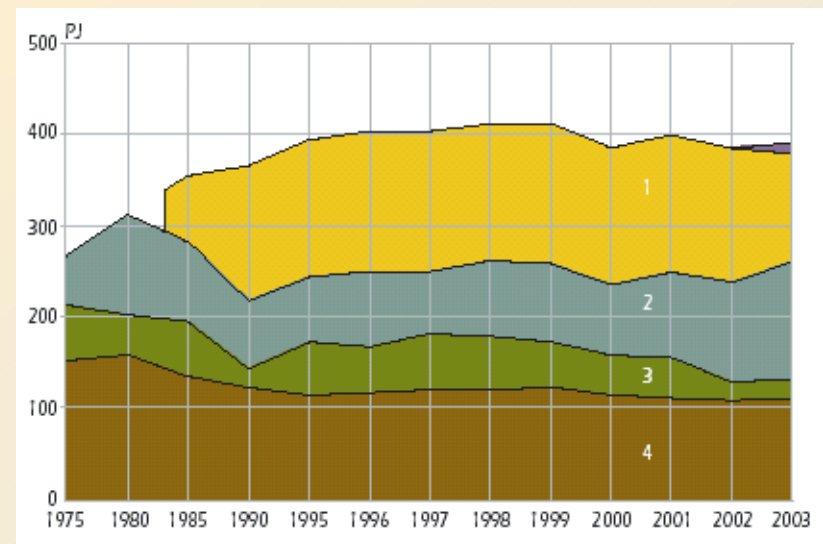
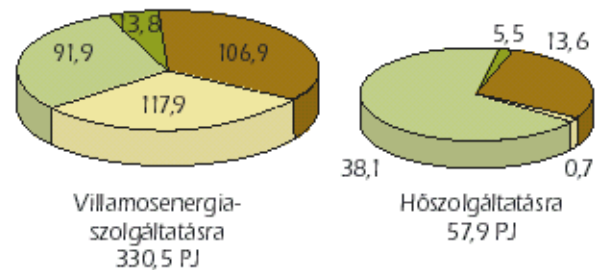
- Coal ● Hydrocarbon ● Nuclear ● Hydropower ● Gas turbine reserve

Source: Hungarian Electricity Board

Primer energy usage in Hungary for electricity generation



- 1 Nuclear
- 2 Natural gas
- 3 Oil
- 4 Coal
- Other / waste



Source: Hungarian Electricity Board

Energy balance in Hungary - 2003

Power plant	Power MW	Electricity GWh	Heat TJ	Usage h/a	Energy source solid	liquid	TJ gas	nuclear	renewable	total
Dunamenti	2143	5053	6005	2448		2508	48775			49283
Paksi	1866	10338	601	5902				120146		120146
Tisza	860	2405	0	2930		9609	14311			23920
Mátrai	836	5032	300	6819	62433	1153				63586
Csepeli	390	1893	1219	5026		647	14382			15029
Oroszlányi	240	1032	392	4846	14057	141				14198
Tiszapalkonyai	200	477	679	2730	7416	223	566			8205
Kelenföldi	191	602	3151	3298		242	6948			7190
Lorinci	170	5	0	27		57				57
Borsodi	137	281	1174	2511	5026	5	653		1084	6768
Pécsi	130	513	2620	4823	9209	338				9547
Litéri	120	1	0	8		12				12
Sajószögedi	120	3	0	28		39				39
Újpesti	110	423	3124	4016		110	5501			5611
Ajkai	102	205	2824	2764	6732	50				6782
Bánhidai	100	462	30	5004	5555	112				5667
Debreceni	95	731	1246	7818			5718			5718
EMA	69	114	3870	2220		704	6506			7210
large plants	7879	29570	27235	4046	110428	15951	101360	120146	1084	348969
small plants	657	1809	22208	3448	1802	4028	29192	0	3260	38282
Import	870	6938		7975						24977

Source: Hungarian Electricity Board

Energy balance in Hungary - 2004

Power plant	Power MW	Electricity GWh	Heat TJ	Usage h/a	Energy source		TJ			total
					solid	liquid	gas	nuclear	renewable	
Dunamenti	2143	4500	5800	2170		2000	43000			45000
Paksi	1866	11560	600	6592				134182		134182
Tisza	860	1650	0	2093		4600	12000			16600
Mátrai	836	4900	300	6699	61500	1200				62700
Csepeli	396	1640	1200	4293		500	12800			13300
Oroszlányi	240	930	350	4167	13000	150				13150
Tiszapalkonyai	200	350	700	2000	6000	200	400			6600
Kelenföldi	191	580	3000	3141		200	6600			6800
Lorinci	170	5	0	27		57				57
Borsodi	137	250	1000	2336	4800	5	500		1084	6389
Pécsi	132	460	2500	4242	7500	200			900	8600
Litéri	120	1	0	8		13				13
Sajószögedi	120	1	0	8		13				13
Újpesti	110	410	2800	4000		100	5400			5500
Kispesti	110	140	1800	1364		100	2900			3000
Ajkai	102	200	2800	2745	5000	50			1500	6550
Bánhidai	100	230	30	2500	2800	50				2850
Debreceni	95	680	1200	7368			5700			5400
EMA	69	110	3800	1739		50	6000			6050
large plants	7997	28597	27880	3861	100600	9488	95000	134182	3484	342754
small plants	698	1923	20560	3287	1400	3960	27600	0	2790	35750
Import	1050	7830		7457						28188

Source: Hungarian Electricity Board

Energy balance in Hungary - plan for 2005

Power plant	Power MW	Electricity GWh	Heat TJ	Usage h/a	Energy source		TJ			
					solid	liquid	gas	nuclear	renewable	total
Dunamenti	1693	4500	5600	2658		2000	41000			43000
Paksi	1866	11740	600	6699				136364		136364
Tisza	860	2300	0	2791		8000	15000			23000
Mátrai	836	5100	300	6938	62800	1200				64000
Csepeli	396	1840	1200	4798		500	14000			14500
Oroszlányi	240	830	400	3750	11900	100				12000
Tiszapalkonyai	125	250	500	2400	3000	200	300		1000	4500
Kelenföldi	186	610	3200	3495		200	7000			7200
Lorinci	170	5	0	27		60				60
Borsodi	137	250	1000	2336	4800	5	500		1084	6389
Pécsi	70	250	2600	3714		3380	7800			8138
Litéri	120	1	0	8		13				13
Sajószögedi	120	1	0	8		13				13
Újpesti	110	440	3000	4091		110	5501			5611
Kispesti	110	390	2200	3636	0	50	5400			5450
Ajkai	102	270	2800	2941	5000	50				5050
Bánhidai	100	230	30	2500	2800	50				2850
Debreceni	95	680	1200	7368			5400			5400
EMA	69	93	3800	1638		50	6000			6050
large plants	7168	29150	27400	4350	82700	12884	107401	136364	2084	341433
small plants	910	1970	22000	2291	0	3100	28064	0	9050	40214
Import	1100	8100		7364						29160

Source: Hungarian Electricity Board

Human health external costs related to fossil energy generation (emission data of 1999 and 2000)

Health effect	Pollutant	External cost (mEUR/kWh)						
		Hydro-carbon	Lignite	Lignite with DS	Coal	Coal → gas	Coal → GT	Lauffen
Morbidity	TSP	0.66	1.78	1.78	1.60			0.02
	NO _x , nitrate	0.77	0.71	0.71	0.01	6.01	3.35	0.92
	SO ₂ , sulfate	3.96	30.77	3.04	23.38		1.20	0.26
	Subtotal	5.39	33.27	5.54	24.98	6.01	4.55	1.20
Mortality	TSP	5.14	16.07	16.07	12.51			0.19
	NO _x , nitrate	6.08	6.45	6.45	0.18	54.26	30.23	7.27
	SO ₂ , sulfate	32.81	289.96	28.69	193.54		11.35	2.14
	Subtotal	44.03	312.48	51.21	206.23	54.26	41.57	9.60
Total		49.43	345.75	56.75	231.21	60.27	46.12	10.80

EcoSense 2.0 provided by IER – University of Stuttgart
 (external costs are slightly overestimated compared to the recent knowledge of monetary values and exposition-response functions in *ExternE*)

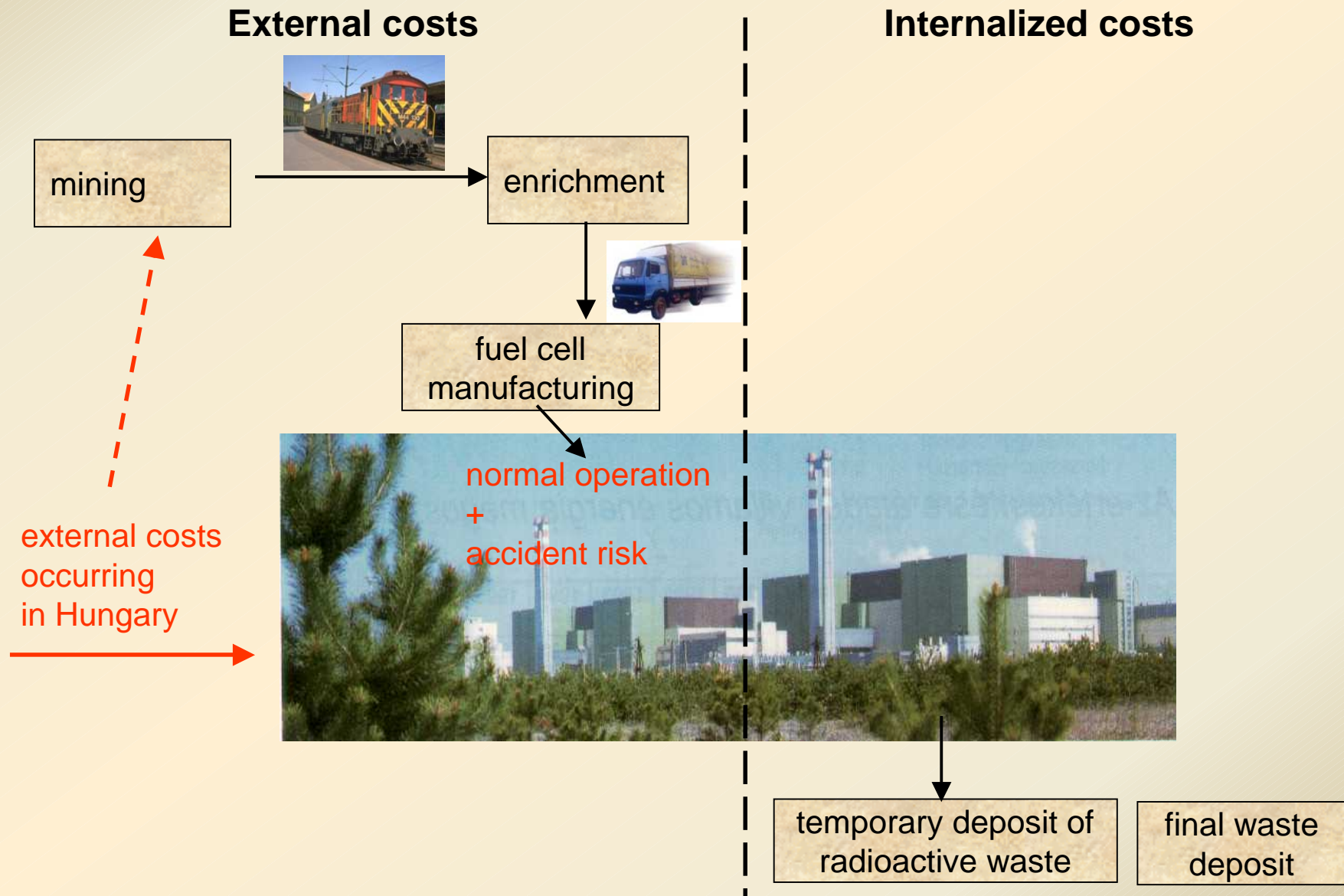
Mortality calculations based on the “YOLL - Years Of Life Lost” approach

Lignite: effect of installed desulfurization units also calculated

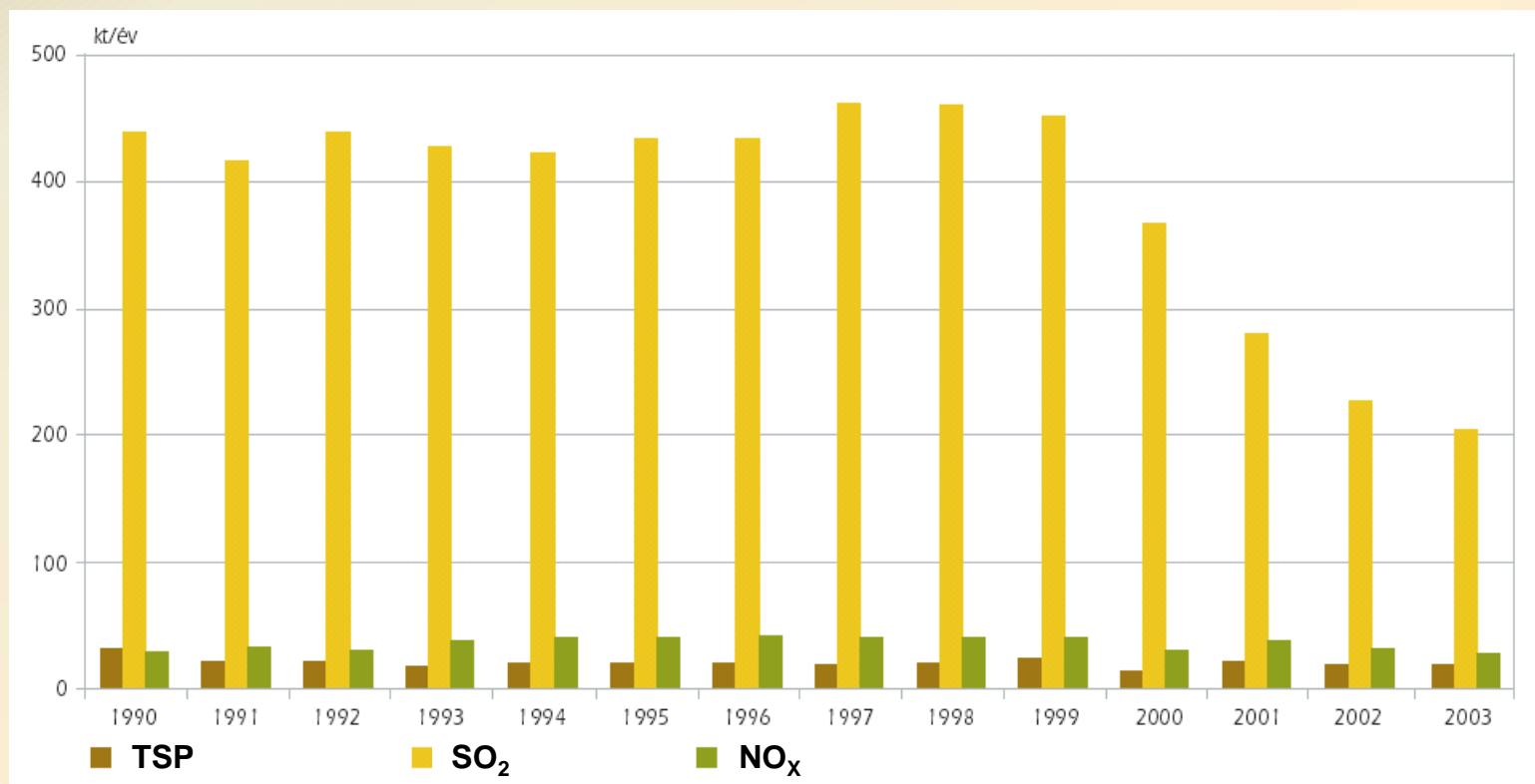
Coal: estimated external costs for switching to natural gas burning or gas turbine operation

Lauffen: hypothetical modern coal burning power plant in Germany
 (only for comparison)

Fuel cycle of nuclear energy generation



Trends in pollutant emissions of power plants in Hungary



“Classical” pollutants: SO₂ emission decreases after 1999 due to the introduction of desulfurization technologies

CO₂ and heavy metals become more and more important

Contribution of biomass combustion increases - should also be addressed

Source: Hungarian Electricity Board

Selection of fossil power plants for case studies in NEEDS

- A.** Lignite fueled power plant (836 MW):
the largest fossil fueled electricity supplier in Hungary
base power plant
continuous improvement due to emission reduction technologies
good connection with the environmental department of the power plant
- B.** Coal burning base plant (150 MW):
coal burning plant having the highest impact (per kWh) at local scale
the coal burning units are replaced with biomass and natural gas burning ones
effect of switch from a type of fuel to another can be studied
- C.** Hydrocarbon fueled peak power plant (860 MW):
combustion of heavy oil and natural gas
(optional)