Geo policies and the cost of energy security

Ionut PURICA
Prof.c.m.AOSR

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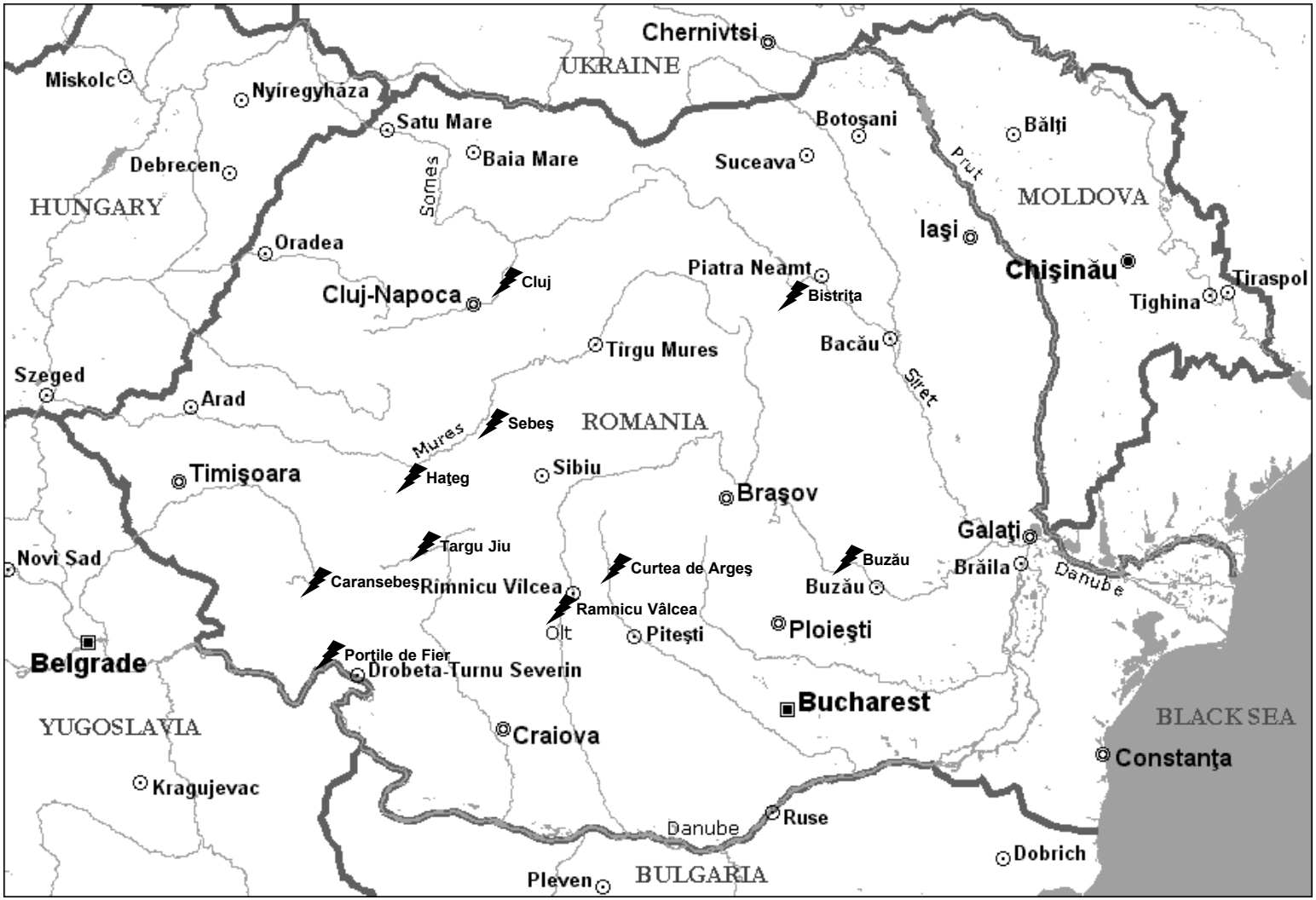
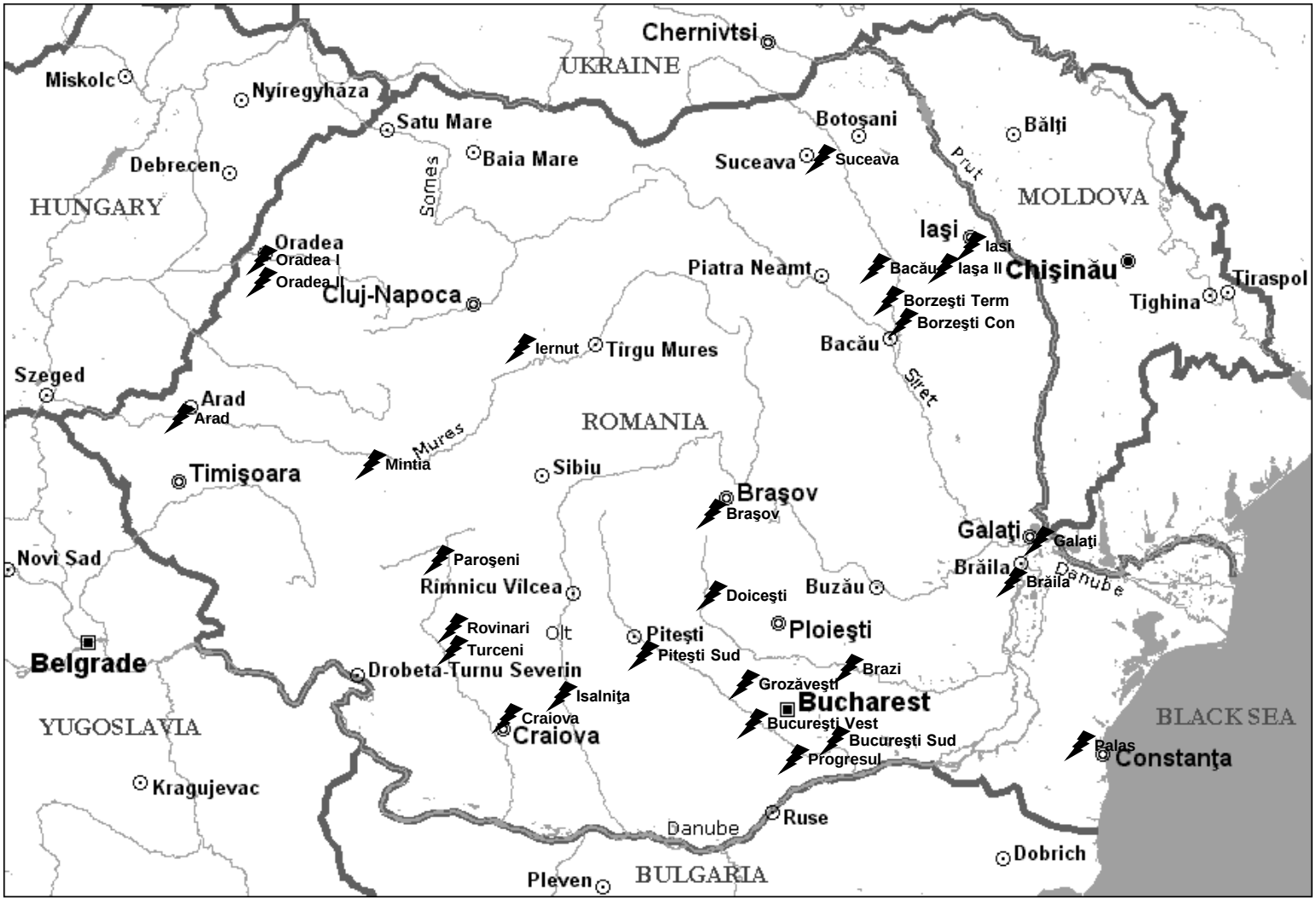
Elements of security

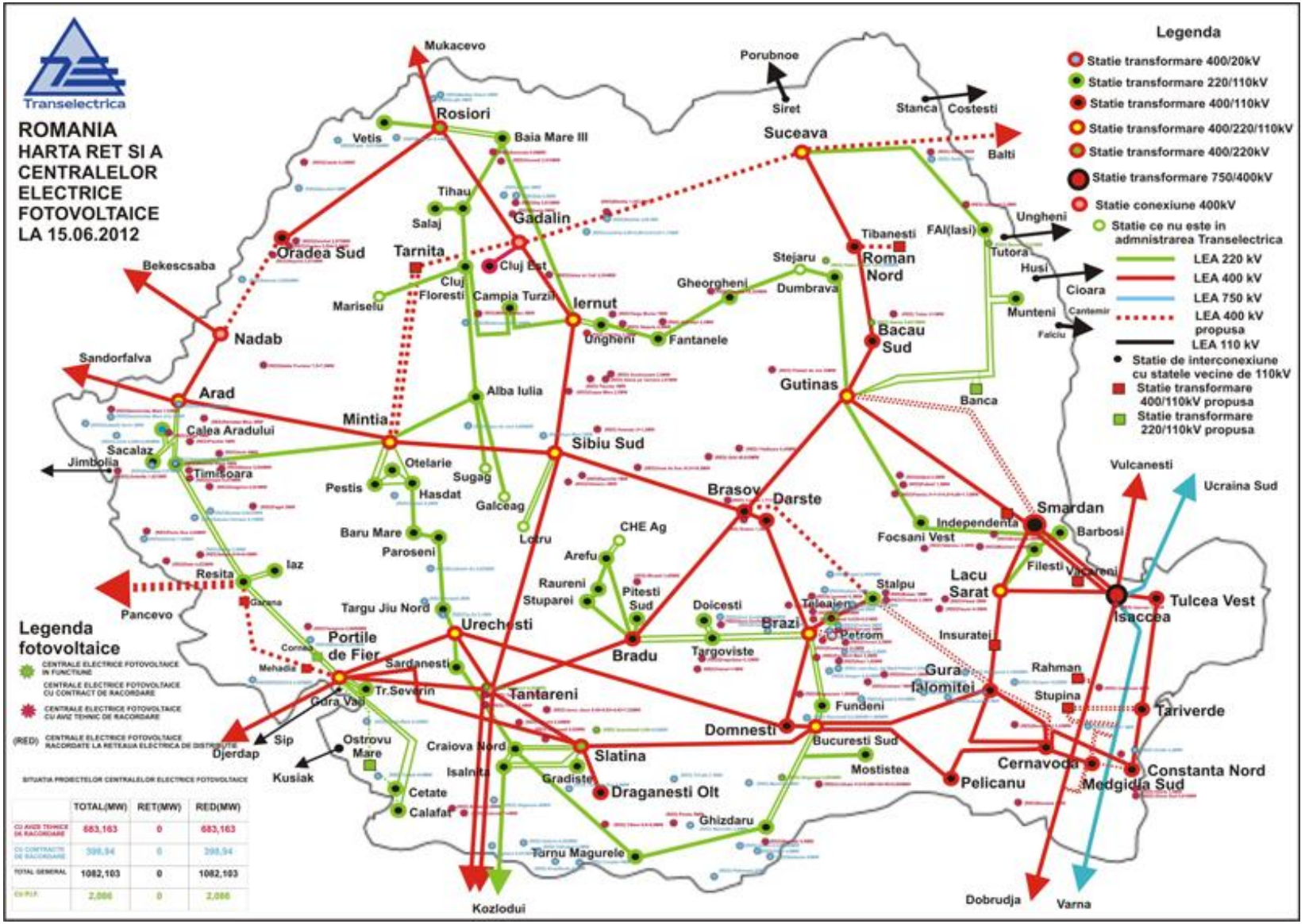
According to the Security strategy of the energy systems launched by the EU Commission in 2014 it is necessary to have a diversified portfolio of electrical energy generation technologies that ensures the coverage of situations when various types of risks manifest themselves. The same applies for gas interconnectors and for the climate change risks impact on critical infrastructures.

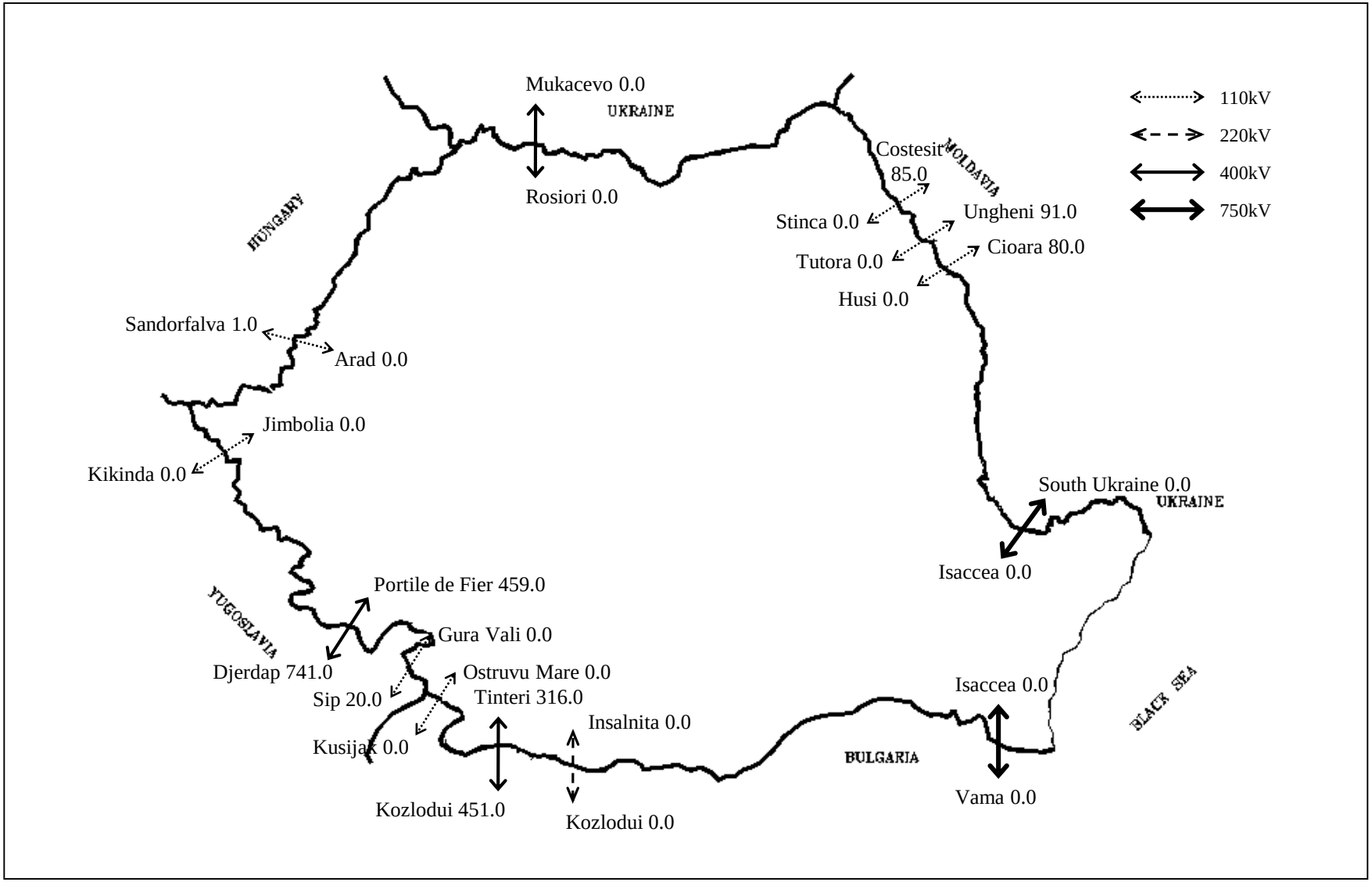


Map 1: Hidroelectrica hydro power plants

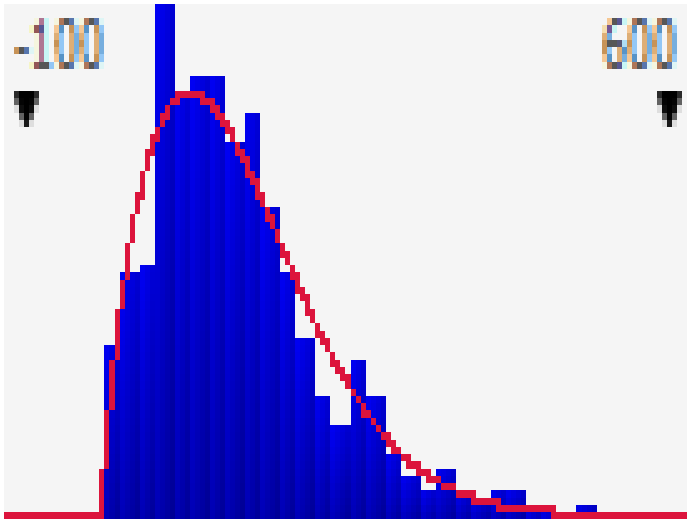


Map 2: Termoelectrica thermal power plants


Transelectrica
ROMANIA
HARTA RET SI A CENTRALELOR ELECTRICE FOTOVOLTAICE LA 15.06.2012
Legenda
Statie transformare 400/20kV
Statie transformare 220/110kV
Statie transformare 400/110kV
Statie transformare 400/220/110kV
Statie transformare 400/220kV
Statie transformare 750/400kV
Statie conexiune 400kV
Statie ce nu este in admnistrarea Transelectrica
LEA 220 kV
LEA 400 kV
LEA 750 kV
LEA 400 kV propusa
LEA 110 kV
Statie de interconexiune cu statele vecine de 110kV
Statie transformare 400/110kV propusa
Statie transformare 220/110kV propusa
Legenda fotovoltaice
CENTRALE ELECTRICE FOTOVOLTAICE IN FUNCTIUNE
CENTRALE ELECTRICE FOTOVOLTAICE CU CONTRACT DE RACORDARE
CENTRALE ELECTRICE FOTOVOLTAICE CU AVIZ TEHNIC DE RACORDARE
(RED) CENTRALE ELECTRICE FOTOVOLTAICE RACORDATE LA RETEAUA ELECTRICA DE DISTRIBUTIE
SITUATIA PROIECTELOR CENTRALELOR ELECTRICE FOTOVOLTAICE
TOTAL(MW) RET(MW) RED(MW)
CU AVIZE TEHNICE DE RACORDARE 683,163 0 683,163
CU CONTRACTE DE RACORDARE 398,94 0 398,94
TOTAL GENERAL 1082,103 0 1082,103
Cu P.I.F. 2,086 0 2,086
Mukacevo
Porubnoe
Siret
Stanca
Costesti
Balti
Rosiori
Vetis
Baia Mare III
Suceava
Tihau
Salaj
Gadalin
Oradea Sud
Tarnita
Cluj Est
Cluj Floresti
Campia Turzii
Iernut
Mariselu
Bekescsaba
Nadab
Sandorfalva
Arad
Calea Aradului
Sacalaz
Jimbolia
Timisoara
Mintia
Alba Iulia
Sibiu Sud
Otelarie
Pestis
Sugag
Hasdat
Galceag
Lotru
Baru Mare
Paroseni
Resita
Iaz
Darana
Pancevo
Targu Jiu Nord
Portile de Fier
Cornea
Mehadia
Sardanesti
Tr.Severin
Cora Vad
Djerdap
Sip
Kusiak
Ostrovu Mare
Urechesti
Tantareni
Craiova Nord
Isalnita
Cetate
Calafat
Slatina
Gradiste
Draganesti Olt
Ghizdaru
Tarnu Magurele
Kozlodui
Tibanesti
Roman Nord
Stejaru
Dumbrava
Gheorgheni
Ungheni
Fantanele
Bacau Sud
Gutinas
Banca
FAI(Iasi)
Tutora
Ungheni
Husi
Cioara
Cantemir
Falciu
Munteni
Brasov
Darste
CHE Ag
Arefu
Raureni
Stuparei
Pitesti Sud
Dolcesti
Targoviste
Bradu
Brazi
Teleajen
Petrom
Stalpu
Insuratei
Gura Ialomitei
Rahman
Stupina
Fundeni
Domnesti
Bucuresti Sud
Mostistea
Pelicanu
Cernavoda
Medgidia Sud
Constanta Nord
Tariverde
Lacu Sarat
Isaccea
Tulcea Vest
Smardan
Independenta
Barbosi
Focsani Vest
Filesti
Vadeni
Vulcanesti
Ucraina Sud
Dobrudja
Varna



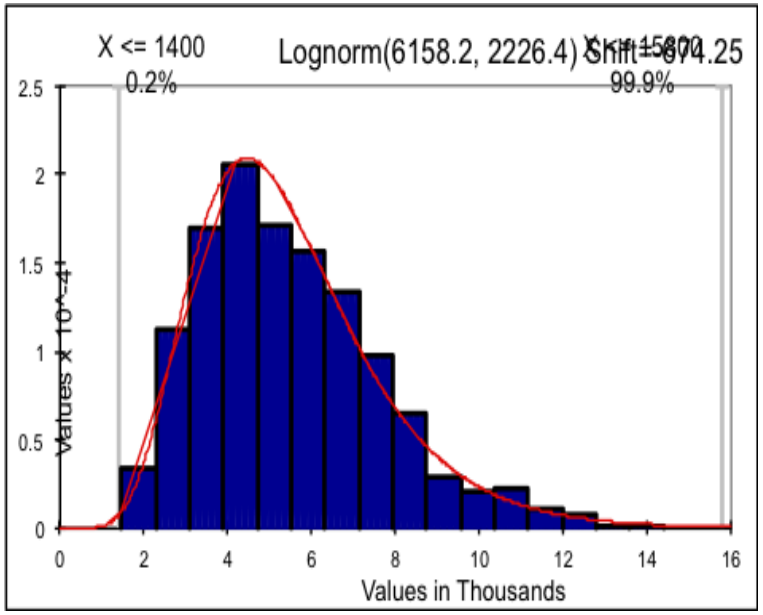
Map 5: Electricity exchanges across interconnections, 2000 (GWh)



Precipitations

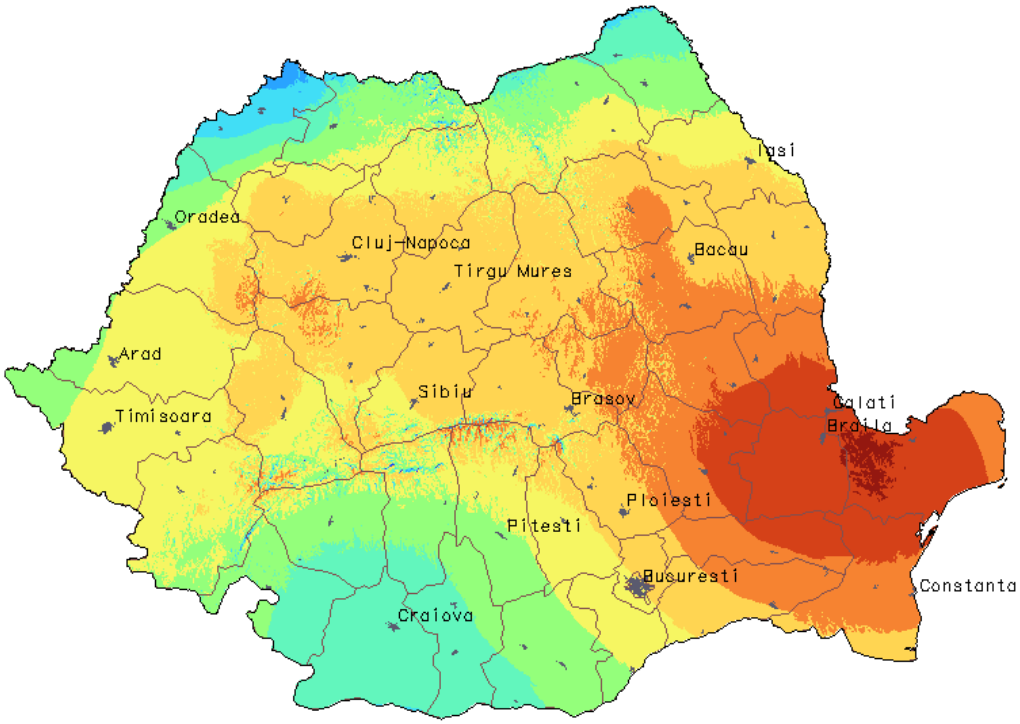
SD/Mean rain	0.65527311	hidro lake	
		TWh	16
		TWh lake	4.8
		h/year	8760
		exposure TWh	3.145310928
		power MW	359.0537589

Danube

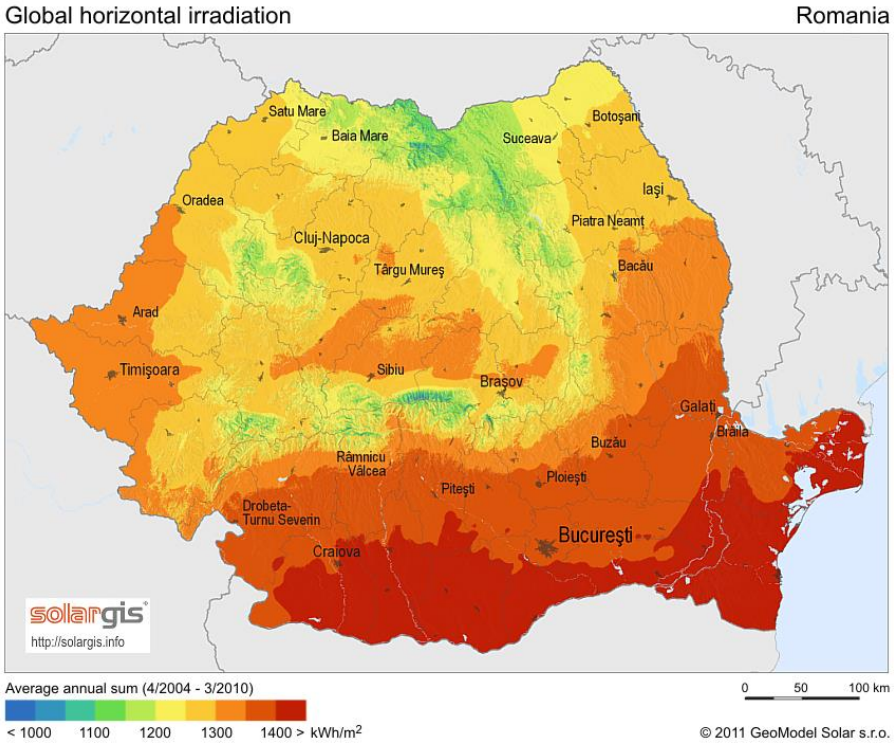


SD/Mean Danube	**0.36153 4215**			
		Needed security hydro run river		
		TWh	16	
		TWh run river	11.2	
		h/year	8760	
		exposure TWh	4.04918 3203	
		power MW	462.235 5254	

Wind



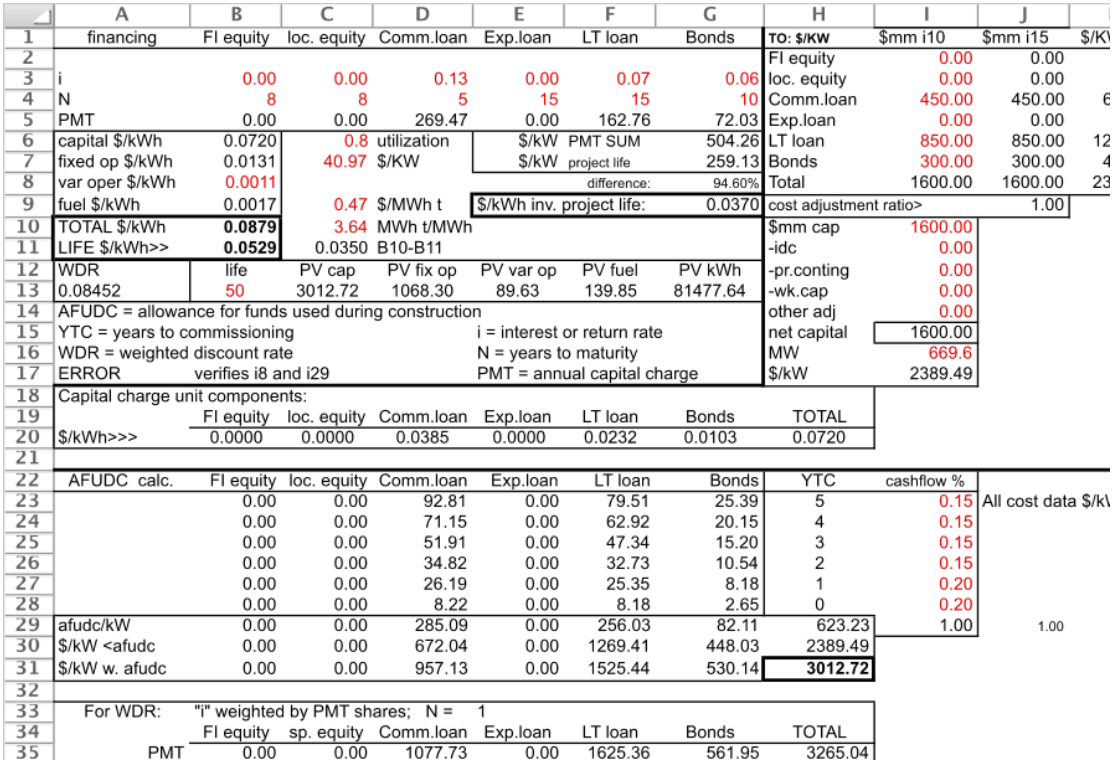
SD/Mean wind	0.5	wind	
		TWh	3
		TWh wind	3
		h/year	8760
		exposure TWh	1.5
		power MW	171.2328767



Photovoltaic

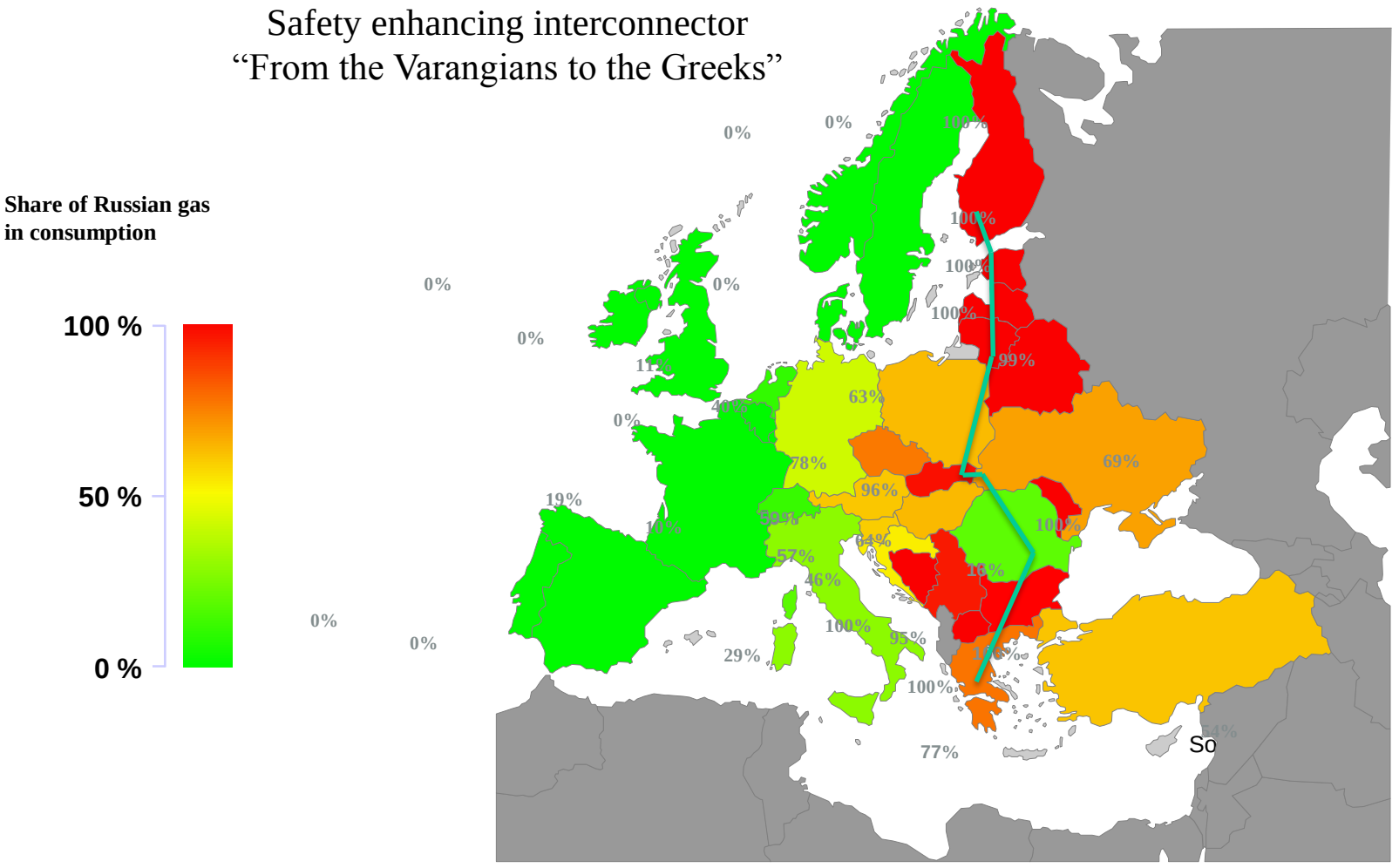
SD/Mean PV	0.6	PV	
		TWh	1
		TWh PV	1
		h/year	8760
		exposure TWh	0.6
		power MW	68.493150 68

In the table below a simulation of a typical financing scheme is presented for a coal power plant of 669 MW having a total of 3000 US$/kW and a lifetime of 50 years (the monetary units in the table are given in US$ but they can be replaced with Euro without changing the values).



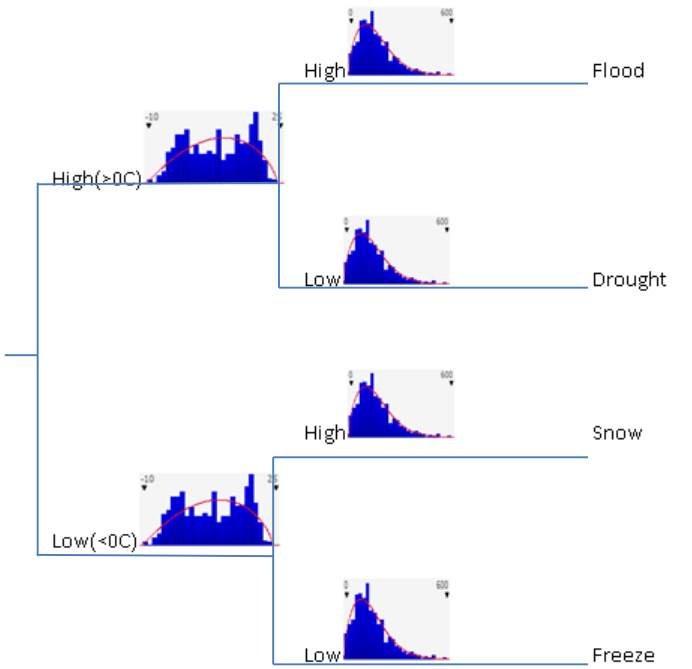
	A	B	C	D	E	F	G	H	I	J
1	financing	FI equity	loc. equity	Comm.loan	Exp.loan	LT loan	Bonds	TO: $/KW	$mm i10	$mm i15
2								FI equity	0.00	0.00
3	i	0.00	0.00	0.13	0.00	0.07	0.06	loc. equity	0.00	0.00
4	N	8	8	5	15	15	10	Comm.loan	450.00	450.00
5	PMT	0.00	0.00	269.47	0.00	162.76	72.03	Exp.loan	0.00	0.00
6	capital $/kWh	0.0720	0.8	utilization	$/kW	PMT SUM	504.26	LT loan	850.00	850.00
7	fixed op $/kWh	0.0131	40.97	$/KW	$/kW	project life	259.13	Bonds	300.00	300.00
8	var oper $/kWh	0.0011				difference:	94.60%	Total	1600.00	1600.00
9	fuel $/kWh	0.0017	0.47	$/MWh t	$/kWh inv. project life:		0.0370	cost adjustment ratio>		1.00
10	TOTAL $/kWh	**0.0879**	3.64	MWh t/MWh				$mm cap	1600.00	
11	LIFE $/kWh>>	**0.0529**	0.0350	B10-B11				-idc	0.00	
12	WDR	life	PV cap	PV fix op	PV var op	PV fuel	PV kWh	-pr.conting	0.00	
13	0.08452	50	3012.72	1068.30	89.63	139.85	81477.64	-wk.cap	0.00	
14	AFUDC = allowance for funds used during construction							other adj	0.00	
15	YTC = years to commissioning				i = interest or return rate			net capital	1600.00	
16	WDR = weighted discount rate				N = years to maturity			MW	669.6	
17	ERROR	verifies i8 and i29			PMT = annual capital charge			$/kW	2389.49	
18	Capital charge unit components:									
19		FI equity	loc. equity	Comm.loan	Exp.loan	LT loan	Bonds	TOTAL		
20	$/kWh>>>	0.0000	0.0000	0.0385	0.0000	0.0232	0.0103	0.0720		
21										
22	AFUDC calc.	FI equity	loc. equity	Comm.loan	Exp.loan	LT loan	Bonds	YTC	cashflow %	
23		0.00	0.00	92.81	0.00	79.51	25.39	5	0.15	All cost data $/k
24		0.00	0.00	71.15	0.00	62.92	20.15	4	0.15	
25		0.00	0.00	51.91	0.00	47.34	15.20	3	0.15	
26		0.00	0.00	34.82	0.00	32.73	10.54	2	0.15	
27		0.00	0.00	26.19	0.00	25.35	8.18	1	0.20	
28		0.00	0.00	8.22	0.00	8.18	2.65	0	0.20	
29	afudc/kW	0.00	0.00	285.09	0.00	256.03	82.11	623.23	1.00	1.00
30	$/kW <afudc	0.00	0.00	672.04	0.00	1269.41	448.03	2389.49		
31	$/kW w. afudc	0.00	0.00	957.13	0.00	1525.44	530.14	**3012.72**		
32										
33	For WDR:	"i" weighted by PMT shares; N =	1							
34		FI equity	sp. equity	Comm.loan	Exp.loan	LT loan	Bonds	TOTAL		
35	PMT	0.00	0.00	1077.73	0.00	1625.36	561.95	3265.04		

Dependency on Russian gas imports

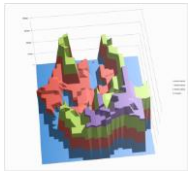


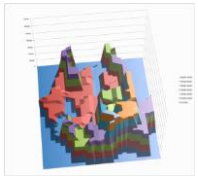
Source : CEDIGAZ- Estimate of international gas trade by pipeline in 2009

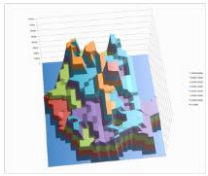
Event tree for Climate change events

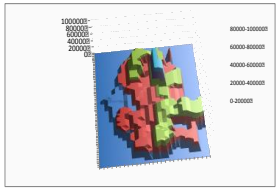


Risk maps

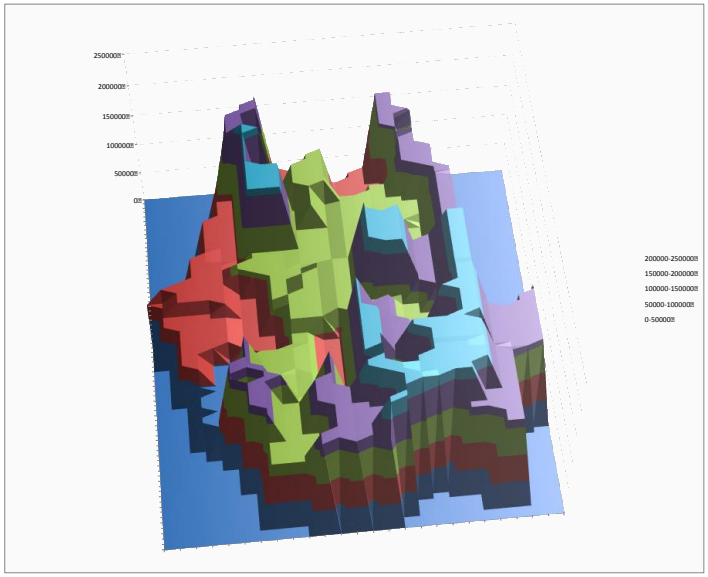








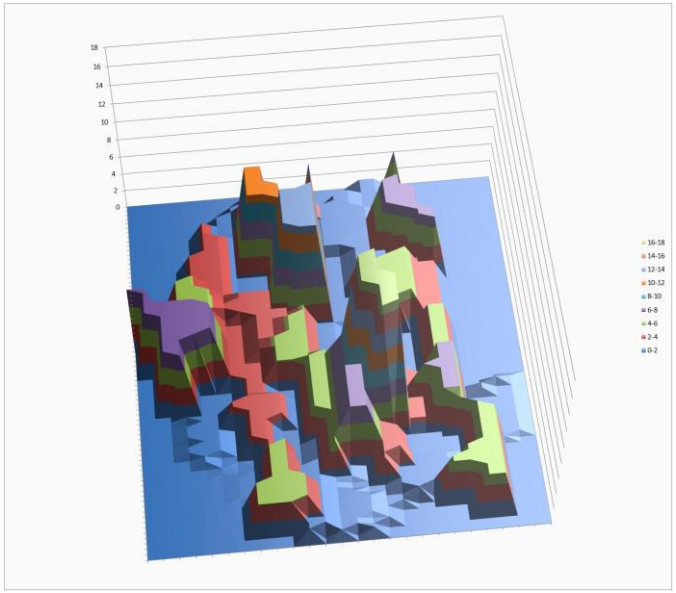
Total CC events risk map [thousands US$]



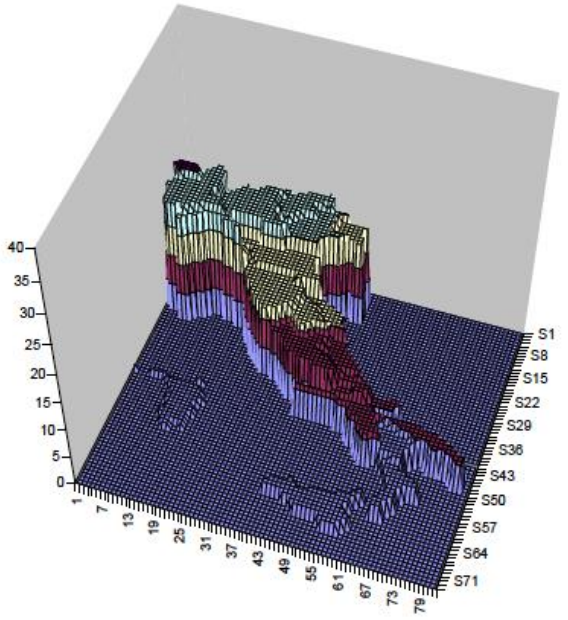
distribution of risk pemium per cap

County	Premium Risk /cap US$	County	Premium Risk /cap US$
Bucuresti	0	Harghita	19.68
Alba	17.05	Hunedoara	8.44
Arad	11.81	Ialomita	43.59
Arges	8.28	Iasi	12.27
Bacau	8.33	Ilfov	6.68
Bihor	8.43	Maramures	8.31
Bistrita Nasaud	27.29	Mehedinti	32.56
Botosani	20.53	Mures	11.32
Braila	35.06	Neamt	11.59
Brasov	12.96	Olt	21.09
Buzau	16.20	Prahova	11.77
Calarasi	40.17	Salaj	51.13
Caras Severin	8.74	Satu Mare	31.13
Cluj	8.77	Sibiu	17.69
Constanta	13.86	Suceava	5.13
Covasna	59.81	Teleorman	23.70
Dambovita	22.91	Timis	6.71
Dolj	9.90	Tulcea	36.61
Galati	20.83	Valcea	15.41
Giurgiu	46.07	Vaslui	22.73
Gorj	16.76	Vrancea	25.50

Romania gas grid CC and mechanical risk [probable deaths/1000 cap]



Natural gas risk in Italy [probable deaths / million inhabitants]



Conclusions

the results of evaluating the mitigation and adaptation measures to the risks in the energy system (considering only hydraulicity, wind and photovoltaic) lead to the need of coal capacities of at least 1000 MW

Security to gas supply may be enhanced with North South interconnectors that link the three seas in the East of the EU.
Climate change risk becomes important and an insurance policy should be considered fast.

The energy sector may not be regarded from only a commercial view point, its strategic importance as well as the social one make necessary taking into consideration noncommercial costs that must be internalized in the financing scheme to reach optimal decisions.

THANK YOU

puricai@yahoo.com

+40745167781