SUSTAINABLE ENERGY

CHALLENGES & OPPORTUNITIES IN THE ADRIATIC REGION

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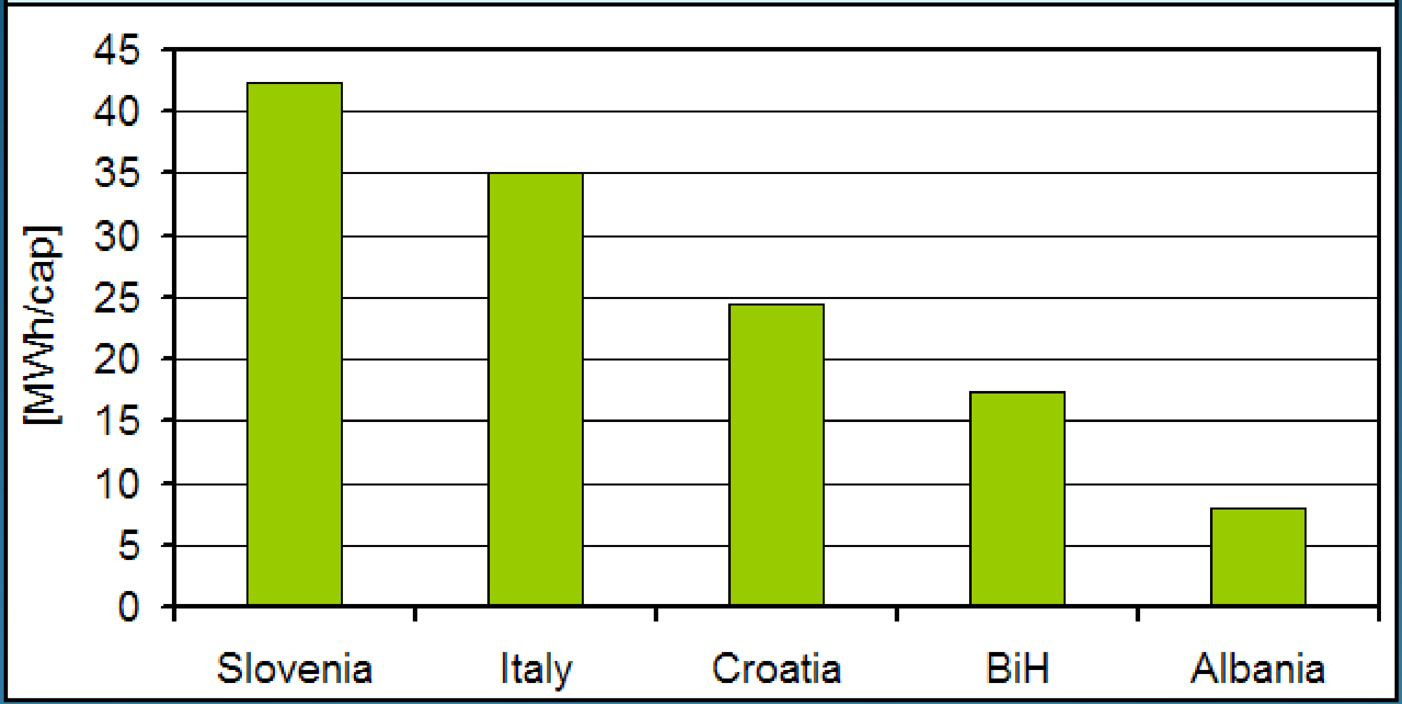
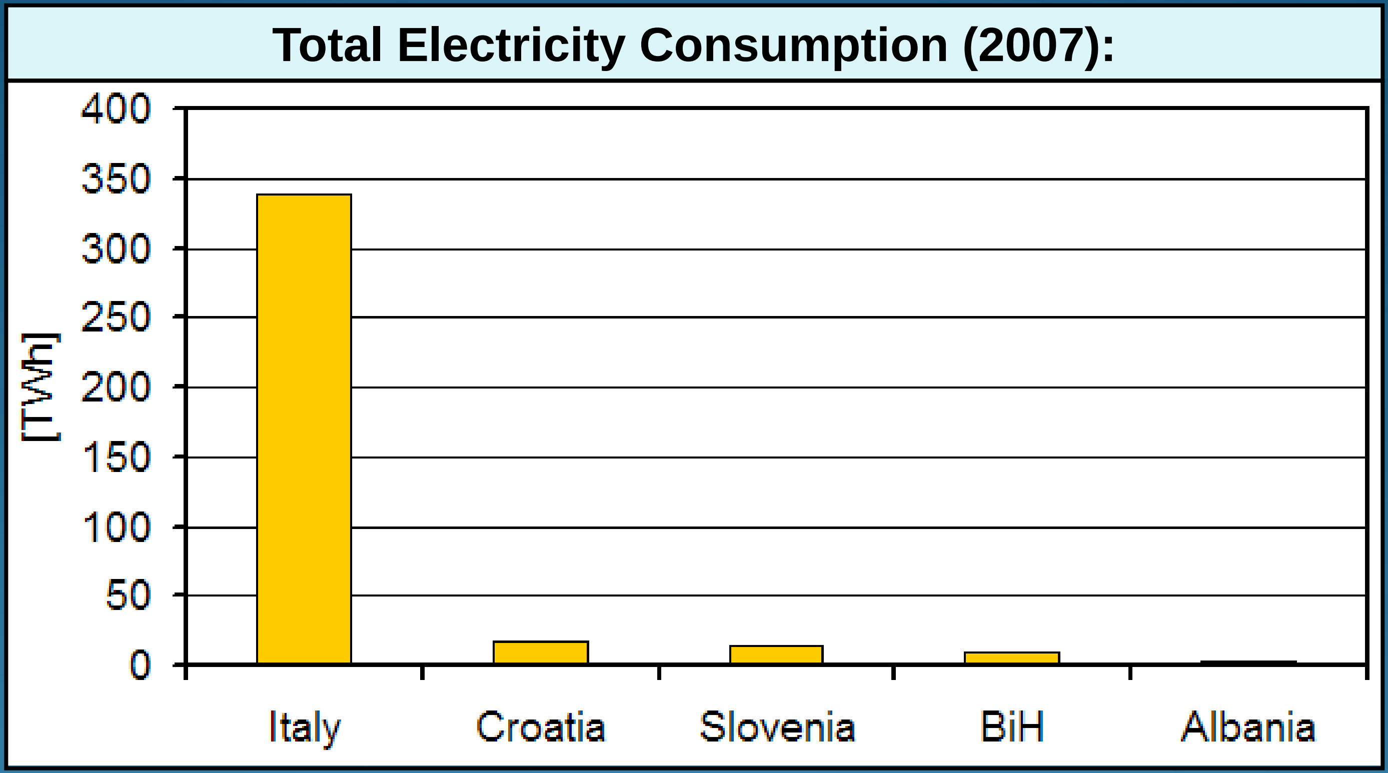
Countries of the Adriatic Region:
Italy, Croatia, Slovenia, Bosnia&Herzegovina, Montenegro, Albania

How much energy do we need?

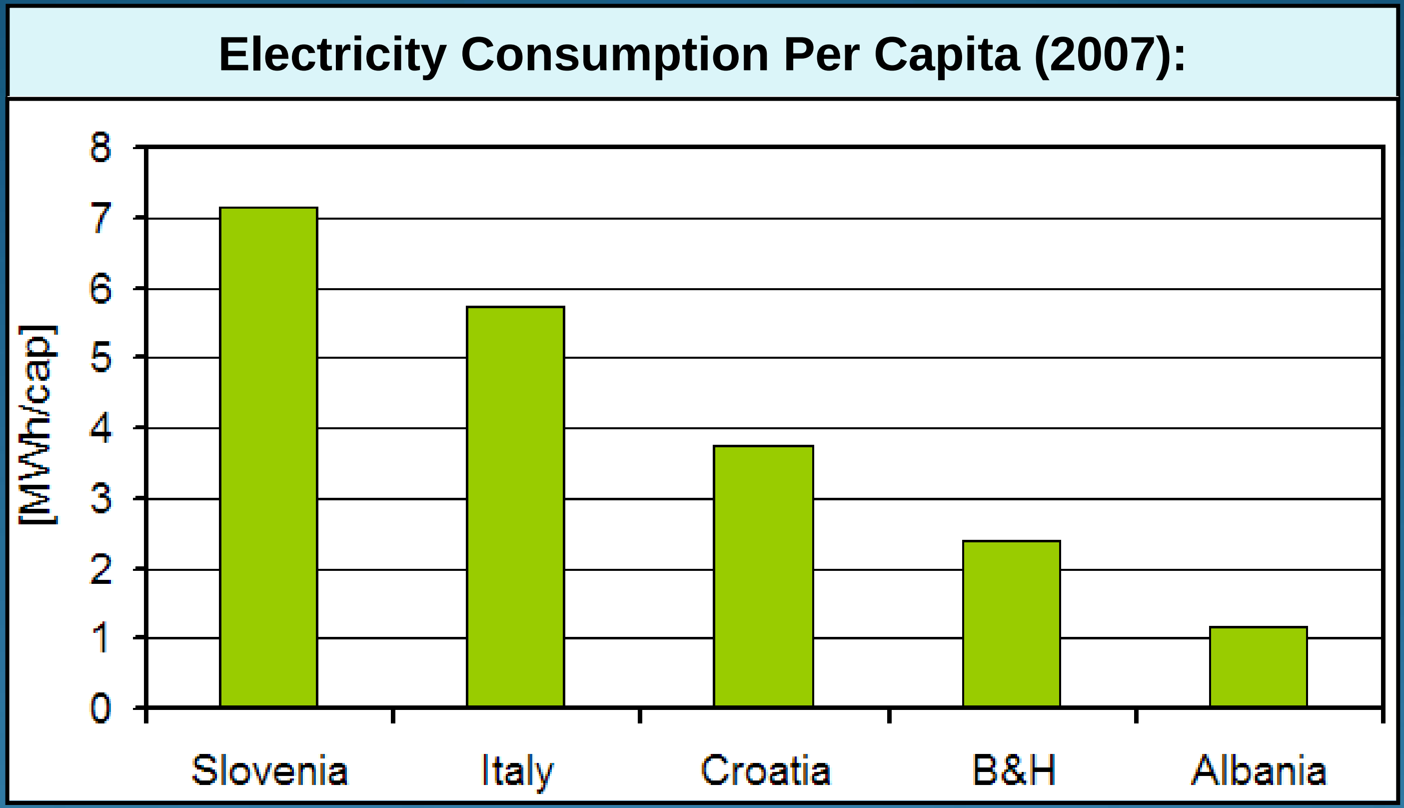
Total Primary Energy Supply per Capita (2007):



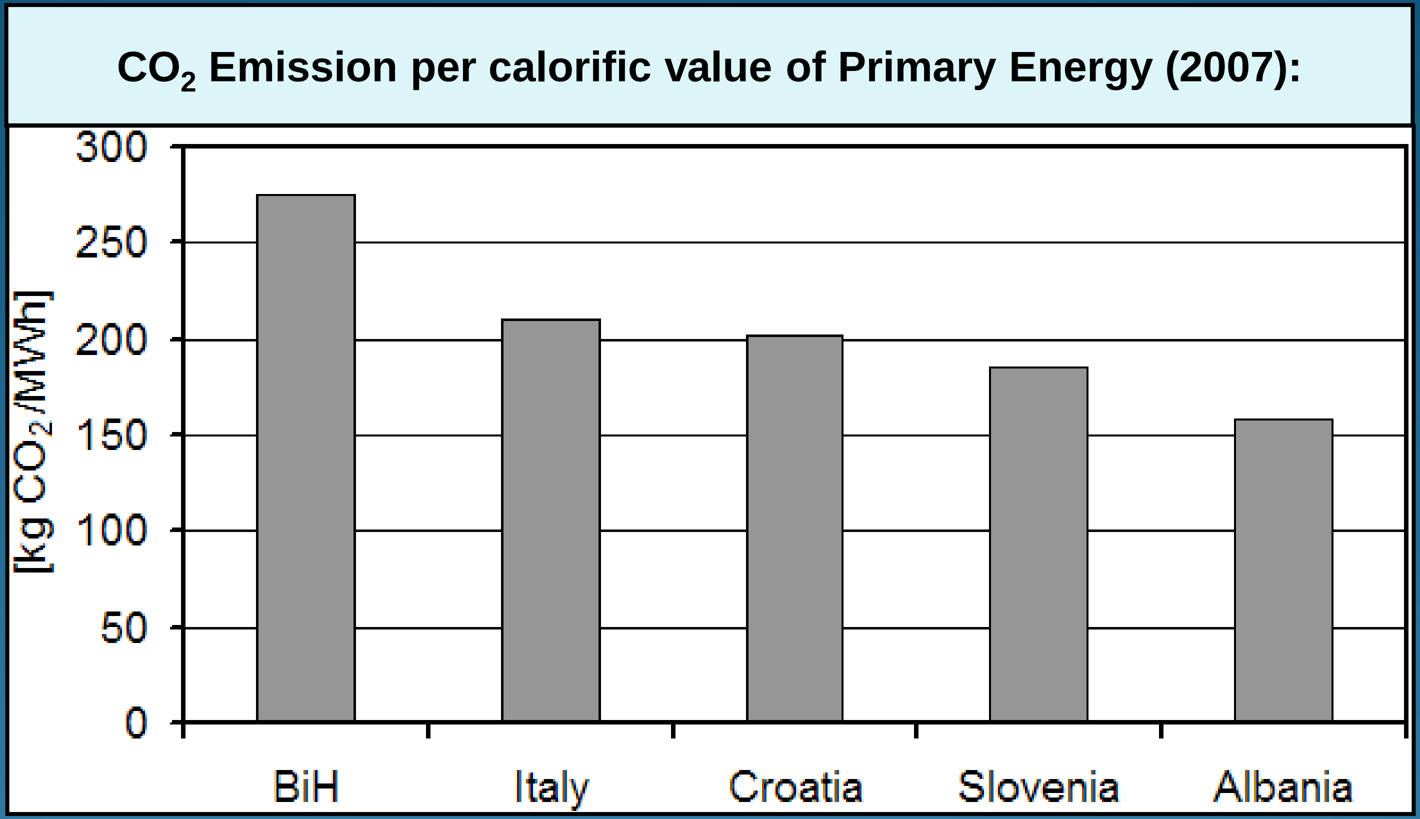
How much energy do we need?



How much energy do we need?

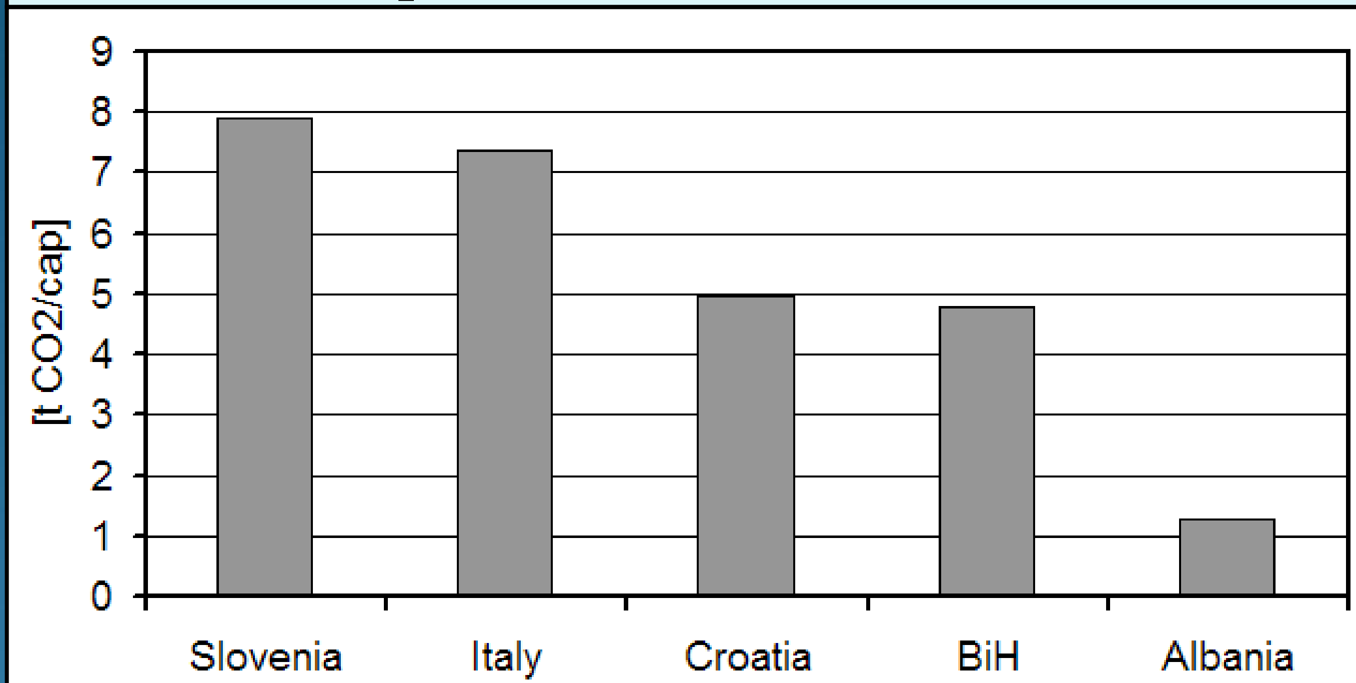


How clean is the energy we use?

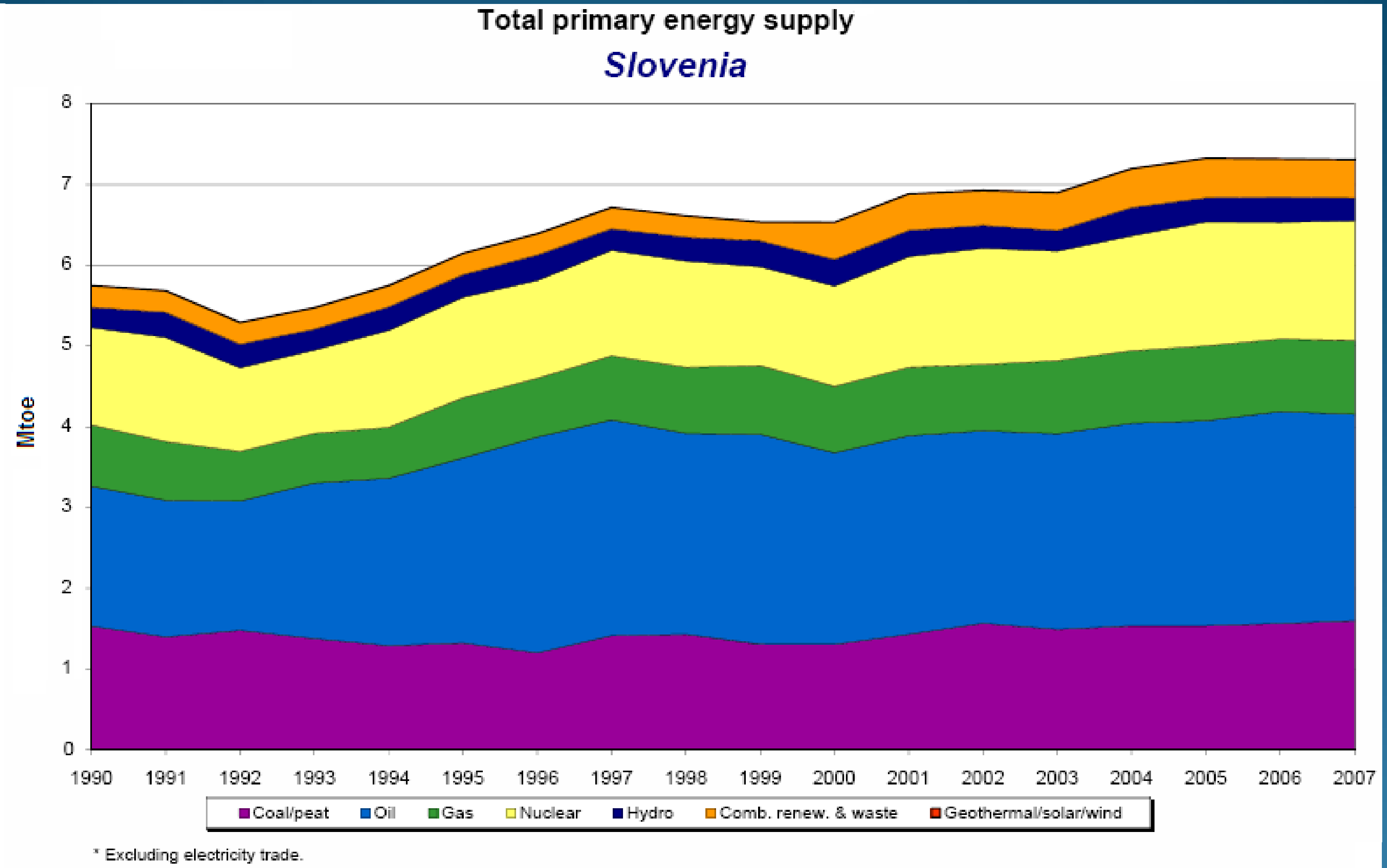


How much CO_2 do we emit?

CO_2 Emission per capita (2007):

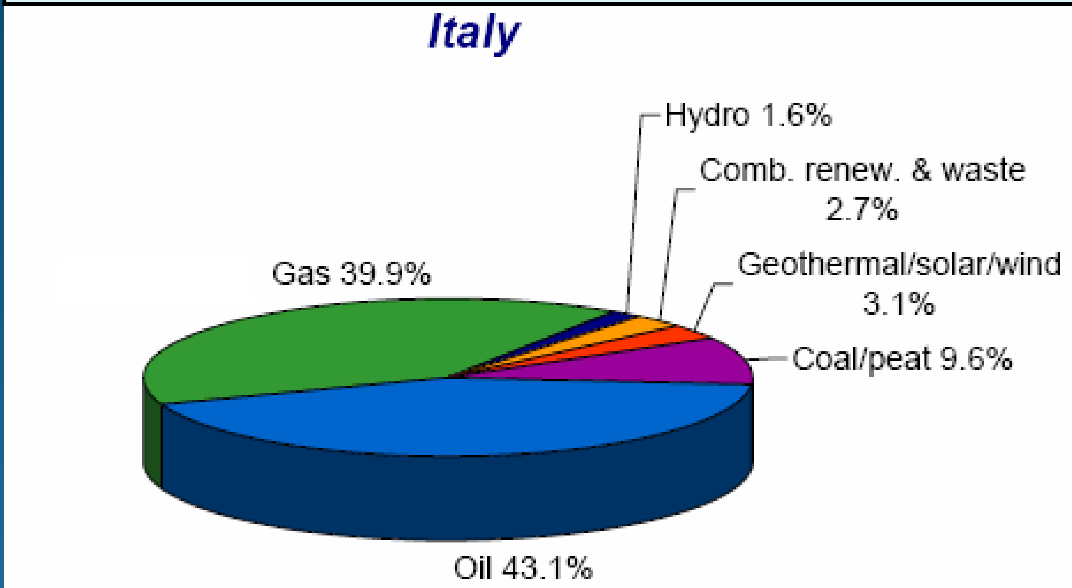


Energy equivalent: 1 Mtoe = 11.67 TWh



What are the energy sources that we consume?

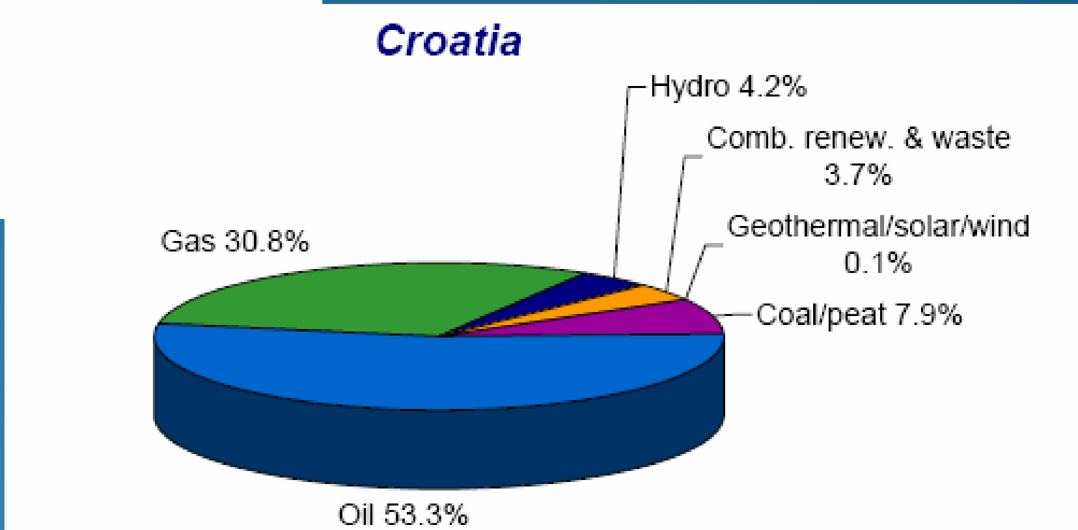
Shares in Total Primary Energy Supply - TPES (2007):



Total: 2080 TWh

Energy Production in TPES: 15%

Energy Dependency: 85%



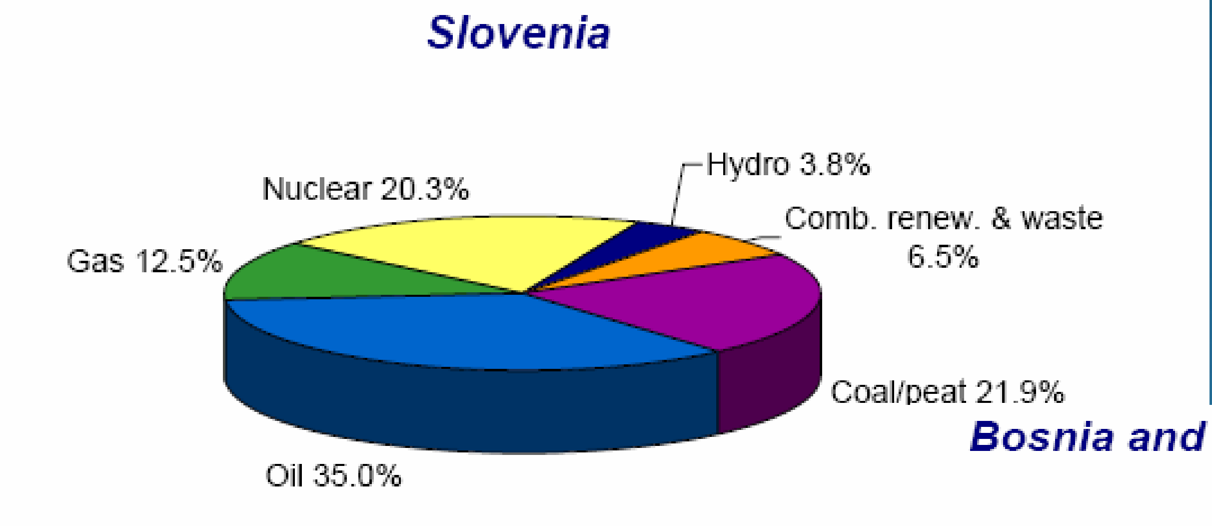
Total: 108.7 TWh

Energy Production in TPES: 43.5%

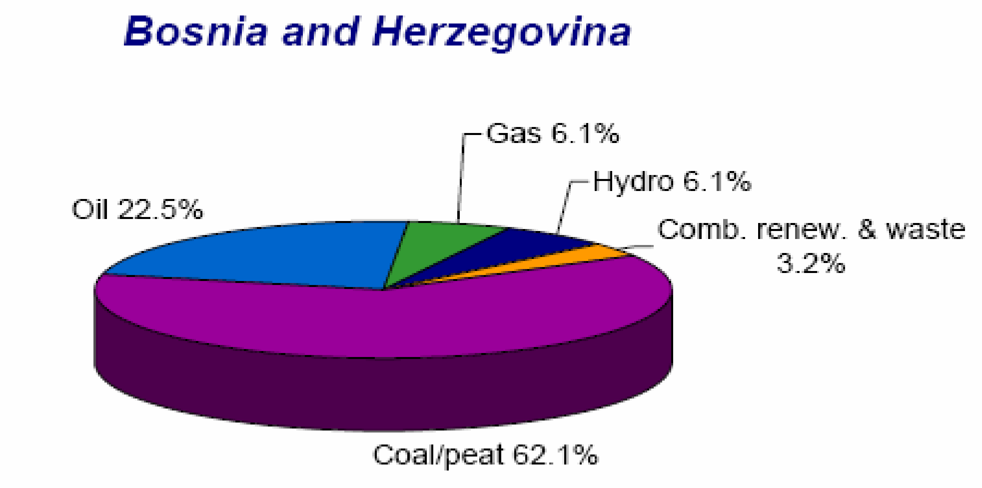
Energy Dependency: 56.5%

What are the energy sources that we consume?

Shares in Total Primary Energy Supply - TPES (2007):



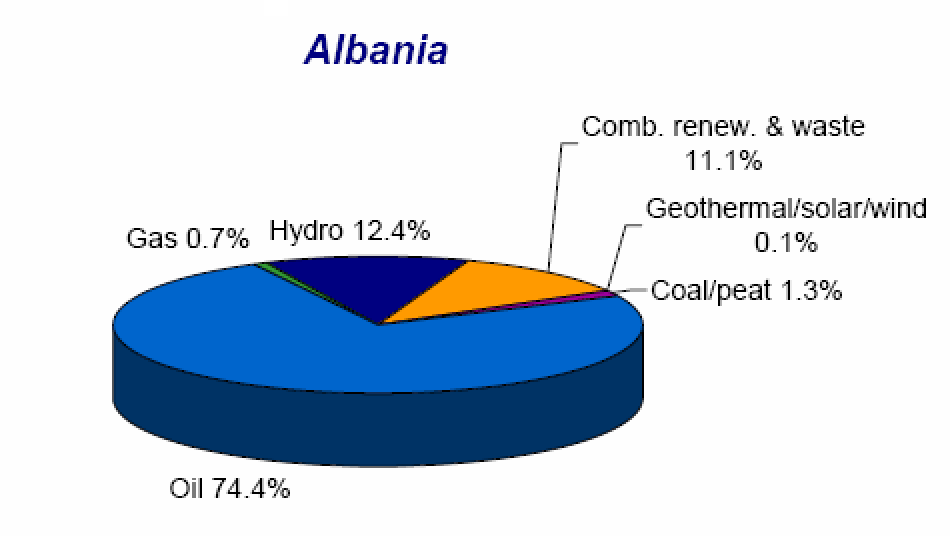
Total: 85.5 TWh
Energy Production in TPES: 47.3%
Energy Dependency: 52.7%



Total: 65.4 TWh
Energy Production in TPES: 70.3%
Energy Dependency: 29.7%

What are the energy sources that we consume?

Shares in Total Primary Energy Supply - TPES (2007):



Total: 25.4 TWh

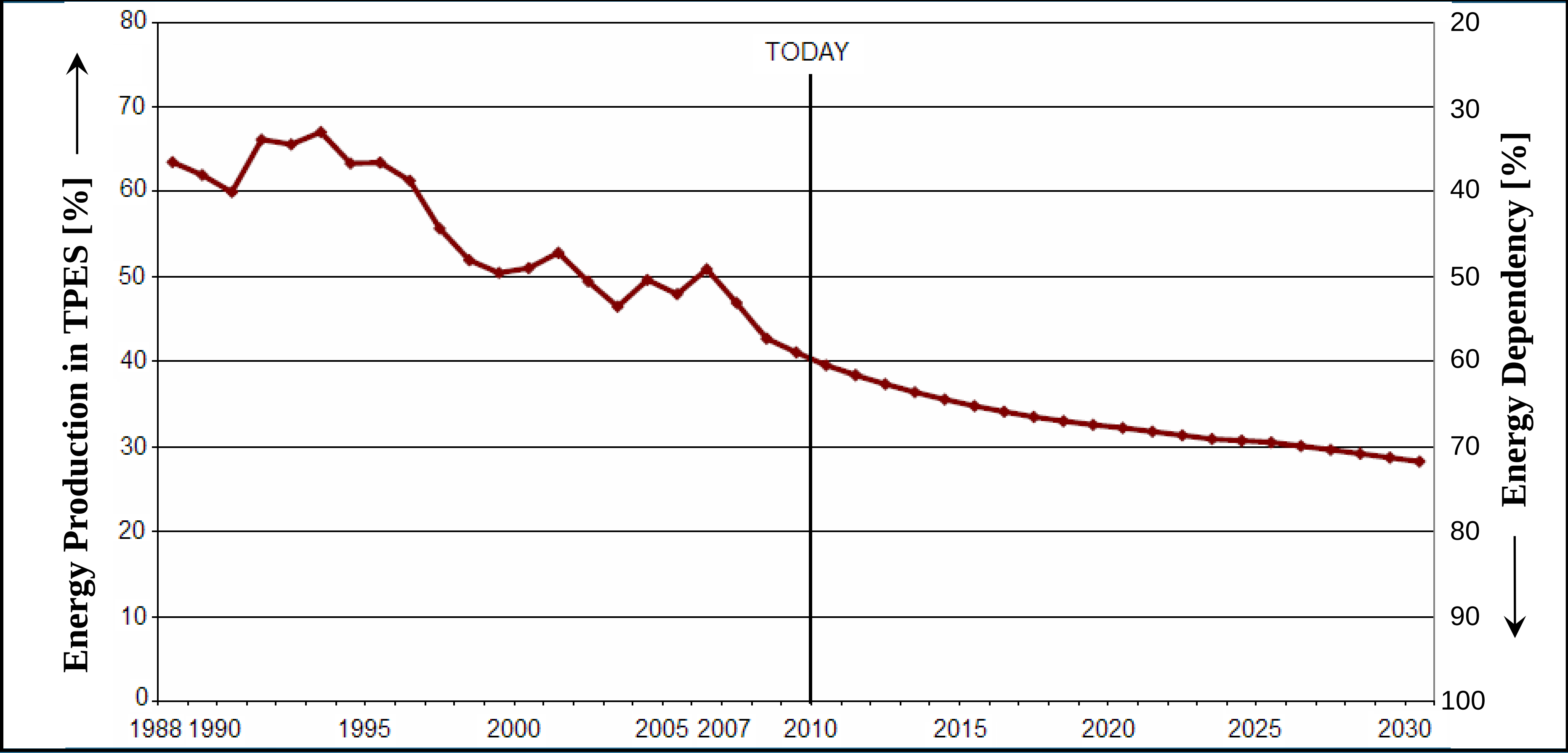
Energy Production in TPES: 48.6%

Energy Dependency: 51.4%

Energy Dependency of Countries in the Adriatic Region: 80.6%

What brings the Future?

Predicted Energy Dependency in Croatia till 2030



The energy dependency of Croatia will be about 70% in 2030.

How much are we dependent on others' energy sources?

	EU Member State	Gross Energy consumption[1]	Net imports[2]	Energy Dependency[3]
1	Cyprus	2.6	3	100%
2	Malta	0.9	0.9	100%
3	Luxembourg	4.7	4.7	98.9%
4	Ireland	15.5	14.2	90.9%
5	Italy	186.1	164.6	86.8%
6	Portugal	25.3	21.6	83.1%
7	Spain	143.9	123.8	81.4%
8	Belgium	60.4	53.5	77.9%
9	Austria	34.1	24.9	72.9%
10	Greece	31.5	24.9	71.9%
11	Latvia	4.6	3.2	65.7%
12	Lithuania	8.4	5.5	64%
13	Slovakia	18.8	12	64%
14	Hungary	27.8	17.3	62.5%

	EU Member State	Gross Energy Consumption	Net imports	Energy Dependency
15	Germany	349	215.5	61.3%
	Croatia	9.3	5.3	56.5%
16	Finland	37.8	20.9	54.6%
17	Slovenia	7.3	3.8	52.1%
18	France	273.1	141.7	51.4%
19	Bulgaria	20.5	9.5	46.2%
20	Netherlands	80.5	37.2	38%
21	Sweden	50.8	19.8	37.4%
22	Estonia	5.4	1.9	33.5%
23	Romania	40.9	11.9	29.1%
24	Czech Republic	46.2	12.9	28%
25	United Kingdom	229.5	49.3	21.3%
26	Poland	98.3	19.6	19.9%
27	Denmark	20.9	-8.1	-36.8[4]
	EU27	1825.2	1010.1	53.8%

1) Gross energy consumption in Million tonnes oil equivalent (Mtoe). Defined as primary production plus imports, less exports.
1 Mtoe = 11.67 TWh

2) Net imports means imports minus exports.

3) Imports divided by gross energy consumption.

4) Denmark is a net exporter of energy.

How long will last the World energy reserves?

Estimated date of exhaustion of fossil fuels and uranium at current consumption rates and dimensions of proved reserves

Natural Gas (in cubic meters)

Total world reserves Jan. 1st 2010: 171514266542404
World usage per second: 92653
Estimated date of exhaustion: 09:25 Sep 12, 2068

Oil (in barrels)

Total world reserves Jan. 1st 2010: 1175686472626
World usage per second: 986
Estimated date of exhaustion: 20:58 Oct 22, 2047

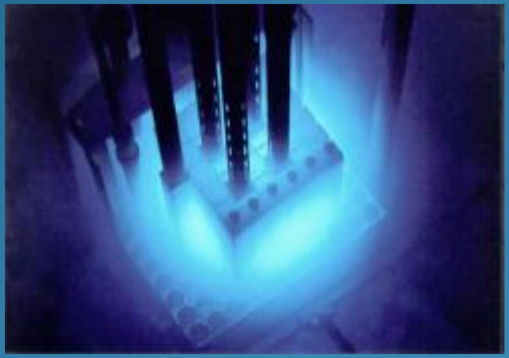
Coal (in metric tonnes)

Total world reserves Jan. 1st 2010: 834684384000
World usage per second: 203
Estimated date of exhaustion: 20:05 May 19, 2140

Uranium (in metric tonnes U-235)

Total world reserves Jan. 1st 2010: 17963
World usage per second: 0.0000042222017
Estimated date of exhaustion: 23:12 Nov 28, 2144

www.energy.eu

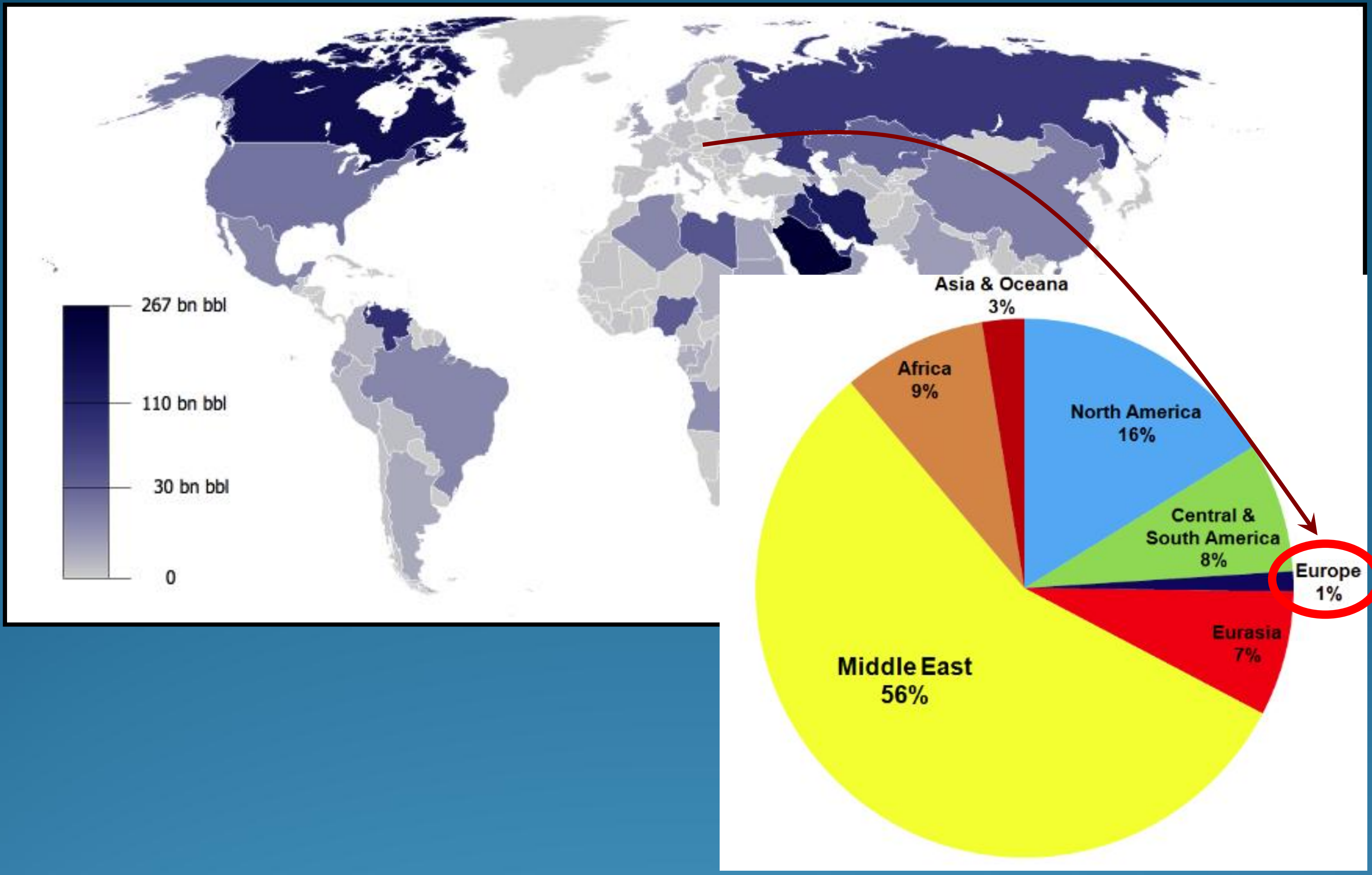


Build new nuclear powerplants?

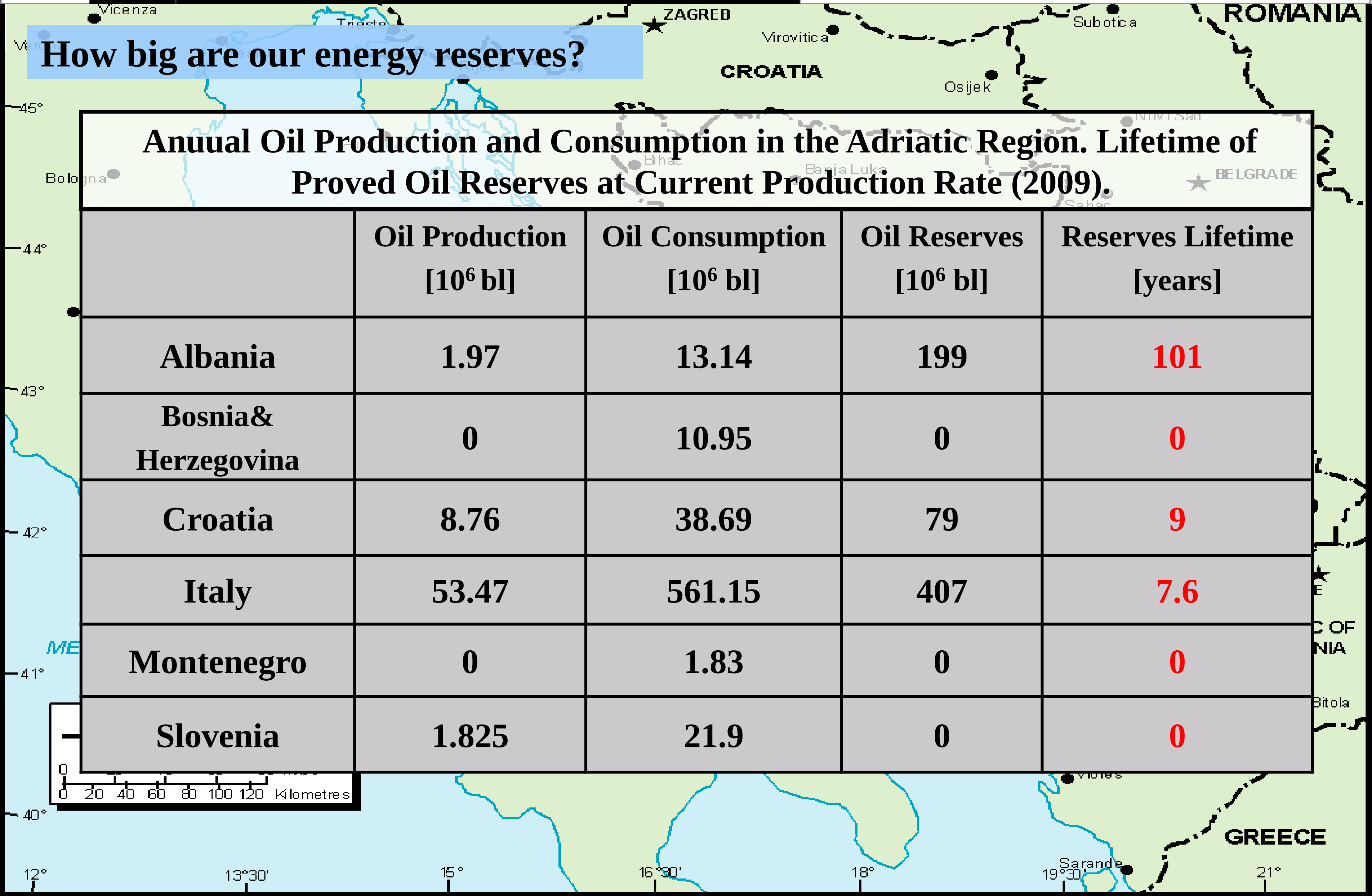
More nuclear to replace fossil fuels?

	Installed capacity [MW]	Electricity from nuclear [%]	Number of reactors: Existing	Under Construction	Planned	Proposed
USA	101 120	19.7	104	1	11	19
France	63 473	76.2	59	1	1	1
Russia	21 750	16.9	31	9	7	37
Germany	20 340	28.3	17	0	0	0
China	8 600	2.2	11	20	37	120
India	3 780	2	17	6	23	15
South Africa	1 842	5.3	2	0	3	24
Italy	0	0	0	0	0	10
Slovenia	696	41.7	1/2	0	0	1
Croatia	696	8	1/2	0	0	1
Albania, B&H, MNE	0	0	0	0	0	0
World	371 500	14	436	58	139	325

How big are our energy reserves? - oil

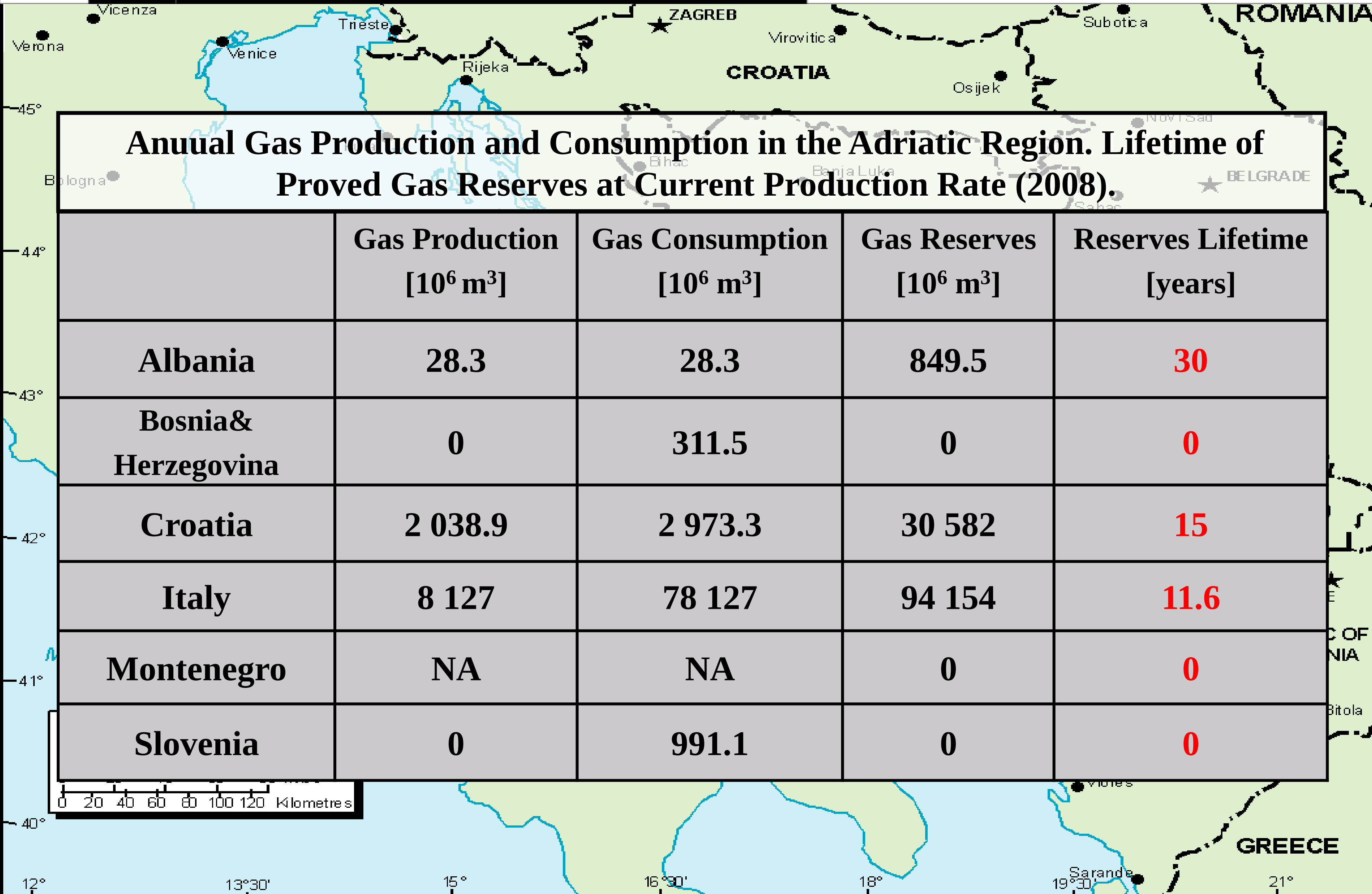


How big are our energy reserves?



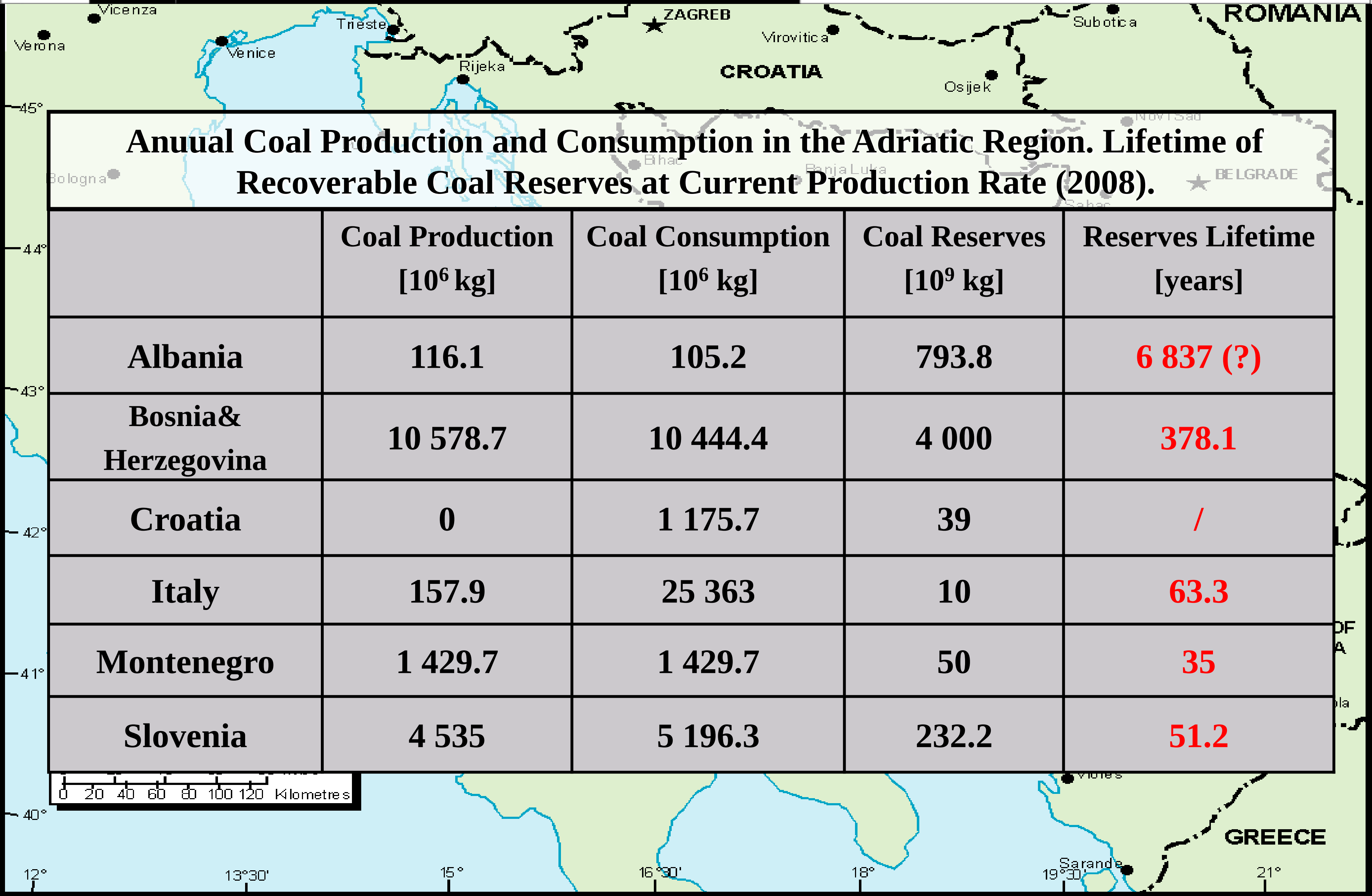
Anuual Oil Production and Consumption in the Adriatic Region. Lifetime of Proved Oil Reserves at Current Production Rate (2009).

	Oil Production [10^6 bl]	Oil Consumption [10^6 bl]	Oil Reserves [10^6 bl]	Reserves Lifetime [years]
Albania	1.97	13.14	199	101
Bosnia& Herzegovina	0	10.95	0	0
Croatia	8.76	38.69	79	9
Italy	53.47	561.15	407	7.6
Montenegro	0	1.83	0	0
Slovenia	1.825	21.9	0	0



Anuual Gas Production and Consumption in the Adriatic Region. Lifetime of Proved Gas Reserves at Current Production Rate (2008).

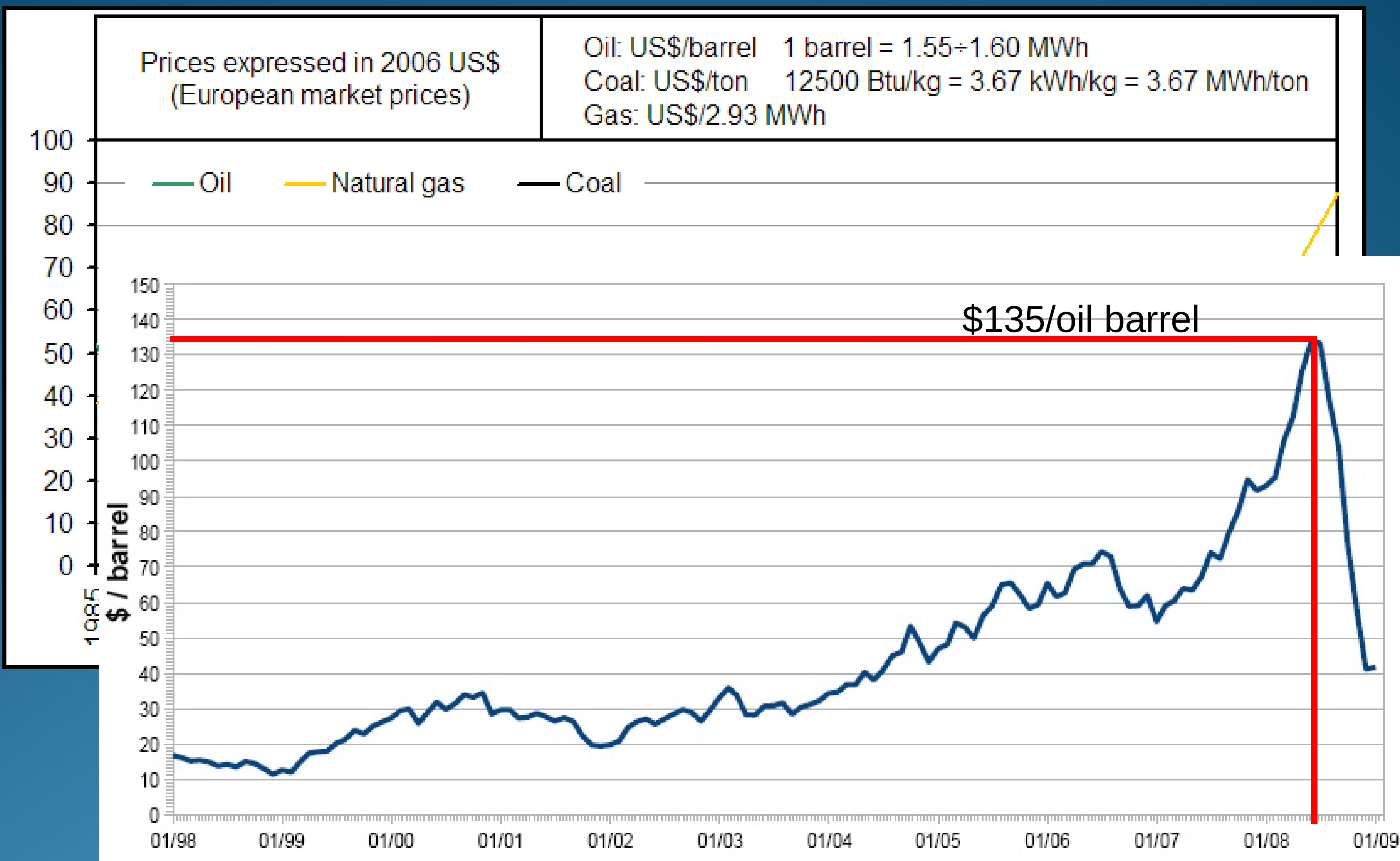
	Gas Production [10^6 m^3]	Gas Consumption [10^6 m^3]	Gas Reserves [10^6 m^3]	Reserves Lifetime [years]
Albania	28.3	28.3	849.5	30
Bosnia& Herzegovina	0	311.5	0	0
Croatia	2 038.9	2 973.3	30 582	15
Italy	8 127	78 127	94 154	11.6
Montenegro	NA	NA	0	0
Slovenia	0	991.1	0	0



Anuual Coal Production and Consumption in the Adriatic Region. Lifetime of Recoverable Coal Reserves at Current Production Rate (2008).

	Coal Production [10^6 kg]	Coal Consumption [10^6 kg]	Coal Reserves [10^9 kg]	Reserves Lifetime [years]
Albania	**116.1**	**105.2**	**793.8**	**6 837 (?)**
Bosnia& Herzegovina	**10 578.7**	**10 444.4**	**4 000**	**378.1**
Croatia	**0**	**1 175.7**	**39**	**/**
Italy	**157.9**	**25 363**	**10**	**63.3**
Montenegro	**1 429.7**	**1 429.7**	**50**	**35**
Slovenia	**4 535**	**5 196.3**	**232.2**	**51.2**

How much does cost the energy we are buying?



Sustainable energy?

energy production, its supply and exploitation for meeting the needs of the present without compromising the ability of future generations to meet their own energy needs.
Sustainable energy sources have the ability to continue providing energy replenishing themselves within a human lifetime and without causing damages to humans and to the environment.

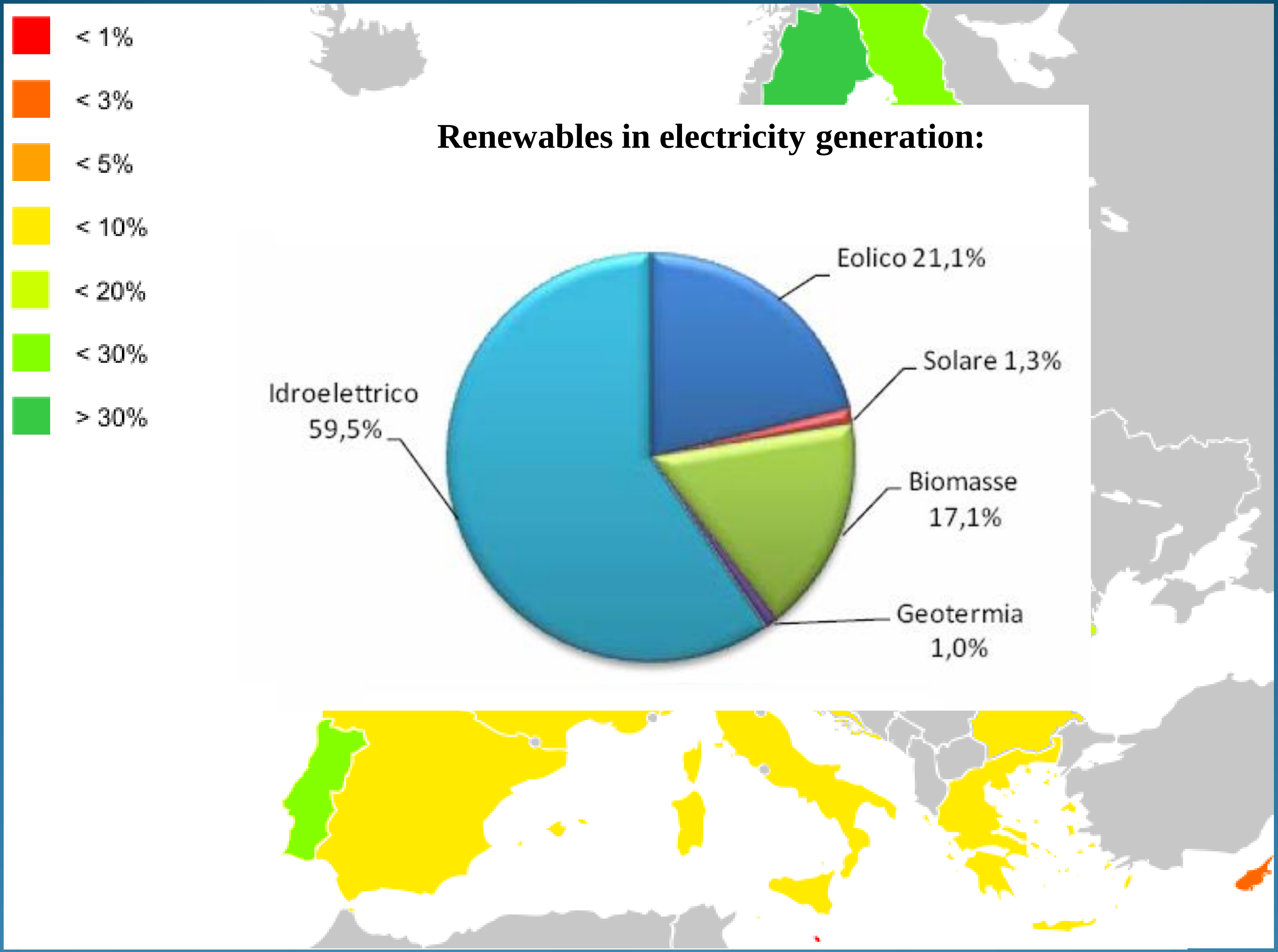
Renewable energy?

energy that is naturally replenished and which comes from natural sources such as sunlight, wind, hydro, waves & tides, biomass and geothermal heat.

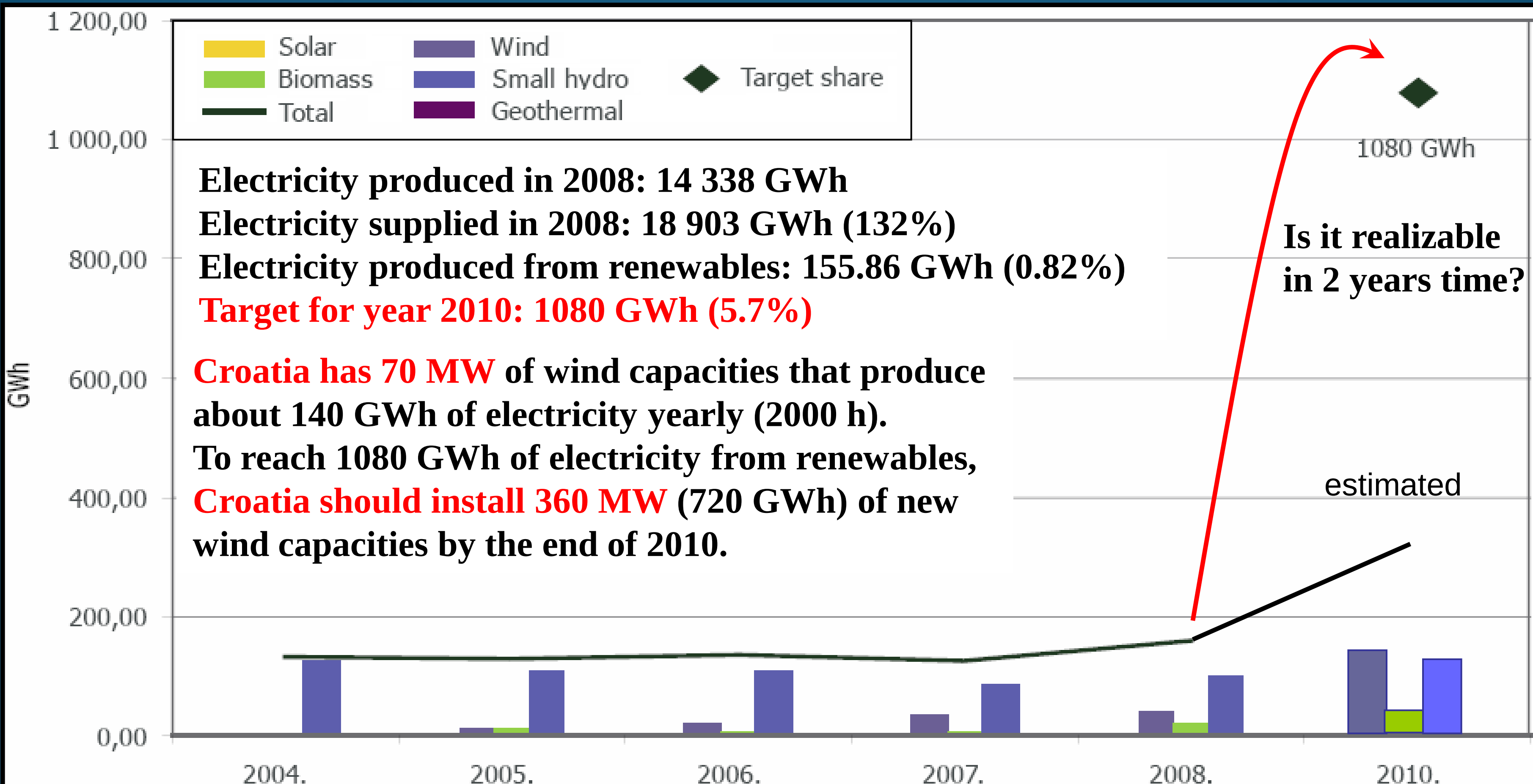
Sustainable energy includes:

1. renewable energy sources
2. energy efficiency
3. energy conservation
4. sustainable transport

Renewable energy in final energy consumption (DIRECTIVE 2009/28/EC):



The Croatian "White Book" propose:



Electricity produced in 2008: 14 338 GWh
Electricity supplied in 2008: 18 903 GWh (132%)
Electricity produced from renewables: 155.86 GWh (0.82%)
Target for year 2010: 1080 GWh (5.7%)

Croatia has 70 MW of wind capacities that produce about 140 GWh of electricity yearly (2000 h).
To reach 1080 GWh of electricity from renewables, Croatia should install 360 MW (720 GWh) of new wind capacities by the end of 2010.

Is it realizable in 2 years time?

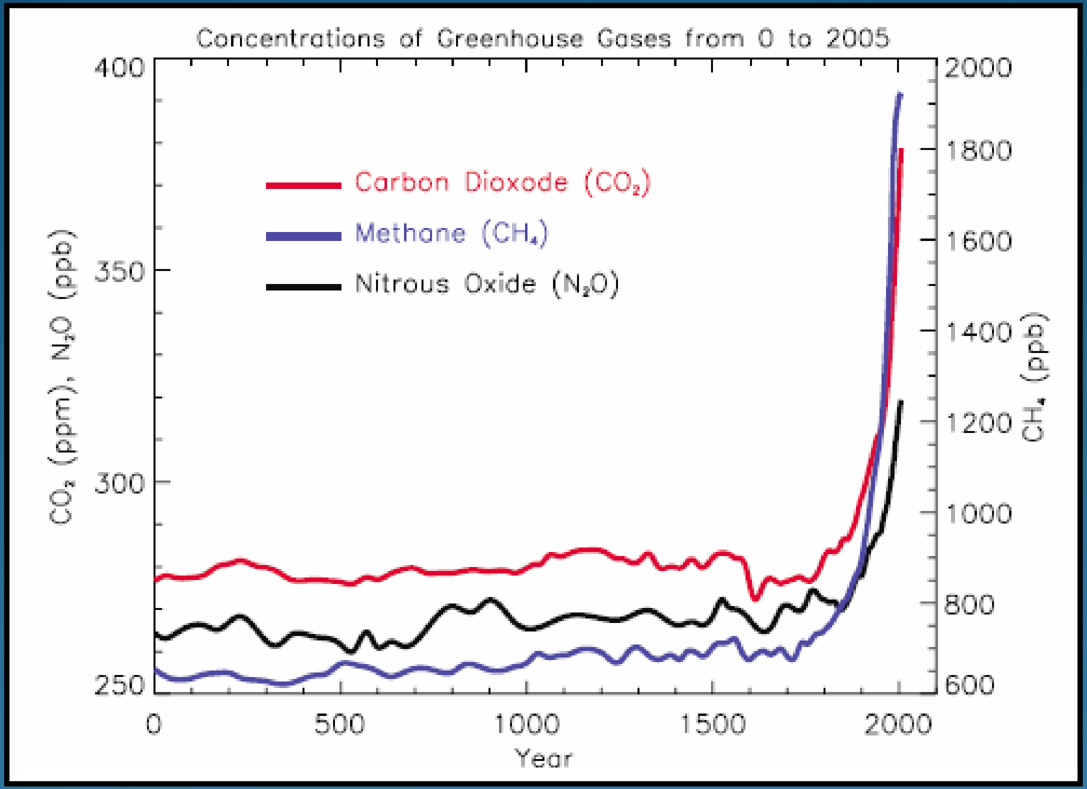
Emission of greenhouse gases (CO_2, CH_4, N_20, HFCs, PFCs, SF_6) in the EU:

Figures are in Megaton (Mt CO2-eq).

EU MEMBER STATE	2003	2004	2005	2006	2007	KYOTO TARGET 2012	% UNDER KYOTO TARGET
LATVIA	10,7	10,7	10,9	11,7	12,1	23,3	48,07 %
ESTONIA	21,2	21,2	20,7	19,2	22,0	40	45,00 %
LITHUANIA	16,7	21,1	22,6	22,8	24,7	44,1	43,99 %
ROMANIA	NO DATA	160,1	153,7	153,9	152,3	259,9	41,40 %
BULGARIA	NO DATA	68,9	69,8	71,5	75,7	127,3	40,53 %
HUNGARY	83,3	79,5	80,5	78,8	75,9	114,9	33,94 %
SLOVAKIA	51,1	49,5	48,7	49,0	47,0	67,2	30,06 %
POLAND	382,5	396,7	399	399,3	398,9	551,7	27,70 %
CZECH REPUBLIC	147,5	147,1	145,6	149,1	150,8	180,6	16,50 %
SWEDEN	70,9	69,7	67	66,9	65,4	75,2	13,03 %
UNITED KINGDOM	658	660,4	657,4	647,9	636,7	678,3	6,13 %
FRANCE	560,9	556,1	553,4	541,7	531,1	564	5,83 %
GREECE	137,2	137,6	139,2	128,1	131,9	139,6	5,52 %
BELGIUM	147,6	147,6	143,8	136,6	131,3	135,9	3,38 %
GERMANY	1024,4	1025	1001,5	980,0	956,1	972,9	1,73 %
							% OVER KYOTO TARGET
NETHERLANDS	215,4	218,4	212,1	208,5	207,5	200,4	-3,54 %
PORTUGAL	83,7	84,6	85,5	84,7	81,8	77,4	-5,68 %
IRELAND	68,4	68,6	69,9	69,7	69,2	63	-9,84 %
FINLAND	85,4	81,2	69,3	79,9	78,3	71,1	-10,13 %
SLOVENIA	19,7	19,9	20,3	20,5	20,7	18,6	-11,29 %
ITALY	577,3	580,5	582,2	563,0	552,8	485,7	-13,82 %
DENMARK	73,6	68,2	63,9	71,0	66,6	54,8	-21,53 %
AUSTRIA	92,5	91,2	93,3	91,6	88,0	68,7	-28,09 %
SPAIN	407,4	425,2	440,6	433,0	442,3	331,6	-33,38 %
LUXEMBOURG	11,3	12,8	12,7	13,3	12,9	9,1	-41,76 %
MALTA	3,1	3,2	3,4	2,9	3,0	NO TARGET	
CYPRUS	9,2	9,9	9,9	9,9	10,1	NO TARGET	
CROATIA					32,385	29,8 (33,1)[1]	-8,67% (2,16%)

[1] Decision 7/CP.12: +3,5 Mt CO2-eq to be added to base year emissions for Croatia (Conference of the Parties, Nairobi, 2006), not yet approved by Kyoto protocol commission

Concentration of greenhouse gases (CO_2, CH_4, N_20) over the last 2000 years:



Renewable energy projects in Croatia:

Project Title	Technology	Capacity MW	Status
Gracac, Croatia Wind Farm	Wind		under construction

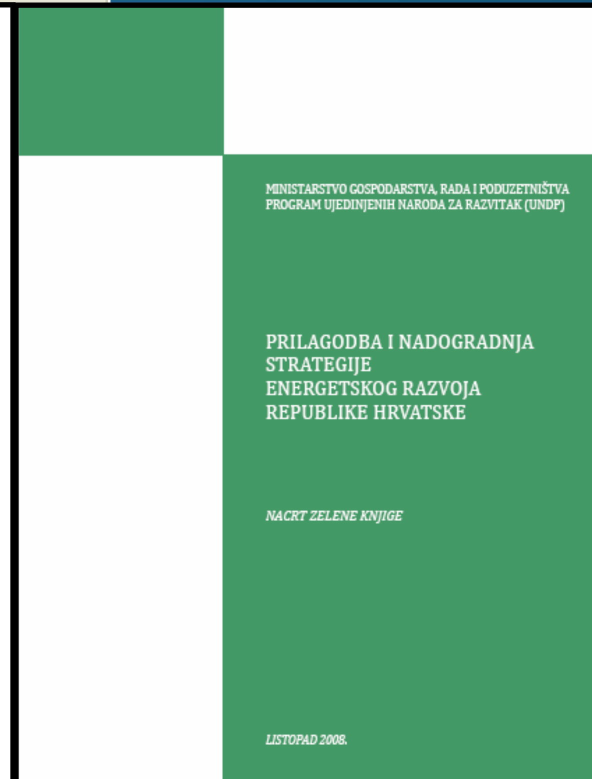
The Energy strategy of Croatia propose:

Conventional powerplants:

1 natural gas power plant	400 MW	(2013)
1 coal power plant	600 MW	(2015)
1 nuclear power plant	1 000 MW	(2020)
a few hydro power plants	300 MW	(2020)

Renewable energy powerplants:

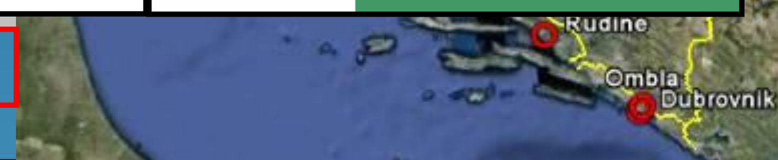
wind	1 200 MW	(2020)
biomass	140 MW	(2020)
small hydro	100 MW	(2020)
solar	45 MW	(2020)
municipal waste	40 MW	(2020)
geothermal	20 MW	(2020)


MINISTARSTVO GOSPODARSTVA, RADA I PODUZETNIŠTVA
PROGRAM UJEDINJENIH NARODA ZA RAZVITAK (UNDP)

PRILAGODBA I NADOGRADNJA STRATEGIJE ENERGETSKOG RAZVOJA REPUBLIKE HRVATSKE

NACRT ZELENE KNJIGE

LISTOPAD 2008.



Wind power dominating

Renewable energy projects in Slovenia:

Project Title	Technology	Capacity MW	Status
Lendava, Sloveia Biogas	Biogas	7.2	planned
Sava River Hydro Slovenia	Hydroelectric	42.5	planned
Slavenian Biodiesel Plant	Biodiesel		planned
Ruse, Slovenia PV silicon plant	Solar PV		construction
Mavcice Solar Plant	Solar PV	.0357	operating
Slovenia Wind Farm Project	Wind	28 MW	Planned
Slovenia Pumped Hydro	Hydroelectric	178	Planned
Blanca Hydro	Hydroelectric	42.5 MW	Construction
Mokrice	Hydroelectric	31.5	Planned
Volovja Persolja	Wind	60.75	Planned
Idrija	Hydroelectric	0.334	Operating
Ilirska Bistrica	Hydroelectric	0.055	Operating
Javornik	Hydroelectric	1.26	Operating
Jelenk	Hydroelectric	0.07	Operating
Knezke Ravne	Hydroelectric	0.91	Operating
total		390	

Hydro power dominating

Renewable energy projects in Albania:

Project Title	Technology	Capacity MW	Status
Ashta Hydro	Hydroelectric	48	announced
Fuzuli Hydropower Plant	Hydroelectric	25	
Northern Albania Energy Park	Wind	374	planned
Devol River Hydropower	Hydroelectric	340	planned
Marseglia Group Wind and Biofuels	Wind	140 MW biomass 234 MW Wind	planned
Vlora Wind Farm	Wind	500	planned
Italgest Kryevidhi, Albania Wind Farm	Wind	150	Proposed
Devoll River (Albania) Hydro	Hydroelectric	300	planned
Kalivaci	Hydroelectric	120	Planned
Bushati	Hydroelectric	84	Planned
Banja Kesh	Hydroelectric	60	Planned
Vukel	Hydroelectric	0.05	Operating
Vau I Deja	Hydroelectric	258	Operating
Ulza	Hydroelectric	25.6	Operating
Theth	Hydroelectric	0.075	Operating

Hydro and wind power dominating

Renewable energy projects in Bosnia and Herzegovina:

Project Title	Technology	Capacity MW	Status
Sutjeska Hydro	Hydroelectric	35	planned
Paunci Hydro	Hydroelectric	36.6	planned
Foca Hydro	Hydroelectric	51.7	planned
Buk Bijela Hydro	Hydroelectric	114.6	planned
Bosna River 25 Run of River Hydro Plants	Hydroelectric	350	under construction
Capljina Pumped-Storage	Hydroelectric	430	under construction
Tomislavgrad Wind Park	Wind	44	funded
EFT Neretva River Hydro	Hydroelectric	35	planned
Drina River EBH Hydro	Hydroelectric		planned
Vrbas River Hydro	Hydroelectric		planned
Brcko, Bosnia Ethanol Plant	Ethanol		planned
Pale, Bosnia Hydro	Hydroelectric	50	planned
Pecina	Hydroelectric	0.6	Planned
Pogledala	Hydroelectric	0.378	Planned
Prsljanica	Hydroelectric	0.24	Planned

Hydro power dominating

Renewable energy projects in Montenegro:

Project Title	Technology	Capacity MW	Status
Mozura's Bar and Ulcinj Wind Farms	Wind	46	financed
Krnovo Wind Power Concession	Wind	50	planned
Moraca River Hydro	Hydroelectric	238	planned
Moraca River Hydro	Hydroelectric	238	planned
Zhur of Prizren Hydro	Hydroelectric		planned
Bajina Basta Hydro PP	Hydroelectric	54 additional to 422MW	under construction
Brodarevo 1 and 2 hydroelectric power projects	Hydroelectric	75	announced
Phaunos Timber Fund Serbian Pellet Mfg.	Wood Pellet Manufacturing		planned
Piva Montenegro Hydro	Hydroelectric		planned
Serbia, Srpska Join on Hydro Plant	Hydroelectric		planned
Eastern Serbian Hydro	Hydroelectric		planned
Piva Hydro in Montenegro	Hydroelectric	342	planned
Zrenjanin, Serbia Bioethanol Plant	Ethanol		planned
Indija Wind turbine production	Wind		planned
Indjija Wind Project (Phase II)	Wind	25	Planned

Hydro and wind power dominating

Renewable energy targets in Italy:

	1997		2002		2006		2008/2012	
Source/technology	MWe	TWh	MWe	TWh	MWe	TWh	MWe	TWh
Hydro > 10 MW	13942	33.47	14300	34.32	14500	34.8	15000	36
Hydro = 10 MW	2187	8.12	2.400	8.88	2600	9.62	3000	11.1
Geothermal	559	3.90	650	4.78	700	5.14	800	5.9
Wind	119	0.12	700	1.4	1400	2.8	2500	5
Solar	16	0.01	25	0.03	100	0.11	300	0.3
Biomass and biogas	192	0.57	380	2.28	800	4.80	2300	13.8
Waste	89	0.25	350	1.75	500	2.50	800	4.0
Total	17104	46.44	18805	53.44	20600	59.77	24.700	76.1

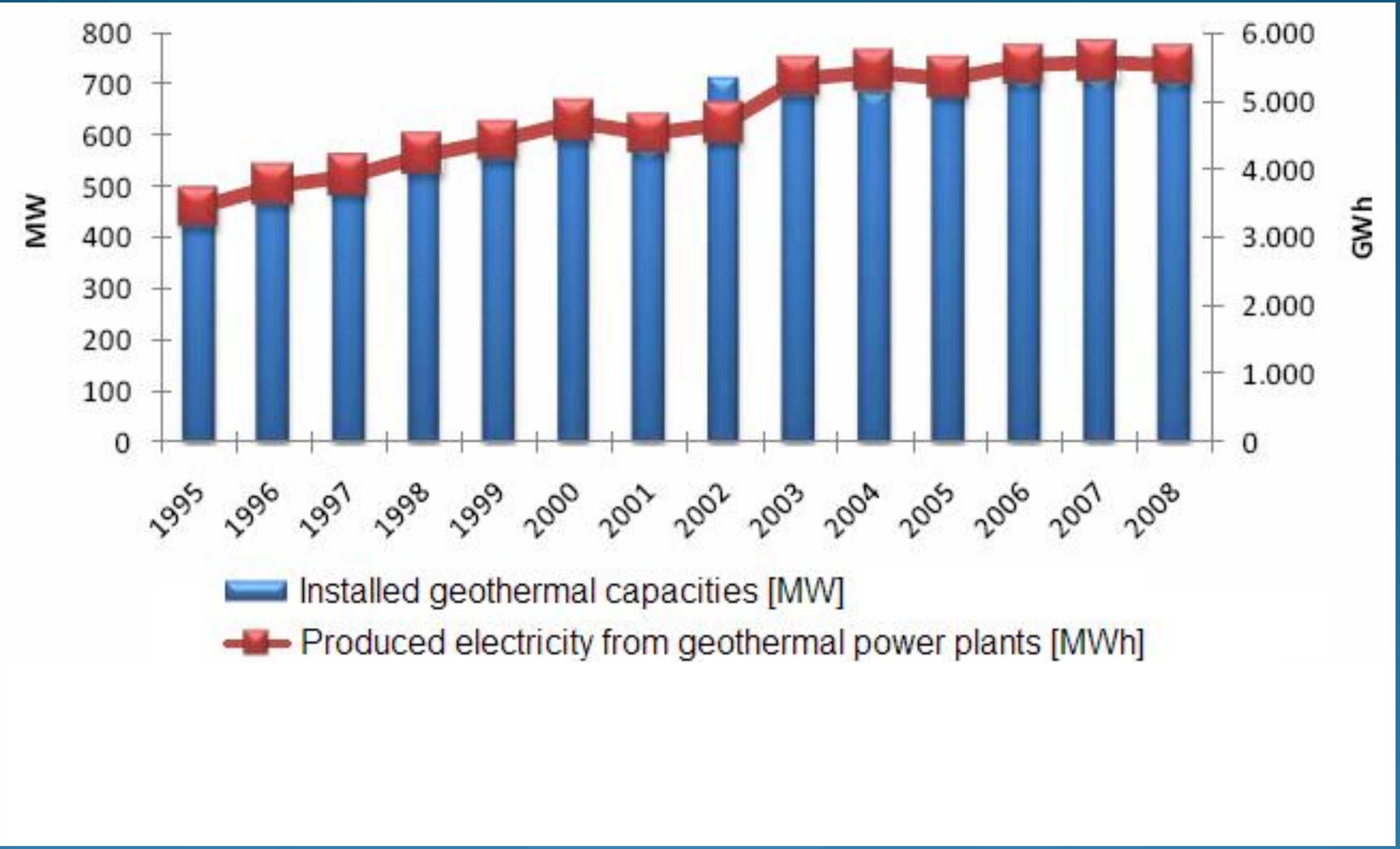
Expected to be achieved at end of 2010

Estimated installed wind capacity by end of 2010: 6 300 MW
Target for year 2020: 12 000 MW (reachable in 2015 if current growth rate continues)
Estimated wind capacity by 2020: 16 200 MW

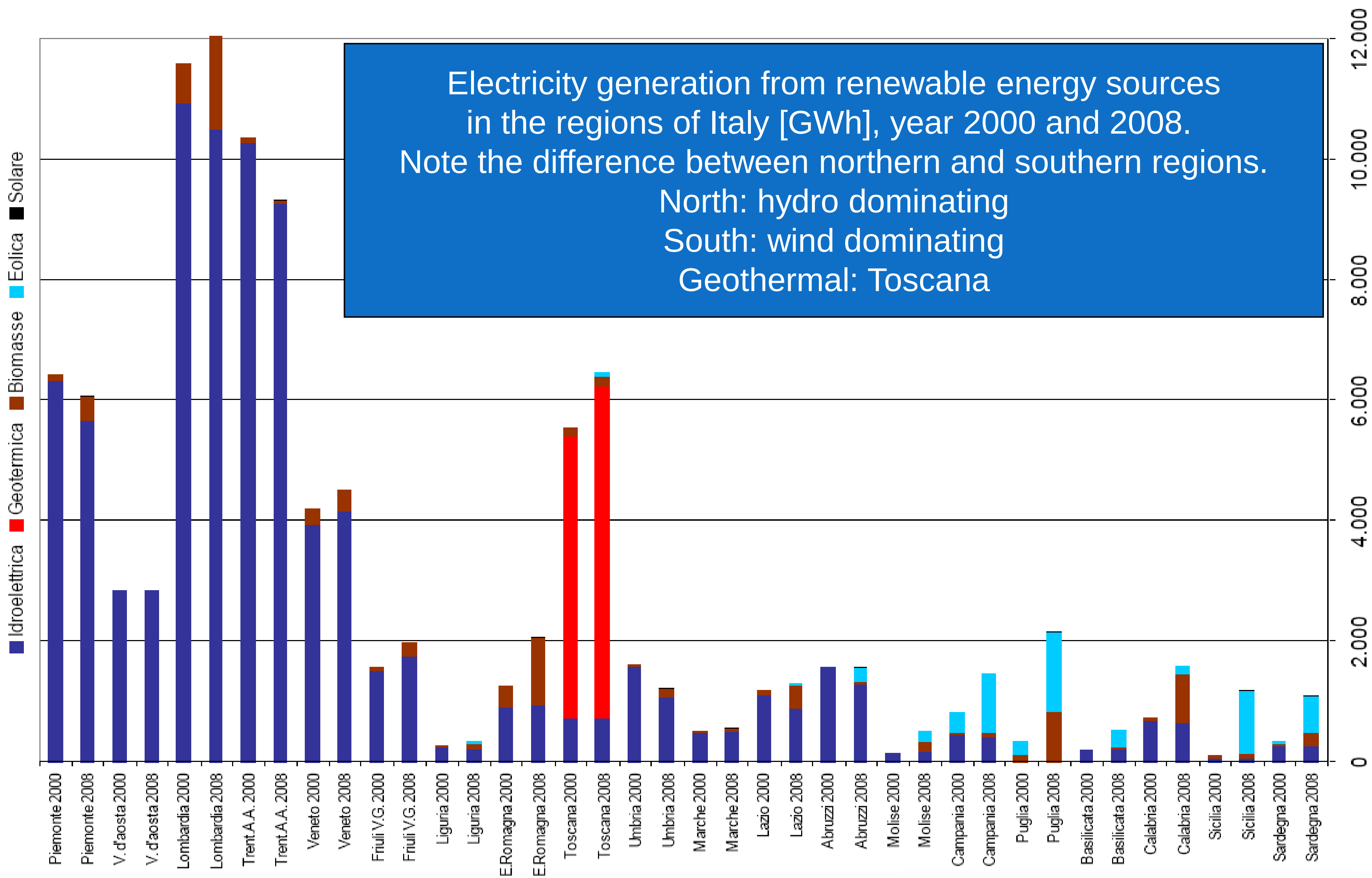
Estimated installed solar PV capacity by end of 2010: 2000 MW
(Project "Tetti fotovoltaici", existing feed-in tariff for 20 years of PV system operation, CRO 12)

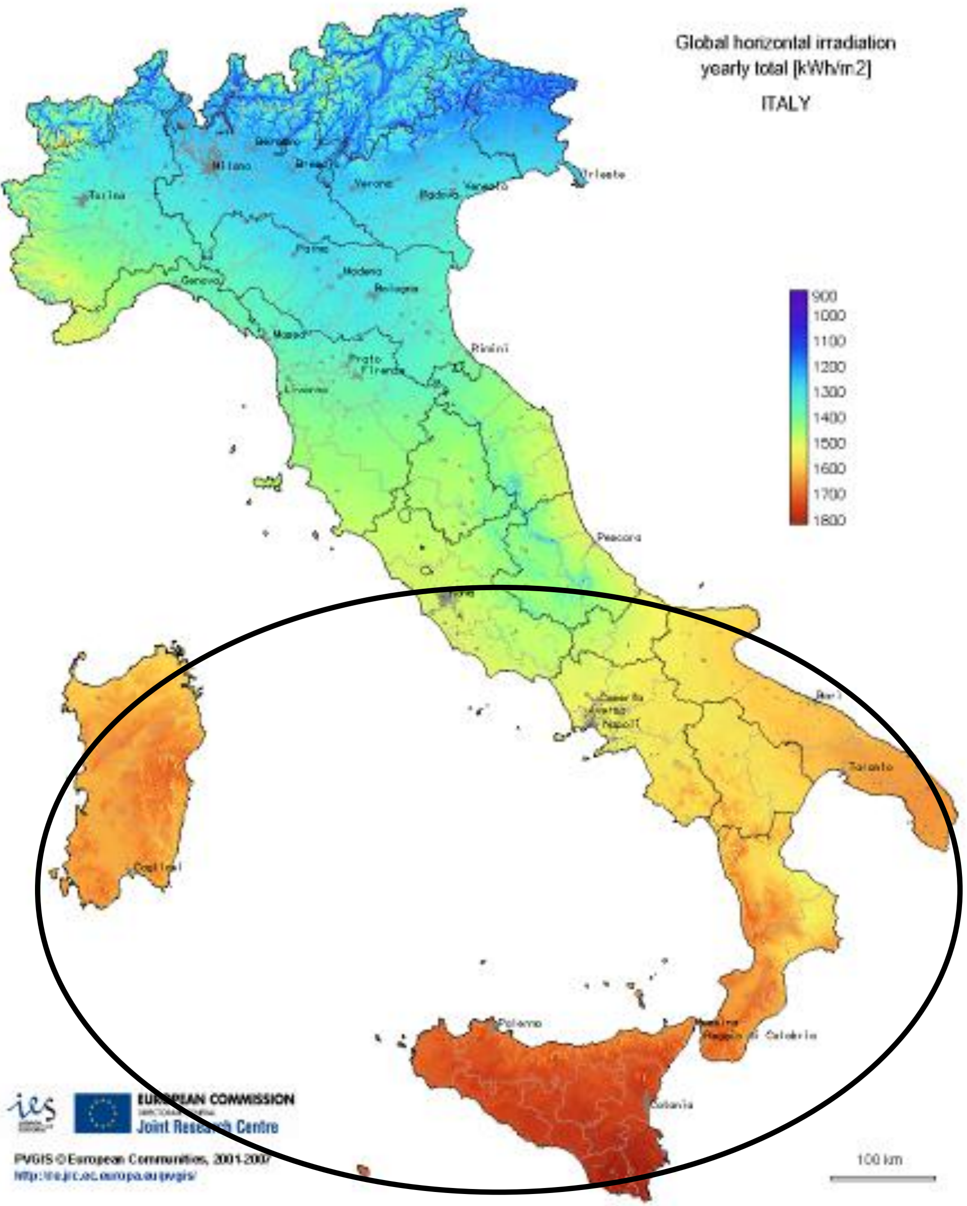
Among EU countries, Italy is third-placed for installed wind and solar capacities, after Germany and Spain

Geothermal power:

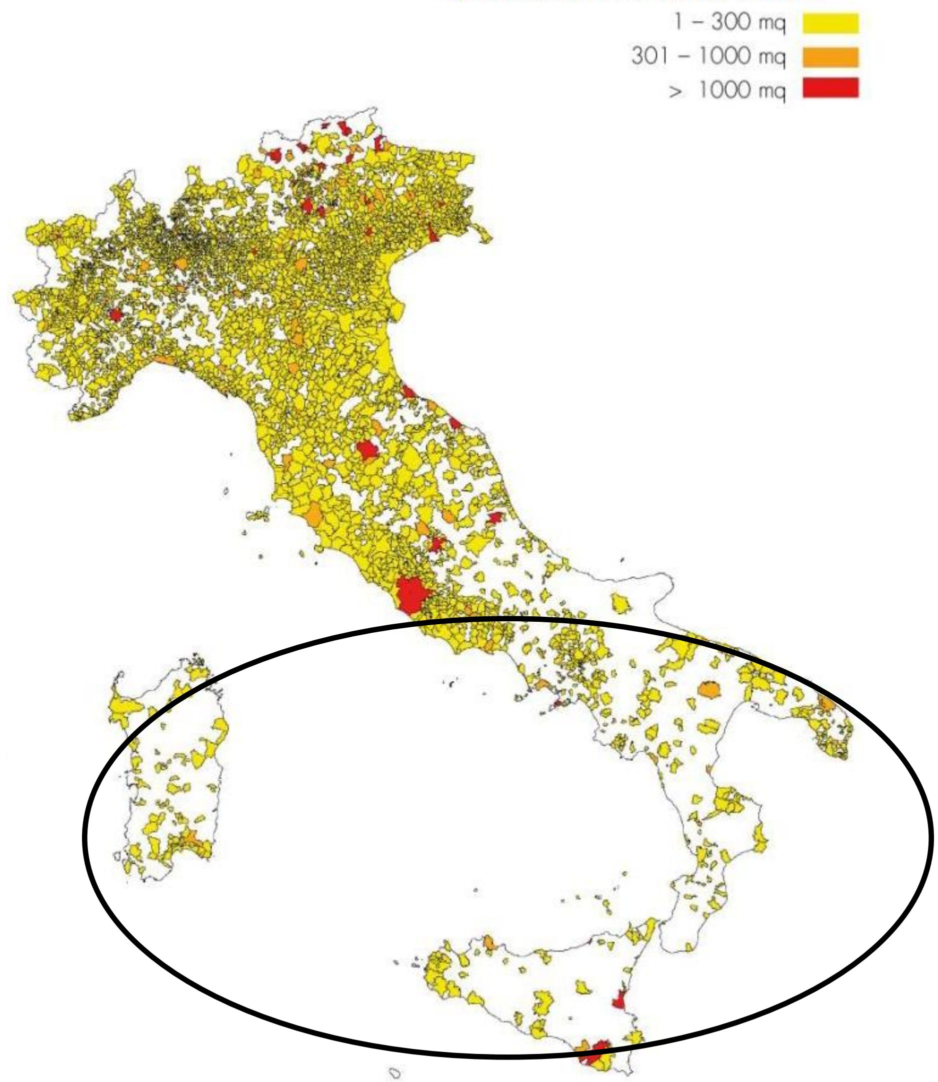


Electricity generation from renewable energy sources in the regions of Italy [GWh], year 2000 and 2008.
Note the difference between northern and southern regions.
North: hydro dominating
South: wind dominating
Geothermal: Toscana



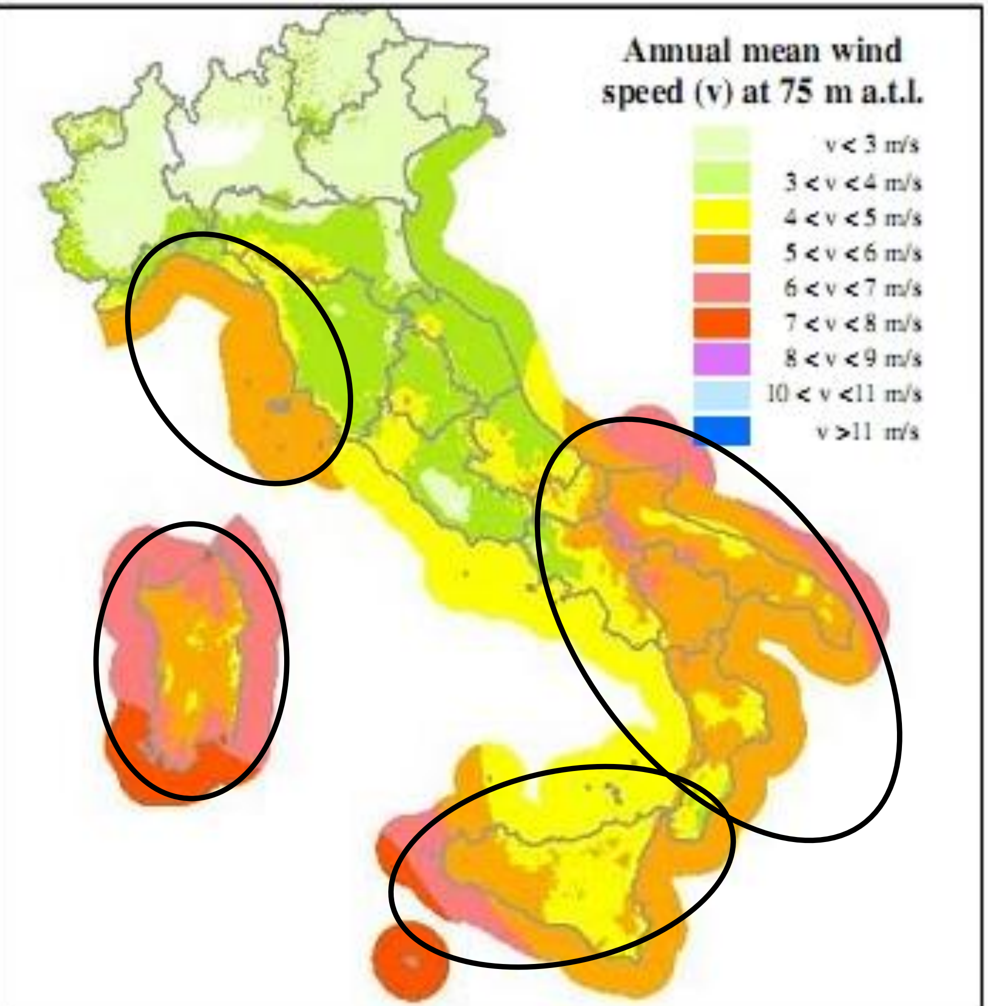


SOLAR COLLECTORS IN THE MUNICIPALITIES OF ITALY



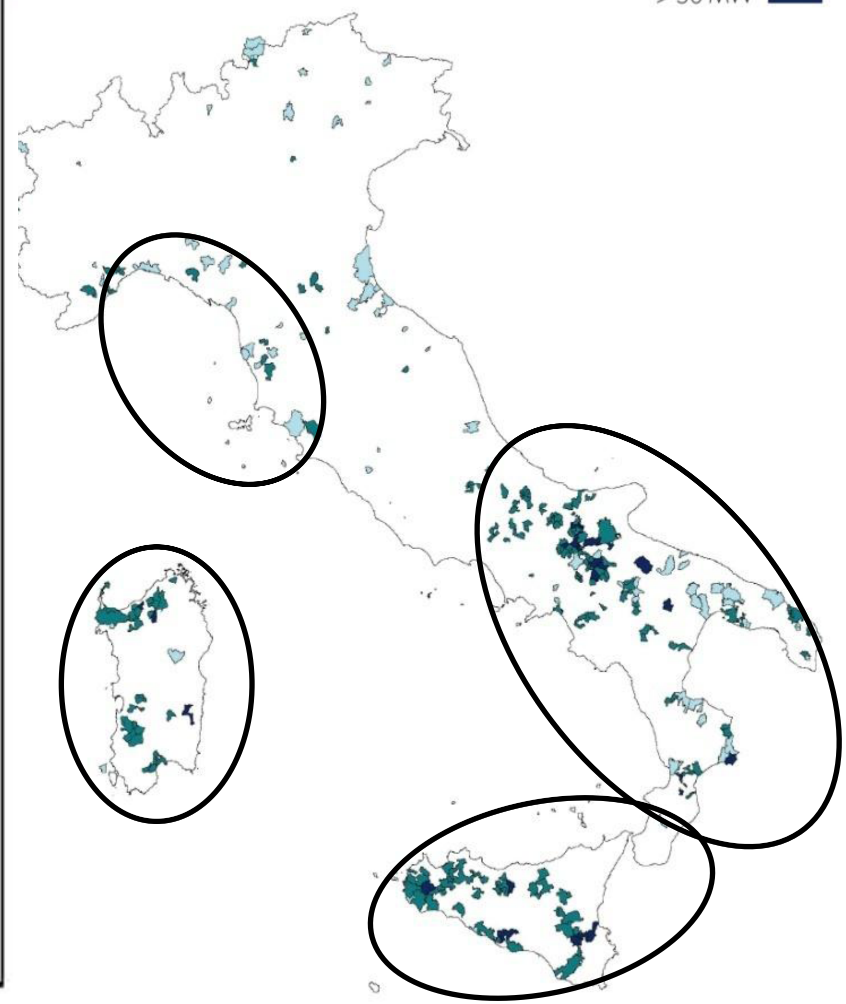
GEOTHERMAL POWER IN THE MUNICIPALITIES OF ITALY

0,1 – 1 MWt
> 1 MWt

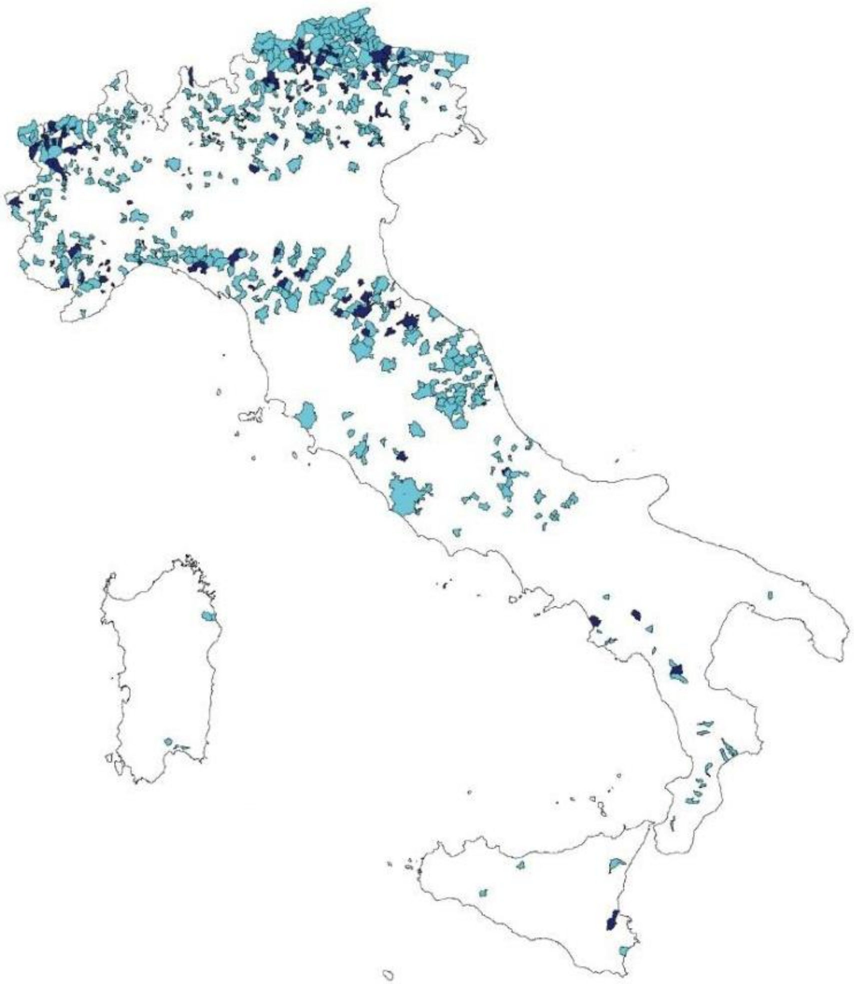


WIND POWER IN THE MUNICIPALITIES OF ITALY

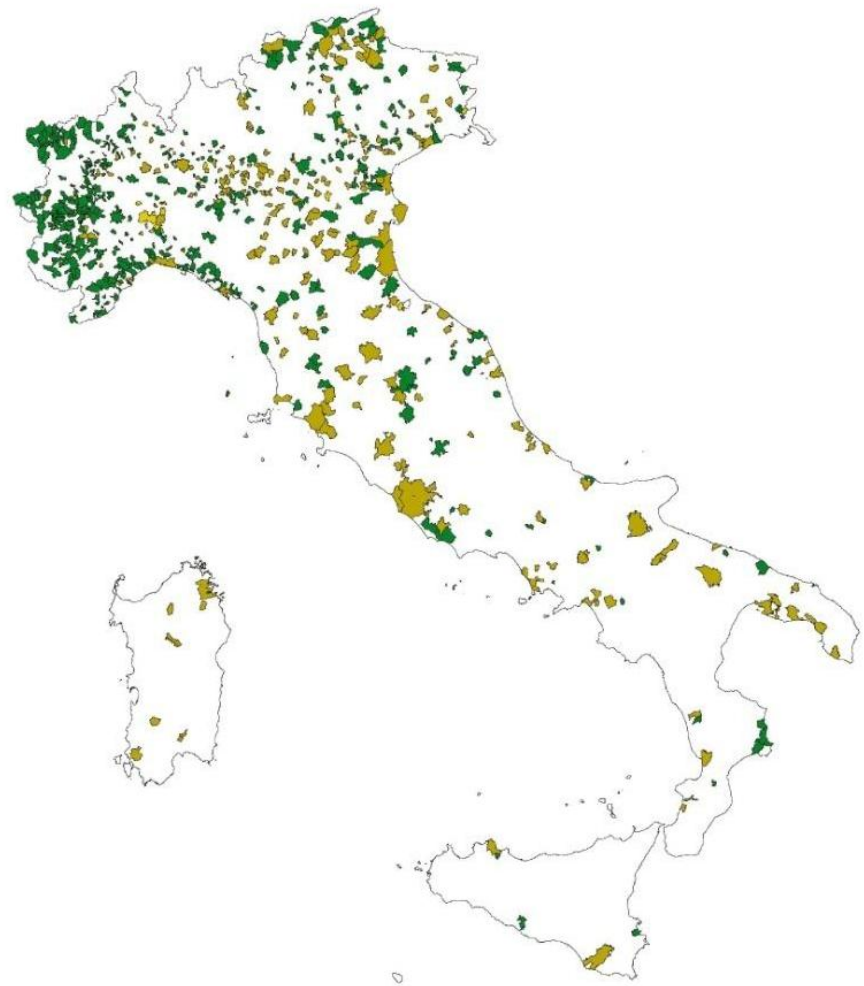
0 – 1 MW
1 – 50 MW
> 50 MW



SMALL HYDRO POWER IN THE MUNICIPALITIES OF ITALY



BIOMASS AND BIOGAS POWER PLANTS IN MUNICIPALITIES OF ITALY

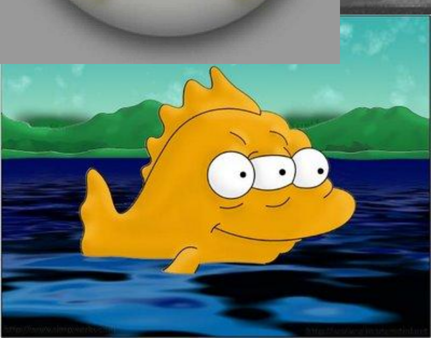


Nuclear power debate in Italy:

Enrico Fermi and Caorso closed in 1990 after the Nuclear power referendum in 1987 fearing from new Chernobyl disasters.
Garigliano closed in 1982. Latina closed in 1987. Montalto cancelled in 1988.
Total nuclear power capacity mothballed: 3 500 MW

A €50 billion mistake?
10% of electricity is imported from France (59 NPP)
10 new reactors are proposed which will produce 25% of electricity by 2030.
Agreements are being signed between Italy and France for expertises and feasibility studies of new EPR (European Pressurized Reactor, Areva) reactors.

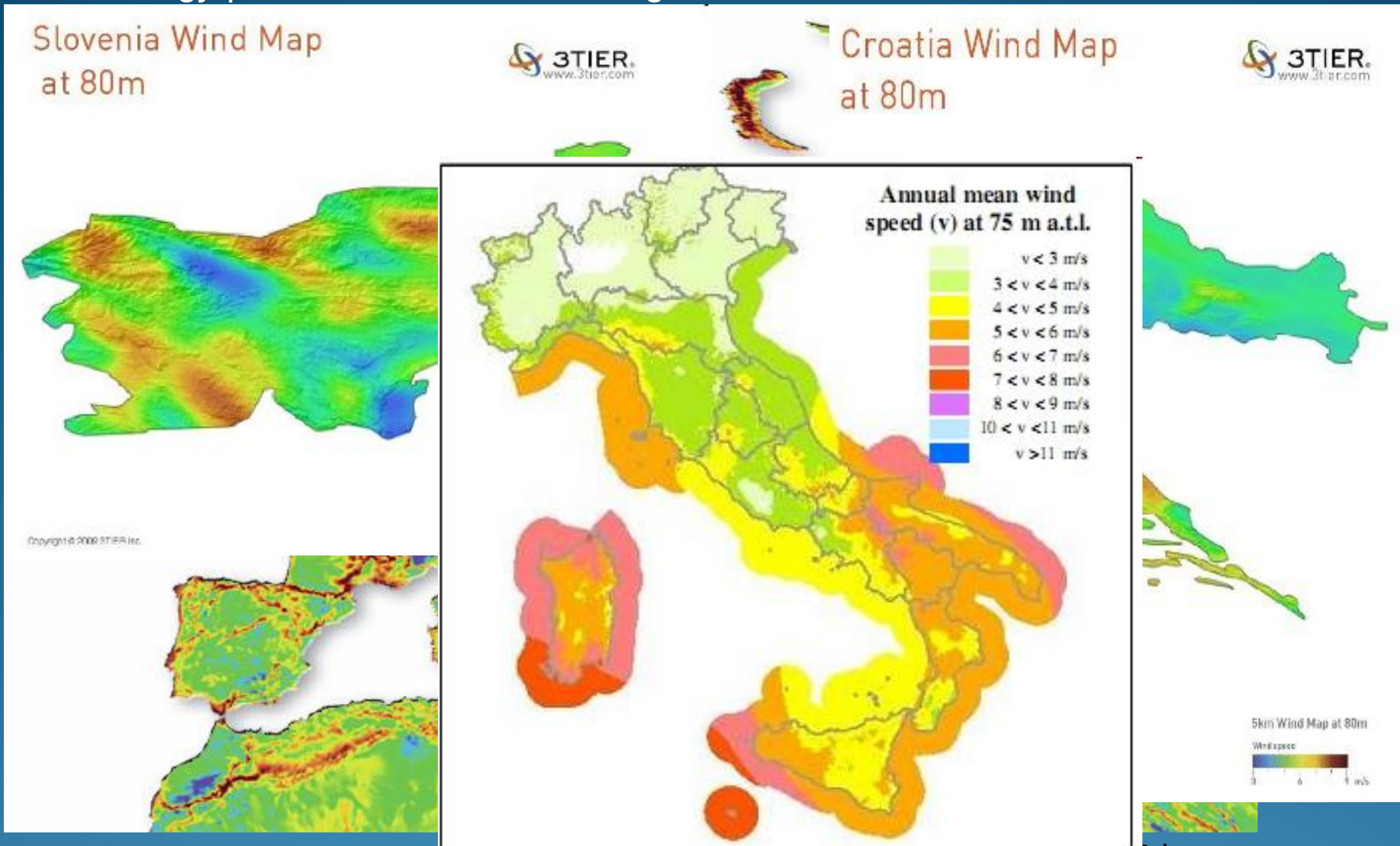
How to show nuclear power to the general public?



Miss Atom, Russian nuclear power propaganda

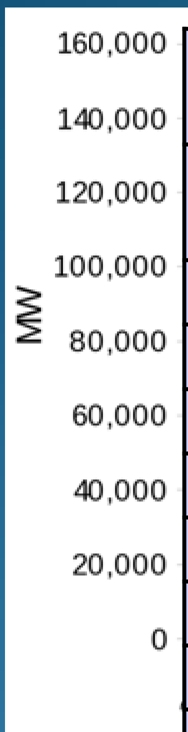
Wind energy

Wind energy potential in the Adriatic region:



3tier.com

Worldwide installed wind power capacities produce 2% of the global electricity. The installed capacity doubles every three years and by the end of the 2010 the worldwide installed wind capacity will be about 200 GW. 80% of the total global capacity is installed in the EU and USA. The installed wind capacity in China has doubled each year since 2005.



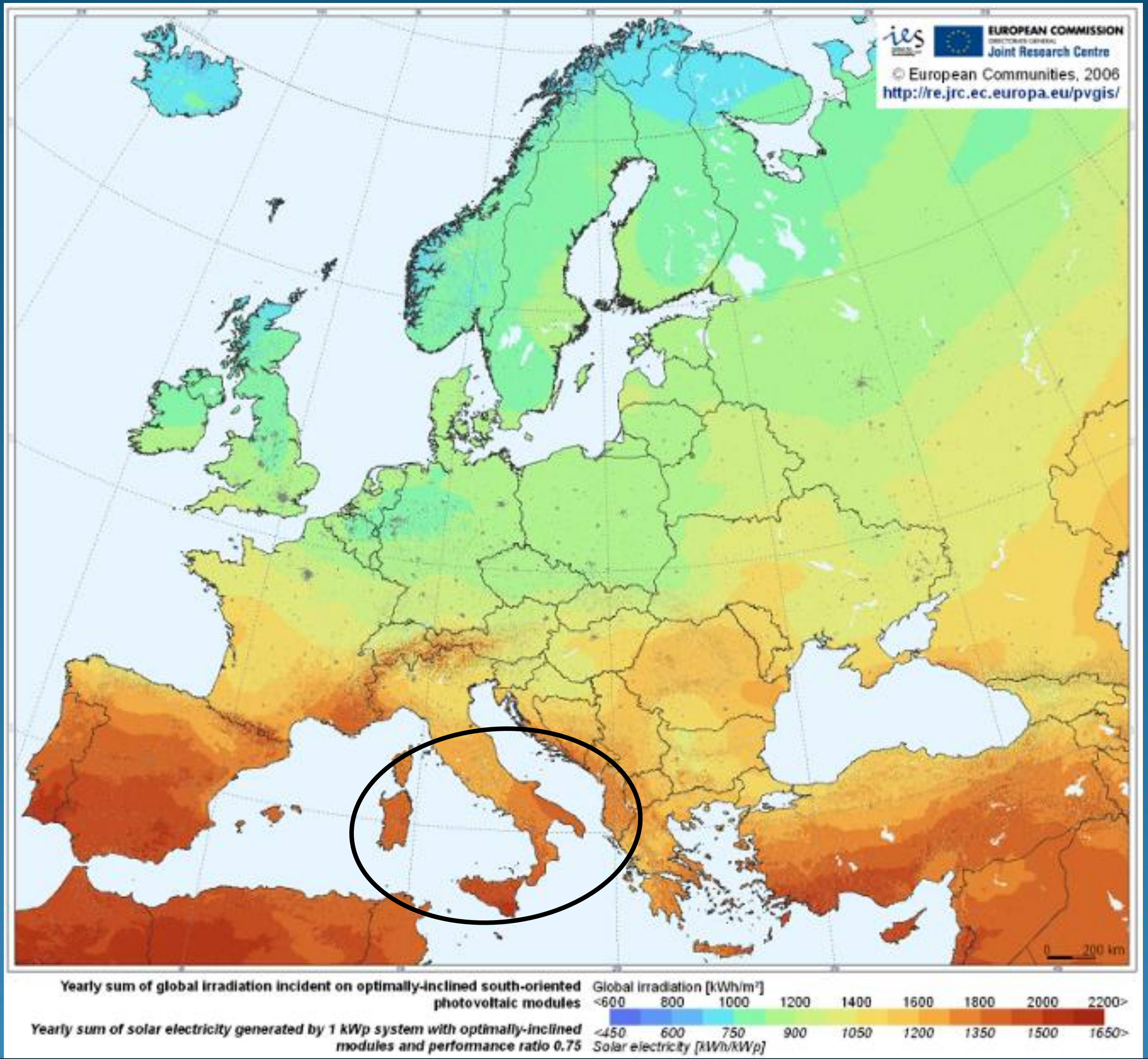
Installed wind capacities by country in MW

	2005	2006	2007	2008	2009
USA	9 149	11 603	16 819	25 170	35 159
Germany	18 428	20 622	22 247	23 903	25 777
China	1 266	2 599	5 912	12 210	25 104
Spain	10 028	11 630	15 145	16 740	19 149
India	4 430	6 270	7 850	9 587	10 925
Italy	1 718	2 123	2 726	3 537	4 850
France	779	1 589	2 477	3 426	4 410
Croatia	6	6	17	59	69
EU	40 722	48 122	56 614	65 255	74 767

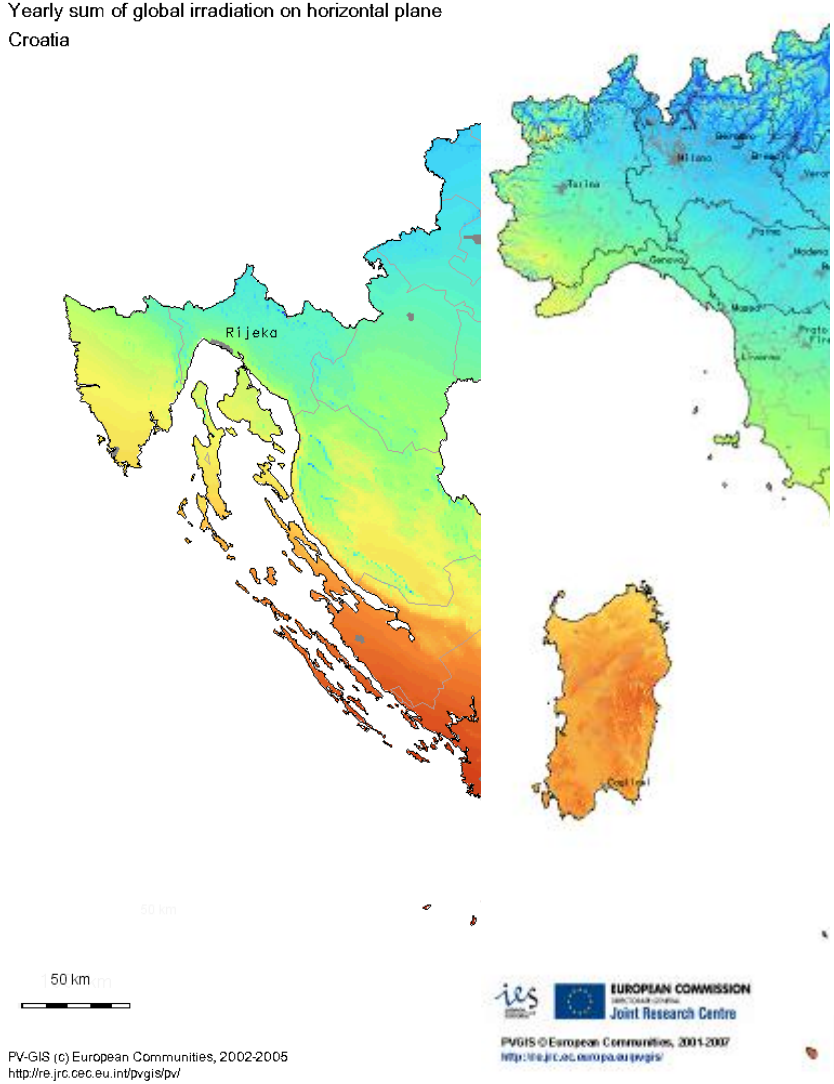
140 000 employees in the wind sector

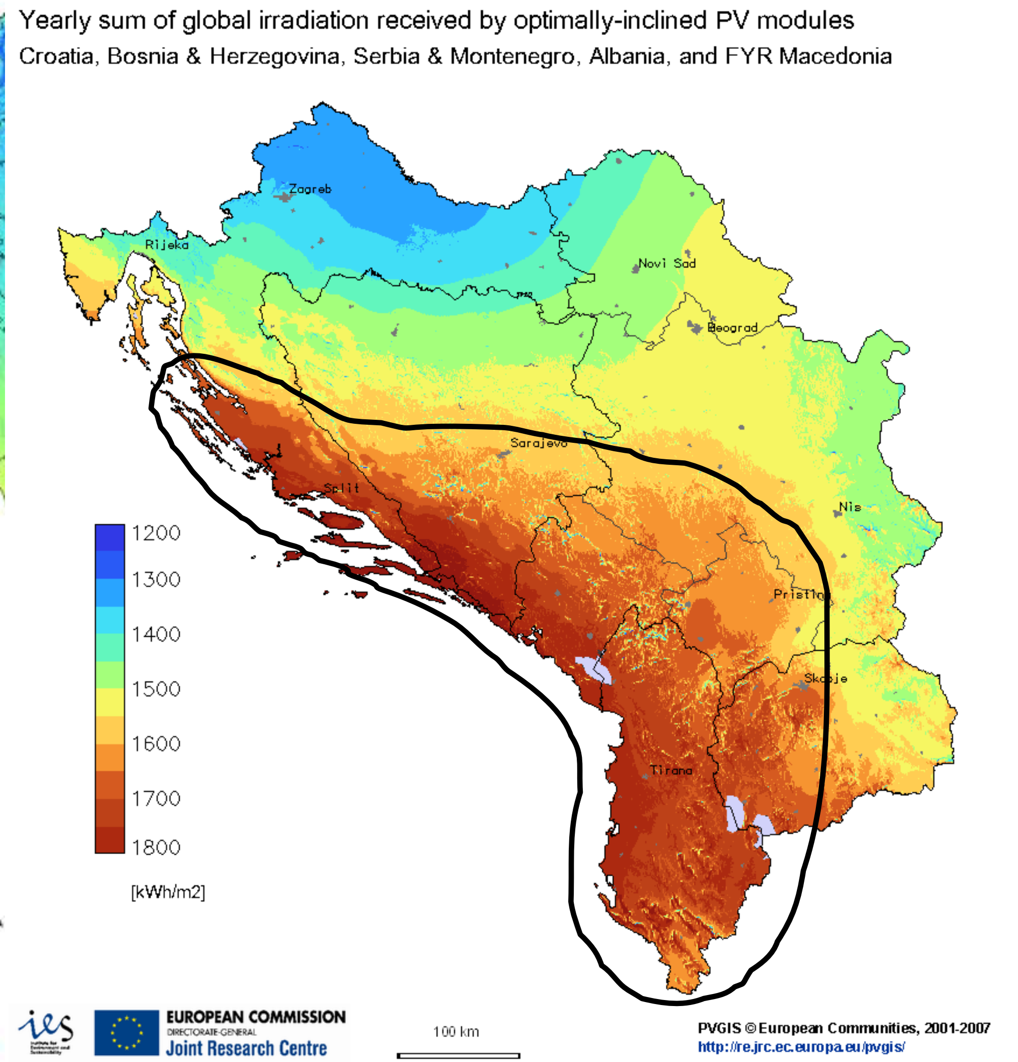
Solar energy

Solar energy potential in Europe:



Solar energy potential in the Adriatic region:



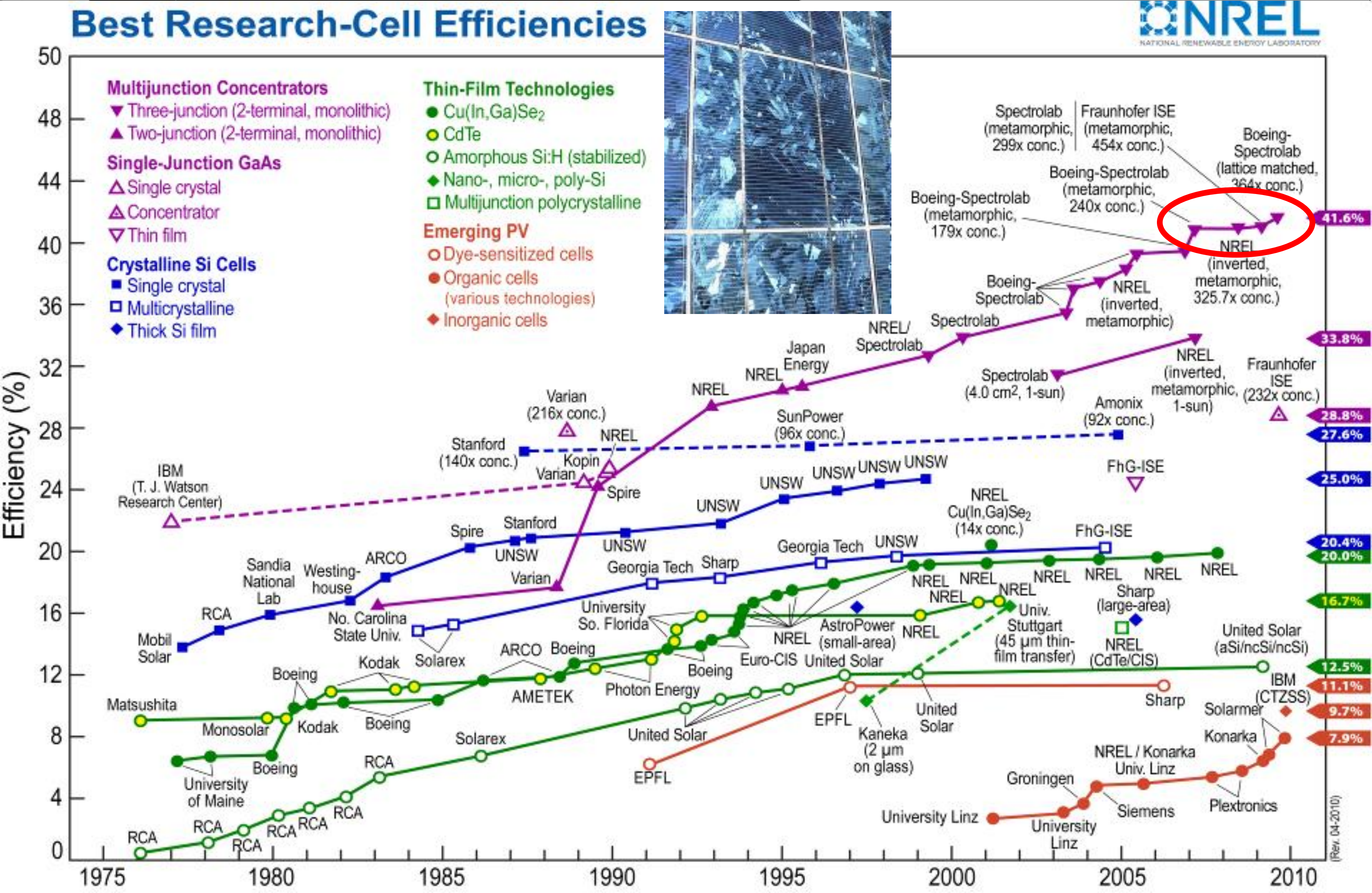


Solar energy conversion systems:

1. small-scale solar heating and cooling systems
2. large-scale PV and concentrating solar thermal for electricity production

Concentrating PV (CPV), η = 35% (Future η = 50%)

Best Research-Cell Efficiencies



Installed on-grid PV capacities by country in MW

	2006	2007	2008	2009
Germany	3 063	3 846	6 019	9 830
Spain	118	733	3 421	3 520
Japan	1 500	1 700	2 000	2 600
USA	300	500	700	1 200
Italy	58	120	458	1 032
Czech Rep.	1	4	55	466
South Korea	50	100	400	400
Croatia		0.05	0.0773	0.4(?)
World	5 100	7 600	13 500	21 000

Installed PV solar capacity = 10% of installed wind capacity

Solar thermal energy:

20 000 GWh ($28.5 \cdot 10^6$ m^2) of energy supplied from solar collectors in the EU:

Germany: 7 920 GWh
Italy: 1 130 GWh
Spain: 1 000 GWh
...
Croatia: 51 GWh

Solar thermal energy supplied per 1000 inhabitants in the EU:

Cyper: 590 MWh (843 m^2)
Austria: 330 MWh (471 m^2)
Greece: 242 MWh (345.7 m^2)
Germany: 96.4 MWh (137.7 m^2)
...
Italy: 18.8 MWh (26.9 m^2)
Croatia: 11.6 MWh (16.6 m^2)

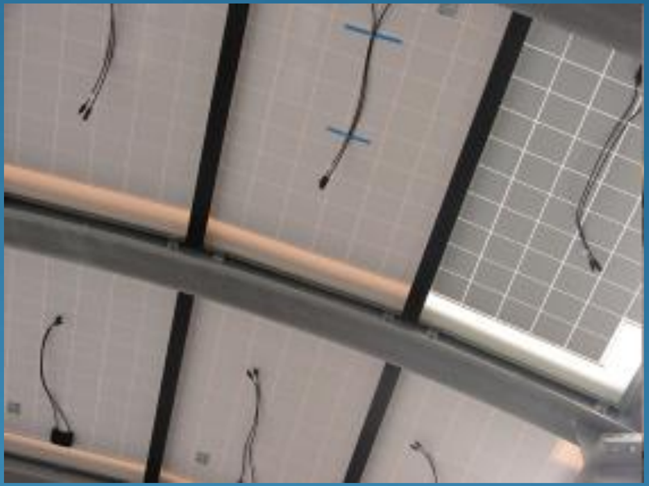
Solar energy in urban environment:

UPC Arena, Graz
1400 m^2 of solar collectors
Thermal energy: 520 MWh/a
Annual CO_2 mitigation: 93.6 tCO_2

1st commercial PV system in Rijeka
44 PV panels
Max output: 9,9 kWp
Area: 75 m^2
Annual electricity production: 9 MWh
Annual CO_2 mitigation: 2 tCO_2

Solar energy in urban environment:

PV system on Rijeka's motorway
1155 PV panels
Max output: 220 kWp
Area: 2260 m^2
Annual electricity production: 217 MWh
Annual CO_2 mitigation: 43.4 tCO_2



Solar energy in urban environment:

Toyota Solar Prius
Max output: 240 Wp
Enough for an additional drive of 15 km

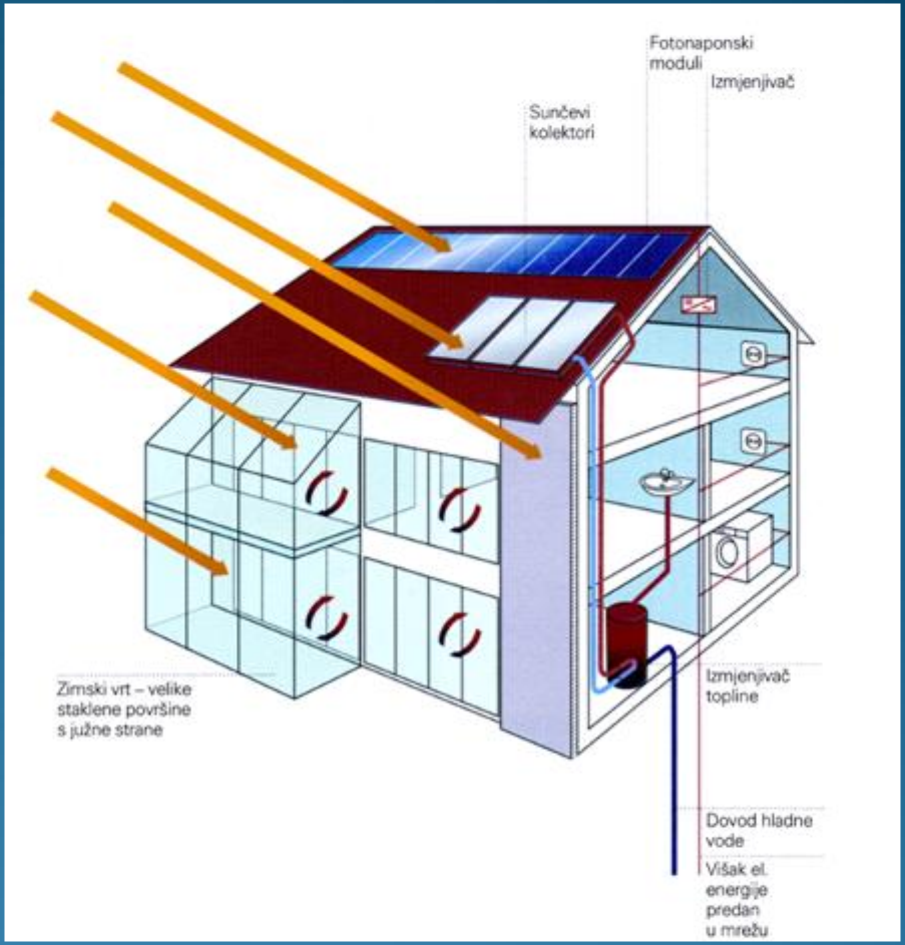
Solartaxi – 6 m^2 of PV panels
Max velocity: 90 km/h
Consumption: 8 kWh/100 km
Battery power: 7,2 kWp
Car mass: 500 kg; Mass of PV trailer: 250 kg

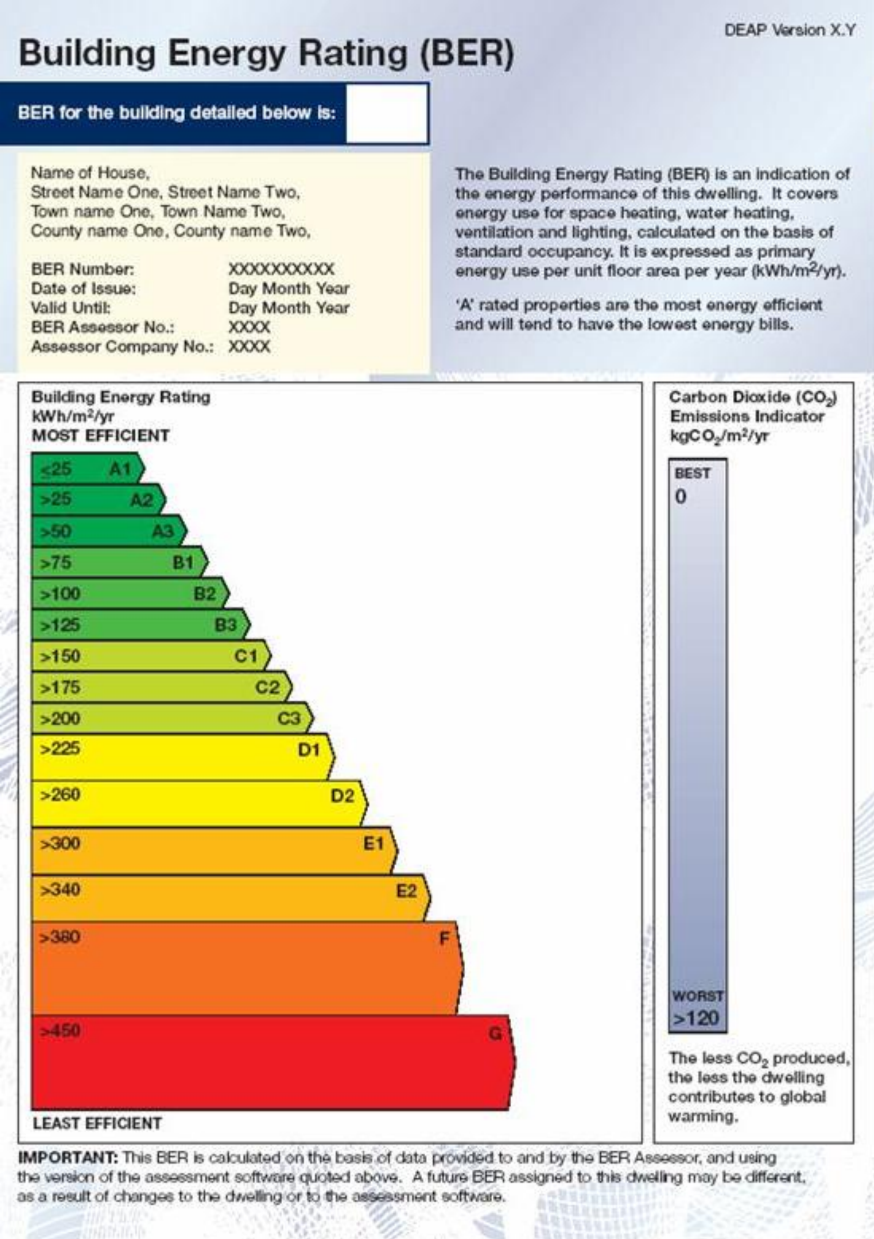
Energy efficiency – Sustainable housing

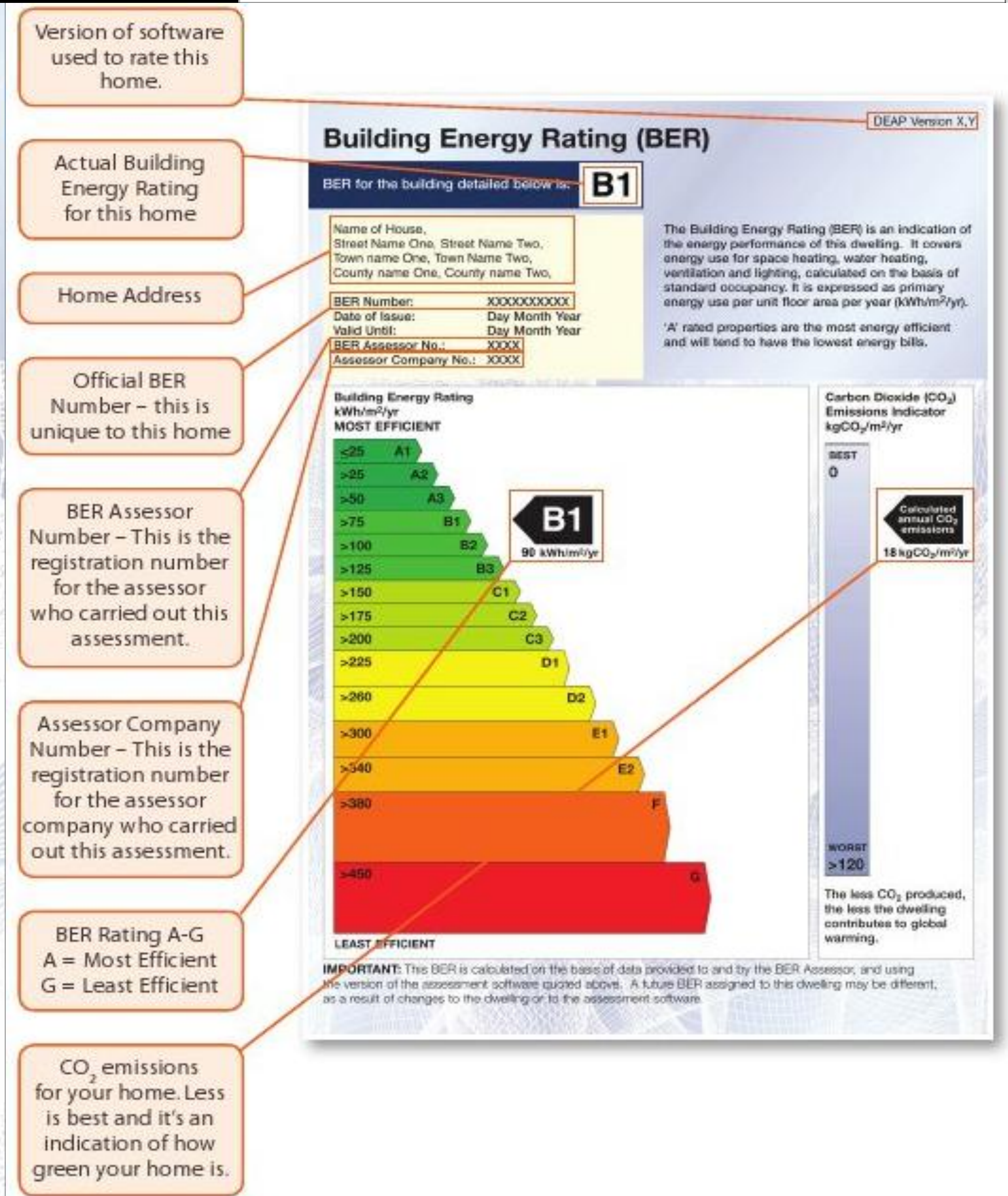
- Advanced building design and solutions
- South-oriented windows with low heat losses
- Well insulated and air-tight building envelope
- No thermal bridges in building envelope
- Trombe walls, massive walls and floor for accumulation of solar energy
- High-efficient HVAC components and household appliances (A++, A+ class)

↓

- High-quality indoor comfort with low energy consumption
- Low environment impact and building CO_2 emissions
- Low energy bills. Renewable energy systems for space and DHW heating



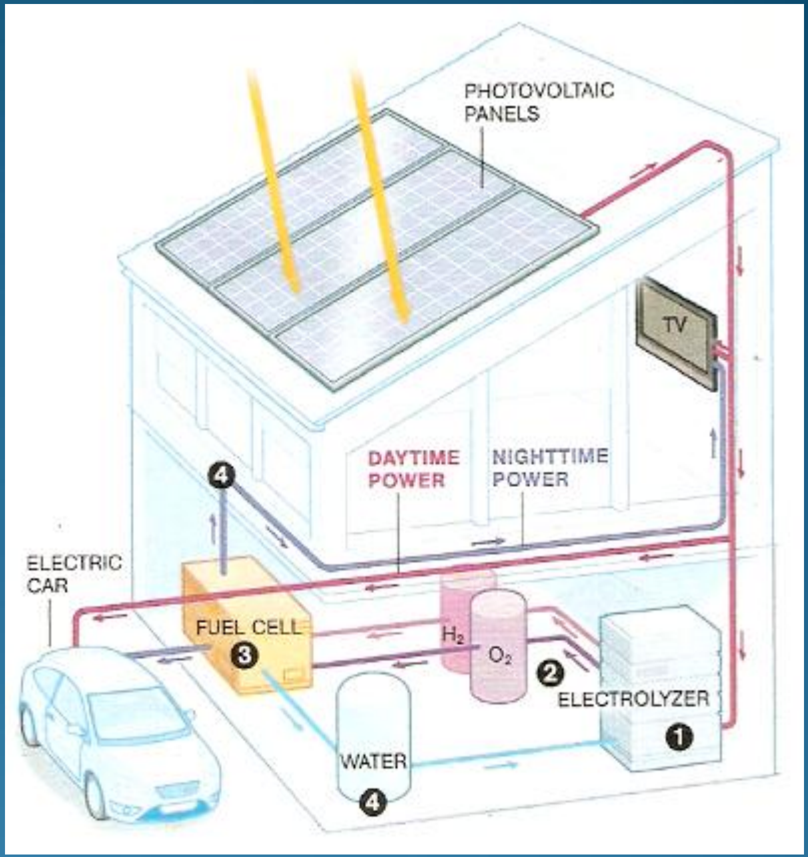

DEAP Version X.Y
Building Energy Rating (BER)
BER for the building detailed below is:
Name of House,
Street Name One, Street Name Two,
Town name One, Town Name Two,
County name One, County name Two,
BER Number: XXXXXXXXXX
Date of Issue: Day Month Year
Valid Until: Day Month Year
BER Assessor No.: XXXX
Assessor Company No.: XXXX
The Building Energy Rating (BER) is an indication of the energy performance of this dwelling. It covers energy use for space heating, water heating, ventilation and lighting, calculated on the basis of standard occupancy. It is expressed as primary energy use per unit floor area per year (kWh/m²/yr).
'A' rated properties are the most energy efficient and will tend to have the lowest energy bills.
Building Energy Rating
kWh/m²/yr
MOST EFFICIENT
≤25 A1
>25 A2
>50 A3
>75 B1
>100 B2
>125 B3
>150 C1
>175 C2
>200 C3
>225 D1
>260 D2
>300 E1
>340 E2
>380 F
>450 G
LEAST EFFICIENT
Carbon Dioxide (CO2) Emissions Indicator
kgCO2/m²/yr
BEST
0
WORST
>120
The less CO2 produced, the less the dwelling contributes to global warming.
IMPORTANT: This BER is calculated on the basis of data provided to and by the BER Assessor, and using the version of the assessment software quoted above. A future BER assigned to this dwelling may be different, as a result of changes to the dwelling or to the assessment software.


Version of software used to rate this home.
Actual Building Energy Rating for this home
Home Address
Official BER Number – this is unique to this home
BER Assessor Number – This is the registration number for the assessor who carried out this assessment.
Assessor Company Number – This is the registration number for the assessor company who carried out this assessment.
BER Rating A-G
A = Most Efficient
G = Least Efficient
CO2 emissions for your home. Less is best and it's an indication of how green your home is.
DEAP Version X.Y
Building Energy Rating (BER)
BER for the building detailed below is: B1
B1
90 kWh/m²/yr
Calculated annual CO2 emissions
18 kgCO2/m²/yr

Sustainable (solar) housing of the next generation

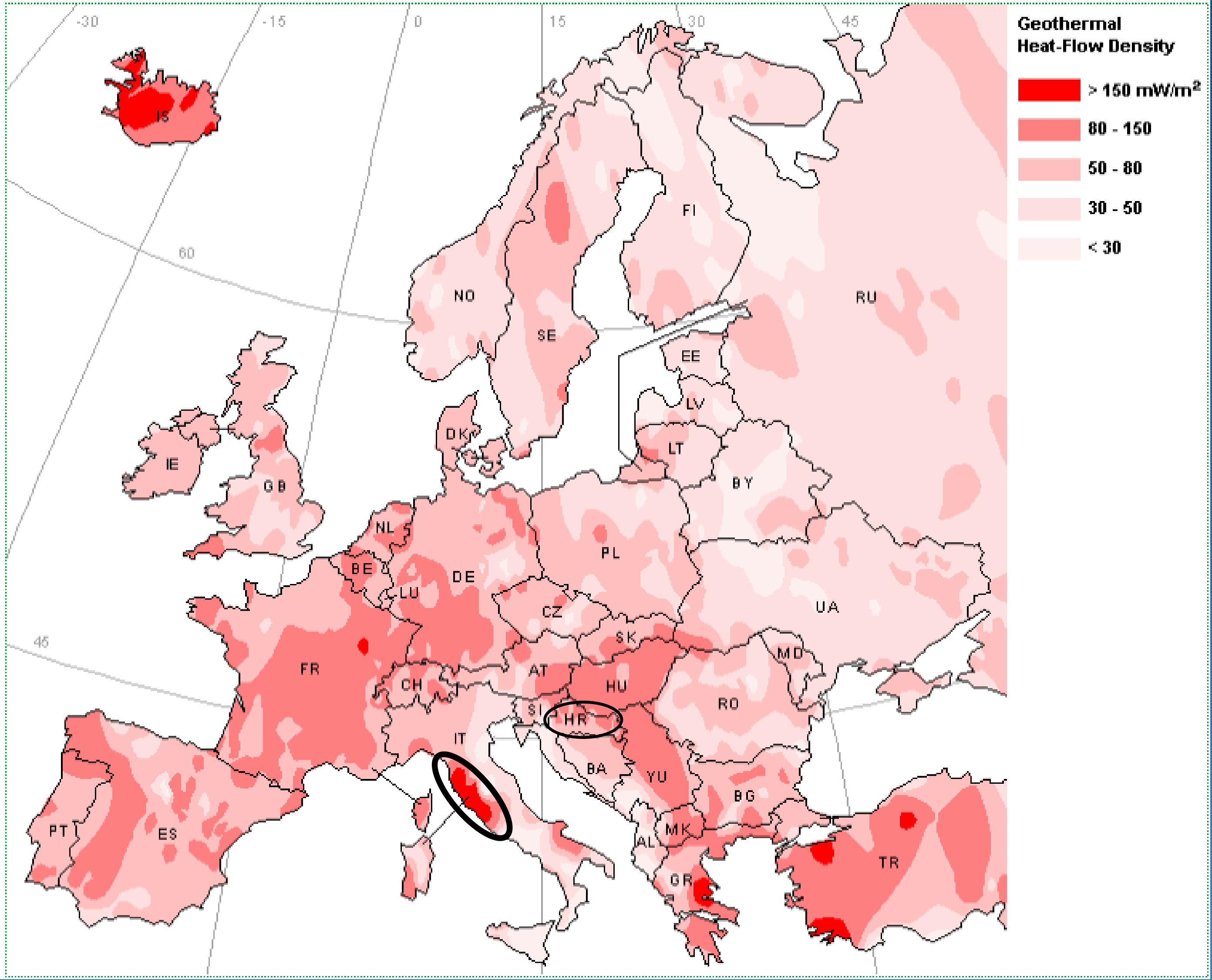
Small home power plant

1. Excess electricity from PV cells goes to the electrolyzer
2. Electricity splits water into oxygen and hydrogen
3. During night hours, the stored hydrogen and oxygen are recombined in a fuel cell, generating electricity
4. Excess electricity or hydrogen could be used to fuel a car



Geothermal energy

Geothermal potential in Europe:



Geothermal energy for electricity generation:

Installed capacity in EU: 720 MW_e (5 800 GWh of electricity in 2008)
Installed capacity in Italy: 670 MW_e or 93% of EU capacity (5 520 GWh of electricity in 2008)
Target for year 2010: 1000 MW_e
Estimated installed capacity at end of 2010: 934 MW_e

Geothermal energy for heating energy generation (medium-temperature sytems):

Installed capacity in EU: 2 560 MW_{th} (8 040 GWh of heating energy in 2008)

Hungary: 700 MW_{th} (2 210 GWh)
Italy: 500 MW_{th} (2 060 GWh)
France: 312 MW_{th} (1 330 GWh)
Croatia: 113.9 MWth (155 GWh)

Geothermal energy for heating energy generation (low-temperature systems):

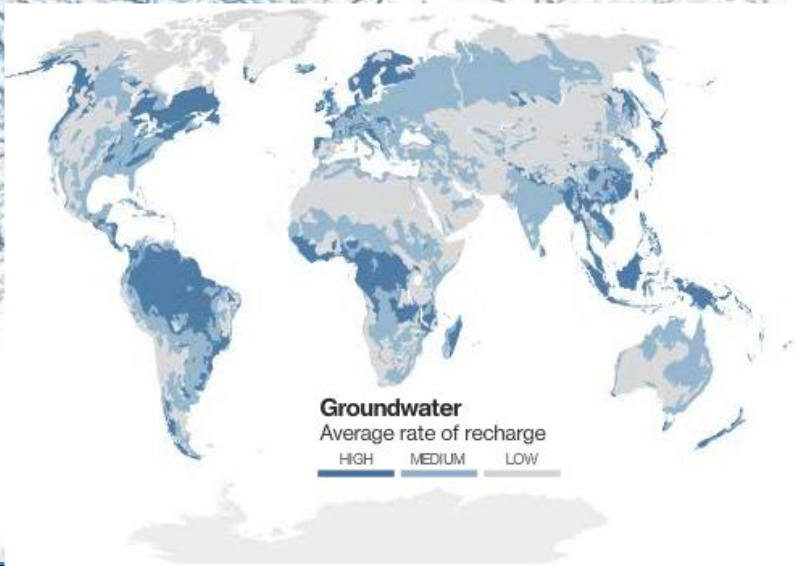
Installed capacity in EU: 9 000 MW_{th} (2008)

Sweden: 2 910 MW_{th}
Germany: 1 650 MW_{th}
France: 1 370 MW_{th}

Target for year 2010 (cumulative medium and low-temperature systems): 5 000 MW_{th}
Estimated installed capacity at end of 2010: 14 560 MW_{th}

Small hydro

Map of rivers and lakes in Europe:



Installed small hydropower (<10 MW) in EU: 12 620 MW (43 560 GWh of electricity, 2008)

Italy: 2 500 MW (8 400 GWh)

France: 2 000 MW (7 100 GWh)

Spain: 1 750 MW (6 300 GWh)

Germany: 1 500 MW (6 250 GWh)

...

Slovenia: 77 MW (270 MW)

Croatia: 27 MW (100 GWh)

Waste

Municipal solid waste in primary energy supply: 80 TWh (2008)

Germany: 14.4 TWh

France: 13.6 TWh

Denmark: 11.2 TWh

Municipal solid waste in primary energy supply per 1000 inhabitants:

Denmark: 2040 MWh

Sweden: 810 MWh

Municipal solid waste in electricity generation: 15.2 TWh (2008)

Germany: 4.5 TWh

France: 1.9 TWh

Italy: 1.6 TWh

Exeter energy facility
31 MW tire-fueled power plant

Cost of electricity generation by year 2016:

Estimated Levelized Cost of New Generation Resources, 2016.

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2008 $/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	69.2	3.8	23.9	3.6	100.4
Advanced Coal	85	81.2	5.3	20.4	3.6	110.5
Advanced Coal with CCS	85	92.6	6.3	26.4	3.9	129.3
Natural Gas-fired						
Conventional Combined Cycle	87	22.9	1.7	54.9	3.6	83.1
Advanced Combined Cycle	87	22.4	1.6	51.7	3.6	79.3
Advanced CC with CCS	87	43.8	2.7	63.0	3.8	113.3
Conventional Combustion Turbine	30	41.1	4.7	82.9	10.8	139.5
Advanced Combustion Turbine	30	38.5	4.1	70.0	10.8	123.5
Advanced Nuclear	90	94.9	11.7	9.4	3.0	119.0
Wind	34.4	130.5	10.4	0.0	8.4	149.3
Wind – Offshore	39.3	159.9	23.8	0.0	7.4	191.1
Solar PV	21.7	376.8	6.4	0.0	13.0	396.1
Solar Thermal	31.2	224.4	21.8	0.0	10.4	256.6
Geothermal	90	88.0	22.9	0.0	4.8	115.7
Biomass	83	73.3	9.1	24.9	3.8	111.0
Hydro	51.4	103.7	3.5	7.1	5.7	119.9

CCS = Carbon Capture and Storage

Source: Energy Information Administration, Annual Energy Outlook 2010, December 2009, DOE/EIA-0383(2009)

Sustainable energy for sustainable transport
Biofuels

Bio-fuels for transport in the EU:

Consumption of bio-fuels in transport: 10.5 Mtoe (2008) or 3.4% of the total energy supply

Target for year 2010: 5.75% of the total energy supply in transport

Prediction at the end of 2010: 17 Mtoe or 5.4% of the total energy supply in trasport

Bio-fuels:

Biodiesel 78.2%

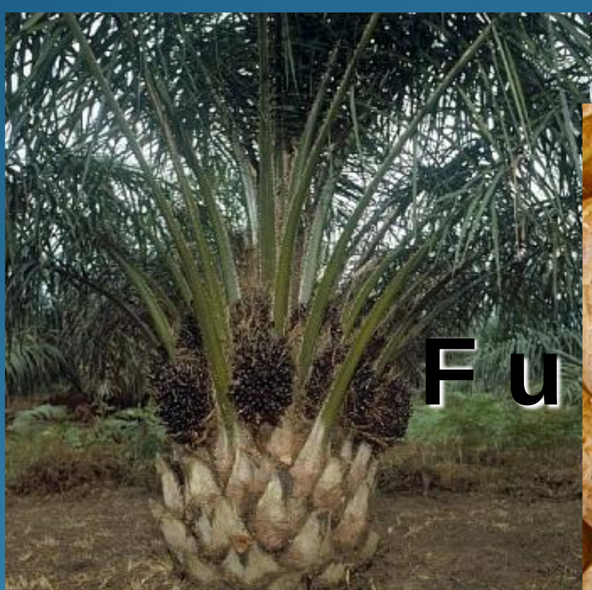
Bioethanol 17.7%

Other 4.1%

Bio-fuels producers:

Germany 31%

France 23%


Oil palm tree

Peanut


Sugarcane

Sustainable transport – vehicles of the next generation

Hybrid electric vehicle:Toyota Prius
Emissions: 90 g/km (SULEV)

Plug-in HEV (rechargeable batteries to plug on external powersource): Chevrolet Volt

Is it an environment friendly solution?
How much CO_2 produces the electricity used to recharge the batteries?

LPG HEV vehicle: Hyundai Elantra LPI Hybrid
LPG + Li-Poly batteries
Consumption: 5.6 lit/100 km
Emissions: 99 g/km (SULEV)

Sustainable transport – vehicles of the next generation

Hydrogen fuel cell vehicle: Honda FCX Clarity
Production cost: $130 000 per vehicle
Specifications: 130 hp
KERS is represented by 288 V Li-ion battery
Range: 450 km
Consumption: 0.86 kg H_2/100 km
Hydrogen cost: $5-$10 per kg H_2
Hydrogen is produced from natural gas
Not yet available for purchase but for leasing at $600/month for 3 years

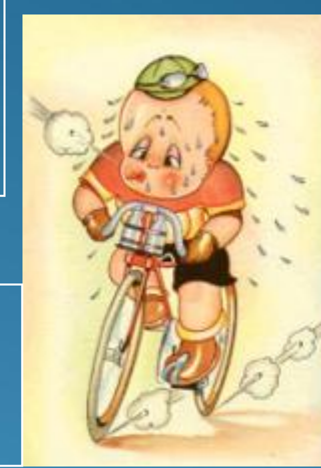
Partial zero-emissions vehicle (PZEV)
Zero-emissions vehicle (ZEV)

ZEV (refers to tailpipe emissions):
Bicycles
Electric vehicles*
Hydrogen vehicles
Solar vehicles

*Although electric vehicles are considered as ZEV-vehicles, they only shift emissions to the location where electricity is produced!

Electric vehicles can be considered as ZEVs if electricity is produced from solar, wind, small hydro, etc.

Bicycles and hydrogen cars both emit only water!



Sustainable energy – renewable energy sources:

1st generation (since 1900): large hydro, biomass combustion, geothermal power & heat
2nd generation (since 1973): solar heating&cooling, wind power, photovoltaics, bioenergy
3rd generation (under R&D): biomass gasification, biorefinery, concentrating solar, ocean energy, hot dry rock geothermal energy

IEA, Renewables in global energy supply

Renewable energy sources for the 1st half of the 21st century:

wind energy
photovoltaic
concentrated solar

hydro power
biofuels
hydrogen
geothermal power
tidal&wave power

Excerpt from National Geographic Magazine, July 2010:

Europe's smart grid: Nine northern European countries agreed to link their grids by building transmission lines under the North Sea.

New lines under the Mediterranean are proposed to tap solar power from the Sahara.

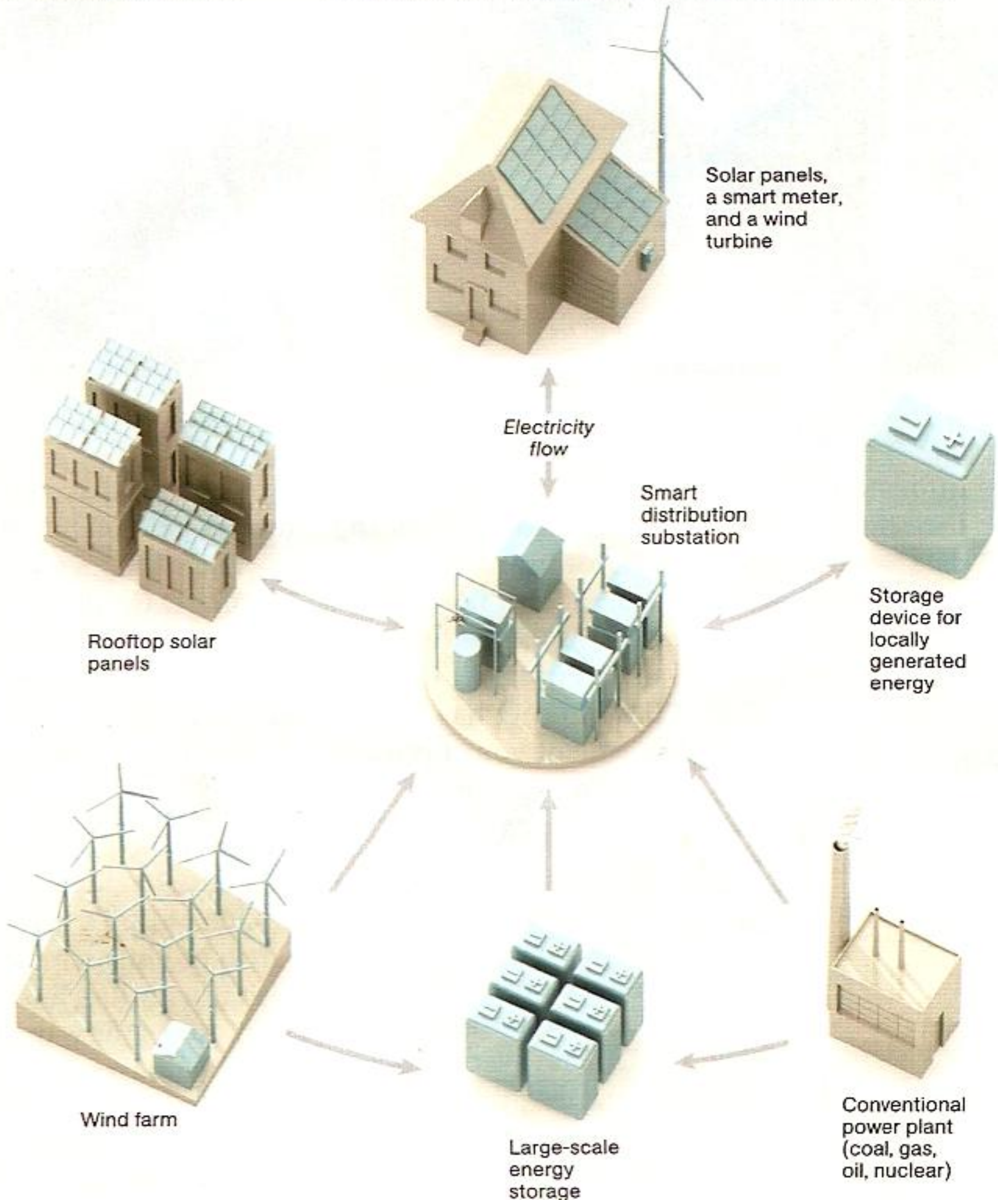
A GRID THAT WORKS BOTH WAYS

A smart grid will change how the average homeowner thinks about electricity by constantly sharing usage data with the power company, which juggles supply (and pricing) accordingly. Consumers are rewarded for not hogging energy at times of peak demand; utilities benefit because power usage is more predictable and they learn immediately of any outages. Other improvements will make it easier to incorporate intermittent renewable energy sources such as wind and solar.

At Home
Smart meters allow consumers to program their appliances to run (or their electric cars to charge) at off-peak hours, when electricity is cheap. Customers who generate energy on a small scale, say from a wind turbine or solar panels, can sell it back to the grid.

Locally
Using data transmitted from homes and offices, utilities can monitor electricity use and tweak the flow—adjusting thermostats, for instance, to flatten spikes in demand. Renewable energy generated locally can be distributed locally, with any surplus diverted into storage.

Regionally
To supplement fossil fuel plants, long-distance transmission lines are starting to stretch out from remote areas, which has plenty of sun and wind. New technology built into the grid will help by storing power during off-peak hours.



Excerpt from NGM, July 2010

Central Control Unit

On November 8, 2009, more than half of Spain's electricity was wind generated.
A hopeful sign that lasted only a few hours.
This was an instance where demand was very low and wind power generation very high.
The average wind power grid penetration is about 10% in Spain.
Denmark has an average wind power grid penetration of 20%.

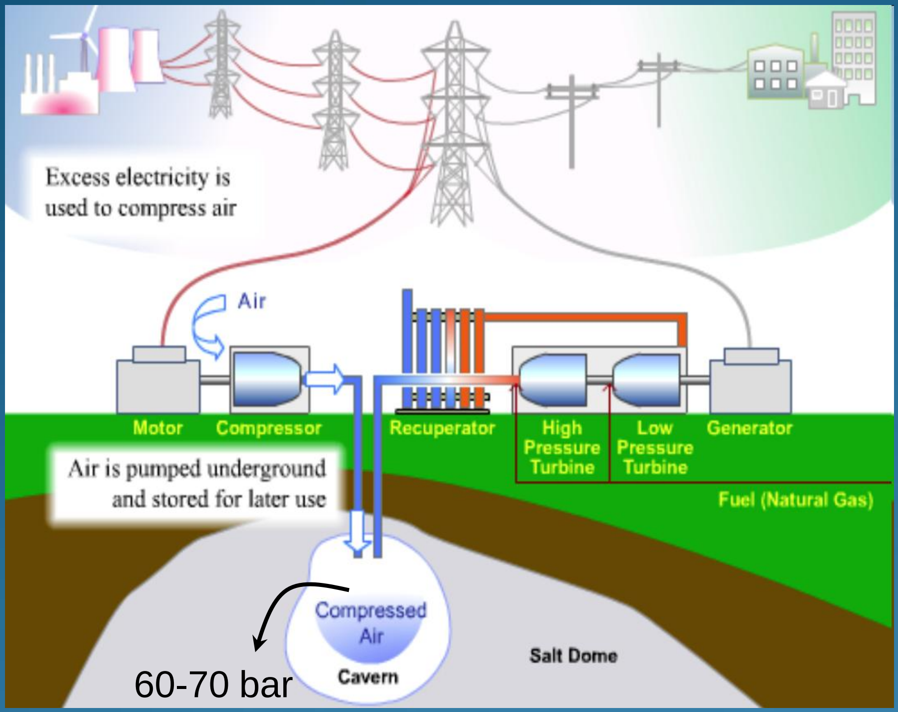
How to rely on wind and solar energy which are intermittent and non-dispatchable?

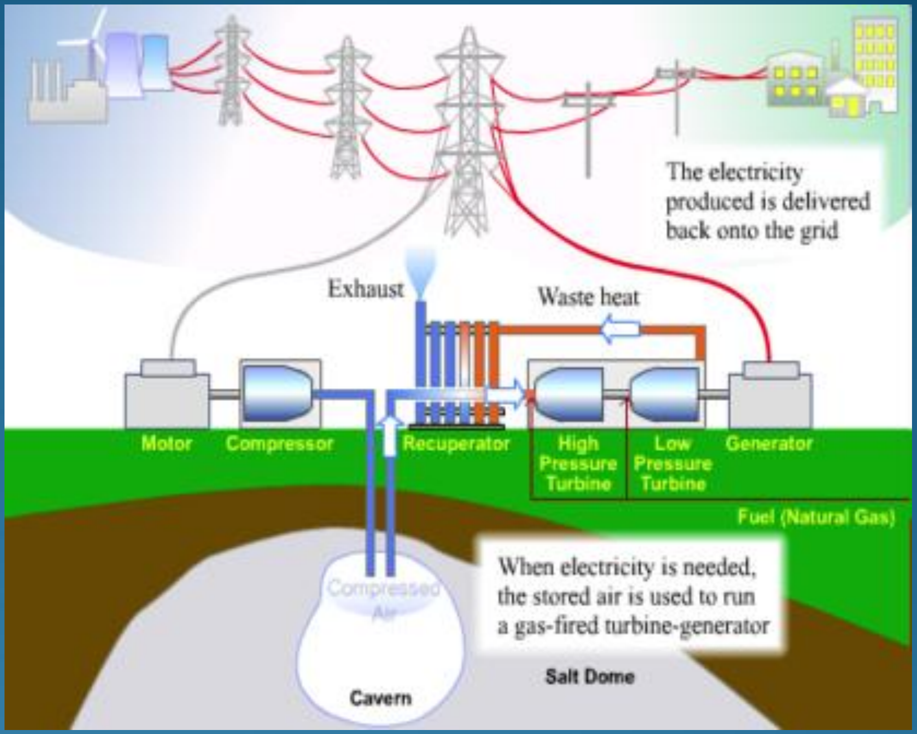
Grid energy storage systems such as compressed air underground tanks, pumped-storage hydro, sodium-sulfur batteries, flywheel storage, thermal energy storage, vehicle-to-grid and hydrogen energy storage may be the solution to the problem insuring round-the-clock electricity distribution!



Wind/CAES system:

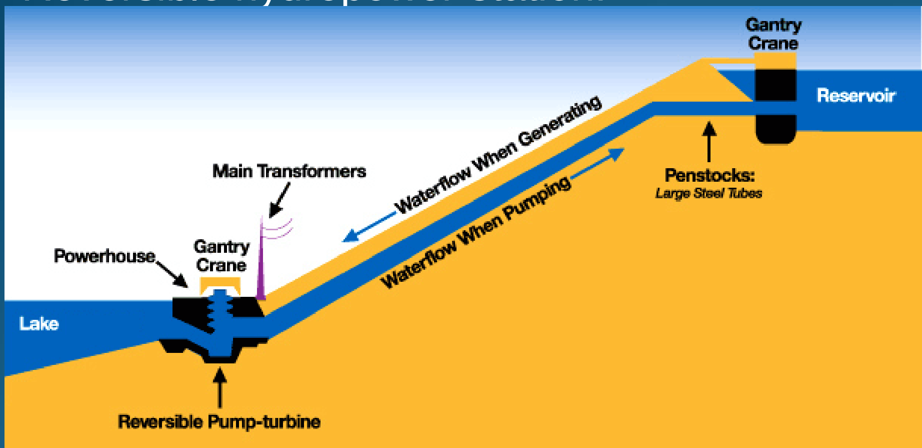
Excess electricity powers the air compressor which fills the cavern with pressurized air





Compressed air runs a gas-fired turbine to produce electricity in periods of shortage of wind or solar electricity

Reversible hydropower station:



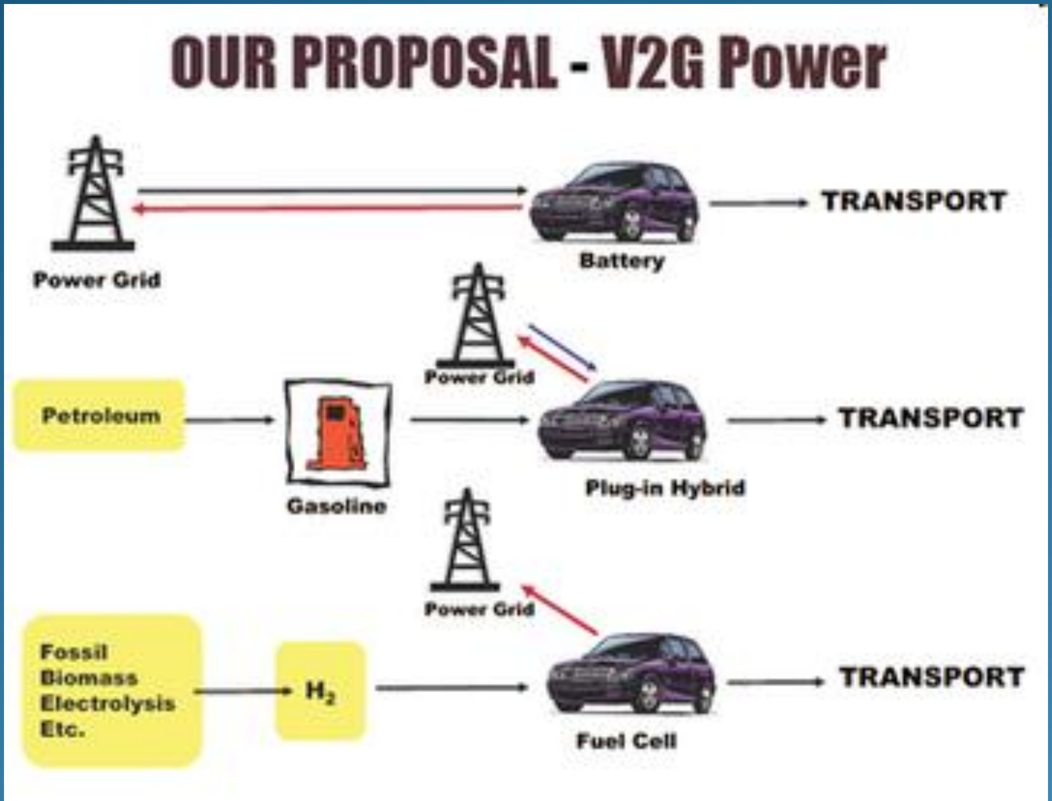
Formula One (2009)
Team: Williams F1
Flywheel-KERS system
Weight: 24 kg,
80 HP for 6.7 s per lap

Nasa G2 flywheel: Magnetic bearings, vacuum chamber. Carbon-fiber rotor at 50 000 rpm

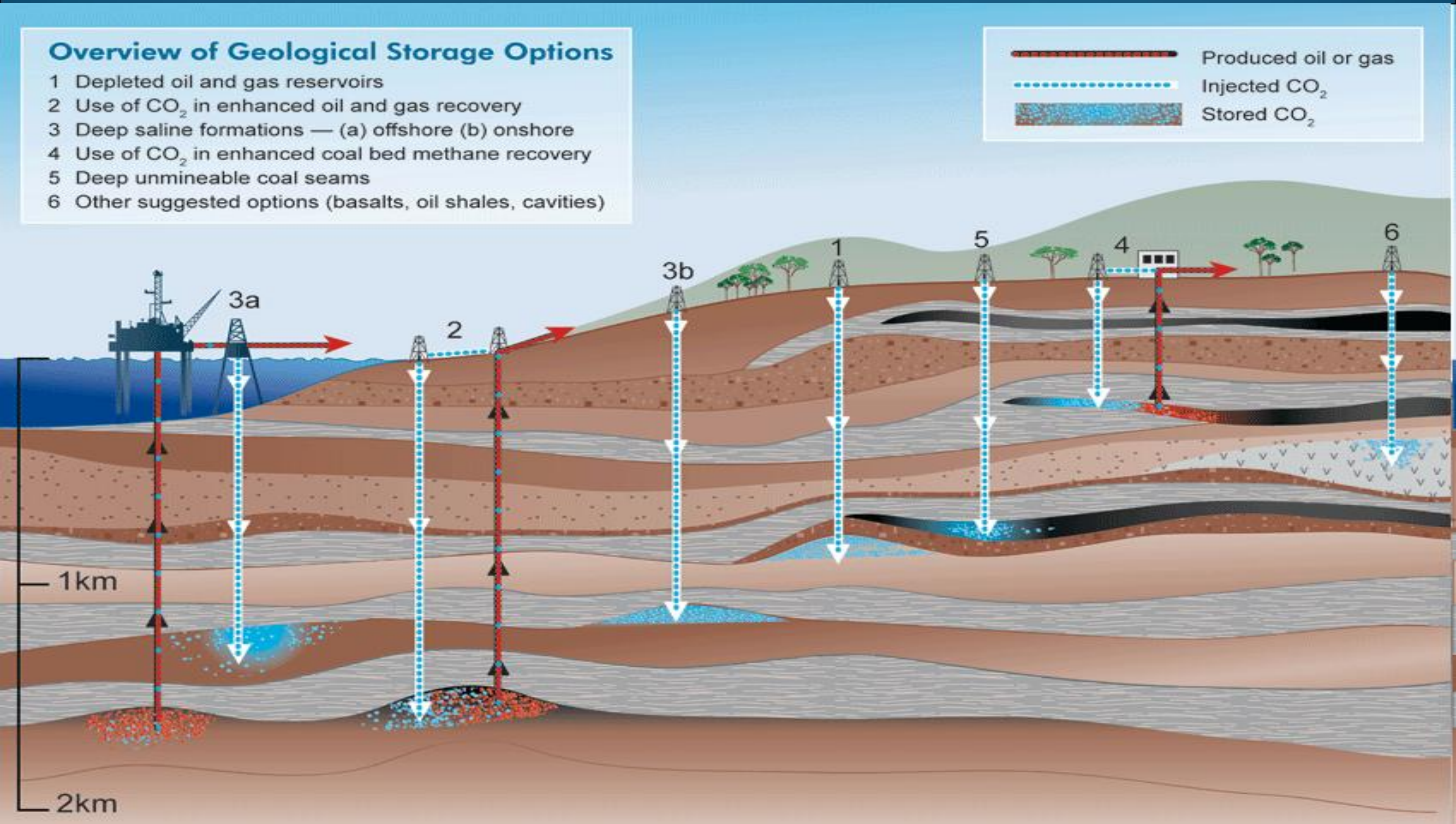
NGK Sodium-sulfur battery: 1.2 MW, 7 hours of autonomy

Vehicle-to-grid energy storage technology: a parked and plugged-in hybrid or electric vehicle can supply electricity from its 20 to 50 kWh battery pack to the grid for meeting peak demands.

The drawback of the vehicle-to-grid idea is the fact that each storage cycle stresses the battery with one complete charge-discharge cycle.



CCS-Carbon Capture & Storage: Works for coal-fired power plants! What about cars and planes?

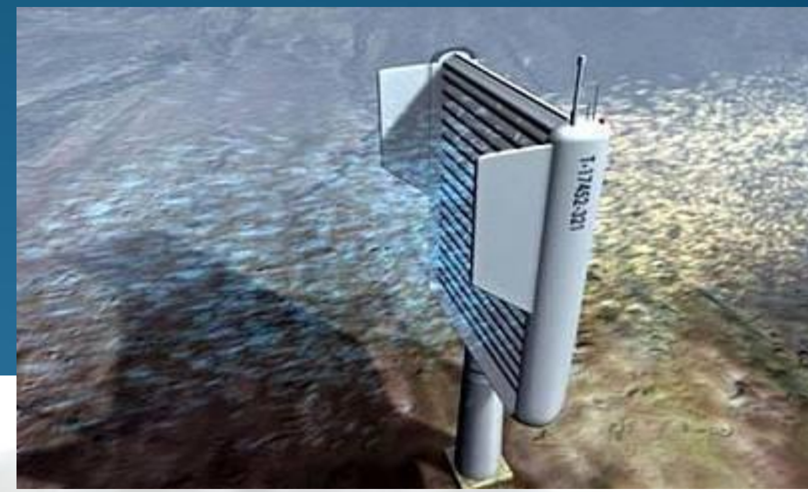


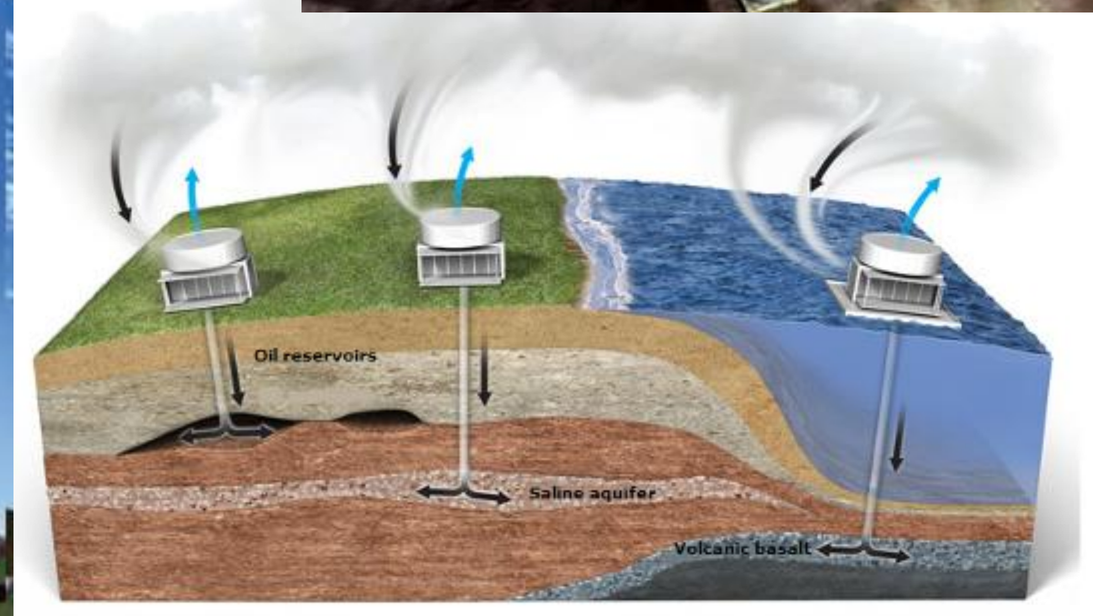
CO_2 – scrubbers!?

How it works?

Wind blows air through plastic filters, which are laced with an absorbing agent that extracts CO_2. The air exits the scrubber with less CO_2. Saturated air filters are rinsed with water vapor in vaccum chambers to remove CO_2. CO_2 is separated from water, pumped to liquid and stored underground.

Klaus Lackner, Columbia University





Eventually, Europe will exploit all of its renewable energy potentials...
But, will this be enough to replace fossil fuels entirely?
If not, what kind of energy will we use? Nuclear power?
Can we hope for breakthroughs in fusion power research?

If we take that 20% of the final energy consumption will be supplied from renewables by 2020, is it reasonable to suppose a 50% renewable share by 2050?

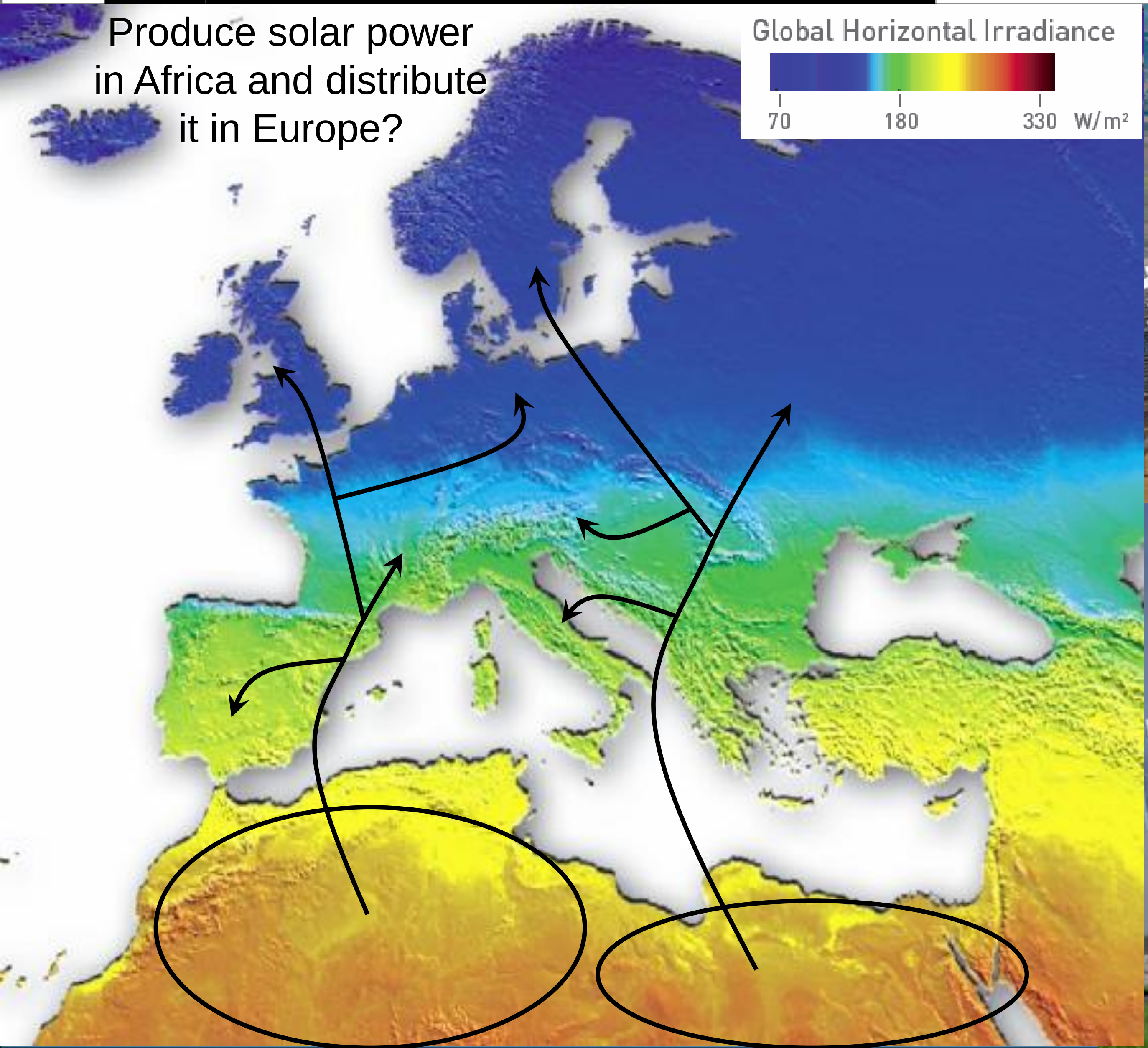
The European Climate Foundation postulates a 80% renewable share, nuclear at 10% and fossil fuels (with extensive use of CCS) at 10% by 2050!
The Greenpeace latest study postulates that renewable energy can cover 92% of the EU's total energy use and 97% of electricity by 2050!?

Towards a 100% renewable energy future

The DESERTEC PROJECT

Clean Power from Deserts for Energy, Water and Climate Security

Produce solar power in Africa and distribute it in Europe?



Desertec Project

DESERTEC PROJECT:
17 000 km^2 of concentrating solar power systems, solar PV systems and wind parks.
High-voltage direct current (HVDC) cables for distribution of electricity in Europe, North Africa and Middle East.
The DESERTEC would supply 15% of Europe's electricity demand.
Estimated cost of the action: €400 billion

Consortium DII GmbH: Munich Re, TREC, Deutsche Bank, Siemens, ABB, E.ON, RWE, Abengoa Solar, Cevital, HSH Nordbank, M & W Zander Holding, MAN Solar Millennium, and Schott Solar.
Interested parties: ENEL, Électricité de France, Red Eléctrica de España, ...

Problem? Generating so much of Europe's electricity in North Africa, a political dependency on northern African countries (which are still unstable, corrupted and lack of cross-border coordination) is being risked.
Problem? Who will be the owner of the project? Europe or North Africa?

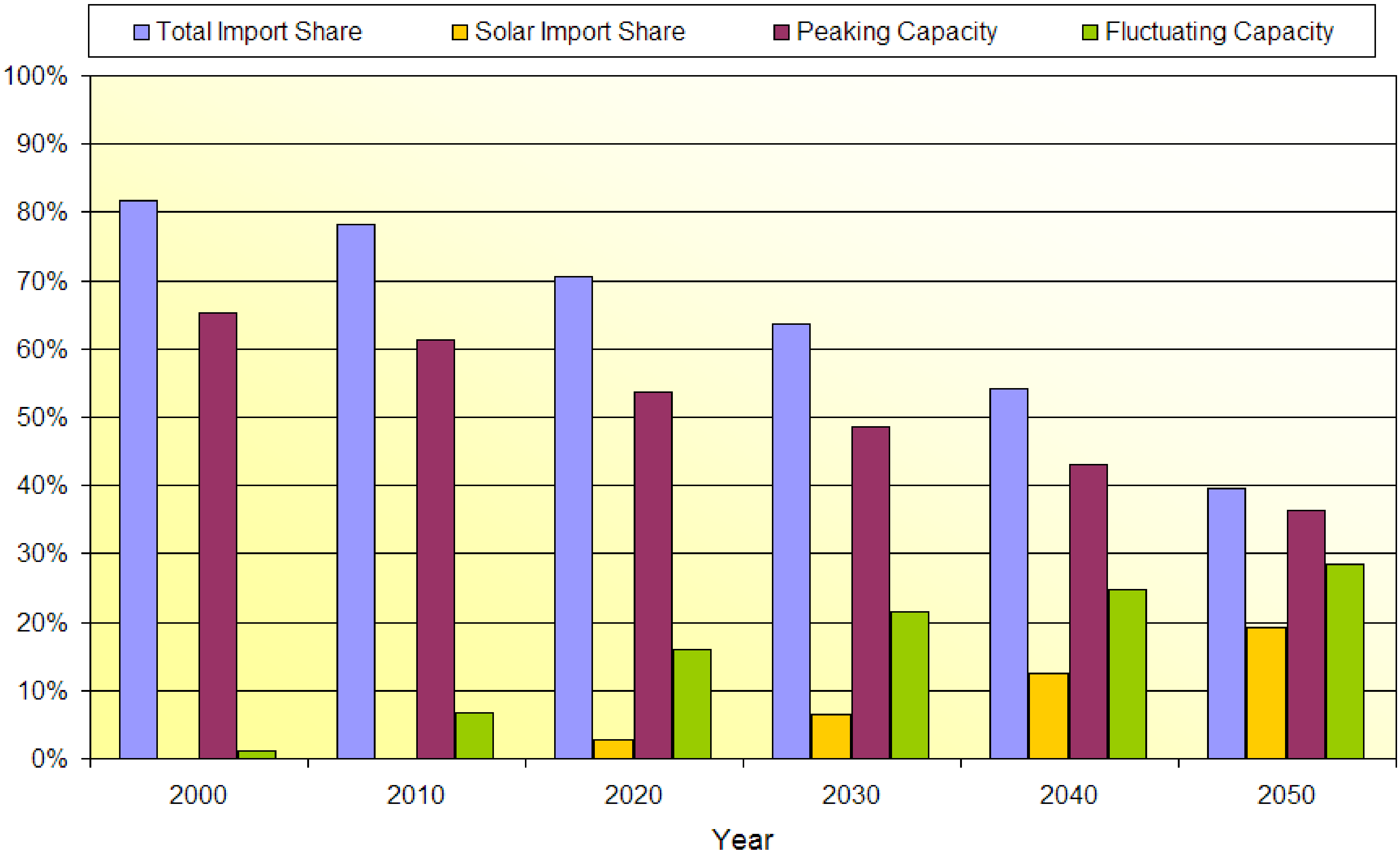
Problem? Cost of cabling, electricity losses, need of a super-smart grid?

The German Aerospace Center (DLR) has carried out studies on DESERTEC.

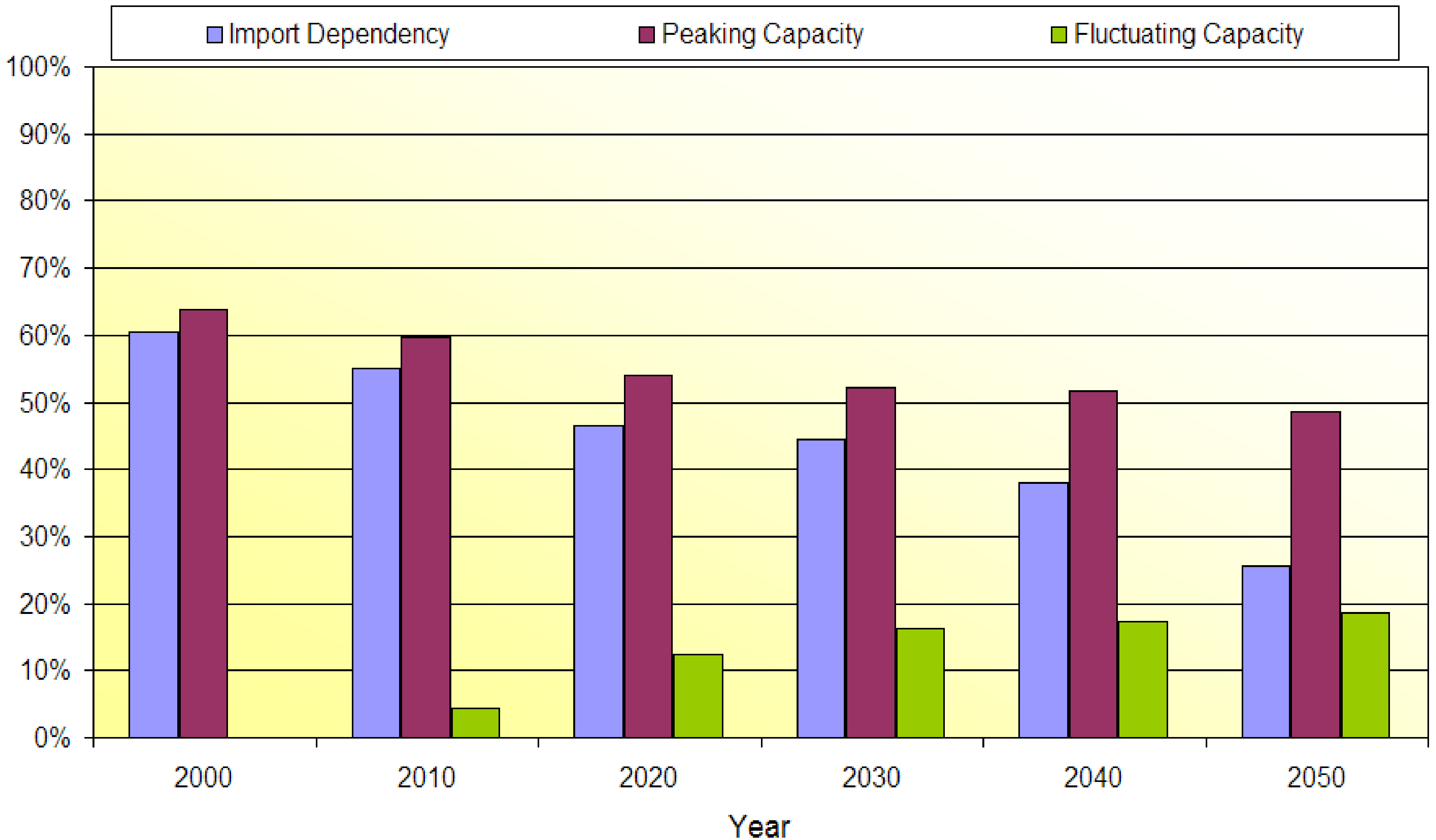
The DESERTEC PROJECT

EXCERPTS from TRANS-CSP study (DLR)

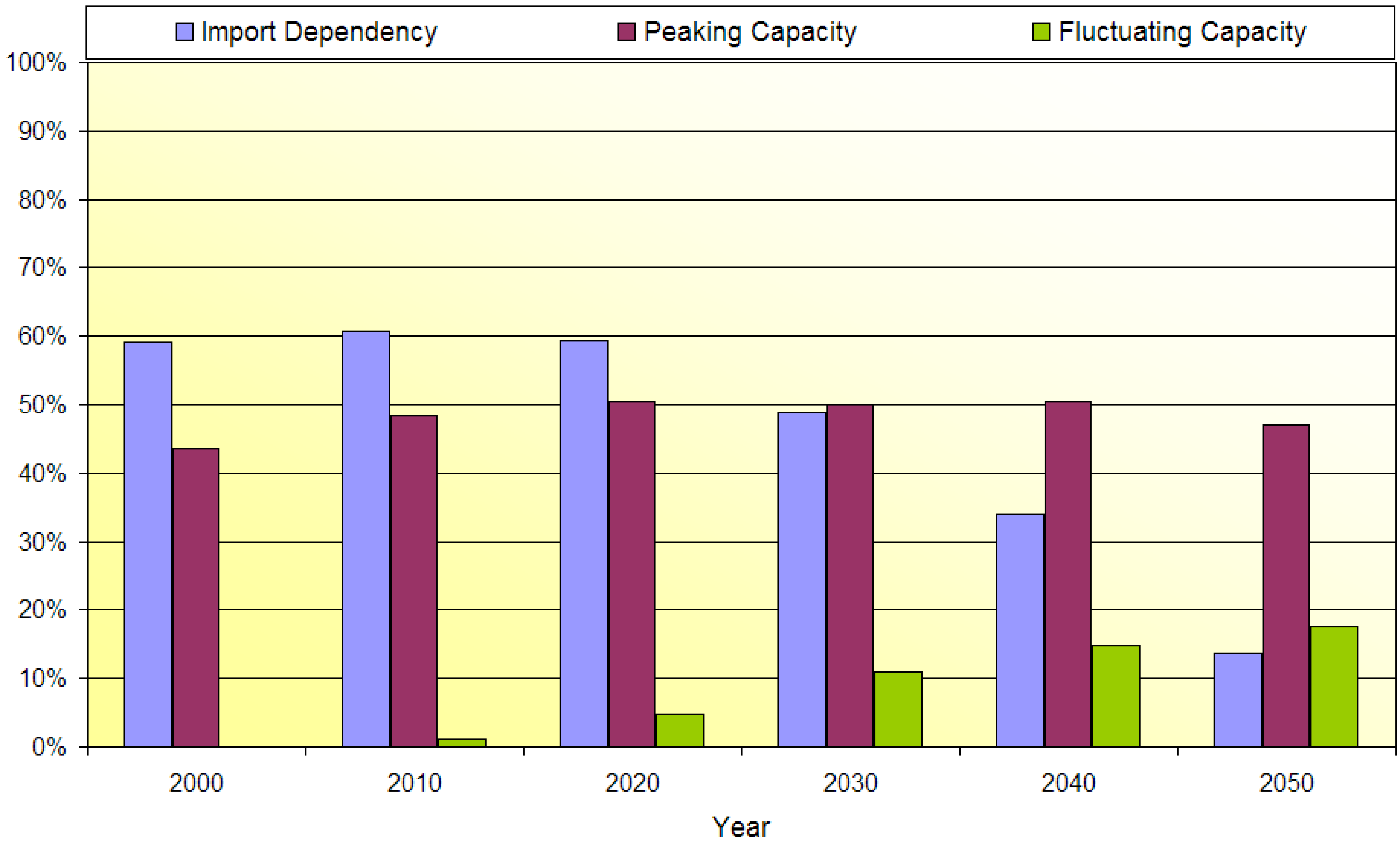
Italy


Total Import Share
Solar Import Share
Peaking Capacity
Fluctuating Capacity
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2000
2010
2020
2030
2040
2050
Year

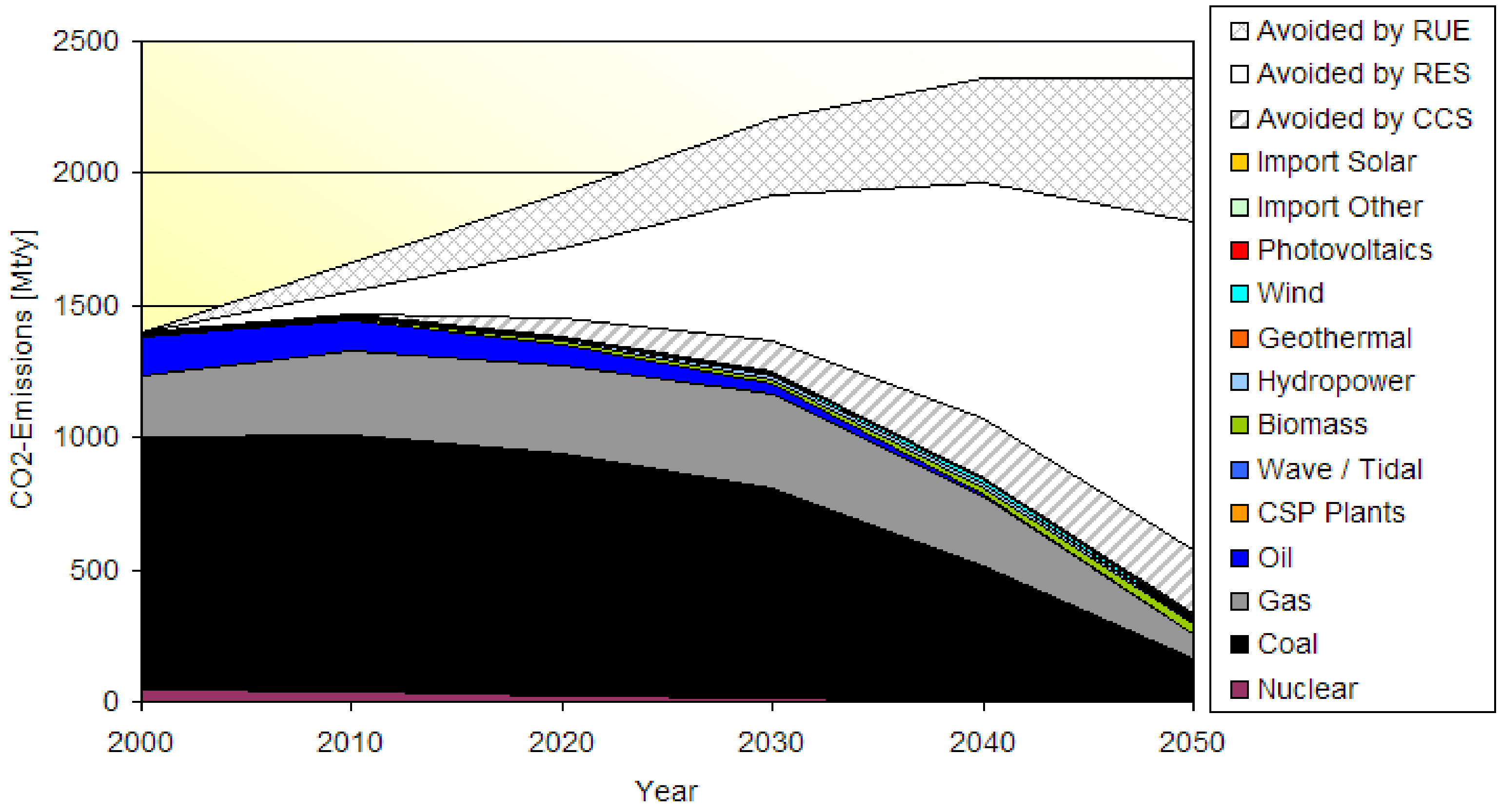
Croatia


Import Dependency
Peaking Capacity
Fluctuating Capacity
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2000
2010
2020
2030
2040
2050
Year

Slovenia


Import Dependency
Peaking Capacity
Fluctuating Capacity
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2000
2010
2020
2030
2040
2050
Year

CO_2 emissions in:
EU27+Turkey, Switzerland, Iceland, Norway, Croatia, Serbia, Montenegro, Bosnia&Herzegovina, Macedonia



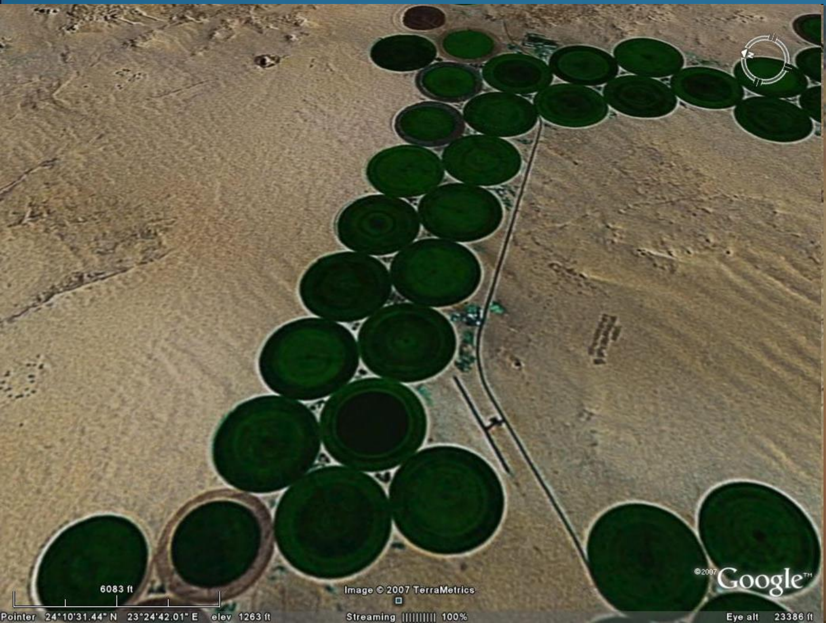
The DESERTEC PROJECT

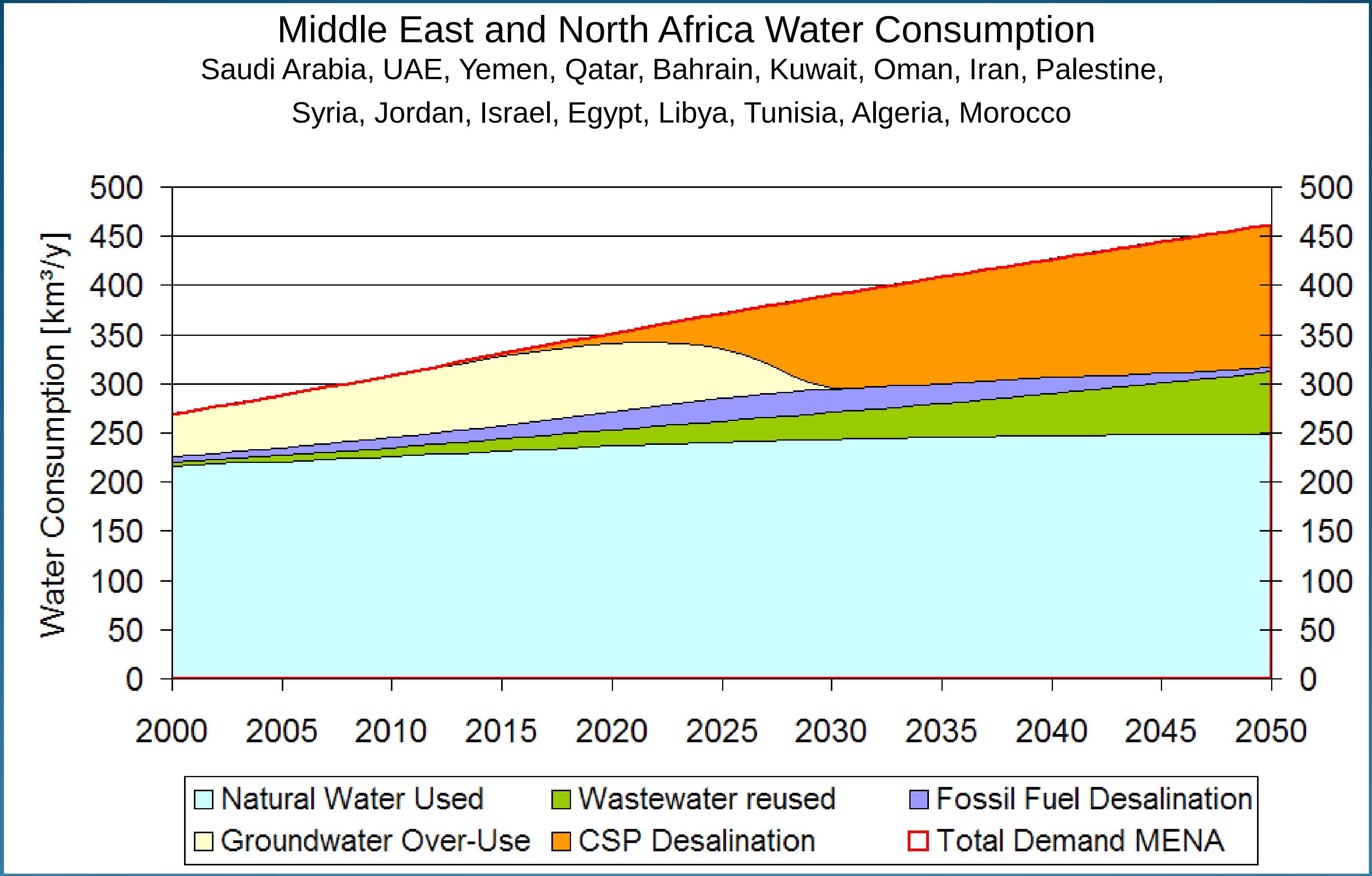
EXCERPTS from AQUA-CSP study (DLR)

The IDEA:

Areas of the deserts in Middle East and North africa could become productive for agriculture when fresh water would become available from the desalination of sea water using the waste heat from CSP plants.

ENERGY+WATER+INCOME = SUSTAINABLE DEVELOPMENT IN ARID REGIONS

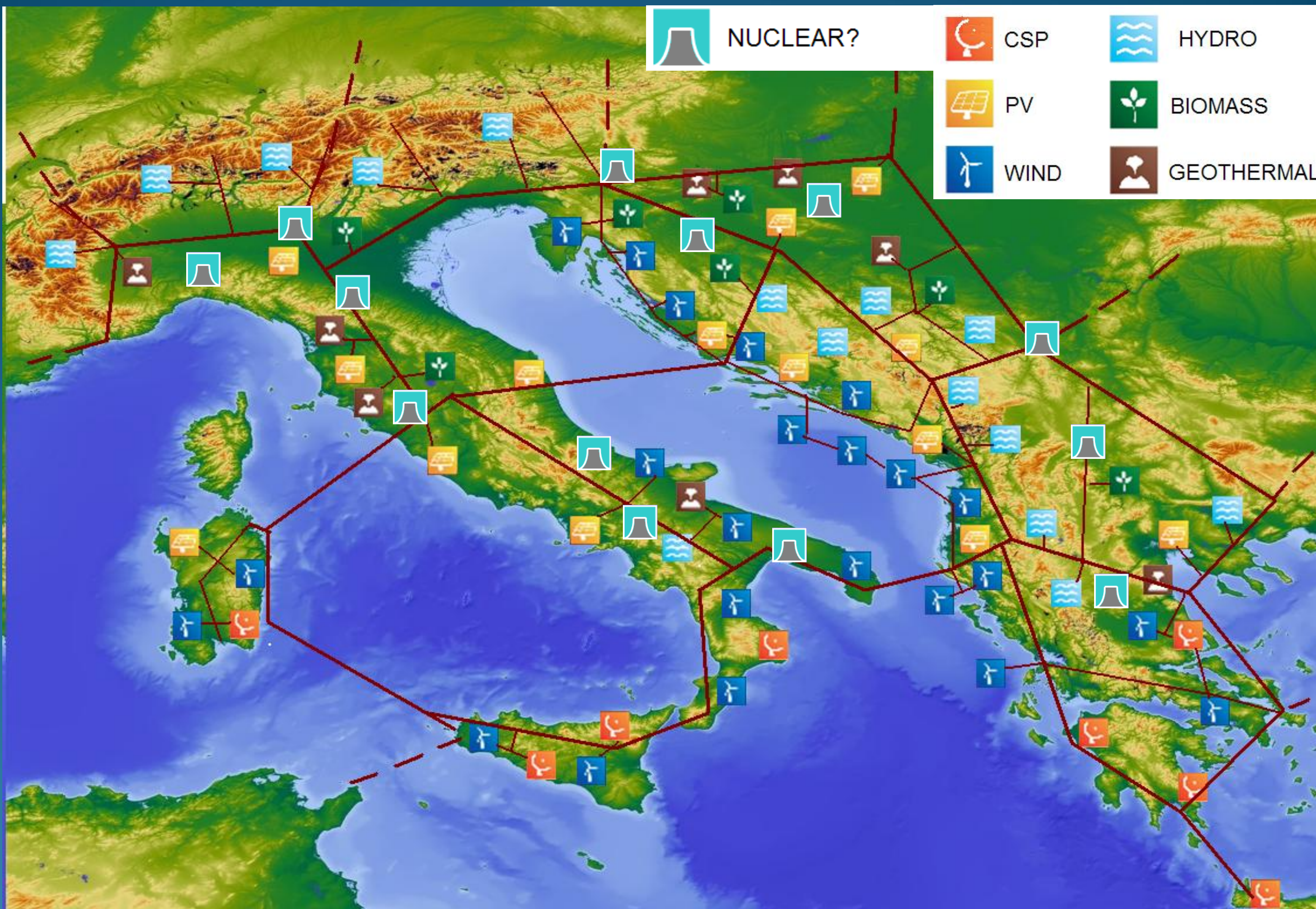



Middle East and North Africa Water Consumption
Saudi Arabia, UAE, Yemen, Qatar, Bahrain, Kuwait, Oman, Iran, Palestine, Syria, Jordan, Israel, Egypt, Libya, Tunisia, Algeria, Morocco
Water Consumption [km³/y]
500
450
400
350
300
250
200
150
100
50
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Natural Water Used
Wastewater reused
Fossil Fuel Desalination
Groundwater Over-Use
CSP Desalination
Total Demand MENA

What if the DESERTEC PROJECT failes?

Should Europe start thinking of smaller, regional energy systems and merge them later on?

Should all the countries of the Adriatic region (South-East Europe) organize themselves to realize an
“ADRIATEC PROJECT”
similar to the North Sea smart grid?


NUCLEAR?
CSP
HYDRO
PV
BIOMASS
WIND
GEOTHERMAL

For gas we already got the South Stream!

NORTH STREAM:
Connection:
Russia-EU (via Baltic sea)
Transport capacity:
55 billion cubic metres/year
Partners:
Gazprom 51%, BASF/Wintershall 20%, E.ON Ruhrgas 20%, Gasunie 9%
Scheduled for operation:
2 Lines. First scheduled for 2011, second for 2012

SOUTH STREAM:
Connection:
Russia-EU (via Black sea)
Transport capacity:
63 billion cubic meters/year
Partners:
Gazprom 50%, ENI 50%
Scheduled for operation:
End of 2015

NABUCCO:
Connection from:
Caspian region, Middle East,Egypt to EU
Transport capacity:
31 billion cubic meters/year
Partners:
BOTAS, BEH, MOL, OMV, RWE, Transgaz. Each 16,67%
Scheduled for operation:
End of 2015

PROJECTED ROUTES OF NORD STREAM, NABUCCO AND SOUTH STREAM PIPELINES

CONCLUSION

A sustainable energy future involving large shares of renewable energy and a low-carbon society would require substantial energy savings through:

- efficiency technologies,
- improved public transport systems,
- shift of freight transport from road to rail,
- hydrogen and electric vehicles,
- smart building design,
- renewable HVAC technologies,
- renewables electricity for industrial processes,
- implementation of supersmart grids,
- phase-out of nuclear and coal power

These challenges will require more of an energy revolution than an evolution! Are we ready for it?

CONCLUSION

The energy future of the countries in the Adriatic region will be strongly interlaced with the energy plans of the EU. However, each country should use its own renewable energy potentials and implement measures to enhance energy efficiency, rational use of energy, sustainable housing and environmental protection as much as possible to reach a stage of sustainable energy.

Thank You!

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