

# COGENERATION OF HEAT & POWER IN S.E. EUROPE

3<sup>rd</sup> South East Europe Energy Dialogue

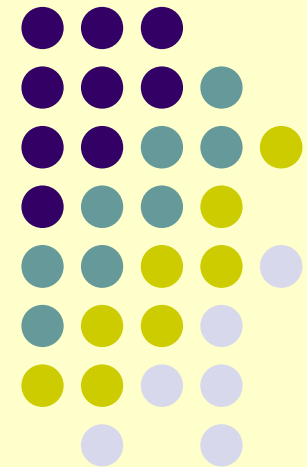
Costas G. Theofylaktos

Member of BoD HACHP

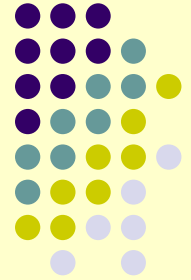
Member Executive Committee COGEN EUROPE



Thessaloniki, June 2009

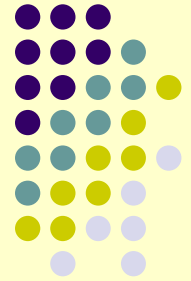


# Data of SE Europe



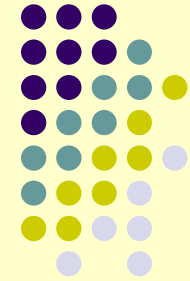
- In SE Europe live 138 million people
- The area is 3 times the size of France
- 11 independent states, where
  - 5 members of EU (1981 and 2004)
  - 2 in negotiation procedures with EU
  - 4 member: Council of Europe and other International Bodies
- Many States in the Region faced turmoil political relations, in the last decades, while political, cultural, financial connections were developed between their inhabitants.

# Natural resources in S.E. Europe



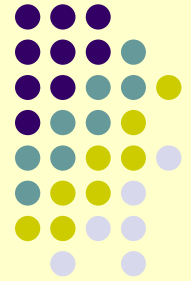
- Rich in oil production (161,000 barrels/day)
- Notable quantities of N.G. (~ 1,00 million Nm<sup>3</sup>/yr)
- Many countries are rich in resources as:
  - coal, lignite
  - bauxite
  - chromites
  - copper
  - iron ore, etc
  - RES (hydro, wind, biomass, solar, geothermal)

# Economic Development in SE Europe



- The GDP Growth rate varies from + 1,3% (min) to + 8,2% (max) before the world economic crisis
- GDP per capita varies from 1730 €/ca (min) to 25,353 €/ca (max)
- Long-term tradition in heavy industries
  - machinery
  - chemical
  - steel, etc, but now facing structural problems
- Heavy industries in many countries is in deteriorating condition, due to political changes, occurred in past decades
- Sustainable Development is in question

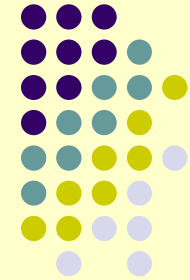
# Energy markets in S.E. Europe



- Monitoring into a new level of development, due to:
  - globalization of energy production
  - Liberalization of energy market
  - Regional Cooperation
  - New technologies

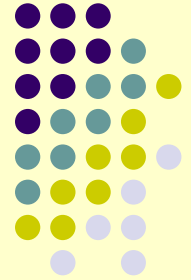


# S.E. Europe Energy Data



	Population millions	GDP/capita \$/capita	Crude Oil		Natural Gas		Coal		Electricity	
			Production	Consumption	Production	Consumption	Production	Consumption	NET Generation	NET Consumption
			1000 barrels/day		Billion Cu Feet		million short tons		billion kWh	
Albania	3,56	4900	5,98	31,8	1	1	0,128	0,143	5,49	3,61
Bosnia & Herzegovina	4,03	6500	0	0	0	0	10,516	10,375	12,84	8,5
Bulgaria	7,8	8200	3,36	124	0	0	31,230	35,609	43,15	30,5
Croatia	4,5	11200	13,67	105	56	96	0	1,886	12,41	15,57
Cyprus	0,73	20300	0	0	0	0	0	0,088	4,37	4,15
Greece	11,04	21300	1	433,39	1	144	71,023	71,22	56,88	55,98
FYR Macedonia	2,05	7100	0	0	0	0	5,556	6,241	6,67	6,78
Romania	21,71	7700	95,4	219	441	660	39,14	45,46	59,28	48,43
Serbia & Montenegro**	10,83	2400	0	97	7	83	39,341	40,786	34,84	28,31
Slovenia	2	19600	0,01	61	0	39	5,029	5,79	14,22	13,4
Turkey	69,66	7400	41,58	675,95	32	1292	79,913	104,731	167,94	141,46
<b>Total</b>	<b>137,91</b>		<b>161</b>				<b>281,876</b>	<b>322,329</b>	<b>418,09</b>	<b>356,69</b>
<b>World</b>			<b>73006</b>	<b>85897</b>	<b>103977</b>	<b>104425</b>	<b>6779</b>	<b>6737</b>	<b>18015</b>	<b>16379</b>
							4,16	4,78	2,32	2,18

# Fossil Fuels



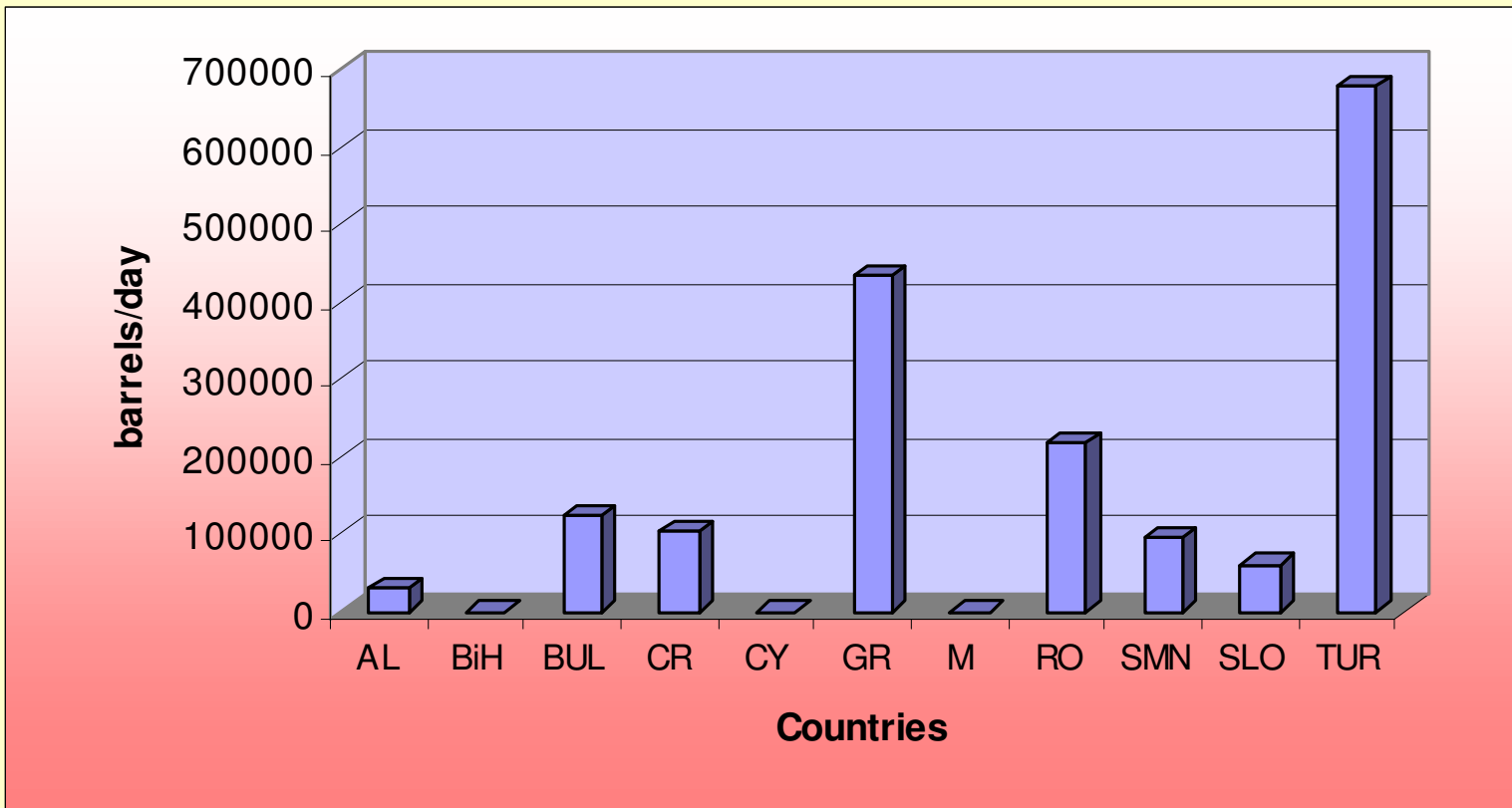
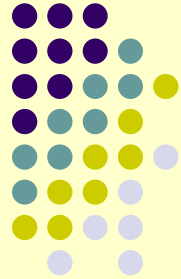
Mainly coal and lignite, in large quantities in reserves

(i.e. Albania - 300 yrs, consumption of 80s, as Kosovo)

- low calorific value,
- high in ash content

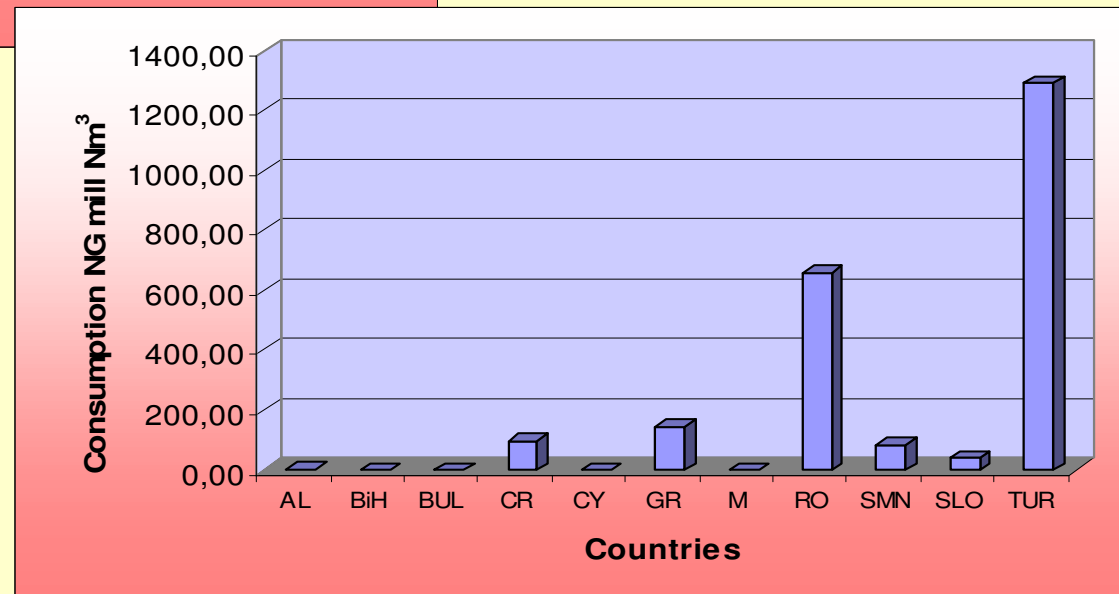
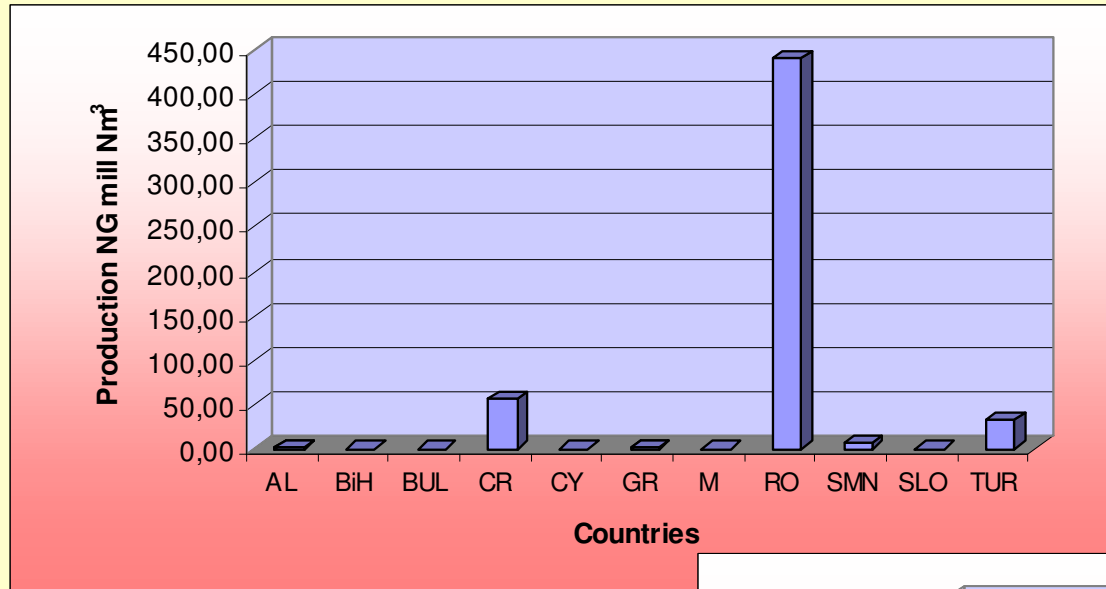
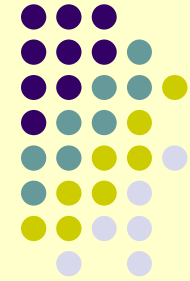
Severe Environmental impact

# Oil consumption per country

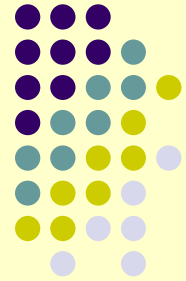




# Production/Consumption of Natural Gas

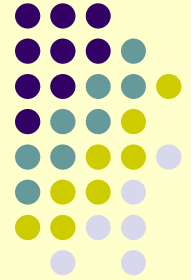


# Electricity Market in the Region



- The growth of electricity consumption has slowed down, due to the economic stagnation in many transition economies in the Region. i.e.
  - in Bulgaria, electricity consumption has been decreasing at an annual rate of 2,3%.
  - in Romania electric market has been shrinking at an annual average annual rate of 5 - 7% until 2005 and now at 2,4% (2007).

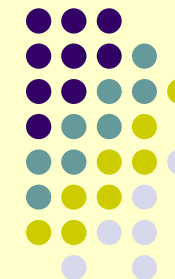
# Electricity Market in the Region



On the other hand, during the last years:

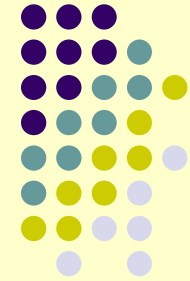
- In Cyprus, the annual increase of electricity production is about 5,7%, highest in EU,
- in FYR of Macedonia, electric demand has been growing constantly at 4% per annum,
- in Turkey, the Turkish industry is expanding fast and the electricity consumption is increasing at high rates,
- as the Greek SME industrial and service sectors are growing fast, this is leading to an increased average annual rate of 3,3% of the electric market.

# Electricity data of SE Europe

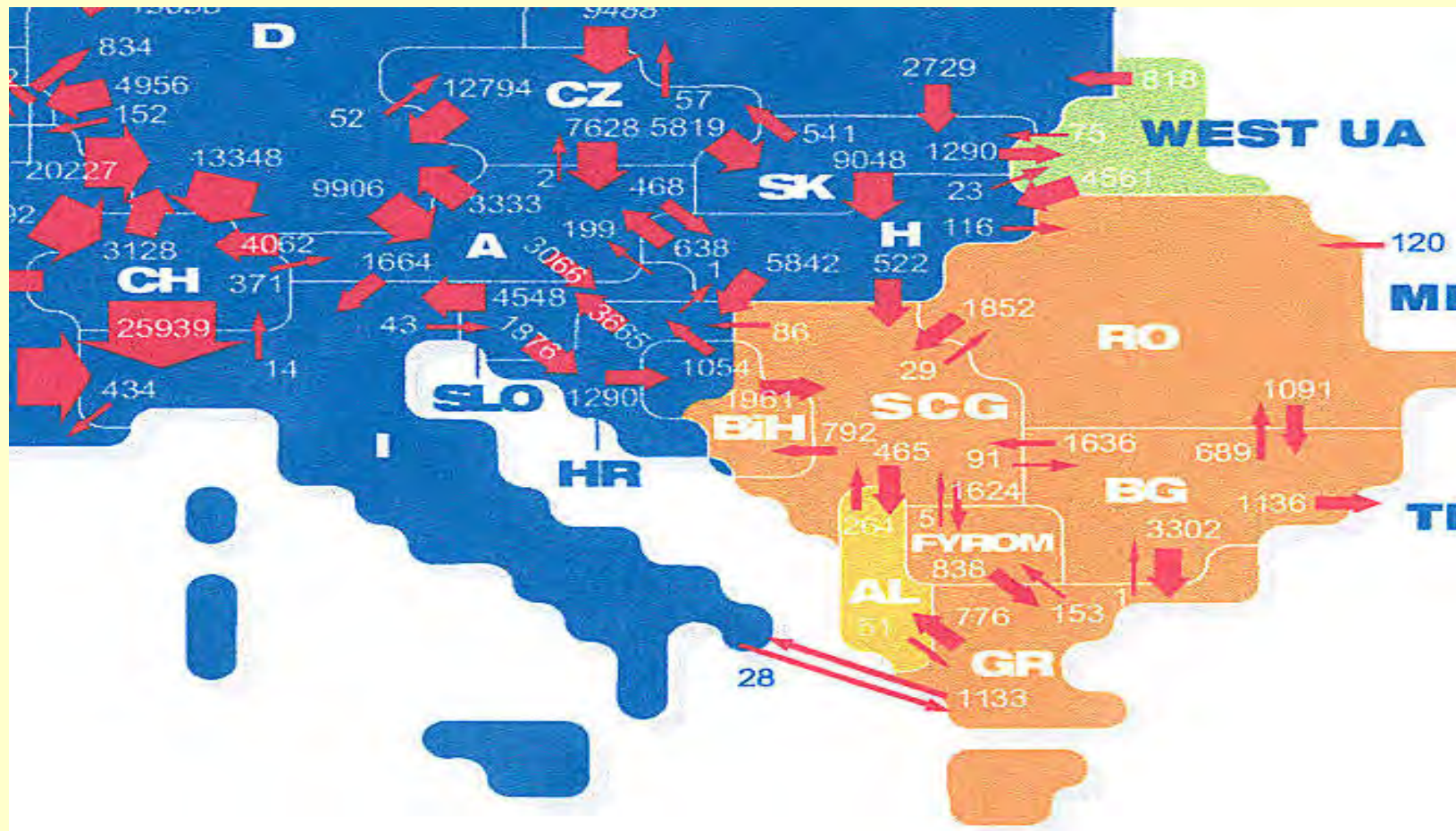


COUNTRY	ELECTR. EXPORT million kWh	NET ELECTRICITY CONSUMPTION billion kWh	NET ELECTRICITY PRODUCTION billion kWh
AL	<b>100</b>	3,61	5,49
BiH	<b>3288</b>	8,5	12,84
BUL	<b>8300</b>	30,5	43,15
CR	<b>406</b>	15,57	12,41
CY	<b>0</b>	4,15	4,37
GR	<b>1100</b>	55,98	56,88
M	<b>0</b>	6,78	6,67
RO	<b>3046</b>	48,43	59,28
SMN	<b>400</b>	28,31	34,84
SLO	<b>7448</b>	13,4	14,22
TUR	<b>433</b>	141,46	167,94
	<b>24521</b>	356,69	418,09

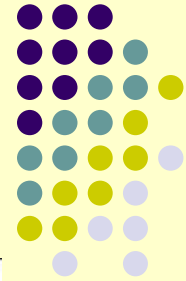
# Regional Cooperation in Energy issues



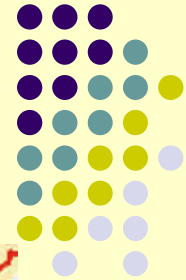
- Electricity interconnection



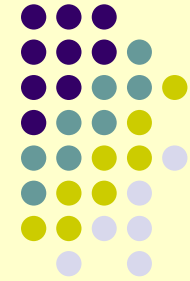
# Oil Interconnections



# Natural Gas networks



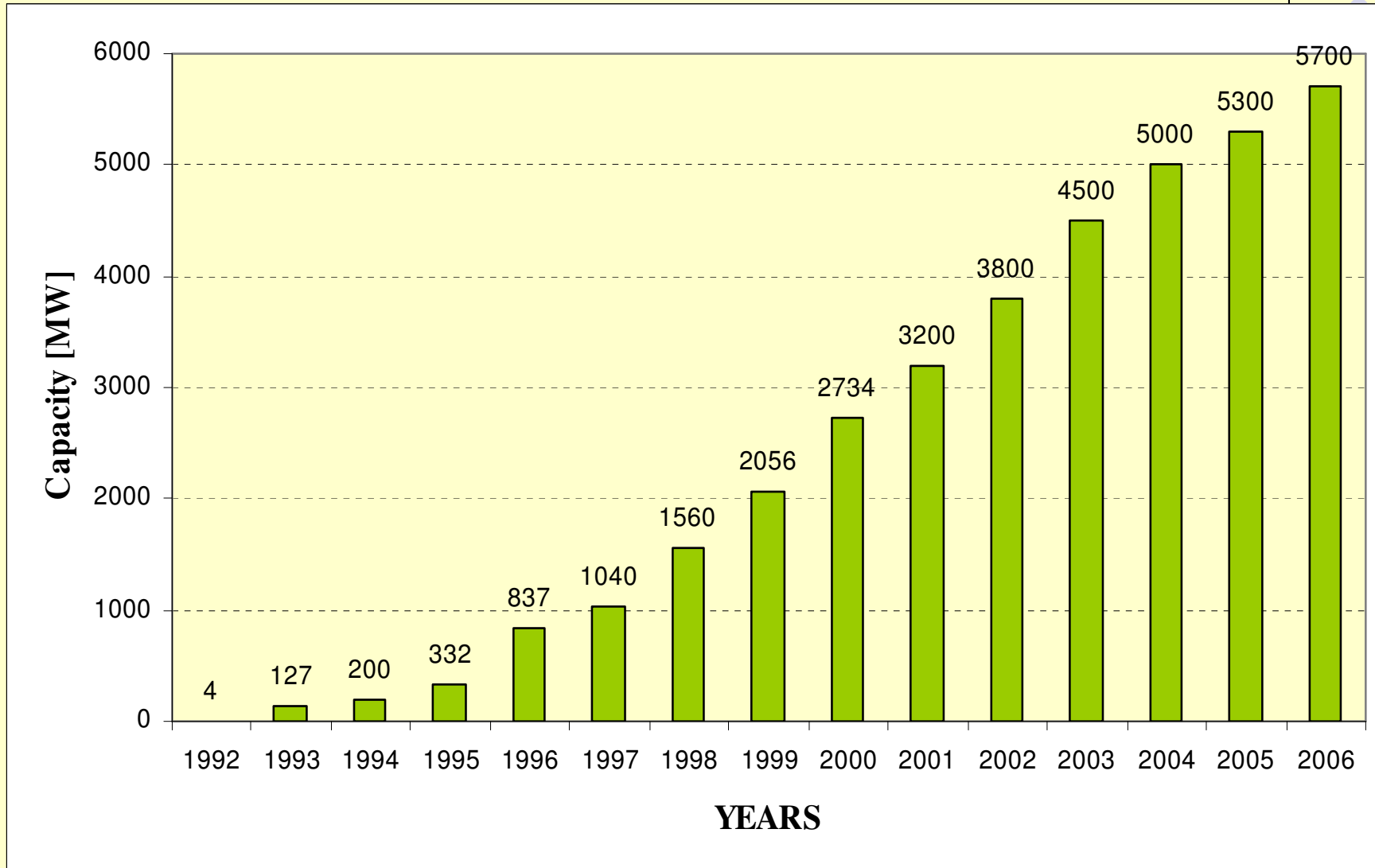
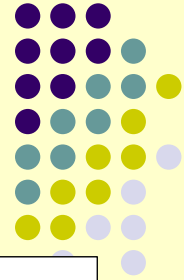
# CHP in SE Europe



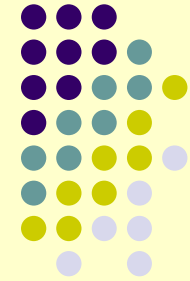
- In countries with planned economy, CHP systems were developed in accordance with DH systems and for industrial purposes
- After political changes in 90s, industrial production was severely reduced and DH systems were ruined.
- In other countries (i.e. Turkey), the increase of CHP installations was remarkable (4 MW<sub>e</sub> in 1994, 4500 MW<sub>e</sub> in 2003; 5700 MW<sub>e</sub> in 2006; an increase of 1125%)
- In other countries (i.e. Greece) the penetration of CHP was limited, due to monopoly of the electricity company and other barriers
- In some countries (i.e. Serbia) CHP was strong few years ago, but now is struggling to start again
- Little penetration of CHP in tertiary sector in all countries.



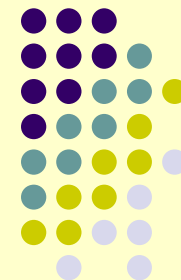
# CHP Growth in Turkey



# Legal framework on CHP in SE Europe



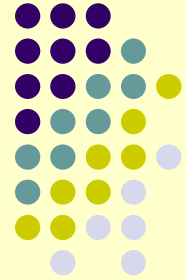
- Many of SE European countries are complying with EU CHP Directive 2004/8/EC
  - Croatia,
  - Serbia
  - Turkey,
  - Bulgaria,
  - Romania,
  - Slovenia,
  - Cyprus,
  - Greece.



# **Case Study: Cogeneration of Heat and Power in Turkey**

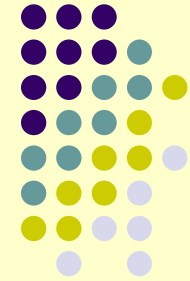
Based on the presentation of Mr Ozkan Agis, President of Turkish Cogen  
Association

# CHP in Turkey



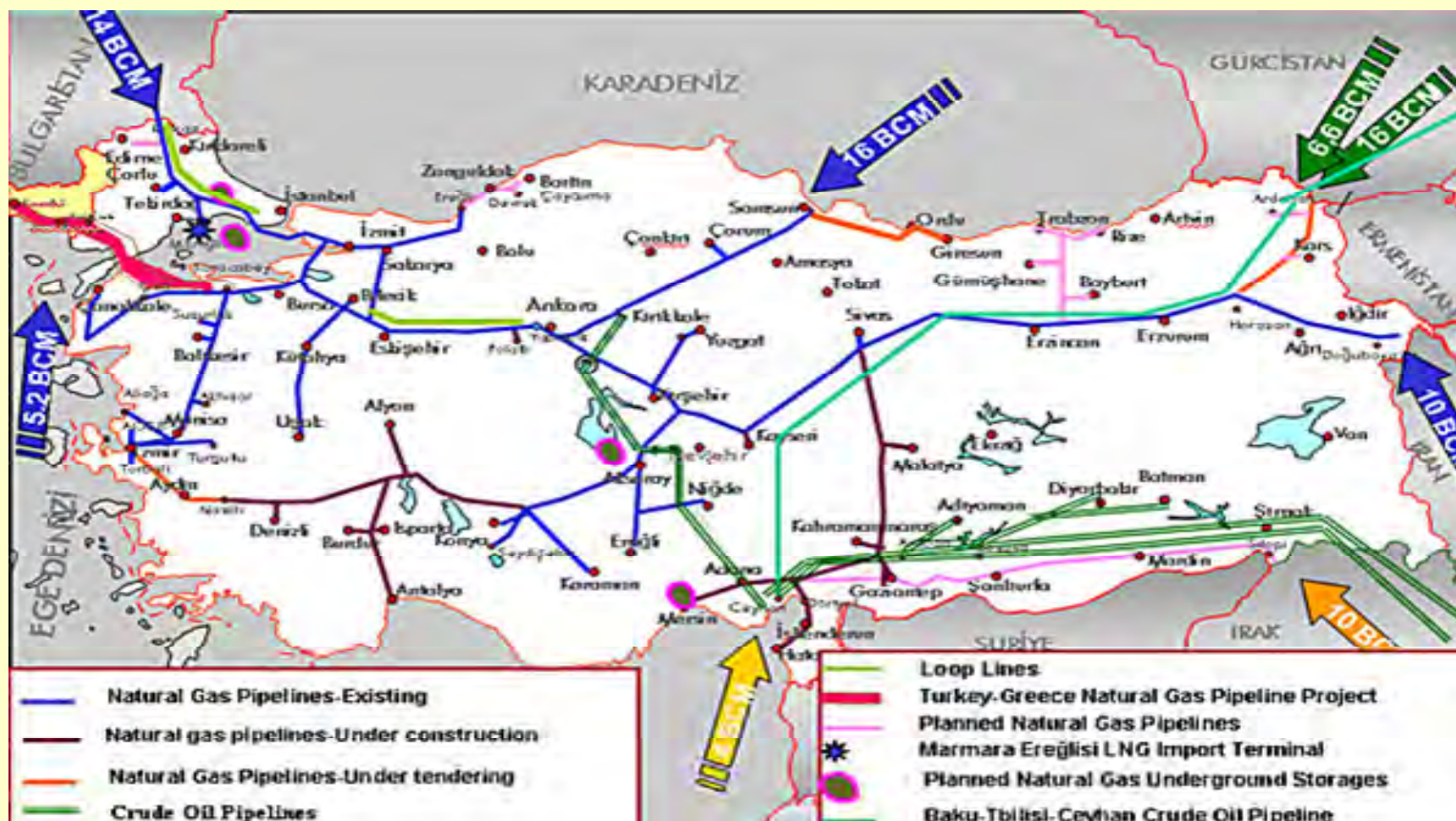
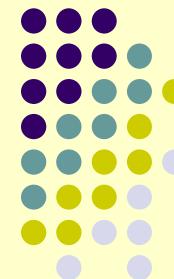
- In 90s, there were shortages and fluctuations in frequency and voltage of electricity, in Turkey.
- With the frequent electricity blackouts added to the above mentioned problems, the industrial consumers had to build and operate their own plants in order to produce high quality electricity.
- Since so many years, industrial consumers were purchasing their electricity from TEK, which is a public enterprise and generating heat from separate boilers.
- Therefore, in early 90s, Industrial Cogeneration started to be implemented in Turkey.

# There are other reasons for decentralised production?

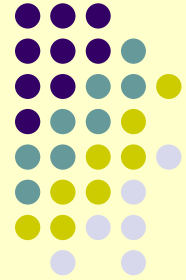


- Although there are rich lignite reserves and hydro potential in Eastern Turkey, these only meet 25% of the need, Turkey has to import the rest 75%.
- In other words Turkey has to import 83 million tones of energy sources, out of the 110 million ton, which is the whole demand. Since such a great amount of energy is imported from outside, it is wise to direct it to the Marmara and Aegean region, where the energy consumption is high, for energy savings by consuming energy where it's being produced.
- This is inevitability directing to Decentralized Energy Systems.

Turkey started to import natural gas from Russia in 1987 for the first time via the Trans Balkan route and the first decentralized energy plant has been deployed in Hamitabat Power Plant near the Bulgarian border.

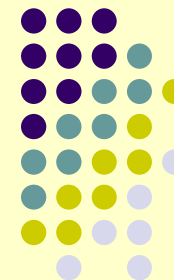


# CHP in Turkey



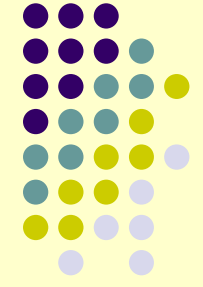
- As seen from the map, natural gas has been transported to places like Istanbul, Izmir, Bursa and Eskisehir, which are densely populated areas and the energy consumption high, from Hamitabat power plant, and caused to the establishment of approx. 200 Cogeneration Plants.
- The capacity of decentralized energy in Turkey increased by 100 times, to 5700 MW in 2006, starting from 1992, due to the advantages that the natural gas provide to the cogeneration plants, with its high efficiency and short payback duration.
- The number of these plants will reached up to 300 by 2009, meaning that, the average plant capacity has become 20 MW.

## Why the developments in cogeneration is slowing down?

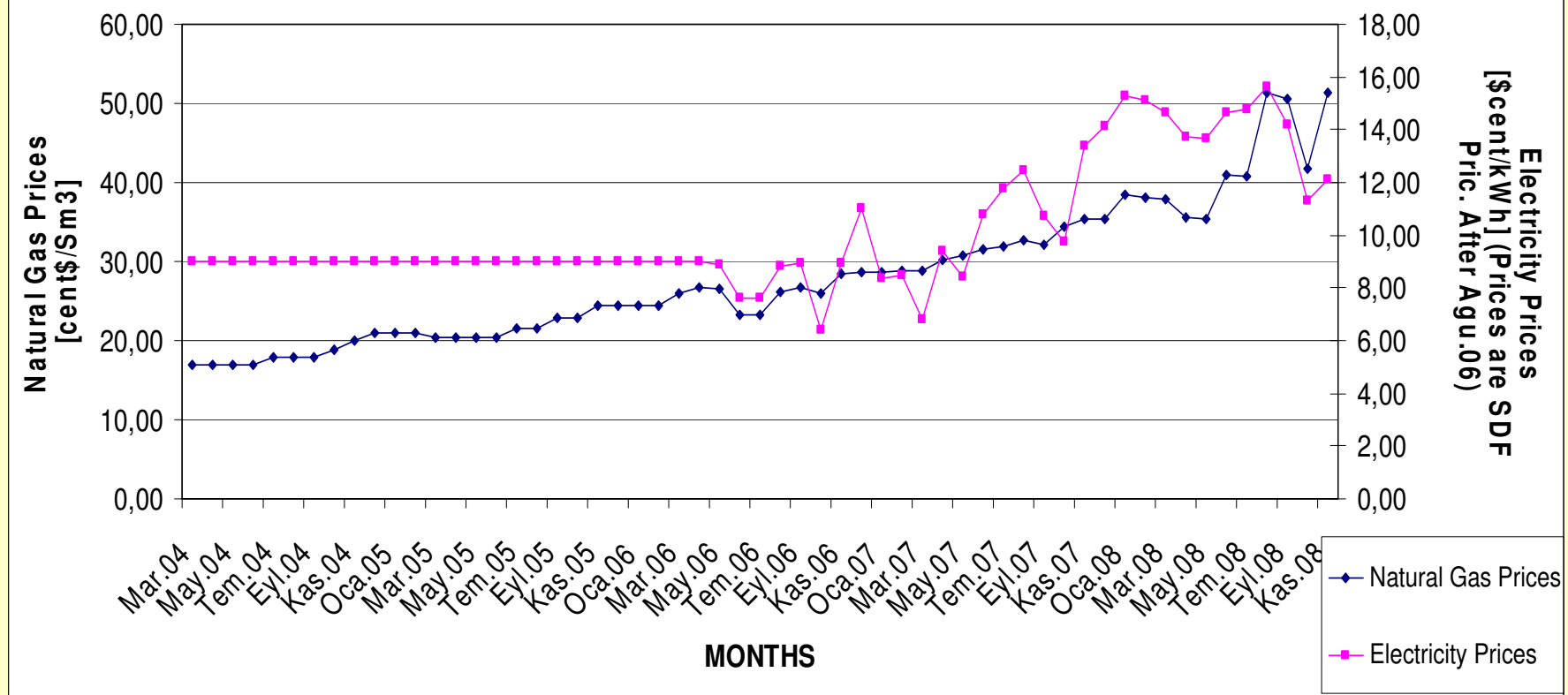


- From 1994 to 2004 there was a rather rapid development in cogeneration. However after the year 2004, natural gas prices were increased. The price rises in natural gas, caused an increase in the electricity production cost and a decrease in profitability of electricity sales.
- Under these circumstances, some cogeneration plants sized down their electricity generation to only meet their own need in the factories.
- This situation created shortages in electricity in Turkey. In August 1st 2006, the government deployed a new regulation to operate the Liberal Electric Market and thus free electricity market started operating.
- Today, as a result, there are 2 prices in the sector: One is the official price from TEDAŞ ( 11.0 US cent/kwh) and the other is the prices melted down in the pot of free market for day, night and peak hours.

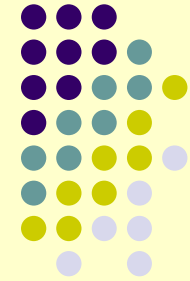




### NATURAL GAS AND ELECTRICITY PRICES (ELECTRICITY PRICES ARE SDF PRICES AFTER AGU. 06)



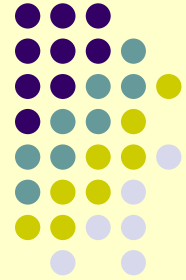
# CHP in Turkey



From the correlation between the natural gas prices and the electricity prices in Turkey it can be seen that:

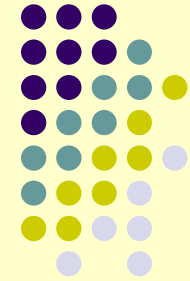
- Gas prices have increased sky high; however the electricity prices stayed almost stable.
- As a result of lobby pressure, the price of electricity has been increased by 22%, where as that of the natural gas has been decreased by 17% in first step and 26% in the second step.

# CHP in Turkey



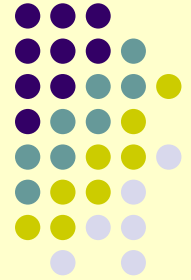
- As far as cogeneration capacity is concerned , by the end of year 2008, it has been recorded that there is 6605 MW total installed capacity in cogeneration sector. This figure corresponds to 15% of Turkey's total capacity, which is 41748 MW.
- In terms of electricity production, the share of CHP plants has been 36353 GWh the total of 198329 GWh in Turkey by the year 2008. (18.3 %); this performance has been reached despite the high gas prices and the global crisis.
- Despite high price of natural gas, (26.0 US cent / m<sup>3</sup>), the Türkiye Cogen believes that, the share of CHP production in total, will have a steady increase of 0.5% per year and its share in total is estimated to reach to 24% in 2015.

## Other obstacles slowing down the cogeneration development



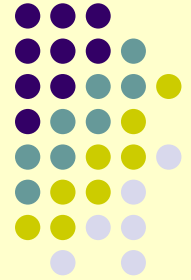
- The obstacles for the development of cogeneration systems are :
  - The reluctance of TEDAS (Electricity Distribution Authority) to facilitate Cogeneration plants to connect to the grid
  - The slow progress in the legislative operations, which regulate implementation of residential cogeneration
  - High taxes and funds on natural gas and other fuels used for cogeneration plants.
  - Wind power developments.

# Micro cogeneration



- Thanks to the intensive follow up of Türkiye Cogen Association the micro-cogeneration has been a part of the Energy Efficiency law numbered 5627, which has passed in the year 2007.
- This law came into force on 02 May 2007 and is almost similar to EU Energy Saving Directive.

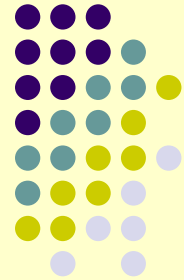
# CHP in SE Europe



In general

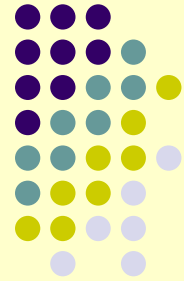
- Existing 'know-how' in CHP installations
- CHP is used mainly for industrial purposes
- The majority of CHP systems are steam/gas turbines
- in many countries of the region CHP systems are strongly connected with District Heating, but
- many of them need rehabilitation and therefore financial assistance
- Operation of DH systems in Greece creates a remarkable expertise (technical, maintenance)
- No trigeneration applications

# Proposals



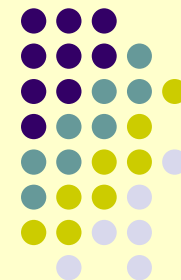
- In the 21<sup>st</sup> century cooperation in Energy between SE European countries should become more real.
- Distribution networks, N.G. and oil pipelines - planned and/or under construction - show the way.
- Promotion of Decentralised Tri-generation Units Used for the Operation of DHC Systems in the Region.
- Cogeneration of Heat/Cool and Power is a field where cooperation and common actions should take place, benefiting the Environment, the Economy of the Region and improving the living standards of the inhabitants with continuous energy supply, better quality, primary energy sources conservation.

# Steps for promoting cogeneration in SE Europe



- Procedures of grid connection, technical, engineering and construction in general
- Procedures and feed-in-tariffs for the CHP
- Defined purchasing price for surplus of cogenerated electricity
- Recognize potential contribution to emissions reductions
- Better tariffs for power delivered to grid and natural gas
- Set national target of CHP production
- Capacity building for CHP consulting and designers
- Informing and educating potential users
- Fiscal and other initial measures (role of ESCOs, TPF, EU Programmes)





THANK YOU FOR YOUR ATTENTION!

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[www.cogen.org](http://www.cogen.org)