Energy System Outlook to 2030 for South-East Europe

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PRIMES Model

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PRIMES-based Outlook

- Comprehensive energy-economy-emissions scenarios for all countries of the South East Europe
- The projections concern all demand sectors, power generation, energy supply and trade and energy prices
- Various scenarios explore uncertainties about
  - Future policies and targets for Renewables
  - Measures promoting energy efficiency
  - Constraints and ETS for emissions of CO_2
- Projections are available until 2030, by 5-year steps
- Data updated reflecting the crisis and beginning of recovery

Long term Projection of economic growth

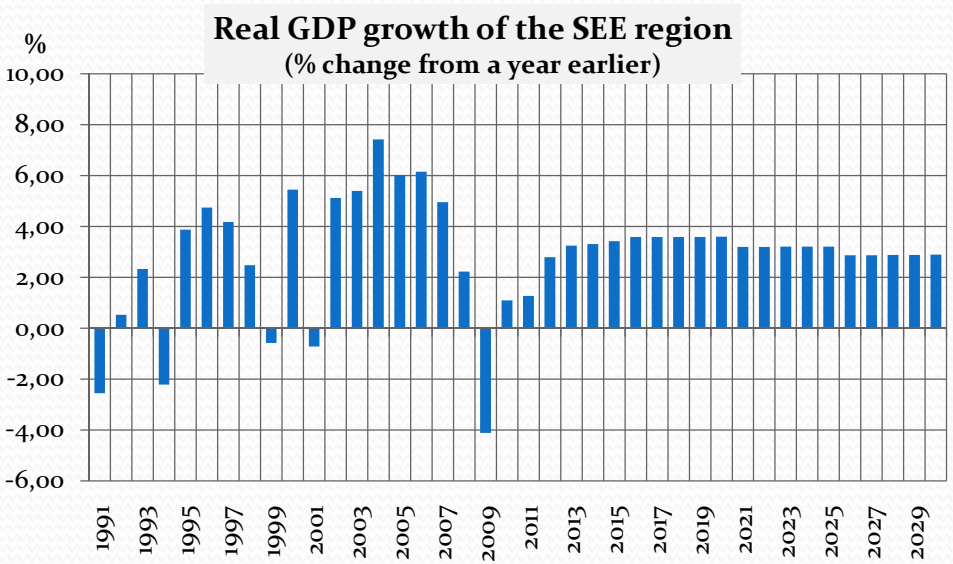
The SEE region experienced high economic growth in the first decade of the 21st century

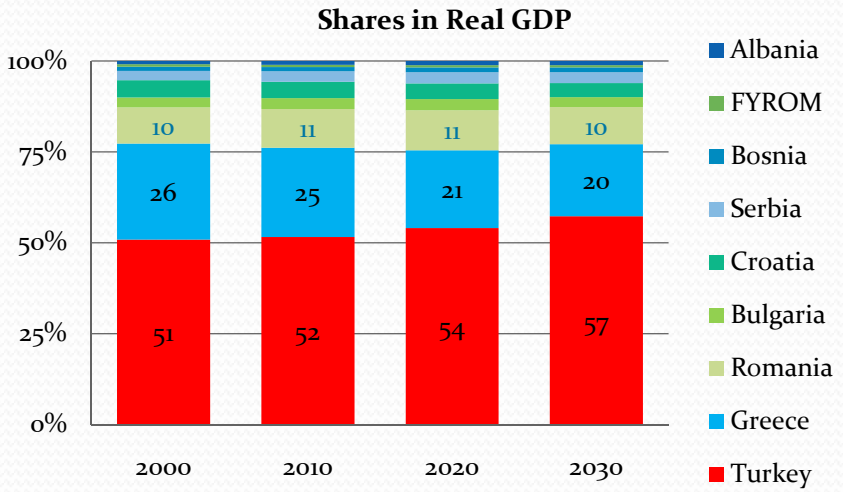
Slowdown and depression trends caused by the global crisis will be reversed starting from 2011-12

The projection shows growth rates between 4.5 and 5% per year during the recovery period 2012-2020, except for Greece

A slowdown of the growth pace is projected for the period 2020 to 2030. The reasons are:

- Poor demographic developments in some countries, mainly in countries members of the EU
- Fierce global competition from emerging economies
- Long-term growth of the EU not exceeding 2% per year

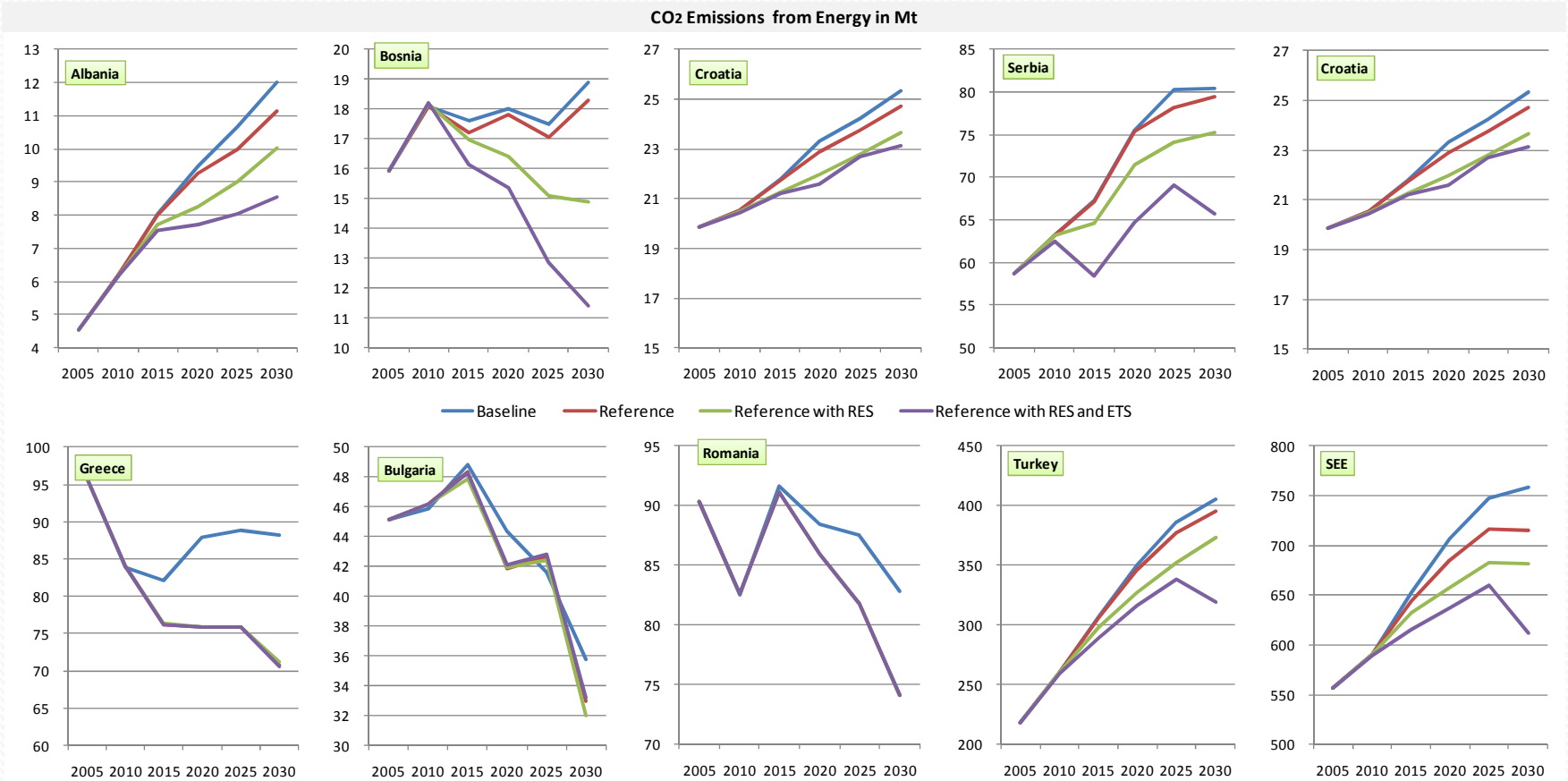




The Reference Scenario

- The Reference scenario analyses the impacts from full implementation of the EU legislative package for ETS, renewables and energy efficiency.
- The scenario assumes that this legislation (both RES and ETS) do not apply to the non EU countries of the SEE
- As strong parallel policies develop, the EU-ETS carbon prices stay at lower levels than in Baseline, namely at 17 EUR'08/tCO2 in 2020 and 36 EUR'08/tCO2 in 2030
- Two alternative Reference scenarios explore
  - What if Renewables policies also apply to non EU countries
  - What if also EU ETS applies to the non EU countries of SEE

Implications on CO_2 Emissions



Implications on CO_2 Emissions

- The policies involved in the Reference scenario variants succeed curbing CO2 emissions in the SEE region; the reduction from Baseline ranges between 3 and 10% in 2020 and between 6 and 19% in 2030.
- Applying the EU RES policies in all SEE countries imply emission reduction of 7% in 2020 and 10% in 2030; applying in addition the EU ETS delivers more reduction: 10% from baseline in 2020 and 19% in 2030.
- The Reference scenario which applies the EU 20-20-20 policies only on the EU members of the SEE has smaller impacts on emissions in the SEE taken as a whole; although not applying additional policies in the non EU countries, the Reference scenario shows some emission reduction in these countries as well.
- It is worth noting that even the Reference scenario with RES and ETS does not succeed to reduce emissions from 2005 levels in the SEE region, the results showing that emissions still increase by 10% in 2020 relative to 2005 and remain at that higher level until 2030.

Impacts on the SEE

RES as % of Gross Demand is 15% in Reference and increases to 18-19% if RES and ETS policies were applied to all SEE countries. Untapped possibilities exist for wind, solar, hydro and biofuels with incremental investment amounts of 30 billion EUR'08 in the period 2011-2030

Average SEE Electricity prices increase only after 2020 and especially for households and tertiary, the industrial prices being less influenced.

The participation of the entire SEE region in the EU ETS has dramatic effects on solid fuels generation, with gas-based generation reducing much.

The auction payments for the carbon allowances drive electricity prices upwards: 7% up in 2020 and 14% up in 2030 from Baseline levels.

The Reference with RES and ETS scenario requires 63 billion EUR'08 more than in Baseline for the period 2011-2030 for energy investment.

SEE	Baseline		Reference		Ref. with RES		Ref. RES and ETS	
	2020	2030	2020	2030	2020	2030	2020	2030
			% changes from Baseline					
CO2 Emissions (Mt CO2)	706.3	758.3	-3.1	-5.7	-6.9	-10.1	-9.8	-19.3
Total primary energy (ktoe)	280,865	320,952	-1.3	-3.0	-2.5	-5.0	-4.0	-6.7
Total final energy (ktoe)	198,506	231,681	-1.1	-3.0	-0.9	-2.7	-1.5	-3.5
Final Electricity Demand (GWh)	481,987	606,220	-0.6	-0.2	-6.1	-6.4	-8.3	-8.9
Total demand for Solids (ktoe)	69,536	65,904	-2.5	-9.3	-7.0	-15.5	-15.1	-33.3
Total demand for Oil (ktoe)	91,461	100,863	-2.2	-2.9	-2.6	-3.4	-2.9	-4.6
Total demand for Gas (ktoe)	80,249	99,648	-4.6	-5.1	-11.7	-12.1	-9.6	-10.3
Total Renewables (ktoe)	29,475	33,579	12.4	13.1	31.9	39.7	32.5	42.0
Total Nuclear Fuel (ktoe)	9,801	20,508	0.0	0.0	0.0	-18.0	0.0	5.5
	(values)							
RES as % Gross Demand	13.6	12.9	15.4	14.8	18.2	18.6	18.5	19.0
Net Imports of Electricity (GWh)	3,992	5,237	3,992	5,237	3,992	5,237	3,992	5,237
Structure of Power generation	%		%		%		%	
Nuclear	6.6	11.6	6.7	11.7	7.1	10.1	7.3	13.5
Solids	31.8	26.7	31.0	23.5	30.9	22.5	28.0	16.6
Gas	34.0	35.1	32.6	35.4	29.1	31.6	31.1	32.8
Oil	1.4	0.7	1.4	0.7	1.4	0.7	1.4	0.7
Hydro	20.1	17.6	20.2	17.6	21.5	18.8	22.0	19.4
Wind	4.2	5.2	5.8	7.2	6.7	8.5	6.9	8.9
Biomass	0.9	1.4	1.3	2.1	2.2	3.6	2.2	3.8
Solar etc.	0.9	1.8	1.0	1.8	1.2	4.1	1.2	4.3
Carbon intensity (tCO2/MWh)	0.42	0.35	0.41	0.32	0.39	0.30	0.37	0.22
Pre-tax Electricity Prices (€'08/MWh)	(values)							
Average	99.7	104.2	98.4	103.7	99.6	108.1	107.1	119.8
Energy intensive industries	74.4	73.9	71.9	72.4	70.8	71.8	78.3	80.2
Other industries	95.9	98.7	94.5	98.0	95.5	101.7	104.5	113.7
Households	104.0	112.1	103.1	112.0	106.1	118.2	113.5	131.7
Services	114.0	115.0	113.3	114.1	117.3	122.0	125.2	134.8
Cost of Power Supply (€'08/MWh)	(values)							
Generation	80.7	80.3	79.1	79.4	80.2	82.7	86.6	92.4
Capital	37.2	39.0	38.3	40.3	40.4	44.8	41.2	48.0
Variable	39.1	36.4	38.2	36.1	37.1	34.7	37.3	34.4
Fuel Taxes and Auction payments	4.3	4.8	2.6	3.1	2.7	3.2	8.1	10.1
Grid	19.7	24.6	19.9	25.0	20.1	26.0	21.1	28.1
Total Cost of Energy in billion €'05	255.6	364.3	256.9	368.0	255.6	368.5	259.2	376.8
	11-20	21-30	11-20	21-30	11-20	21-30	11-20	21-30
Total Energy Investment (billion €'08)	350.3	369.2	361.3	387.9	349.4	400.5	350.6	432.5
Differences from Reference			10.9	18.8	-0.9	31.4	0.3	63.3

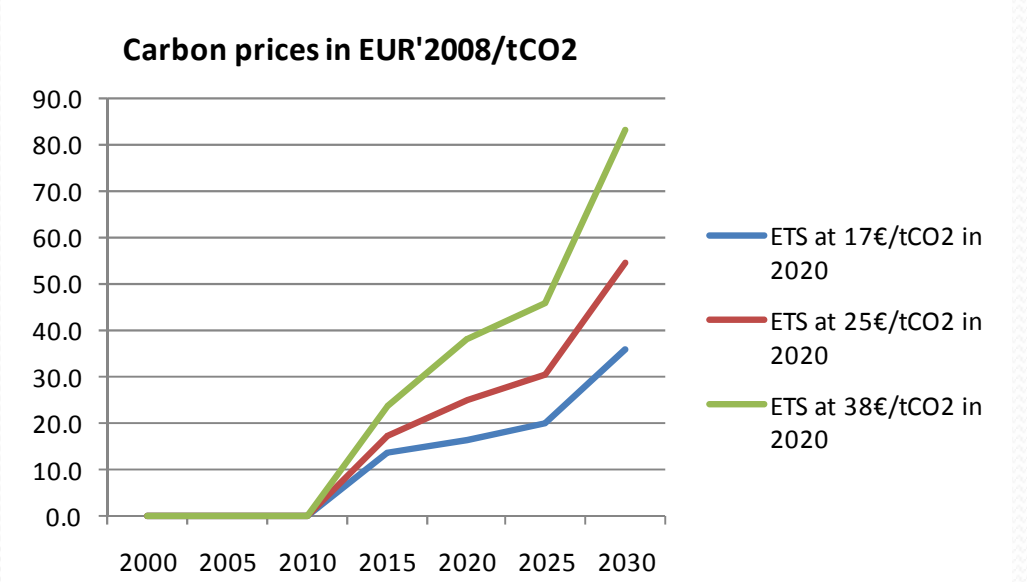
Impact of High Carbon Prices

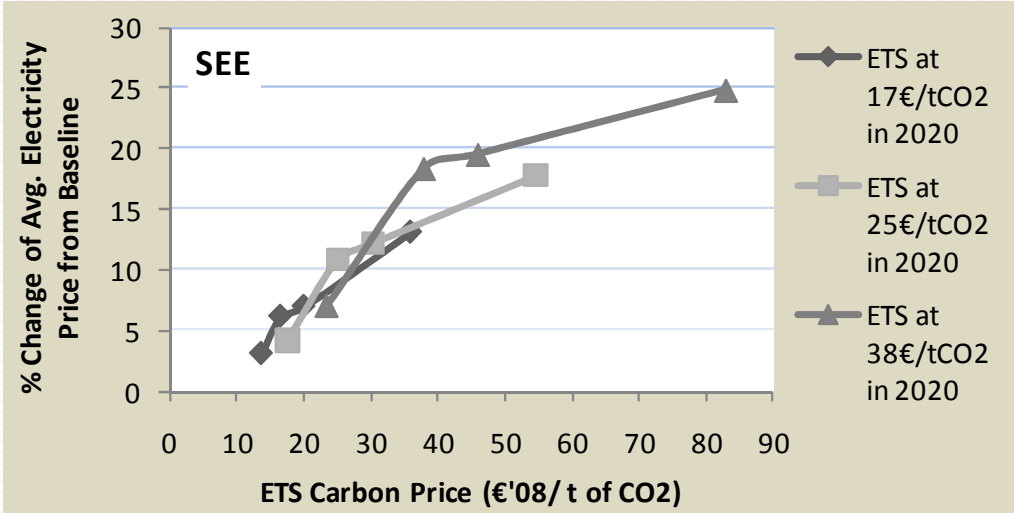
It is assumed that the entire SEE region joins the EU ETS mechanism, which involve full auctioning of emission allowances from 2013 onwards.

The carbon prices influence the mix of technologies and fuels in power generation inducing more development of carbon free generation, such as nuclear, renewables and CCS (which has near zero but not zero emissions).

Obviously carbon prices are detrimental for conventional generation based on fossil fuels, however usually gas-based generation may be favoured in some circumstances as gas emits less than coal.

As emission allowances involve payments in the auctions, the carbon prices increase the variable costs of forms of generation that emit CO_2; to the extent these forms of generation participate in the determination of marginal costs of electricity, auction payments induce higher costs hence higher electricity prices. Higher cost of energy for consumers further induce lower demand for energy.





Impact of High Carbon Prices

- The participation of all the SEE countries in the ETS market with full auctioning of emission allowances will imply considerable changes in the structure of power generation and will have strong impacts on costs and prices.
- Power will be generated by using more nuclear (10 to 14% more, 12 GW in the maximum case), significantly more renewables (20 to 25% more than in Baseline), less solid fuels (30 to 37% less than in Baseline) and slightly less gas. CCS plants will be commissioned mainly after 2025 with capacities ranging from 6 to 17.5 GW depending on the level of the carbon prices; in the highest carbon price case CCS represents 24% of total power generation capturing 16% of total emissions from the SEE energy system.
- For carbon prices above 30 EUR/tCO2 solid fuel generation without CCS is not economic; in general, gas-based generation becomes the marginal fuel in price setting in all carbon pricing scenarios.
- The RES% share attains 16% in all carbon price scenarios. Wind power reaches 27 GW in 2030 for the highest carbon price case (17 GW in Baseline), solar PV being 16 GW (7 GW in Baseline with biomass capacities at 3.3 GW (1.4 GW in Baseline).

Impact of High Carbon Prices

- Carbon intensity of power generation in 2030 is 60% lower than in Baseline in this high carbon price case and total CO_2 emissions reduce by 27% from baseline level in 2030.
- Electricity prices increase between 10 and 18% in 2020 from Baseline levels and between 18 and 25% in 2030. In the highest carbon price case, electricity prices in 2030 are found 50% higher than present levels. The impacts on prices for energy intensive industries are smaller than for households and services sectors. The grid tariffs are likely to increase between 5 and 10% from Baseline levels. Incremental investment needs are 16 billion EUR'08 for the highest carbon price case in the period 2011-2030, which is 20% above Baseline levels.
- Total cost of energy in the highest carbon price case in incremental terms from Baseline is between 0.4 and 0.6% of SEE GDP in real terms.
- The SEE countries that are members of the EU bear small impacts from escalating carbon prices, relative to the Baseline; the cost structure mainly changes reducing auction payments and increasing costs of developing carbon free sources.
- The non EU SEE countries incur high additional costs from raising carbon pricing with Bosnia, FYROM and Serbia being more vulnerable than Croatia, Albania and Turkey.

Impact of High ETS Prices

As expected carbon prices induce lower CO_2 emissions. The rates of decrease differ by country depending on possibilities and the economics of developing against the potential of carbon free resources. The degree of exploitation of the carbon free potential in the beginning of the simulation also influences the size of effects from carbon prices, as for example for countries that have already today achieved low carbon intensity.

For example Bulgaria and Romania show lower response rates to carbon prices because they have developed significant carbon free resources in the business as usual trends; contrasted examples are those of Serbia, Bosnia and Greece which show higher response rates to carbon prices also because they have a carbon intensive energy system at present.

Generally the range of emission reductions in 2030 between the Baseline and the highest carbon price case examined is between 20 and 45% for the year 2030.

SEE	*Baseline*		*ETS at 17€/tCO2 in 2020*		*ETS at 25€/tCO2 in 2020*		*ETS at 38€/tCO2 in 2020*	
	2020	*2030*	*2020*	*2030*	*2020*	*2030*	*2020*	*2030*
			% changes from Baseline					
CO2 Emissions (Mt CO2)	706.3	758.3	*-5.5*	*-16.3*	*-8.6*	*-24.1*	*-10.5*	*-27.4*
Total primary energy (ktoe)	280,865	320,952	*-2.7*	*-5.7*	*-4.1*	*-6.1*	*-5.2*	*-6.2*
Total final energy (ktoe)	198,506	231,681	*-1.7*	*-3.9*	*-1.9*	*-4.1*	*-2.3*	*-4.6*
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Total Renewables (ktoe)	29,475	33,579	*13.0*	*17.5*	*15.3*	*22.4*	*14.6*	*24.2*
Total Nuclear Fuel (ktoe)	9,801	20,508	*0.0*	*5.5*	*0.0*	*9.7*	*1.4*	*15.1*
	(values)							
RES as % Gross Demand	13.6	12.9	15.6	15.6	16.0	16.2	16.0	16.5
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Gas	34.0	35.1	33.5	36.4	35.7	34.7	37.1	33.0
Oil	1.4	0.7	1.4	0.7	1.4	0.7	1.4	0.7
Hydro	20.1	17.6	20.7	18.2	21.7	19.0	21.5	18.8
Wind	4.2	5.2	6.1	8.0	6.6	8.5	6.8	8.7
Biomass	0.9	1.4	1.3	2.1	1.4	2.2	1.4	2.6
Solar etc.	0.9	1.8	1.0	3.2	1.0	3.9	1.0	4.0
Carbon intensity (tCO2/MWh)	0.42	0.35	0.39	0.24	0.36	0.16	0.35	0.14
Pre-tax Electricity Prices (€'08/MWh)	*(values)*							
Average	99.7	104.2	105.9	117.9	110.5	122.8	118.0	130.1
Energy intensive industries	74.4	73.9	79.4	81.3	83.2	82.8	88.1	86.6
Other industries	95.9	98.7	102.2	111.7	107.3	116.8	115.5	125.3
Households	104.0	112.1	110.9	128.1	115.8	134.0	124.2	142.2
Services	114.0	115.0	121.6	130.6	126.9	136.9	135.4	145.2
Cost of Power Supply (€'08/MWh)	*(values)*							
Generation	80.7	80.3	85.5	91.1	89.6	95.0	96.3	101.2
Capital	37.2	39.0	39.0	45.2	40.0	48.6	40.8	50.7
Variable	39.1	36.4	38.0	35.2	37.7	35.1	38.0	35.8
Fuel Taxes and Auction payments	4.3	4.8	8.5	10.6	11.9	11.3	17.5	14.6
Grid	19.7	24.6	21.0	27.5	21.6	28.5	22.4	29.6
Total Cost of Energy in billion €'05	255.6	364.3	260.7	378.2	262.8	381.5	266.6	387.3
	11-20	***21-30***	***11-20***	***21-30***	***11-20***	***21-30***	***11-20***	***21-30***
Total Energy Investment (billion €'08)	350.3	369.2	362.9	436.8	367.6	466.5	371.2	484.1
Differences from Reference			12.6	67.6	17.3	97.3	20.9	115.0

Concluding Remarks

- The SEE region is projected to grow less than expected some years before the recent economic crisis. This implies less energy demand growth than expected. Hence, new infrastructure projects and new investments need to downsize relative to older plans.
- Gasification trends anticipated in the past are still valid in the new conditions, as gas complies with new growing environmental concerns. Incremental gas requirements will be lower in the future than expected. The gasification in power generation in the long term remains a dominant trend but the volumes are limited because of expectations about new investment in nuclear, renewables and CCS depending on the policy constraints that will prevail in the future. If decarbonisation and RES policies are pursued more intensively gas requirements will not necessarily increase from Baseline levels, as other options will develop faster. Nevertheless, gas generation capacities will remain important and has to develop in order to support intermittency of renewables and dispatching flexibility.
- Oil will remain an important constituent in the fuel mix but its role will decline in substitutable uses remaining however dominant in specific uses, such as in transportation. Possible change of energy carrier in this sector, for example through electro-mobility, will have strong effects on demand for oil.
- Solid fuels constitute an important indigenous energy source of the SEE countries but their future use in power generation is very sensitive on carbon prices and other policies such as for the RES. Maintaining use of solid fuels in power generation at business as usual levels will depend on the development of CCS in the long term. CO_2 storage possibilities exist in some Balkan countries.

Concluding Remarks

- Nuclear energy is shown to develop up to maximum possibilities in three of the SEE countries. The results show inflexibility for further expansion of nuclear energy.
- Renewables have a great untapped potential in the SEE region. Wind power is likely to become the fastest expanding source of generation, but the wind potential is rather limited in the central and west Balkan countries. Solar PV has also a great potential especially in the southern countries of the region. The volume of unexploited biomass resources is remarkably high in most of the SEE countries.
- Developing the RES in power generation will require higher capital investment and will be possible only if specific RES supporting policies are in place, such as the feed-in tariffs with attractive price levels. The development of RES will also require investment in the grids and the presence of sufficient ancillary and back-up services. They will both imply higher generation and electricity supply costs, but the development of RES reduces other cost components especially the auction payments if carbon pricing in EU ETS is generally applied in the region.
- Electricity prices are projected to increase significantly in the future relative to present levels. A major reason is the pricing below total true costs that has been practiced in the past in most of the SEE countries. The increasing role of gas will also have implications on prices as in the wholesale markets gas will be increasingly be the marginal fuel in price setting, especially in load following. The grid costs components will also increase substantially. The prices for energy intensive industries are expected to increase much less than the prices for households (generally cross-subsidised) and for services sectors.

Concluding Remarks

- The generalisation of strong RES policies in the rest of the SEE countries is possible and initiatives are on going for this purpose. The RES can develop substantially and will have some moderate impacts in electricity costs and prices.
- The participation of all the SEE countries in the EU ETS is not currently in the policy agenda but there are chances to emerge in the future within the process of concerted actions towards decarbonisation and in the negotiation of agreements with the European Union.
- The generalisation of the EU ETS with full auctioning of allowances will drive considerable change in power generation: it will put solid fuel projects at risk but will favour CCS in the long term; it will provide a strong push to RES but less to nuclear; it will sustain gasification trends. The most important effect will be on electricity prices, because the price of allowances will influence marginal costs at various load levels and will be passed through to consumer prices.
- The simulations shows that prices in some of the SEE countries, such as Serbia (grouping also Montenegro and Kosovo), Bosnia, FYROM and Turkey, are likely to increase between 25 and 50% from Baseline levels depending on the level of the EU ETS carbon prices in the future. The electricity prices in Greece are also likely to increase considerably from past levels but this increase is projected to take place also under the Baseline conditions. The rest of the SEE countries are less vulnerable to carbon pricing.
- In the context of carbon pricing the increasing penetration of renewables do not add on total costs and prices but imply a shift in cost components from auction payments to capital and grid costs.