



Source: Energy Community

1

EU and draft Candidate countries energy and CO2 emission trends

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E³M ~ Lab

Scenario Approach

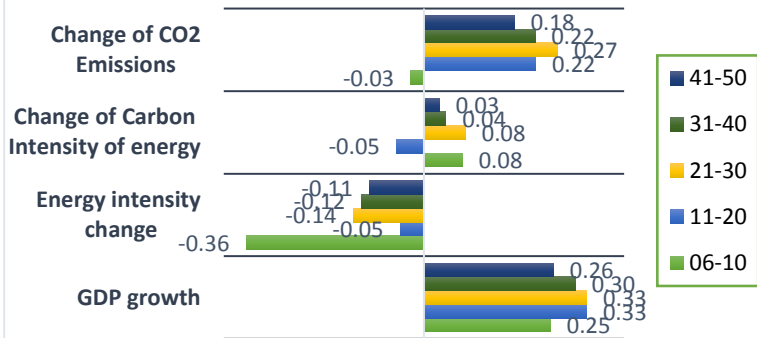
2

- Energy demand, supply, investment and CO₂ emission projection up to 2050
- Reference scenario context:
 - ▣ Only implemented policies included, no new policies
 - ▣ However, market and technology dynamics captured
 - ▣ Increasing fossil fuel import prices assumed as in EU Reference 2013
- Database fully updated (latest year with complete data is 2012)
- Models:
 - ▣ GEM-E3 for macroeconomic and sectoral activity projection
 - ▣ PRIMES model for the energy system, investment, prices and CO₂ emissions
- Project context: EUCLIMIT-2 funded by European Commission, DG Climate action

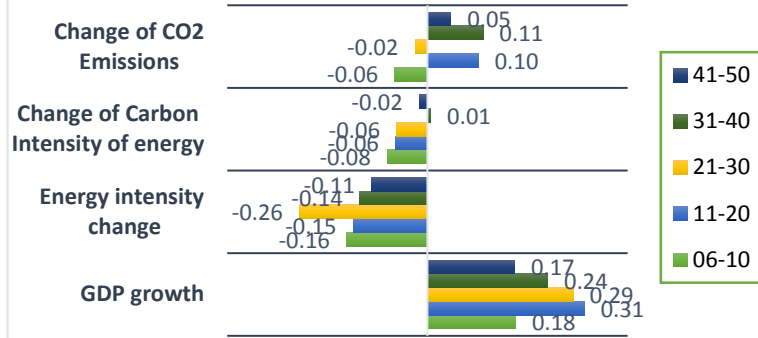
Overview of CO₂ Emission Projection

3

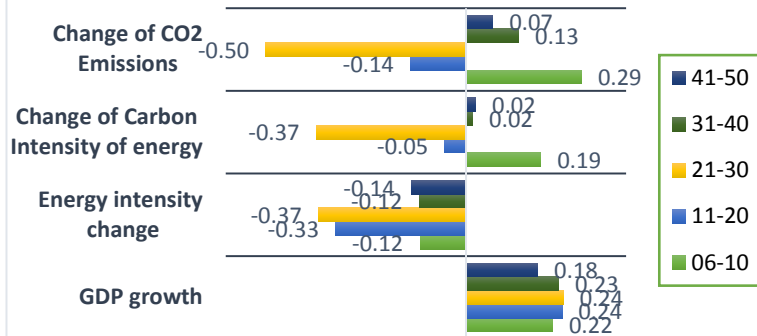
Albania : Factors influencing % change of CO₂



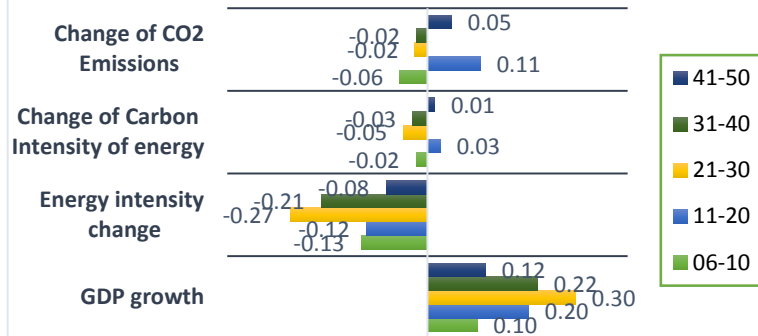
FYROM : Factors influencing % change of CO₂



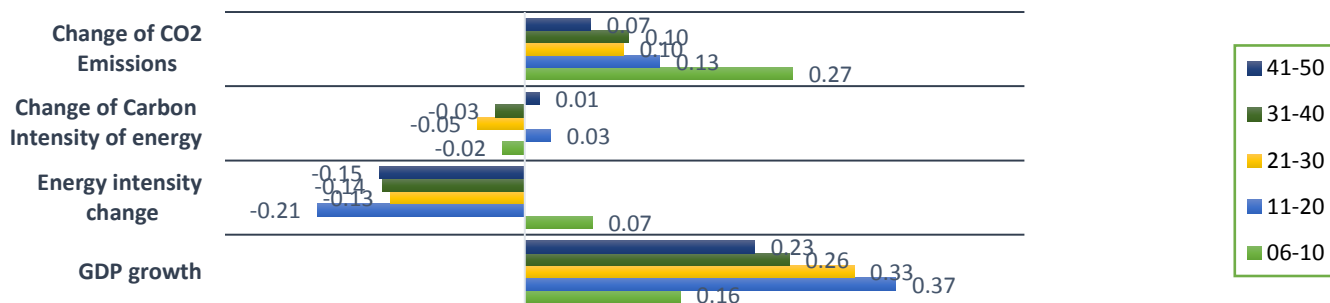
Montenegro : Factors influencing % change of CO₂



Serbia : Factors influencing % change of CO₂



Turkey : Factors influencing % change of CO₂



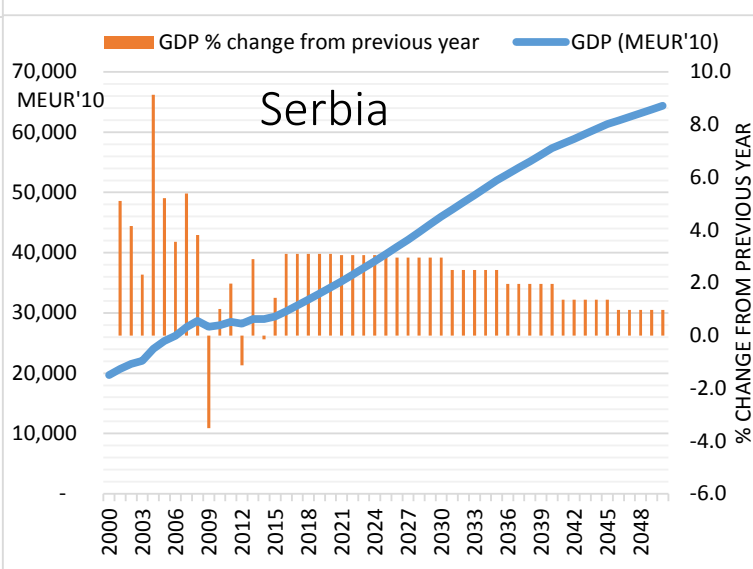
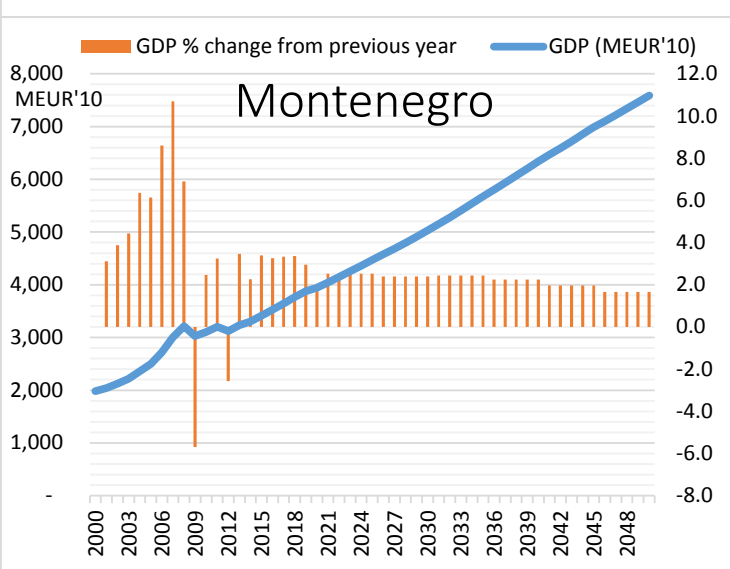
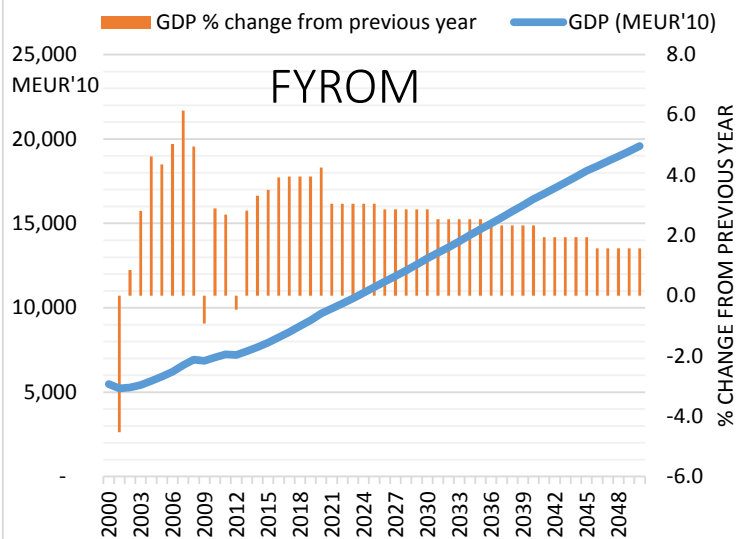
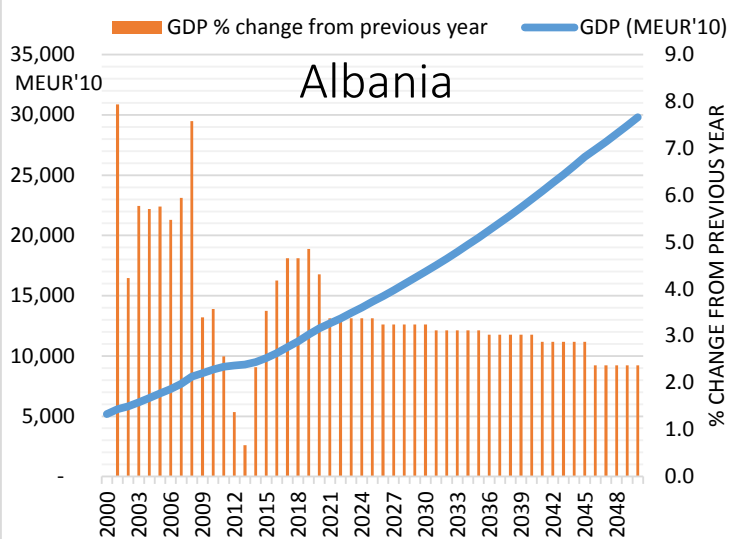
The increase of CO₂ emissions is mainly driven by GDP growth

The increase of emissions is significantly mitigated by reduction of energy intensity of GDP

Carbon intensity of energy is not reducing significantly, except in Montenegro

Macroeconomic Outlook

4



Sustained growth of the economy

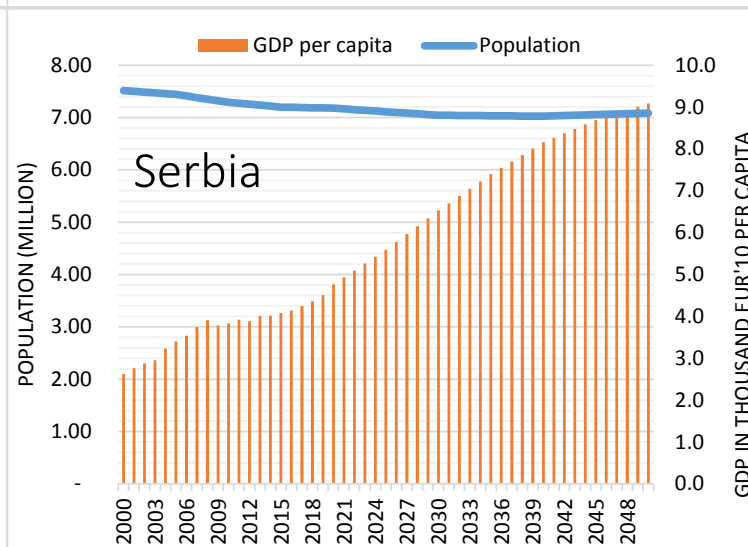
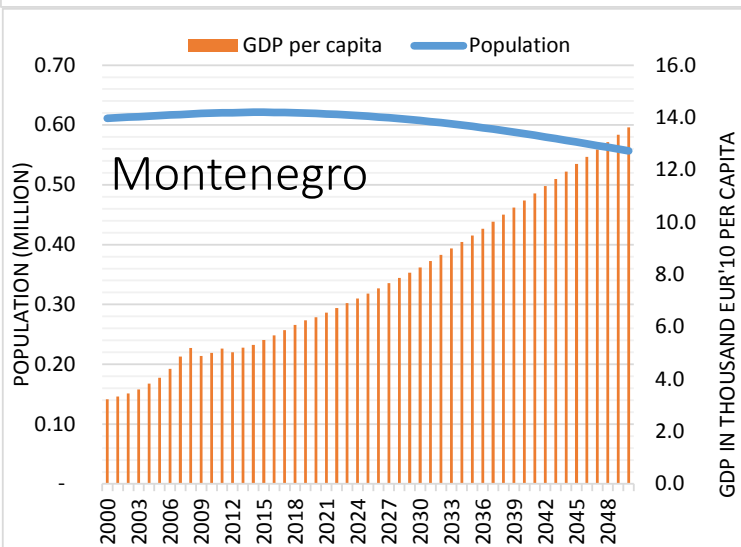
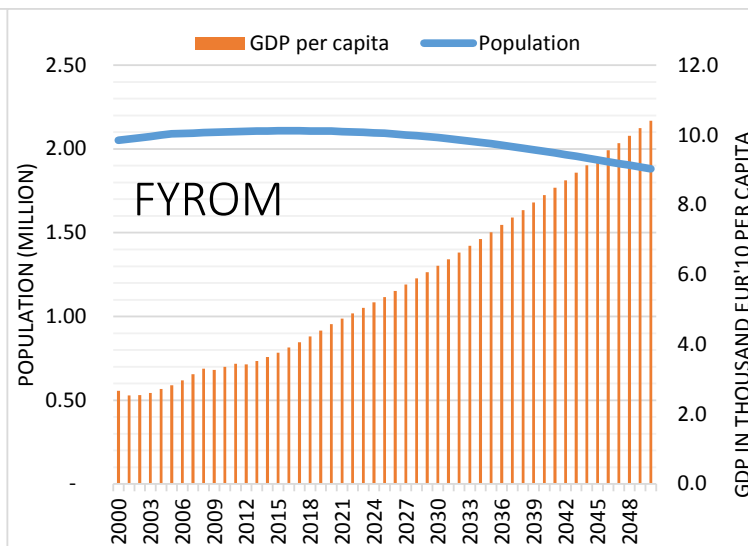
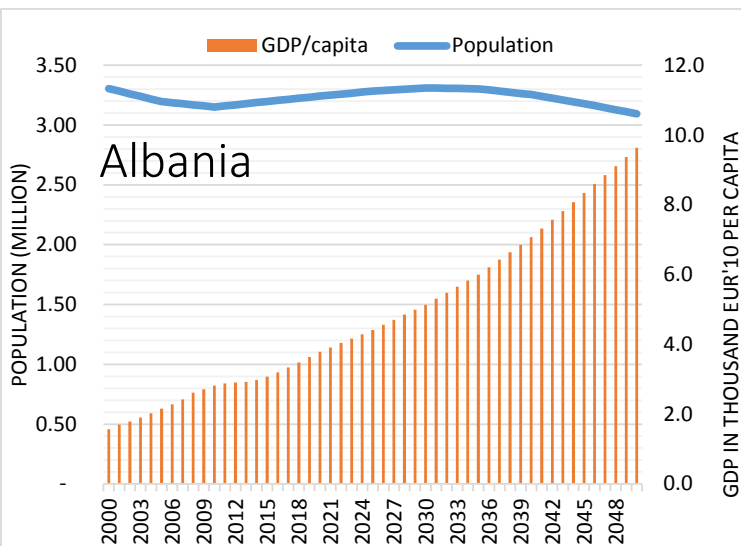
Yet insufficient growth to achieve convergence with EU members of the region

Slowdown of growth rates in the long term

Growth driven by services, high value added industry and less based on energy intensive industry

Population and Income Outlook

5



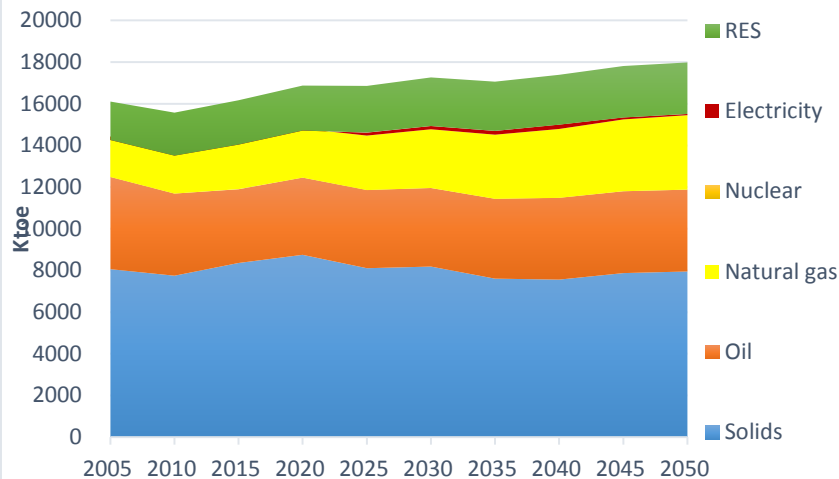
Slightly decreasing population in the long term

Income per capita increasing at sustained pace, between 2.5 and 3.5 % per year

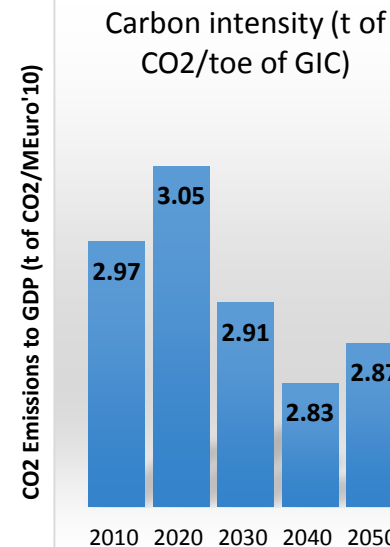
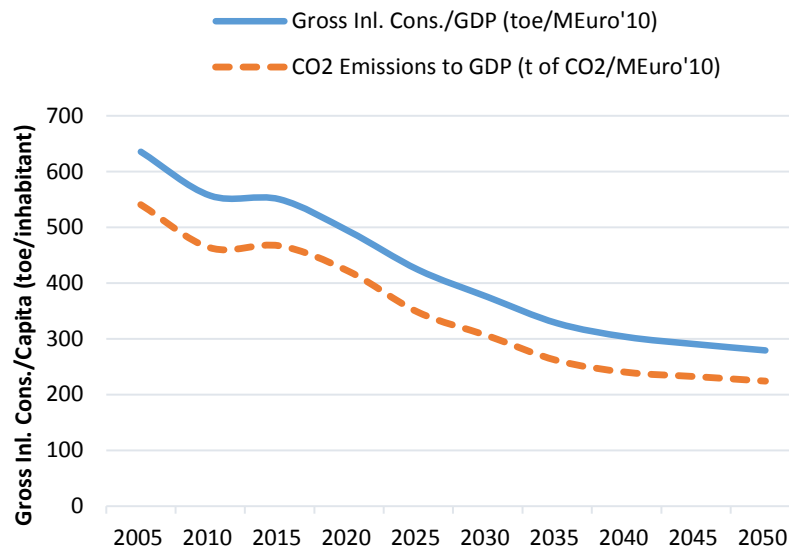
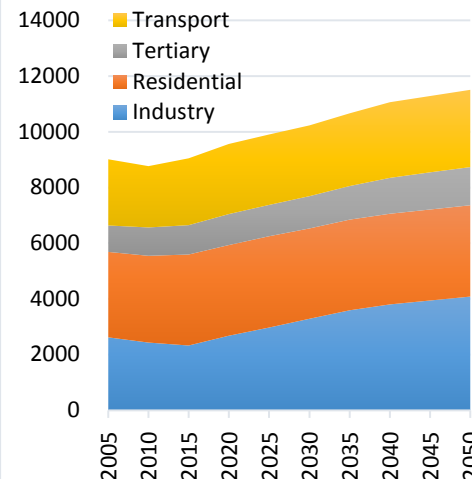
Serbia: Energy Demand

6

Gross Inland Consumption



Final energy (ktoe)



Primary energy requirements increase by a mere 0.4% pa

Nat. gas share increases while solid fuels remain the dominant energy form, albeit losing share in the fuel mix. Oil remains stable and RES increase modestly.

Energy and carbon intensity of GDP steadily decrease, by 1.7% per year on average

Carbon intensity of primary energy slightly decreases, but remain at a high level driven by continued use of solids

Energy demand growth is mainly due to industry and transport

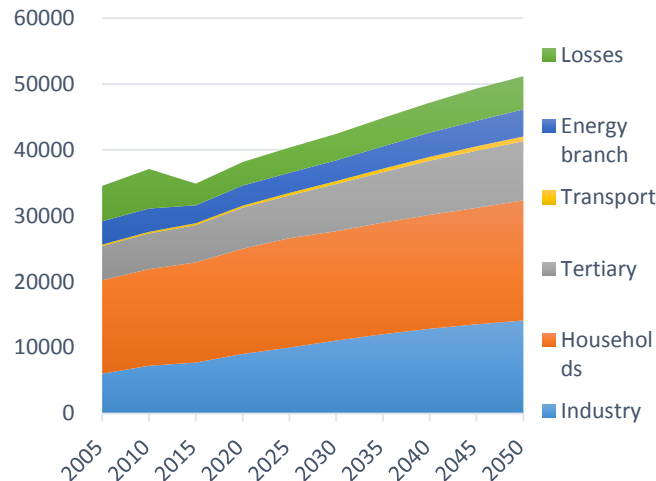
Electricity is the fastest growing energy form in final demand (mainly in industry and services), followed by gas

Energy efficiency improves in all sectors, but mostly in domestic sector

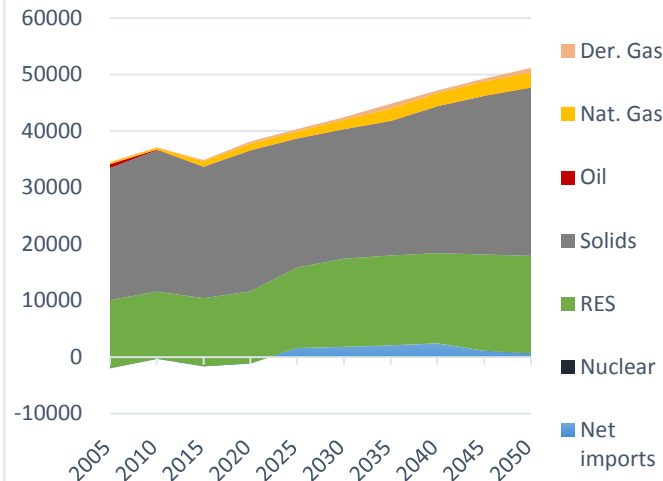
Serbia : Electricity Outlook

7

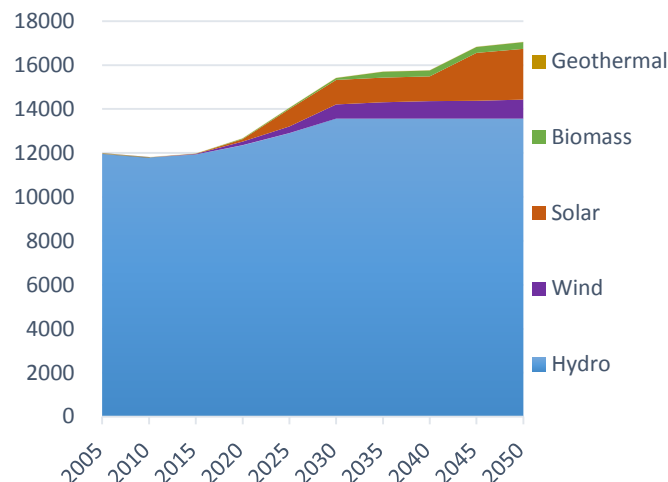
Electricity consumption (in GWh)



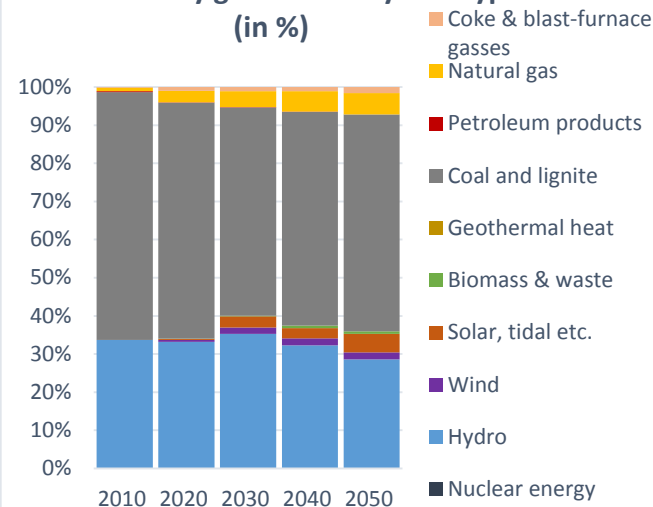
Gross Electricity supply (in GWh)



Net Generation by Renewables (GWh)



Net Electricity generation by fuel type (in %)



Demand for electricity increases by 1.1% per year on average

Major power source are the solid fuels which maintain a rather stable share in the future

RES increase modestly, mainly solar and hydro and less wind

Gas' share in power sector increases but remain below 10%

Power capacity expansion is based on solid fuel plants. Considerable investment is required to replace and refurbish aged solid fuel plants.

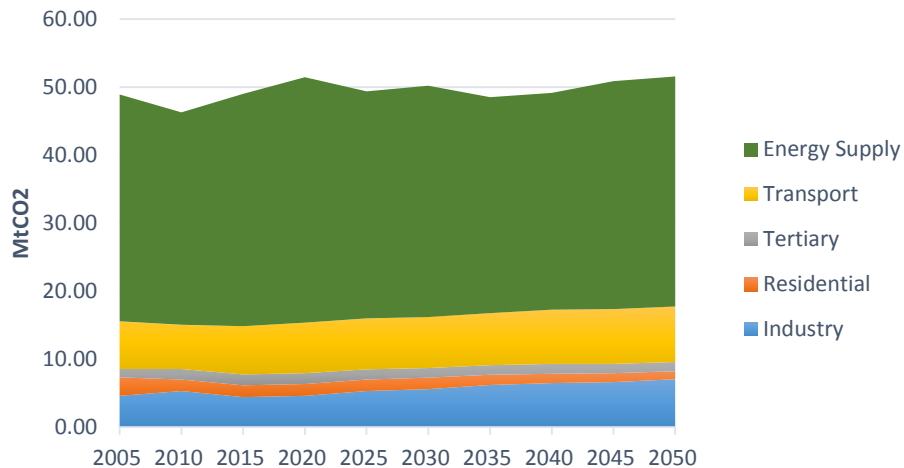
Solar PV gets a noticeable share in investment in the long term.

Electricity prices tend to increase significantly throughout the projection to recover costs (mainly capital costs) as they start from low levels. Mainly households and services see electricity price increases whereas industrial prices remain at rather low levels.

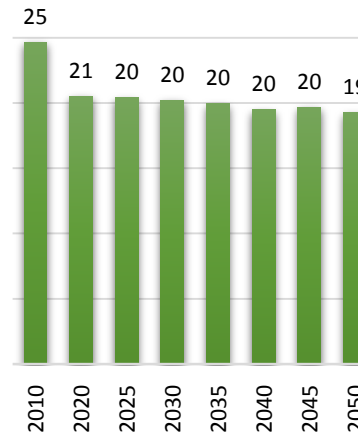
Serbia : Emissions and Costs

8

Energy related CO2 emissions



Overall RES Share (%)



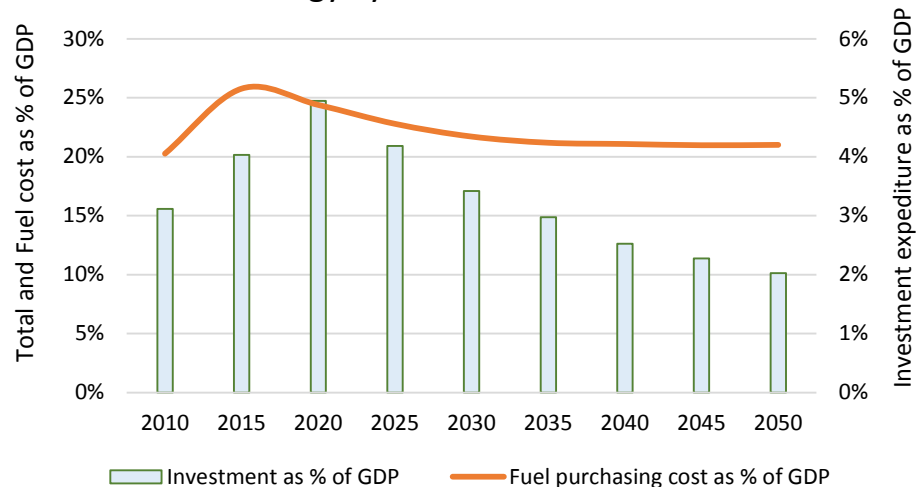
Despite continued use of solid fuels, carbon emissions remain rather stable. More than 2/3 are due to the power sector. Carbon intensity does not aggravate but remains at a high level.

The RES share might remain at a level close to 20% mainly due to hydro power if no further policy action is taken

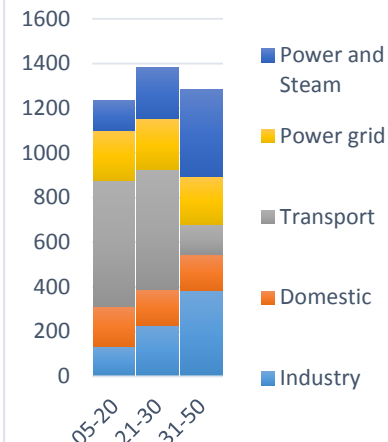
Energy costs as % of GDP slightly decrease in the future

Investment requirements are high in the short term driven by fleet replacement in transport sector and continue to be high in the long term driven by the power sector where solid fuel plants need to be replaced and also by industry.

Energy System Cost Indicators



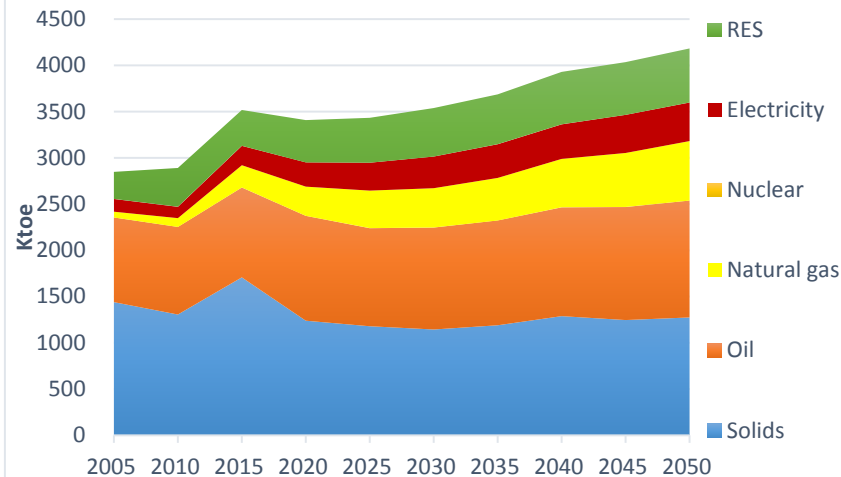
Investment per year (million €)



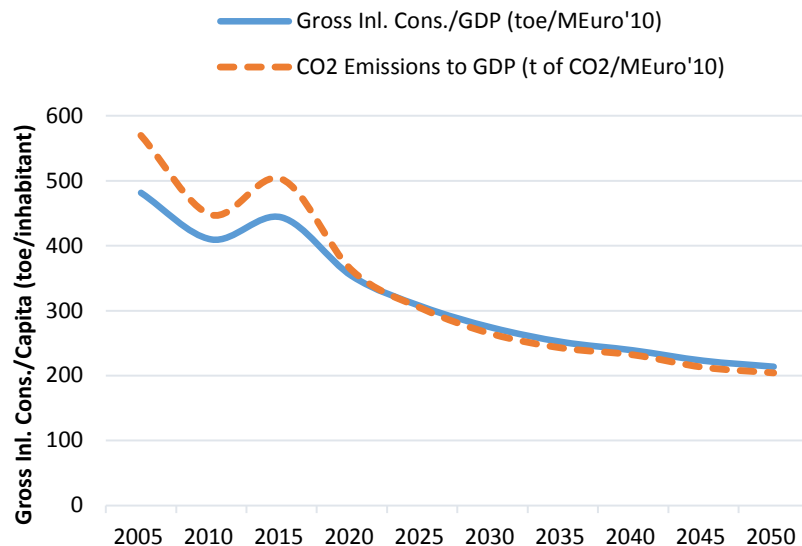
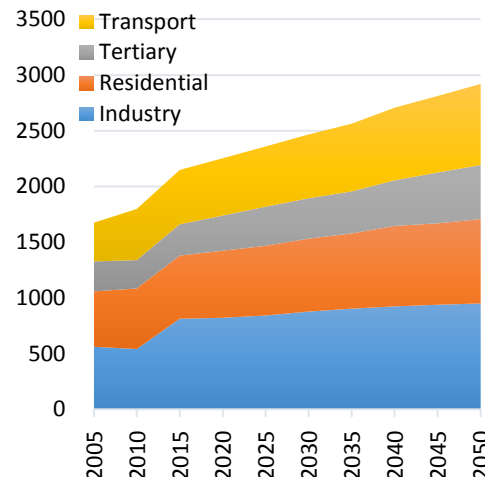
FYROM : Energy demand

9

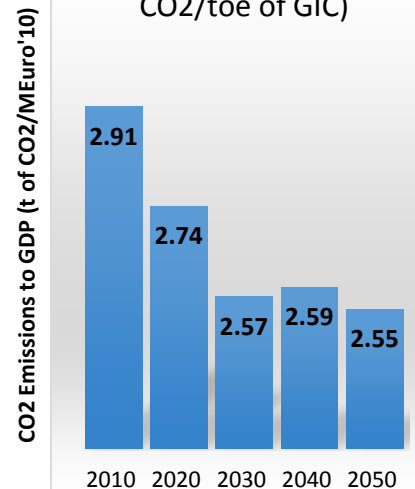
Gross Inland Consumption



Final energy (ktoe)



Carbon intensity (t of CO2/toe of GIC)



Primary energy requirements increase by less than 1% per year

Nat. gas imports increase there share while electricity imports also increase

Energy and carbon intensity of GDP steadily decrease, between 1.6 and 2% per year on average

Carbon intensity of primary energy slightly decreases

Energy demand growth mainly takes place in all end-use sectors

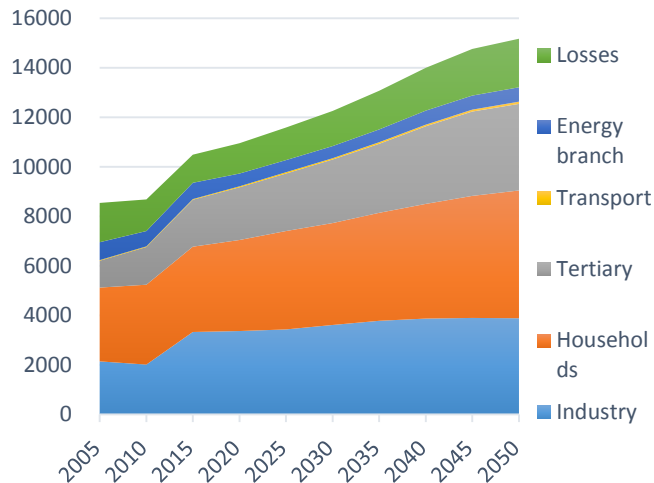
More use of gas and electricity are the main trends, while oil use increases by 0.8% per year driven by moderate transport demand increase

Energy efficiency improves in all sectors, but mostly in domestic sector

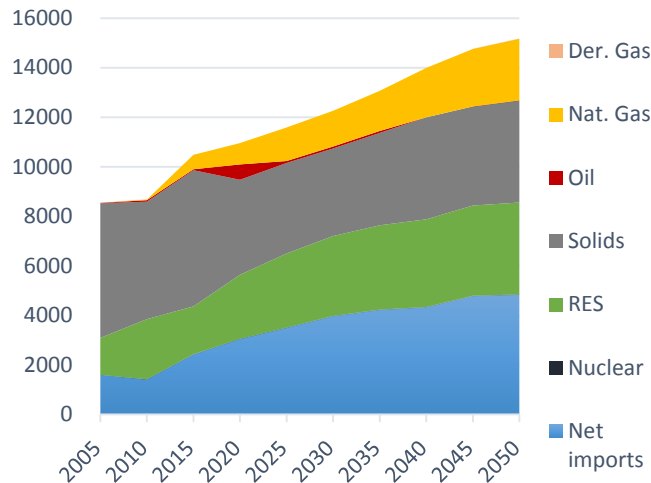
FYROM : Electricity Outlook

10

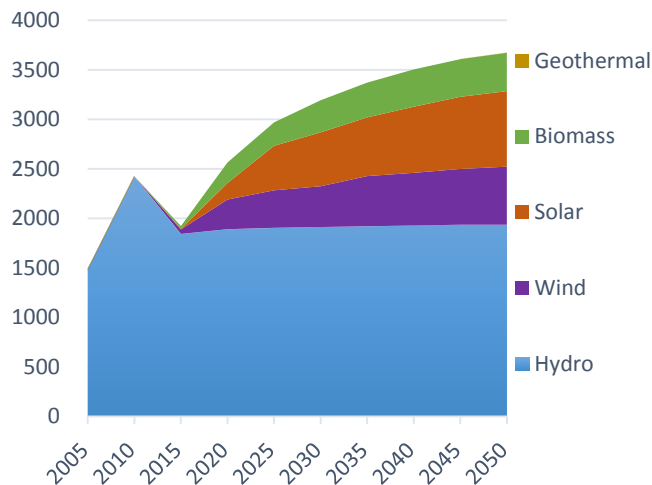
Electricity consumption (in GWh)



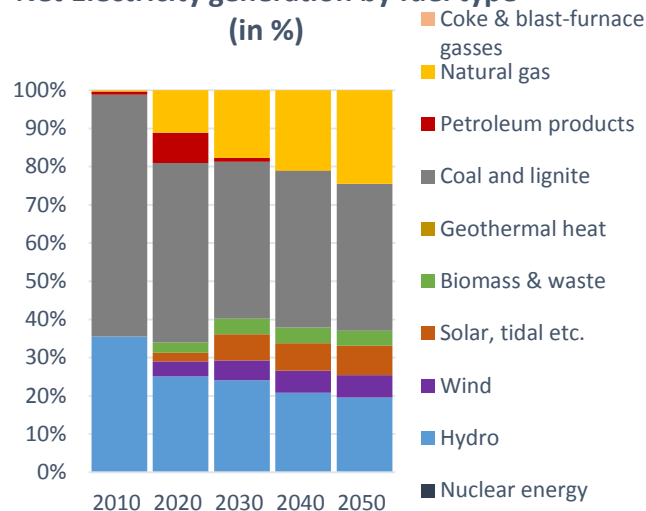
Gross Electricity supply (in GWh)



Net Generation by Renewables (GWh)



Net Electricity generation by fuel type (in %)



Demand for electricity increases by 1.4% per year on average

Generation continues to rely on solid fuels, but incremental demand is met mainly by RES and gas plants

Hydro remains stable, while solar, wind and biomass develop in power sector, reaching 16% of total by 2030

All RES represent above 35% of total in the long term, while gas share attains shares above 20%. Thus, solids' share loses 20 percentage points, down from above 65% currently.

Electricity imports double in the long term relative to present levels attaining a share above 30% by 2050

Capacity expansion is based on gas plants, variable RES and a few biomass plants. Replacement of aged solid-fuel plants is found economic under Reference scenario conditions.

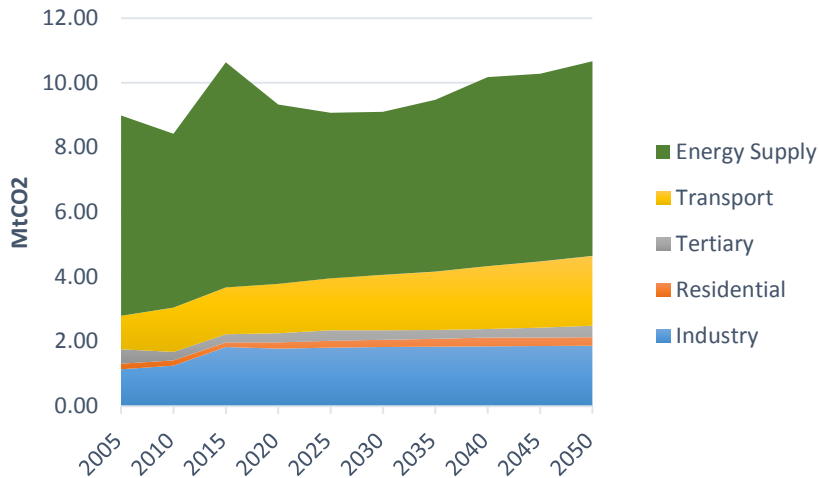
Electricity prices tend to increase, due to higher capital and import costs.

The tariffs for households and services are projected to increase in the future, while industrial tariffs increase only in the short term.

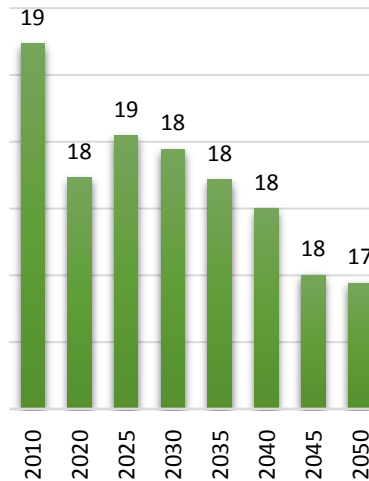
FYROM : Emissions and Costs

11

Energy related CO2 emissions



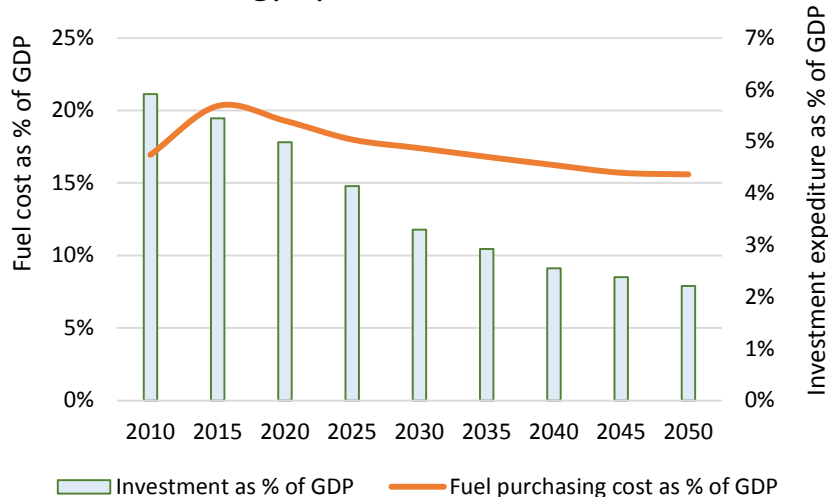
Overall RES Share (%)



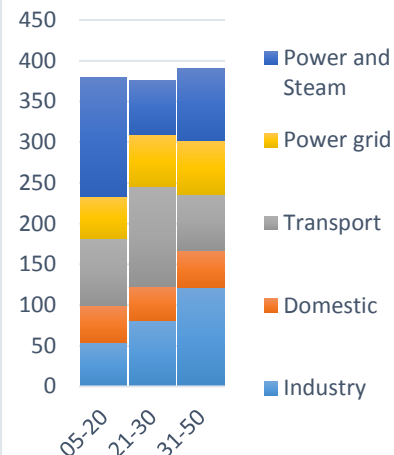
Carbon emissions remain lower than their peak in 2015. More than half are due to use of solid fuels in power sector. Transport related emissions increase moderately.

The RES share might remain rather stable roughly at 18% if no further policy action is taken

Energy System Cost Indicators



Investment per year (million €)

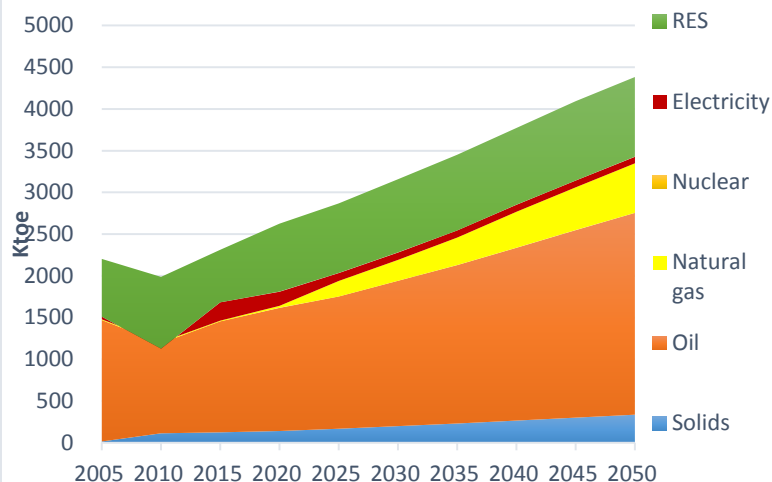


Energy costs as % of GDP remain stable and slightly decrease in the long term. Investment requirements also remain stable over time and decrease as % of GDP.

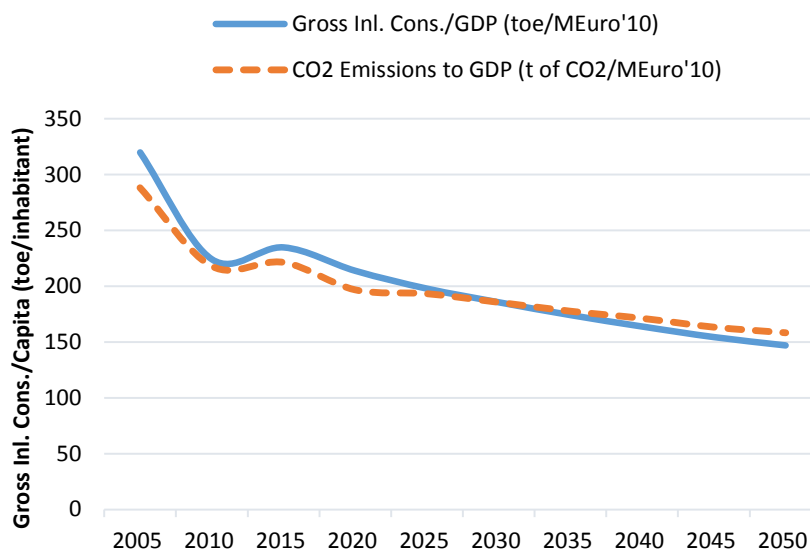
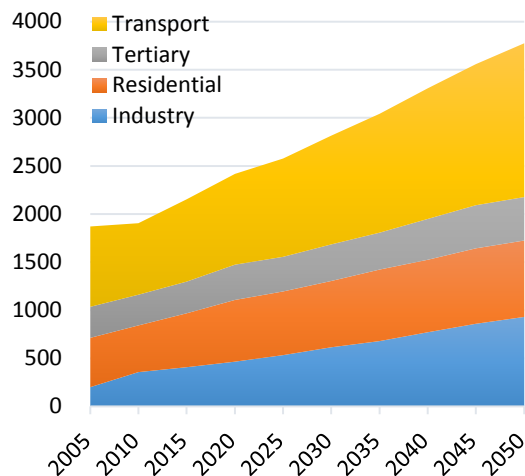
Albania: Energy demand

12

Gross Inland Consumption

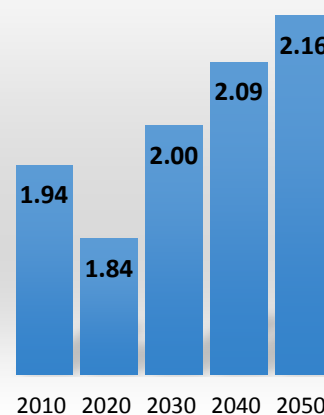


Final energy (ktoe)



CO2 Emissions to GDP (t of CO2/MEuro'10)

Carbon intensity (t of CO2/toe of GIC)



Primary energy requirements increase by 1.8% pa but growth slows down in the long term

Nat. gas imports are projected after 2025

Energy and carbon intensity of GDP steadily decrease, by 1% per year on average

Carbon intensity of primary energy slightly increases

Energy demand growth is mainly due to transport and at a lesser extent to industry

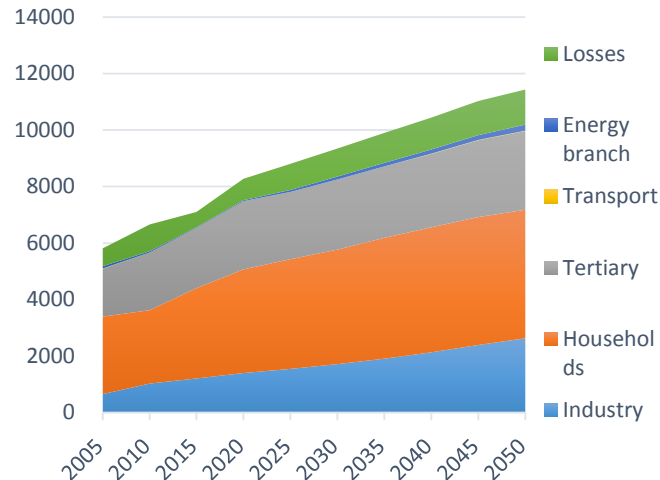
Oil is the fastest growing fuel in final demand, followed by electricity. Gas introduced after 2025 takes a small share

Energy efficiency improves in all sectors, but mostly in domestic sector

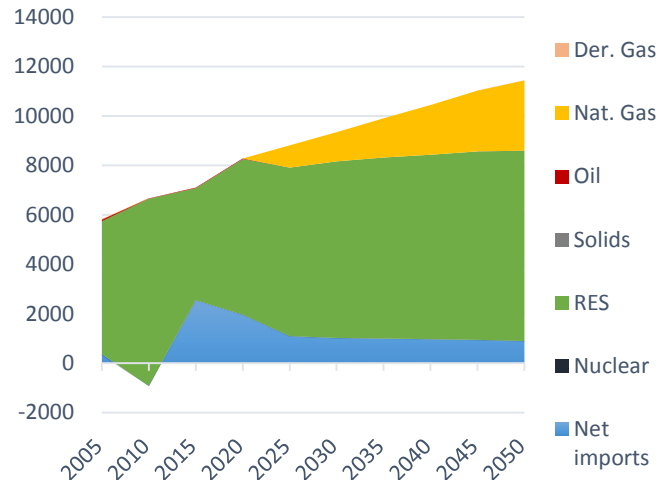
Albania: Electricity Outlook

13

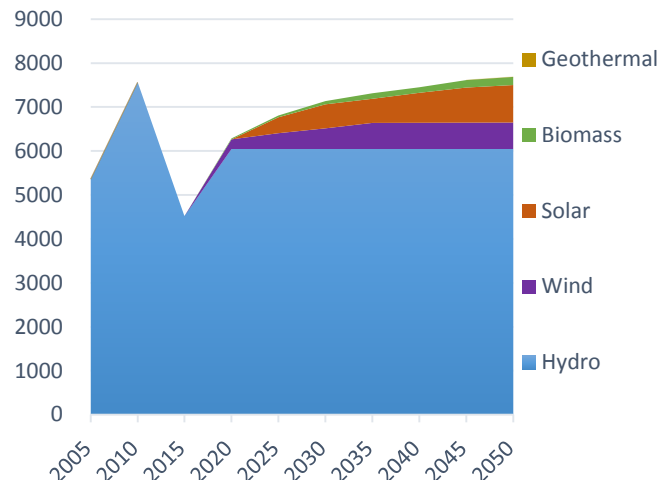
Electricity consumption (in GWh)



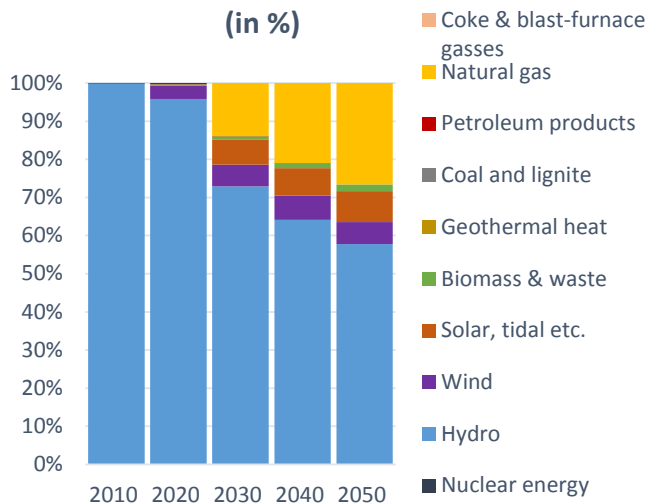
Gross Electricity supply (in GWh)



Net Generation by Renewables (GWh)



Net Electricity generation by fuel type (in %)



Demand for electricity increases between 1.1 and 1.4% per year

Major power source is hydro which is not projected to increase

Other RES develop modestly, mainly solar and wind

Gas is introduced in power sector after 2025 covering incremental demand

Power capacity expansion is based on solar, wind and gas.

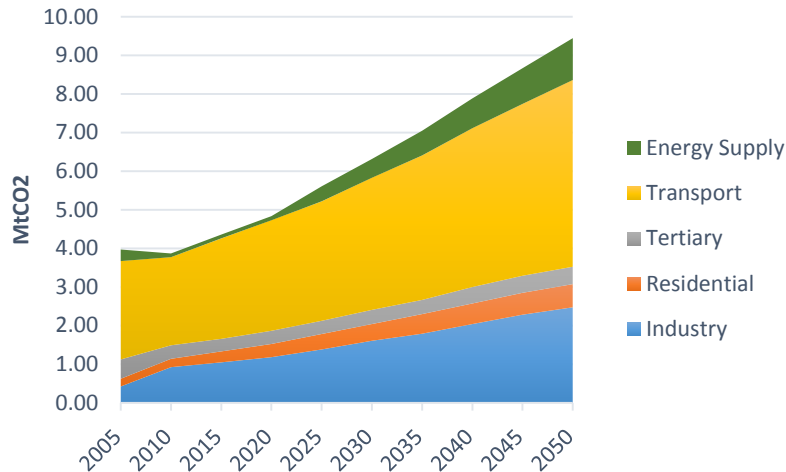
New hydro commissioned before 2020 but no other new large hydro in the future

Electricity prices tend to increase significantly in the medium term to recover costs (mainly capital costs) and stabilize in the long term. Mainly households and services see electricity price increases.

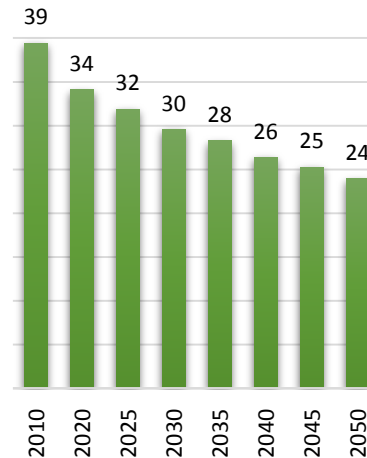
Albania: Emissions and Costs

14

Energy related CO2 emissions



Overall RES Share (%)



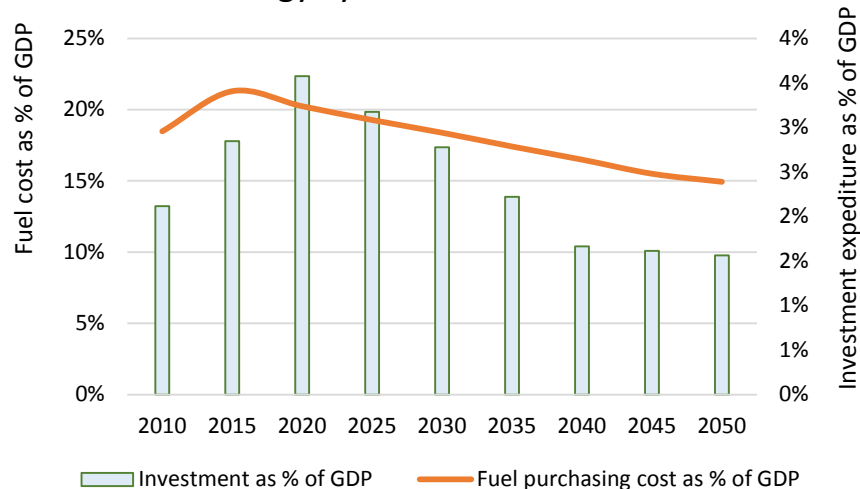
The increase in carbon emissions are mainly due to transport and secondarily to industry

The RES share is high thanks to power sector but might decrease in the future if no further policy action is taken

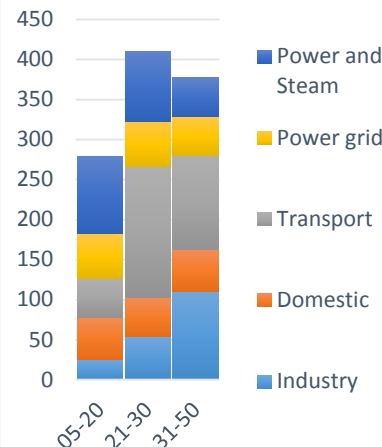
Energy costs as % of GDP tend to slightly increase in the short term but decrease in the long term

Investment requirements are higher in the short term than in the long term.

Energy System Cost Indicators



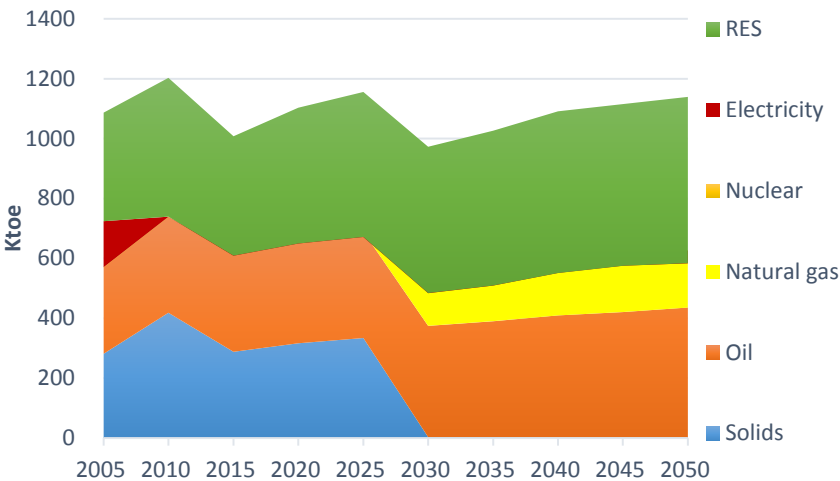
Investment per year (million €)



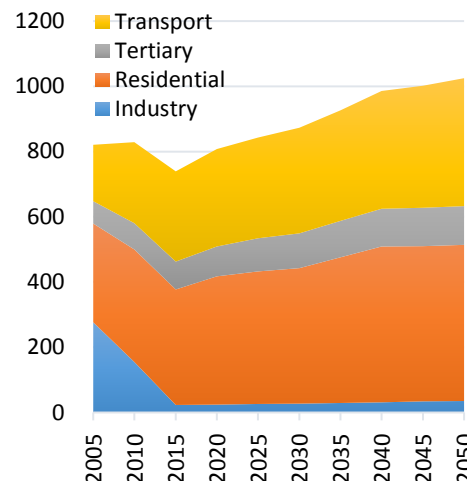
Montenegro: Energy demand

15

Gross Inland Consumption



Final energy (ktoe)



The economic growth pattern, based on services and light industry, drives stabilization of primary energy requirements.

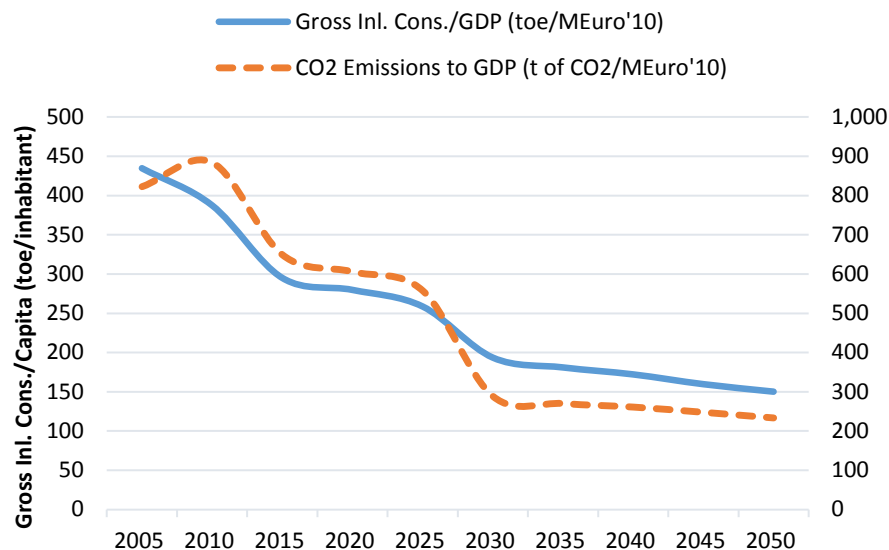
The closure of alumina production and the abolishment of solid fuels until 2030 drive significant reduction of energy and carbon intensities of GDP.

RES maintain an increasing share and natural gas is introduced post 2025.

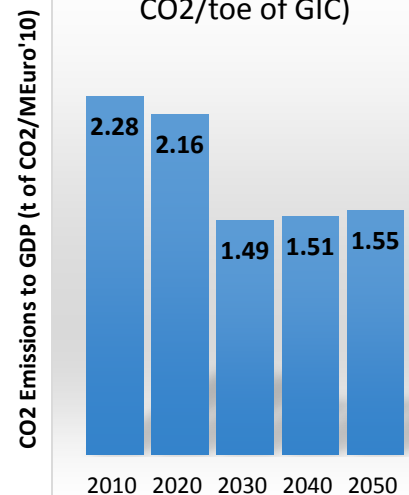
Final energy demand increases mainly in transport sector and slightly in residential, while industrial energy demand remains very low after the closure of the alumina plant.

Gas penetration in end-use sectors is slow and limited, while electrification is pursued at fast pace

The domestic sector displays significant energy efficiency gains.



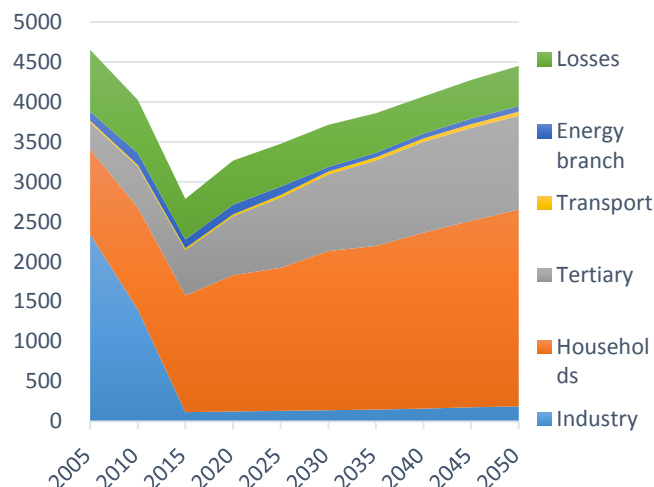
Carbon intensity (t of CO2/toe of GIC)



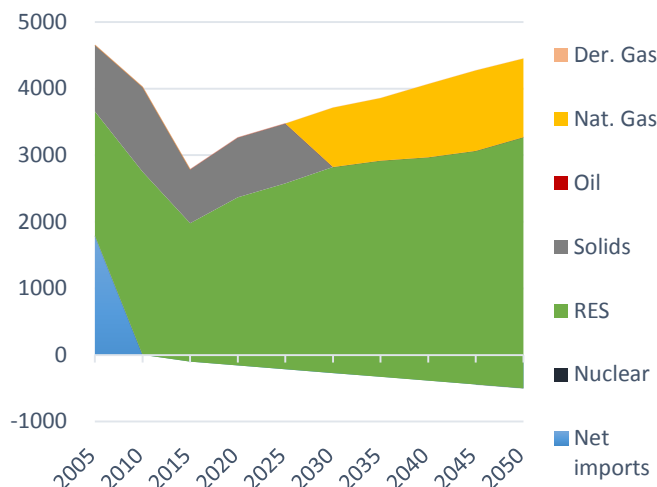
Montenegro : Electricity Outlook

16

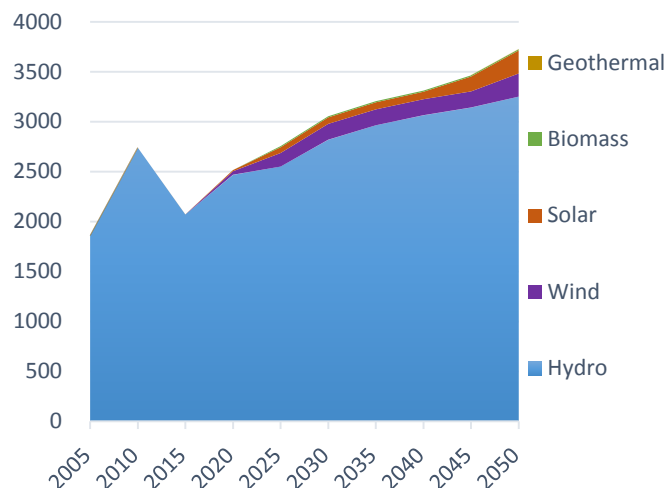
Electricity consumption (in GWh)



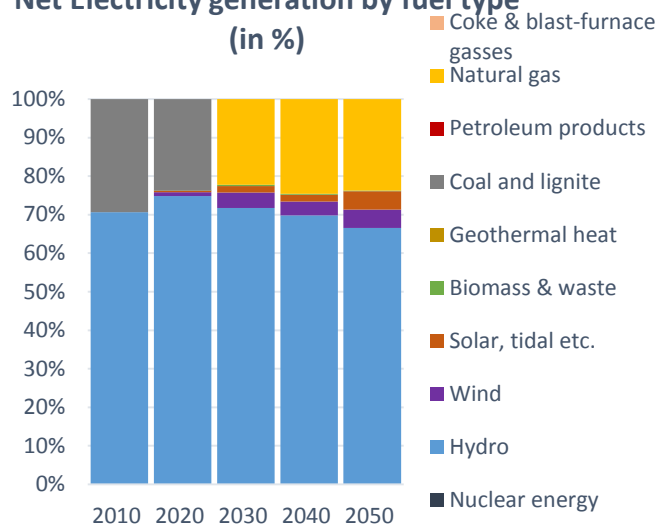
Gross Electricity supply (in GWh)



Net Generation by Renewables (GWh)



Net Electricity generation by fuel type (in %)



Electricity consumption drops because of reduction of industrial activity and grows post 2015 only in the domestic sector at 1.4% per year.

Generation using solid fuels is replaced by gas, post 2025, while RES (mainly hydro, representing 70% of total) remain the dominant source.

Variable RES develop modestly, but hydro power expands, allowing exports of electricity.

Power capacity expansion is primarily based on hydro. Gas plant investment is of the same size as decommissioned solid fuels plants.

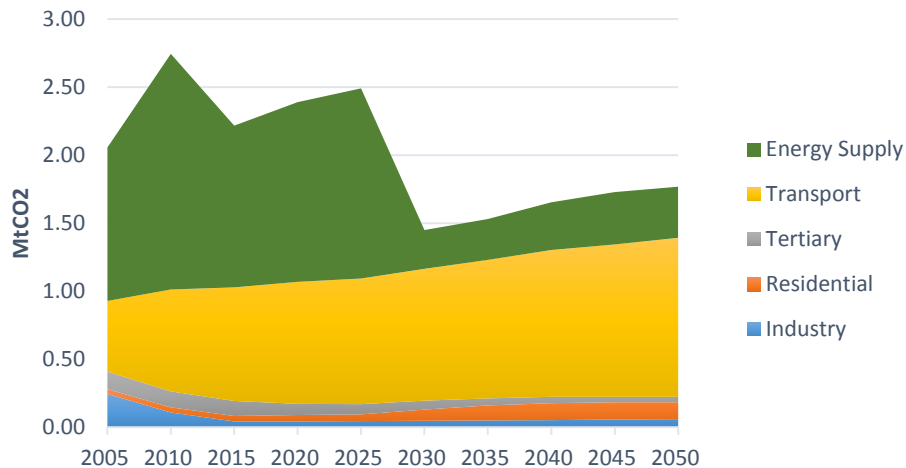
Investment in wind power is limited, compared to resources and solar PV develops mainly in the long term.

Electricity prices increase significantly in the short term to recover mainly capital costs and also because of taxation. Prices stabilize in the medium and long term and prices for households and services slightly decrease post 2020.

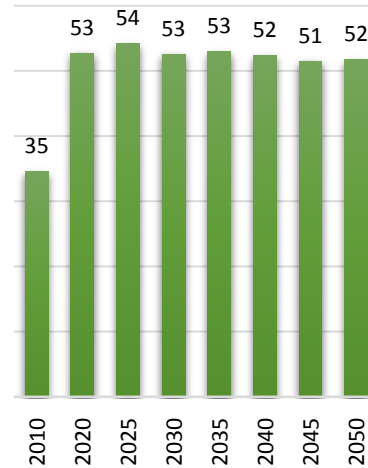
Montenegro : Emissions and Costs

17

Energy related CO2 emissions



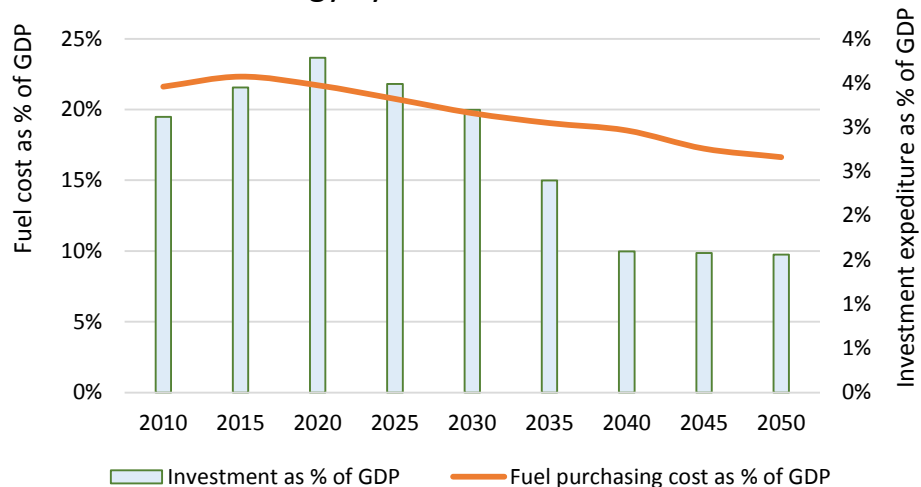
Overall RES Share (%)



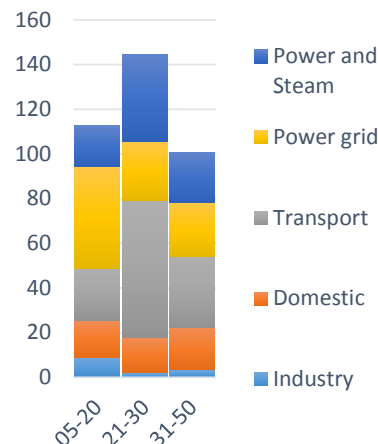
The reduction of industrial activity and the substitution of solid fuels lead to substantial reduction of carbon emissions. The majority of remaining emissions are due to transport where they tend to increase in the future.

The RES share remains above 50% thanks to power sector and remains stable in the future.

Energy System Cost Indicators



Investment per year (million €)

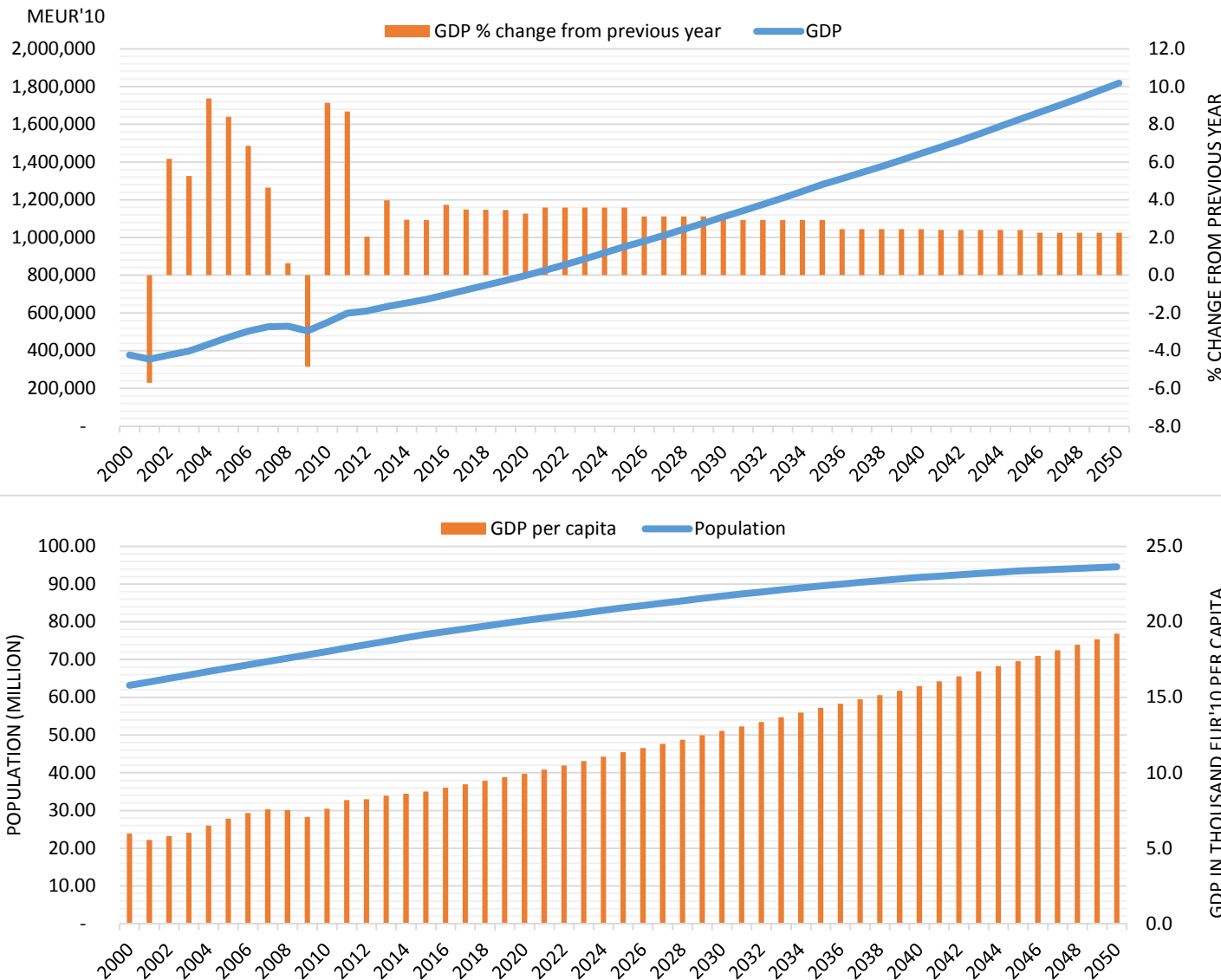


Energy costs as % of GDP tend to decrease.

Investment requirements are considerable in the short term (power sector) but decrease in the long term.

Turkey : Macroeconomic Outlook

18



Sustained GDP growth is projected (3% per year on average), based on demographic dynamics and industrialization.

Population increase continues past trends at a slower pace (0.6% pa until 2030, compared to above 1% pa growth in the past)

Income per capita steadily increase at a rate a little above 2% per year.

Industrial activity is projected to grow by 2.8% per year (a little below GDP growth) with energy intensive industry maintaining a large share in total industrial value added (between 25-30%)

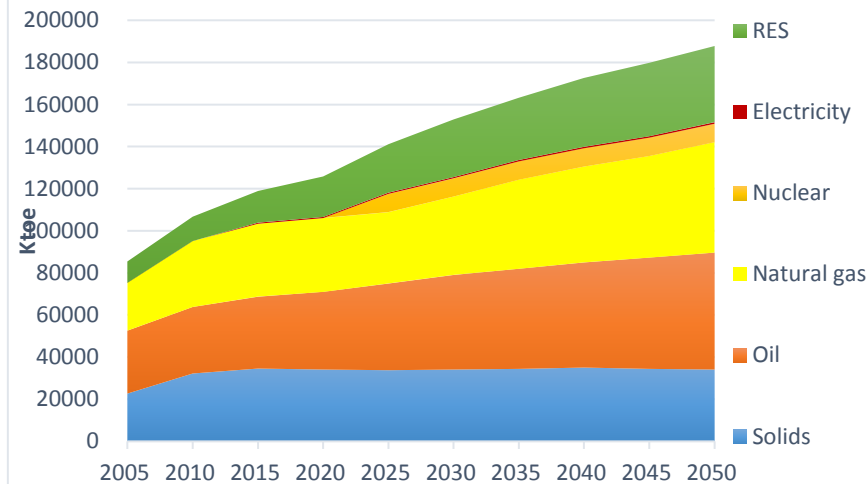
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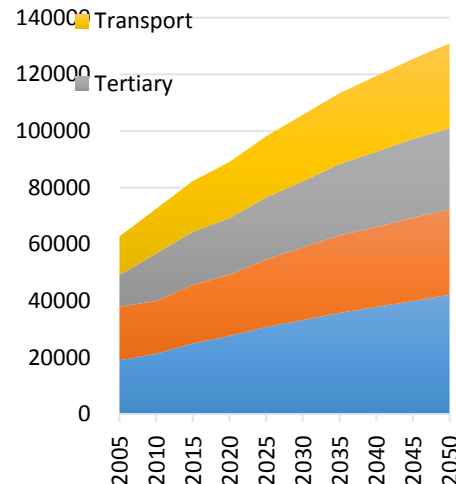
Turkey : Energy demand

19

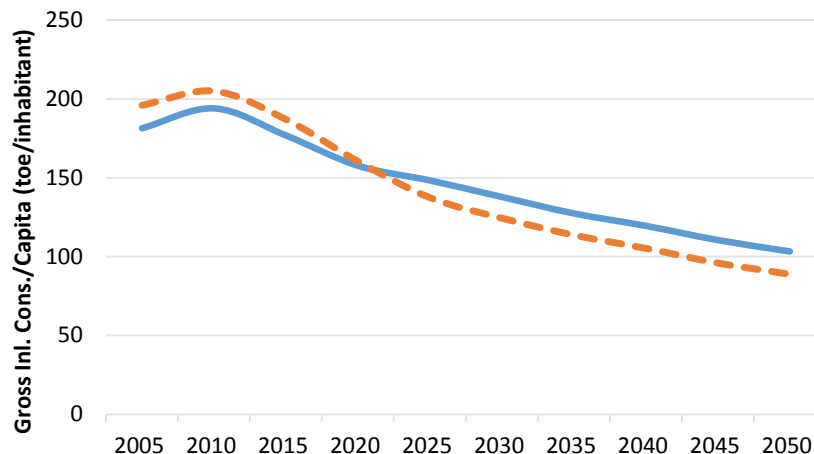
Gross Inland Consumption



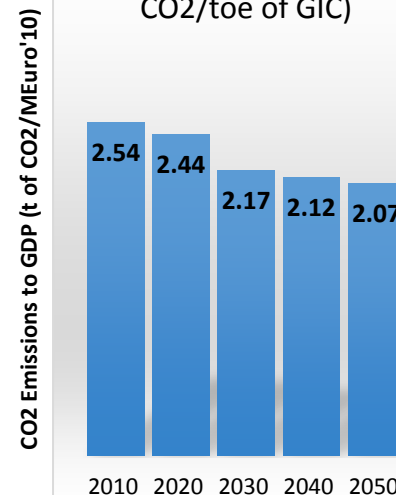
Final energy (ktoe)



— Gross Inl. Cons./GDP (toe/MEuro'10)
 - - - CO2 Emissions to GDP (t of CO2/MEuro'10)



Carbon intensity (t of CO2/toe of GIC)



Primary energy requirements increase by 1.4% pa which is half of GDP growth rate

Oil and gas demand increase at rates similar to total energy but RES increase faster, while solid fuels remain stable. Nuclear energy is introduced in the fuel mix post 2020 but attains a mere 5% of total.

Energy intensity of GDP decreases by 1.6% per year and carbon intensity of GDP decreases by 2.1% year. However, carbon intensity of primary energy remains at rather high levels despite penetration of RES and nuclear.

Final energy demand increases in all sectors (between 1.4% and 1.7% pa depending on the sector), including industry.

The substantial improvement of energy efficiency in all sectors is not sufficient to curb demand rise.

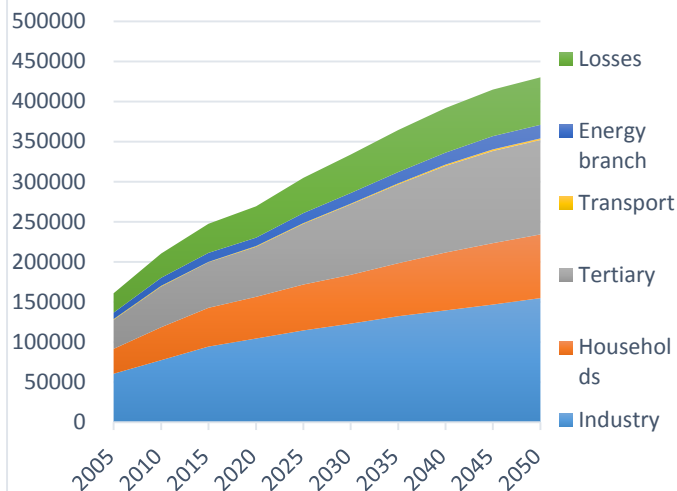
Gas is the fastest growing energy form in end-use, followed by electricity. RES in final demand increases modestly as traditional biomass decreases and new forms of RES increase only slowly. Demand for oil is driven by consumption in transport sector (1.4% growth pa).

The energy system is heavily dependent on imports of oil and gas.

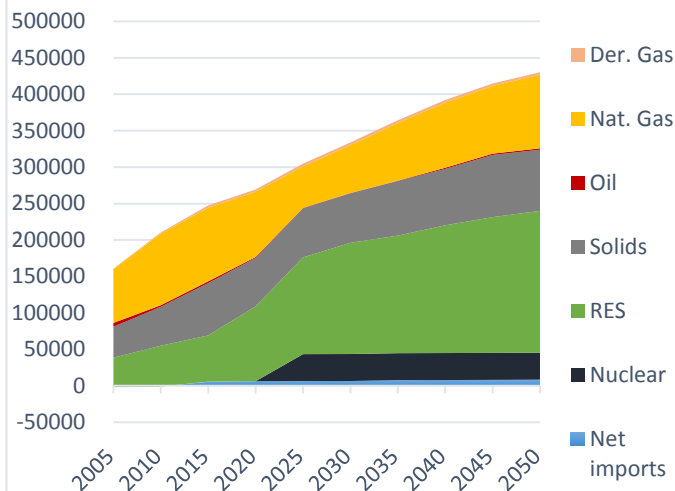
Turkey : Electricity Outlook

20

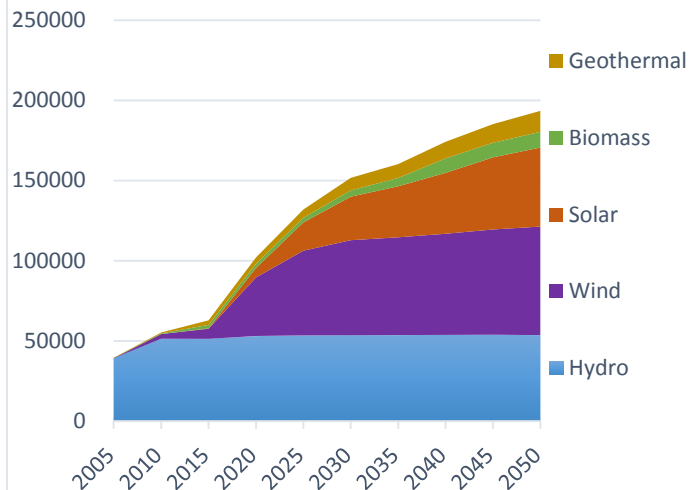
Electricity consumption (in GWh)



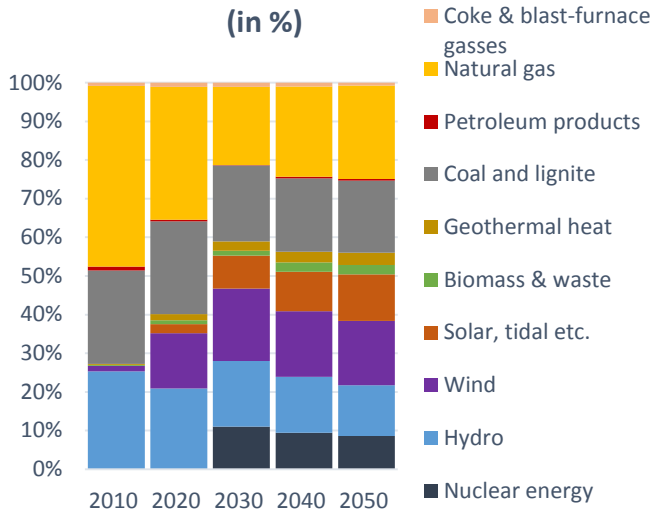
Gross Electricity supply (in GWh)



Net Generation by Renewables (GWh)



Net Electricity generation by fuel type (in %)



Demand for electricity increases by 1.8% per year on average and increases its share in all sectors except transport.

Nuclear energy stays below 10% of total generation and investment beyond capacities under construction was not found economic.

The share of solid fuels remain stable while the share of gas decreases, displaced firstly by nuclear and then by renewables.

The renewables reach 40% of generation by 2020 and stay close to 45% throughout the projection. RES deployment takes place mainly after 2020 and is driven by economics, favoring both wind and solar energy.

Imports of electricity remain at low levels (below 2% of total).

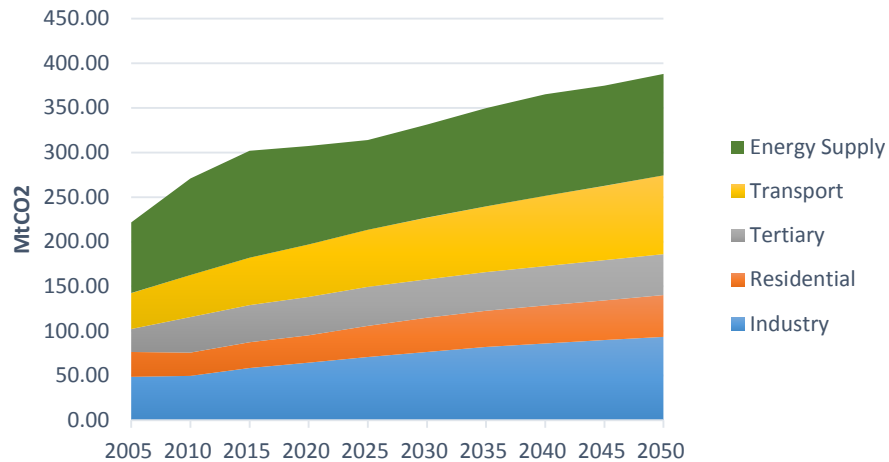
Capacity expansion is dominated by renewables in the long term. Considerable investment in gas plants is projected but the rate of use of gas plants decline over time.

Electricity prices significantly increase until 2020, as needed to cover increased capital costs of investment in nuclear, hydro and other RES, but remain stable after 2020. Residential and services tariffs increase but industrial prices remain stable.

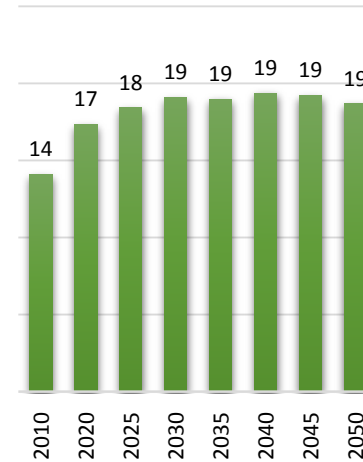
Turkey : Emissions and Costs

21

Energy related CO2 emissions



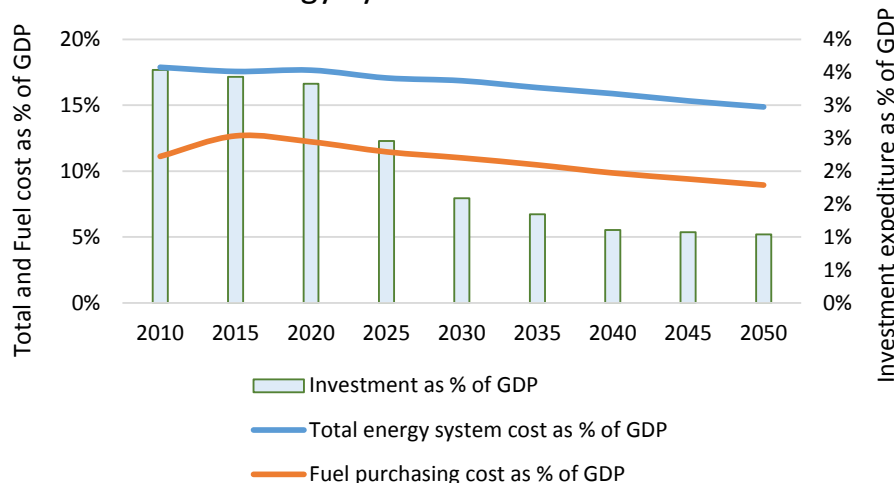
Overall RES Share (%)



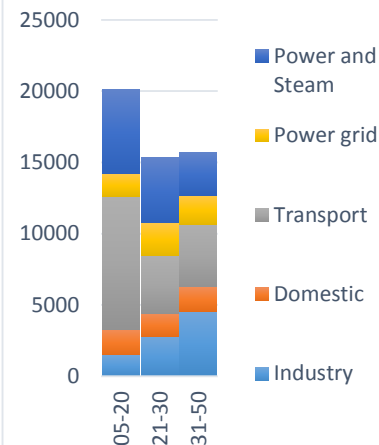
Carbon emissions increase by 1% per year despite decrease of carbon intensity of power generation (by 1.6% pa). Carbon emissions increase mainly in transport and industry and remain stable in the power sector.

The penetration of RES drives upwards the overall RES share which attains a level of 19% in 2030, up from 14% in 2010.

Energy System Cost Indicators



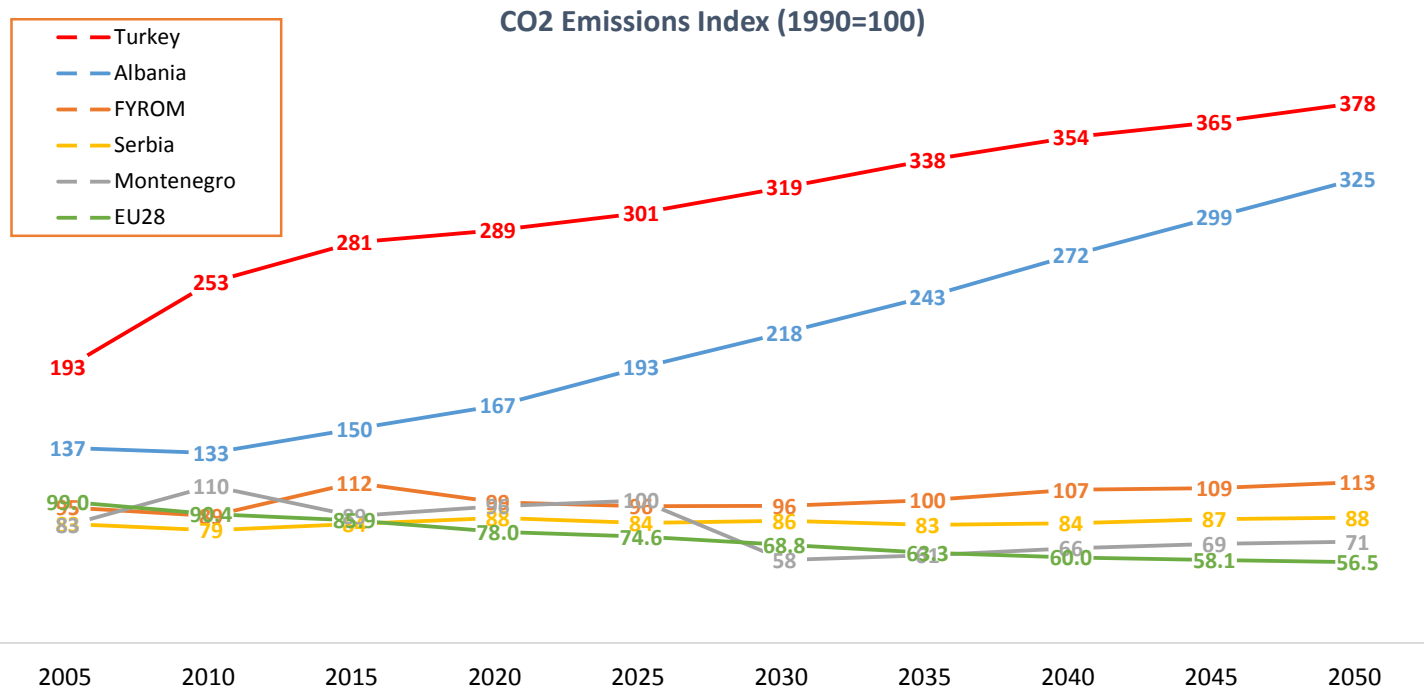
Investment per year (million €)



Energy system costs as % of GDP increase in the short term but steadily decrease in the medium and long term. The amount of energy related investments is higher in the short term (3.5% of GDP annually) and decreases in the long term (up to 1.5% of GDP). The investments are mainly in the transport sector, followed by the power sector and by industry, mainly in the long term.

Conclusions on Emissions

22



Except Turkey and Albania the rest of countries' CO2 emissions stay close to 1990 levels until 2030.

Turkey's and Albania's emissions are projected to grow significantly under Reference scenario assumptions

However, in all countries, the growth of emissions is significantly lower than GDP growth.

Despite declining emissions (except in Turkey where they increase), the carbon intensity of the economies remain high.

CO2 Emissions to GDP (t of CO2/MEuro'10)

