INFLUENCE OF THE REORGANIZATION OF ENERGY INFRASTRUCTURE TO AIR POLLUTION IN THE BALTIC STATES
Enerģijas infrastruktūras reorganizācijas ietekme uz gaisa piesārņojumu Baltijas valstīs

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Abstract
Prognosis of environmental quality in Baltic states related with the closure of Ignalina Nuclear Power Plant according to two electricity production scenarios was made. (Scenario 1 - closure date of Block 1 is 2005, closure date of Block 2 is 2011; Scenario 2 - closure date of Block 1 is 2005, exploitation of Block 2 will be extended at least until 2020.) We can see that in accordance with both scenarios CO_2 an SO_2 emission will increase every year. Although the influence of the largest air pollution sources such as Estonian/Baltic PP, Lithuanian PP Riga CHP and others remains very significant to the situation in Baltic States, new power plants will forward the rise of total emission.

Keywords: ***environmental quality, Baltic States, energy infrastructure.***

Introduction

The change of cities and districts' infrastructure is an ordinary occurrence to be investigated by historical, technical and ecological aspects. In course of time the economical activities characteristic of a separate region, grow more or less intensive, become numb, fail or transform to another activity. Every change of infrastructure is attended by changes characterized from the point of view of environmental quality evaluation. We can find a lot of unique examples both in the past and at present.

These occurrences in the post communist countries including the countries of the Eastern Shores of the Baltic Sea are taking place rather intensively and, we suppose, it will still take place for a long time. Therefore the prognosis of environmental quality related with these occurrences become very important. Since the closing time of Ignalina Nuclear Power Plant (INPP) approaches the question is: what ecological consequences of this step will be?

When the service time of nuclear fuel channels expires the exploitation of reactors will have to be ceased. There is two possible scenarios for INPP future:

1. Scenario 1 - closure date of Block 1 is 2005, closure date of Block 2 is 2011
2. Scenario 2 - closure date of Block 1 is 2005, exploitation of Block 2 will be extended at least until 2020 [1,2].

However, the closing of INPP will cause a lot of negative social, environmental and other consequences. Other ecological consequences of closing INPP could also be expected.

So it is of the huge importance to evaluate the impact of Ignalina NPP closure on the possibilities of Lithuania and other Baltic states as well to comply with obligation of international conventions on air pollution. For this reason it is necessary to determine the increased atmospheric pollution levels when the both units of Ignalina NPP will be closed and new generating capacities will be installed according the least cost power sector development plan.

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Analysis data

The Balmorel model was applied for three countries Lithuania, Latvia and Estonia. Electricity market was assumed to be common for all three countries.

The model reflects the interdependency between heat and power production. CHP plants in certain areas can be forced to produce because of the heat demand, even though there is no need for electricity production. In these situations, it may be necessary to reduce the electricity production at other plants in the "system" or increase the export. Electricity production in Lithuania, Latvia and Estonia according to the Scenario 1 presented in Picture 1 [1, 2].

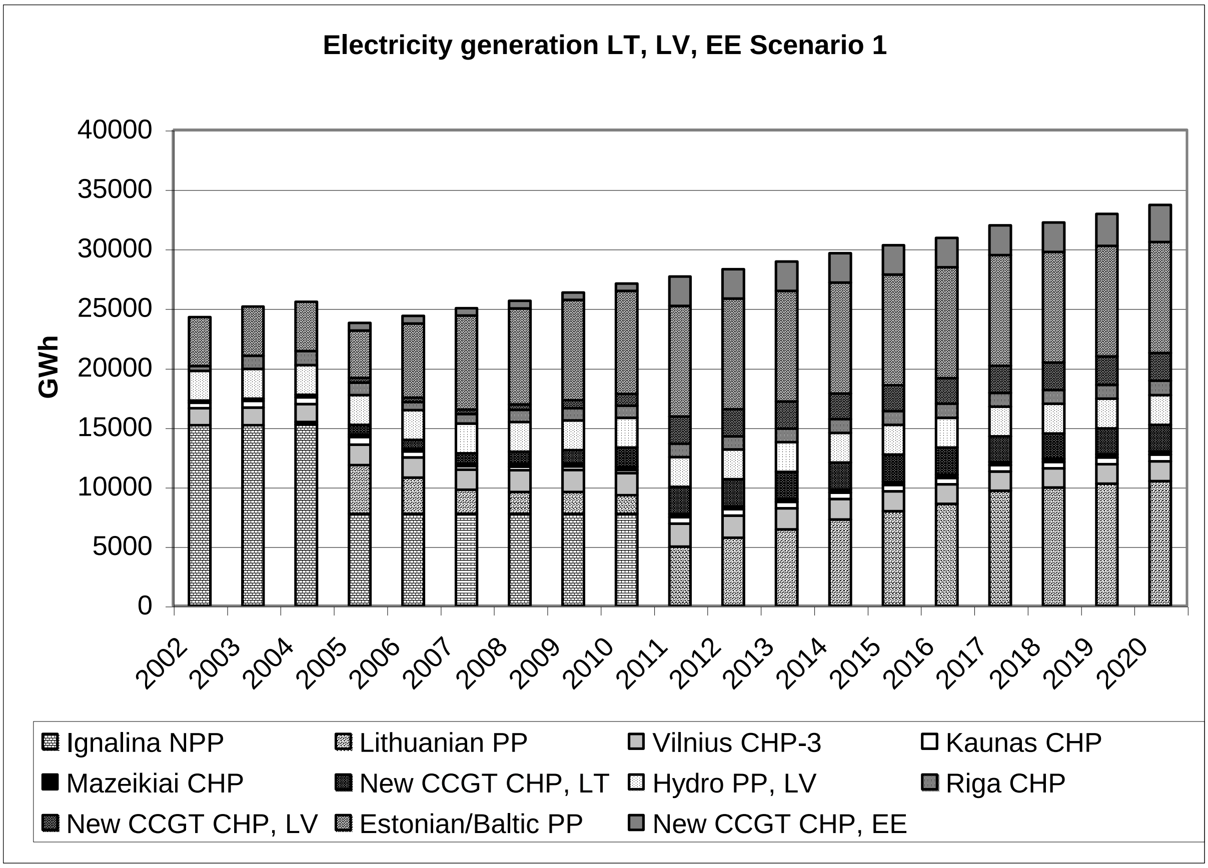

Fig.1. Electricity generation in Lithuania, Latvia and Estonia according to Scenario 1

Electricity production in Lithuania, Latvia and Estonia according to the Scenario 1 presented in Picture 2 [1, 2].

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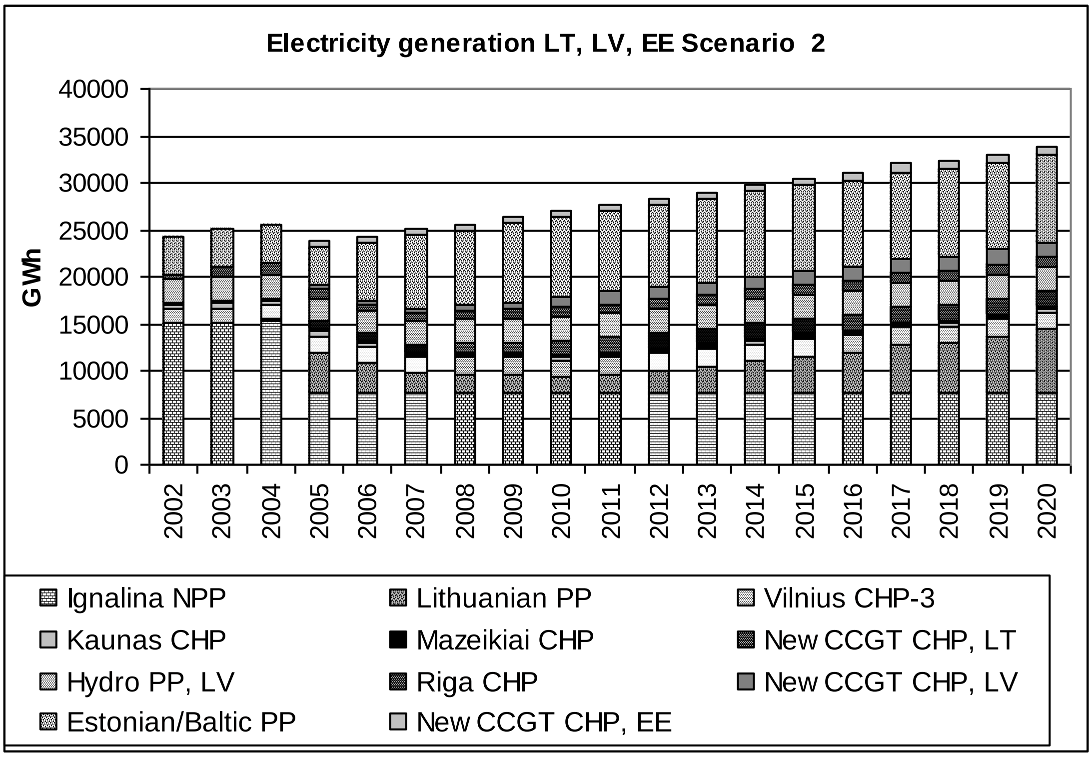

Fig.2. Electricity generation in Lithuania, Latvia and Estonia according to Scenario 2

For pollutants formation forecast we used a formation (emission) factors taken mainly from literature source [4]. Only for shale combustion in Estonian power plants we calculated necessary emission factors according to official information about annual emissions [5].

Formation factors of CO_2 and SO_2 are different and depends on to fuel type. The used formation factors of CO_2 and SO_2 are presented in the table 1.

Table 1.

Pollutants formation (emission) factors, kt/PJ, for different fuel types

Fuel type	**G CO2**	**G SO2**
Natural gas	53,655	0
Heavy fuel oil	78,8	1,463
Heavy fuel oil 40%, natural gas 60%	63,713	0,5852
Orimulsion 40%, natural gas 60%	64,077	0,77
Shale	82,18	0,607

For all power stations will be used combination of heavy fuel oil 40% and natural gas 60% fuel, but Mazeikiai CHP will be used only heavy fuel oil, Lithuanian PP – combination of orimulsion 40% and natural gas 60%, Estonian PP – shale.

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Pollutants formation forecast in the baltic region after inpp closure according to the scenario 1

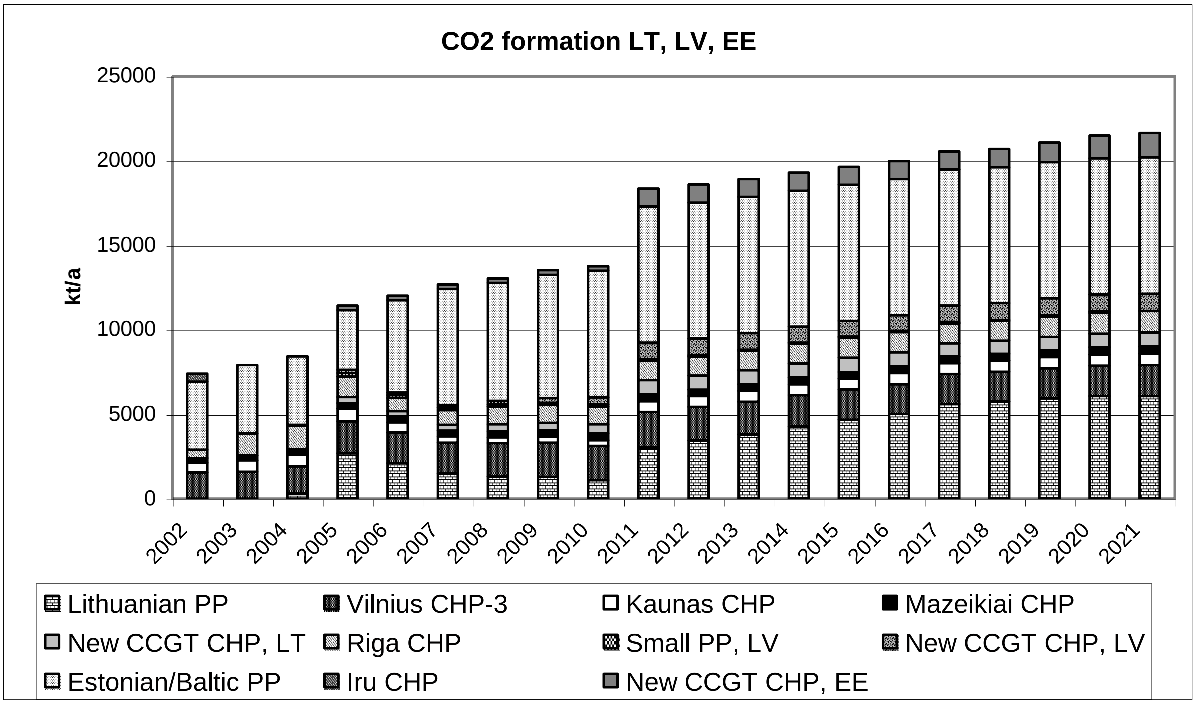

Fig.3. CO_2 formation forecast in Lithuanian, Latvian and Estonian power sector according to Scenario 1

CO_2 formation forecast in the power sector of all three Baltic countries show that emitted CO_2 amount and its distribution between power plants almost correspond the possible fuel consumption. After INPP closure the main input in Lithuania will belong to Lithuanian PP, in Estonia to Estonian/Baltic PP, in Latvia CO_2 formation will practically equally dividual between Riga CHP and new CHP.

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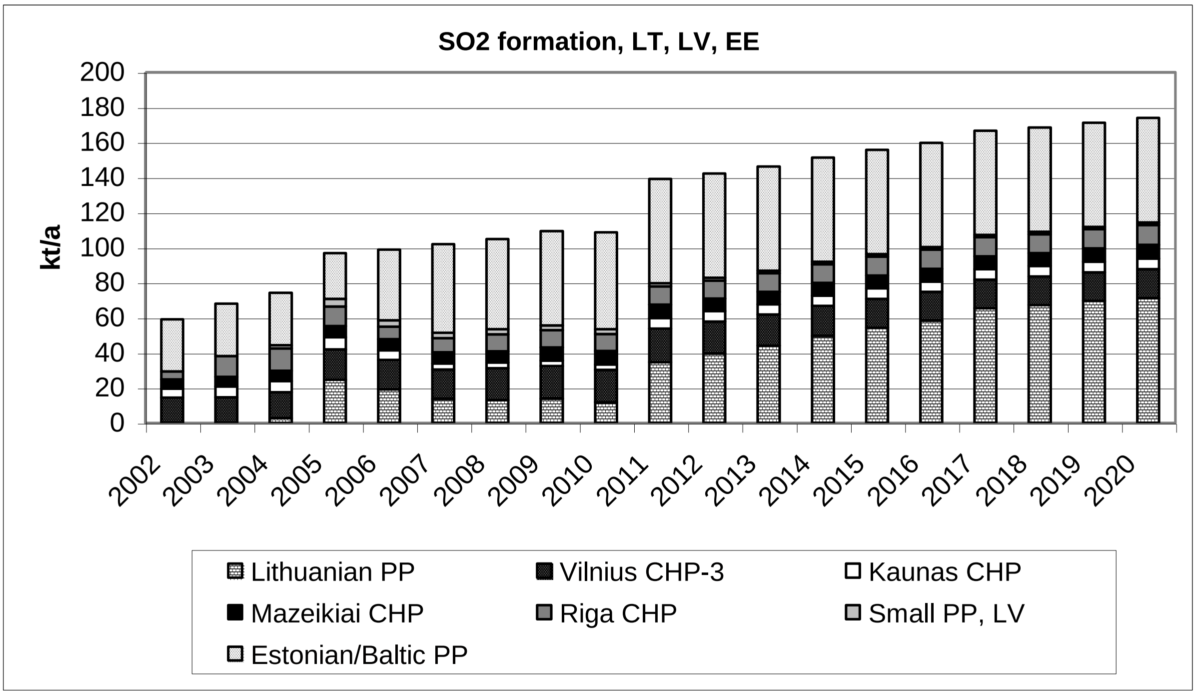

Fig. 4. SO_2 formation forecast in Lithuanian, Latvian and Estonian power sector according to Scenario 1

SO_2 formation forecast in the power sector of all three Baltic countries show that after INPP closure the main in Lithuanian power sector formed SO_2 amount will belong to Lithuanian PP, in Latvia – to Riga CHP, in Estonia – to Estonian/Baltic PP.

After closure of first INPP-unit, the formed SO_2 amount in Lithuania will increase twice, after closure of second INPP-unit this increased amount will increase twice again. So in 2011 the formed SO_2 amount in Lithuania will increase six time. Further the SO_2 formation will geminate only after 10 years.

At the same time in Estonia between 2005 and 2010 formed SO_2 amount will increase twice but graduate. From 2010 this amount will be almost steady.

After closure of first INPP unit the SO_2 formation in Latvian power sector will decreased by use of fuel of less sulphurity and further will not intensive fluctuate.

Pollutants formation forecast in the Baltic region after INPP closure according to the scenario 2

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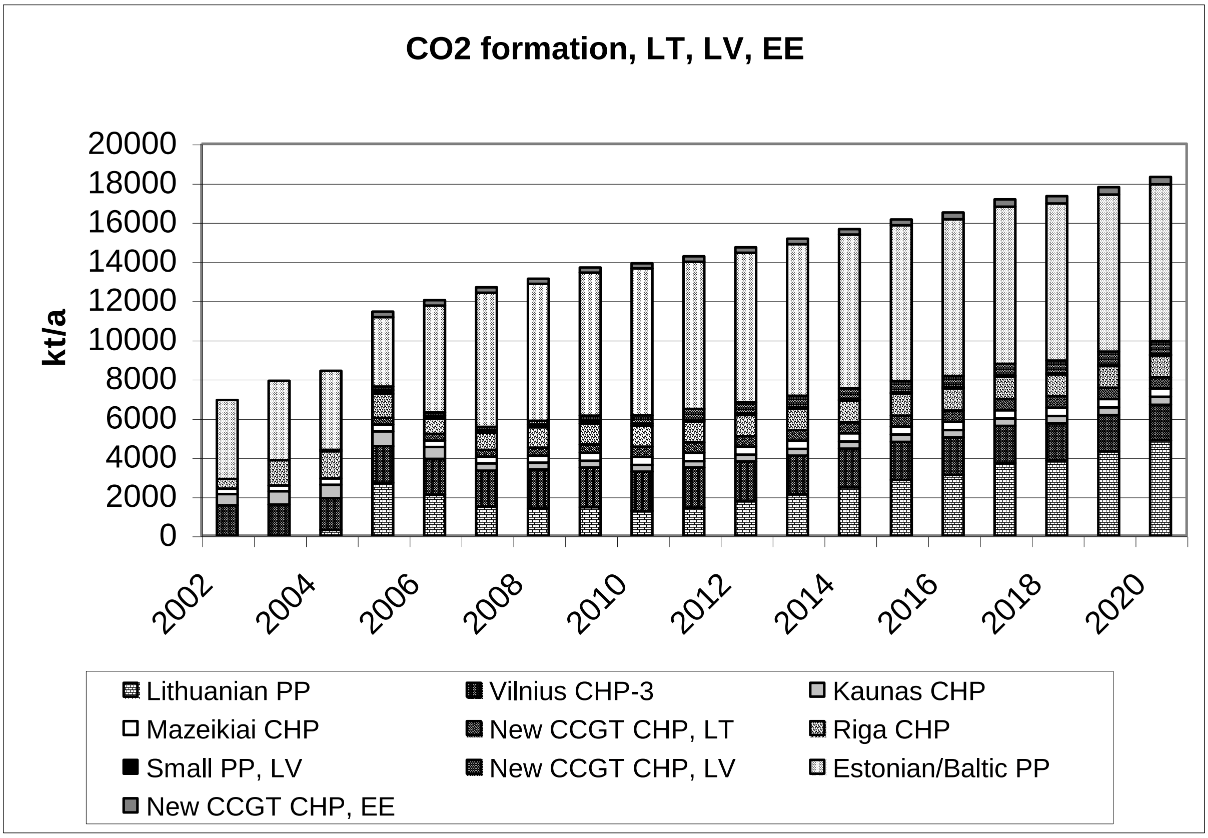

Fig. 5. CO_2 formation forecast in Lithuanian, Latvian and Estonian power sector according to Scenario 2

After the closure of INPP block 1 the main input in Baltic states will belong to Estonian/Baltic PP and Lithuanian PP, besides, the influence of Riga CHP will increase after 2005.

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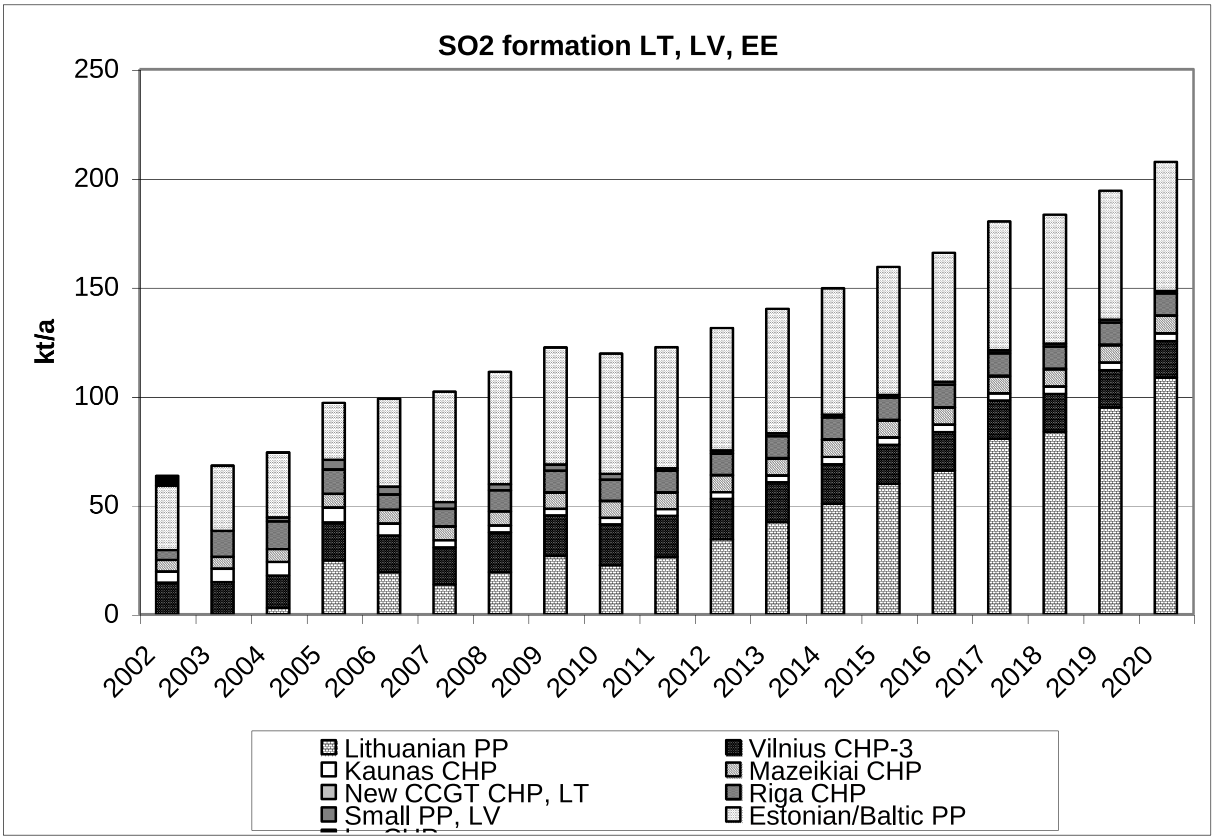

Fig.6. SO_2 formation forecast in Lithuanian, Latvian and Estonian power sector according to Scenario 2

SO_2 formation forecast in the power sector of all three Baltic countries show that after INPP closure the main in Lithuanian power sector formed SO_2 amount will belong to Lithuanian PP, in Latvia – to Riga CHP, in Estonia – to Estonian/Baltic PP.

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Conclusions

a) According to both energy development strategy scenarios CO_2 emission will increase. According to Scenario 1 CO_2 emission will change from 7500 kt/a in 2002 to 21000 kt/a in 2020 (it will reach 20000 kt/a up till 2016). According to Scenario 2 CO_2 emission will change from 7000 kt/a in 2002 to 18000 kt/a in 2020 (it will reach 15000 kt/a up till 2013).

b) According to both energy development strategy scenarios SO_2 emission will grow every year. According to Scenario 1 SO_2 emission will change from 60 kt/a in 2002 to 175 kt/a in 2020. According to Scenario 2 CO_2 emission will change from 65 kt/a in 2002 to 205 kt/a in 2020.

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