Ministry of Environment and Physical Planning
The Government of the Republic of Republic of Macedonia

ANALYSES OF POSSIBLE GHG EMISSIONS LIMITATIONS

Report on measures/policy actions for the scenario for reducing GHG emissions in order to comply with the possible future targets

Third National Communication to the UNFCCC

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The Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I country and party to the Kyoto Protocol without quantified emission limitation and reduction commitment (QELRC). The Republic of Macedonia is a candidate country to European Union (EU) and, for the analyses of this report it is assumed that it could become a member in 2020. Assessing from the accession of Cyprus and Malta, two EU members that were also non-Annex I parties to UNFCCC, the Republic of Macedonia will be asked to request becoming an Annex I country as a part of EU negotiation process.

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Resume

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty with objective to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The Kyoto Protocol to the UNFCCC is an international treaty that sets binding obligations on industrialised countries to reduce emissions of greenhouse gases. As part of the Kyoto Protocol, many developed countries have agreed to legally binding limitations/reductions in their emissions of greenhouse gases in two commitments periods. The first commitment period applies to emissions between 2008-2012, and the second commitment period applies to emissions between 2013-2020, pending Doha amendment entering into legal force. A new platform of negotiations under the Convention has started which is planned to deliver a new and universal greenhouse gas reduction protocol, legal instrument or other outcome with legal force by 2015 for the period beyond 2020.

The Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I country and party to the Kyoto Protocol without quantified emission limitation and reduction commitment (QELRC). The Republic of Macedonia is a candidate country to European Union (EU) and, for the analyses of this report, it is assumed that it could become a member in 2020. Assessing from the accession of Cyprus and Malta, two EU members that were also non-Annex I parties to UNFCCC, the Republic of Macedonia will be asked to request becoming an Annex I country as a part of EU negotiation process.

EU has monitored its emissions from 1990 till 2005 on the national and on block level. It has managed to reduce its GHG emissions by 7.9% during that period. Following the start of the Emission Trading System (ETS) in 2005 covering large industrial and energy installations, it has started to monitor emission separately, in ETS sector and in non-ETS sectors. The Effort Sharing Decision sets national emission targets for non-ETS sector emissions for 2020, expressed as percentage changes from 2005 levels. They range from a 20% emissions reduction for the richest to a 20% increase for the least wealthy one, Bulgaria, collectively delivering a reduction of around 10% compared to 2005

levels. Together with a 21% cut in emissions covered by the EU ETS, this will accomplish the overall emission reduction goal of the climate and energy package, namely a 20% cut below 1990 levels by 2020. In the recent Green Paper "A 2030 framework for climate and energy policies", EC proposes to reduce GHG emissions for by 40% by 2030 compared to 1990, which would convert to QELRC of some 30% for period 2021-28 (assuming the third budget period will be also 8 years as second). It could be reasonable to expect the same division of ETS/non-ETS efforts, so that two thirds of the effort (-40% by 2030 compared to 1990) would continue to be in ETS and one third in non-ETS sector. This means 47% emission reduction in ETS and 22% in non-ETS sectors should be achieved by 2030 compared to 2005 level. The effort sharing beyond 10% in non-ETS sectors would probably be calculated in a straightforward way by multiplying the total additional non-ETS reduction for the EU27 by the share of each Member State's non-ETS emissions in 2020.

The Republic of Macedonia would as Bulgaria have non-ETS sectors emissions (estimated as 36% of the total, 4.7 MtCO2eq) limited to 20% increase by 2020 compared to 2005 (5.6 MtCO2eq or 0.2% of the total EU non-ETS emissions in 2020). The reduction by 2030 would then be 0.2% of the total EU effort (0.7 MtCO2 eq), limiting its non-ETS emissions to 5% increase compared to 2005, or at 4.9 MtCO2eq.

The ETS sector on the other hand has no national targets, making the conversion of the predicted situation into the targets indeterminate, but it could be assumed that the Republic of Macedonia may have to reduce their emissions by 2030 by 20-40%, entirely in its ETS sector. The scenarios should then continue towards 2040 with 35%-60% reduction and towards 2050 with 50%-80% reduction of GHG emissions.

In case of not acceding to the EU, The Republic of Macedonia would have a choice of either offering QELRC compared to base year, possibly 1990, or compared to the baseline/business as usual scenario. In case of base year QELRC all or most of the efforts should come from power sector.

For the purpose of this study, it would be suggested to model wide range of QELRC for 2021-28, starting from -20%going up to +20%. In order to be able to model scenarios up to 2050, for each next budget period, and assuming the same approach will be used with 8 year periods, the QELRC should be reduced by 10 percentage points at each end of the spread.

If the baseline scenario (business as usual, BAU) is taken as the basis of offer, than the Republic of Macedonia may offer more ambitious goals numerically, although their absolute value is depending on the definition of the scenario. The targets to evaluate should be baseline deviation of -10% to -20% for 2020, -15% to -30% for 2028 and -30% to -60% for 2050.

In all cases similar type of policies and measures will be implemented, but with different speed and intensity. Actually, in all cases it makes sense to implement EU type of policies and measures, since they are well balanced, but the Republic of Macedonia may put accent on those measures that would be most beneficial for its development.

In order to reduce GHG emissions, the Republic of Macedonia has many available actions and measures. Some of the actions and measures are already being implemented, some will have faster phase in, some slower, some will happen because of technological spill over effect from equipment producers, some will have to be enacted in the future.

The actions and measures will be described here, by sector, including power, heating, industry, transport and others.

Power (electricity generation) sector:

- renewable electricity target as part of National Renewable Energy Action Plan (NREAP)
- carbon pricing through Emission Trading Scheme(ETS)
- phasing out of old power plants through Large Combustion Plants Directive (LCPD) and Industrial Emissions Directive IED
- power exchange (day ahead, intraday)
- measures for increasing efficiency of transmission and distribution
- smart metering for demand side time management

Heating and cooling sector:

- buildings directive
- renewable heating target as part of NREAP
- heating equipment efficiency improvement
- resistance heater replaced by heat pumps
- increased use of waste heat in district heating
- increased use of heat pumps in district heating
- increased use of waste to energy in district heating
- carbon tax on fuels

Industrial sector:

- carbon pricing through ETS or carbon tax on fuels
- phasing out of old boilers through LCPD and IED
- equipment efficiency improvement
- fuel conversion to gas, biomass and waste (from fuel oil and coal/coke)

Transport sector:

- renewable transport fuel target as part of NREAP
- reduced CO2 emissions per km
- hybrid cars
- modal shift
- improved public transport

Other:

- phase out of incandescent light bulbs
- higher efficiency of electric appliances
- higher efficiency of electronic equipment
- labelling

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty with objective to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The treaty itself set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. In that sense, the treaty is considered legally non-binding. Instead, the treaty provides a framework for negotiating specific international treaties (called "protocols") that may set binding limits on greenhouse gas emissions. It entered into force on 21 March 1994. It has 195 parties and the European Union (EU).

Parties to the UNFCCC listed in Annex I of the Convention are the industrialized (developed) countries and "economies in transition" (EITs). EITs are the former centrally-planned economies of Central and Eastern Europe. The EU is also an Annex I Party. These parties have taken commitments.

Parties to the UNFCCC listed in Annex II of the Convention are members of the Organization for Economic Cooperation and Development (OECD). Annex II Parties are required to provide financial and technical support to the EITs and developing countries to assist them in reducing their greenhouse gas emissions (climate change mitigation) and manage the impacts of climate change (climate change adaptation).

Parties to the UNFCCC not listed in Annex I of the Convention, or non-Annex I countries, are mostly low-income developing countries. Developing countries may volunteer to become Annex I countries when they are sufficiently developed.

The Kyoto Protocol to the UNFCCC is an international treaty that sets binding obligations on industrialised countries to reduce emissions of greenhouse gases. In total 190 countries (all UN members, except Andorra, Canada, South Sudan and the United States), as well as the EU, are Parties to the Protocol. The Protocol was adopted by Parties to the UNFCCC in 1997, and entered into force in 2005.

As part of the Kyoto Protocol, many developed countries have agreed to legally binding limitations/reductions in their emissions of greenhouse gases in two commitments periods. Parties listed in Annex B of the Kyoto Protocol are Annex I Parties with first- or second-round Kyoto greenhouse gas emissions targets. The first-round targets apply over the years 2008–2012. As part of the 2012 Doha climate change talks, an amendment to Annex B was agreed upon containing a list of Annex I Parties who have second-round Kyoto targets, which apply from 2013–2020. The Protocol was amended in 2012, so called Doha amendment, to accommodate the second commitment period, but this amendment has (as of May 2013) not yet entered into legal force.

The Republic of Macedonia is a party to the UNFCCC as a non-Annex I country and party to the Kyoto Protocol without quantified emission limitation and reduction commitment (QELRC).

There are national renewable energy sources (RES) and energy efficiency (EE) targets in line with the EU commitments under energy-climate package - 21% share of RES in final energy consumption in 2020 and energy savings in the amount of 9% of average energy consumption over the period 2002-2006 to be achieved in 2018. Also, the mitigation analyses for the Second national communication under UNFCCC have shown that 20-30% deviation from the business-as-usual greenhouse gases (GHG) emissions can be achieved in 2020 with appropriate mitigation scenarios, which besides EE and RES, assume increased utilization of natural gas.

The Republic of Macedonia is a candidate country to EU. The European Commission has recommended start of negotiations process, but due to naming dispute with one of the EU members the negotiations have not yet started. In order to assess the most abrupt change possible to Macedonia's position related to UNFCCC and for the purpose of this report it will be assumed that the negotiations will start in next two years, it will take 4-5 years as usual with other countries, and it will take two years for the ratification process. Thus, it is assumed that the Republic of Macedonia will become a member of EU in 2020.

In case that the Republic of Macedonia does not enter EU by 2020, it will have two options under UNFCCC. One is to offer QELRC compared to base year GHG emissions or compared to baseline scenario.

The Republic of Macedonia is not under obligation to enter EU ETS or have a national ETS, but may do so voluntarily (as Norway, Iceland, Liechtenstein and Switzerland did – Croatia did so but just 6 months before accession to EU), once in EU, it will be obliged to participate in EU ETS.

Total national GHG emissions and removals in the period 1990-2009 range between 11.5 and 13.3 Mt CO_2-eq (Figure 1). The GHG emissions originate mostly from the Energy sector (73.41%), followed by Agriculture (12.87%) and Waste (7%). The industry sector is accountable for 6.72% of the country emissions. Land Use, Land Use Change and the Forestry sector accounts for 3–10% of emissions, depending on forest fires, the management of soils (limestone and fertilizer application) and the conversion of land in the specified year.

Figure 1. Total National emissions and removals in CO2-eq for the period 1990-2009 [Gg][1]

Emissions from the Energy sector are in the in range of 8.5 -9 Mt CO_2-eq associated to great extent with the predominantly lignite based power generation.

Assessing from the accession of Cyprus and Malta, two EU members that were also non-Annex I parties to UNFCCC, the Republic of Macedonia will be asked to request becoming an Annex I country as a part of the negotiation process.

[1] http://unfccc.org.mk/content/InventoryHtml/InvetoryApplication.html, as accessed on July 1

Cyprus case. Republic of Cyprus was a non-Annex I party to the UNFCCC and to the Kyoto Protocol. It has acceded to the EU in 2004. It has participated in EU Emission Trading System since the phase I. However, in December 2008, through the EU climate and energy package, Cyprus has been allocated with the reduction target of 5% compared to 2005 by 2020 for sectors not included in the Emissions Trading (Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020). These include among other the sectors of transport, agriculture, waste, buildings etc. Moreover, there is also the target of 21% for the ETS installations, which is a target for the whole of the EU (Directive 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community). Cyprus has requested being added to the Annex I in 2011, which has been decided by COP17 (Decision 10/CP.17). It was planned to have it enter in force by January 1, 2013 or later. Consequently to its eventual inclusion in Annex I, Cyprus has been included into the Annex B of the Doha amendment to the Kyoto Protocol, with quantified emission limitation or reduction commitment (2013–2020) set to 80% of base year or period.

Malta case. Republic of Malta was a non-Annex I party to the UNFCCC and to the Kyoto Protocol. It has acceded to the EU in 2004. It has participated in EU Emission Trading System since the phase I. However, in December 2008, through the EU climate and energy package, Malta has been allocated with the limitation target of 5% growth compared to 2005 by 2020 for sectors not included in the Emissions Trading (Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020). Malta has requested being added to the Annex I in 2009, which has been decided by COP15 (Decision 3/CP.15). The amendment entered into force on 26 October 2010. Consequently to its inclusion in Annex I, Malta has been included into the Annex B of the Doha amendment to the Kyoto Protocol, with quantified emission limitation or reduction commitment (2013–2020) set to 80% of the base year or period.

The QELRCs for the European Union and its member States for a second commitment period under the Kyoto Protocol are based on the understanding that these will be fulfilled jointly with the European Union and its member States, in accordance with Article 4 of the Kyoto Protocol. The QELRCs are without prejudice to the subsequent notification by the European Union and its member States of an agreement to fulfil their commitments jointly in accordance with the provisions of the Kyoto Protocol. The actual national emission targets are regulated by EU effort sharing scheme.

EU effort sharing scheme. EU has monitored its emissions from 1990 till 2005 on the national and block level. It has managed to reduce its GHG emissions by 7.9% during that period. Following the start of the Emission Trading System (ETS) in 2005 covering large industrial and energy installations, it has started to monitor emission separately, in ETS sector and in non-ETS sectors. The non-ETS sector is including most other source as defined by Kyoto Protocol, which are not covered by ETS, but is not covering land use, land use change and forestry (LULUCF) sector. Since 2005 is the first year of fully verified emissions in the ETS sector, that year is used as secondary base year. The Effort Sharing Decision sets national emission targets for non-ETS sector emissions for 2020, expressed as percentage changes from 2005 levels. It also lays down how national limits in tonnes for each year from 2013 to 2020 are to be calculated. In March 2013, the Commission formally adopted the national annual limits throughout the period for each Member State. The national emission targets for 2020 have been agreed unanimously. They have been set on the basis of Member States' relative wealth (measured by Gross Domestic Product per capita). They range from a 20% emissions reduction by 2020 (from 2005 levels) for the richest Member States to a 20% increase for the least wealthy one, Bulgaria. Less wealthy countries are allowed emission increases in non-ETS sectors because their relatively higher economic growth is likely to be accompanied by higher emissions. Nevertheless their targets represent a limit on their emissions compared with projected business as usual growth rates. A reduction effort is thus required by all Member States. By 2020, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the non-ETS sectors compared with 2005 levels. Together with a 21% cut in emissions covered by the EU ETS, this will accomplish the overall emission reduction goal of the climate and energy package, namely a 20% cut below 1990 levels by 2020.

The third commitment period. A new platform of negotiations has started under the Convention which is planned to deliver a new and universal greenhouse gas reduction protocol, legal instrument or other outcome with legal force by 2015 for the period beyond 2020. This new negotiation critically includes finding ways to further raise the existing level of national and international action and stated ambition to bring greenhouse gas emissions down. The third commitment period will at least partially coincide with the fourth phase of the EU emission trading scheme, which is planned to run from 2012-2028. In the recent Green Paper "A 2030 framework for climate and energy policies" EC proposes to reduce GHG emissions by 40% by 2030 compared to 1990.

The state-of-the-art in the Republic of Macedonia. The mapping exercise consisted of fact finding mission and studying relevant documents. The institutions visited included UNDP, World Bank, GIZ, Ministry of Environment and Physical Planning, Energy Agency, Ministry of Transport and Communications, USAID, City of Skopje government, MANU and Ministry of Economy.

The awareness of climate change issue is rather high, but there is a general view that it is expensive for the Republic of Macedonia to combat climate change. The capital Skopje is a member of Covenant of Mayors network. Macedonian government has adopted the main strategies in the energy sector and national energy efficiency and renewable energy targets. Also the link energy-climate change has been established by integrating the climate change mitigation into energy planning. The main challenge is to continue the alignment of the energy sector with EU energy-climate objectives, including gradual opening of energy markets, reducing greenhouse gas emissions, increasing energy efficiency and increasing the share of renewable energy. Also, awareness of green economy and potential of new energy sectors in generation employment should be improved.

Building upon previous work that analysed the physical impacts of climate change in the country and recommendations given in the Second National Communication, several examples of climate change integration are offered below that will further help the country to comply with its obligations towards the UNFCCC and to be better prepared for negotiating the climate change chapter with the EU[2]:

[2] Zdraveva P., Grncarovska Obradovic. T., Markovska N., Macedonia: Good practices in the preparation of the Greenhouse Gas Inventories and V&A Assessment, in: Country papers: Preparation of National Communications from Non-Annex I Parties to the UNFCCC; A Compilation of Lessons Learned and Experiences from selected countries, National Communication Support Programme (NCSP), 2012, pp 48-54., http://www.unfccc.org.mk/Default.aspx?LCID=224 as accessed on July 1

- Macedonia has associated to the Copenhagen Accord and submitted its reduction targets and a preliminary list of mitigation actions (without quantifying the associated emission reductions) based on the action plan developed as part of the Second National Communication.
- A number of national documents setting policies for the development of key sectors have been adopted, including the National Strategy for Sustainable Development; the National Environmental Investments Strategy and the National Environmental Approximation Strategy; the Waste Management Strategy and the National Waste Management Plan; the Strategy for Energy Development in the Republic of Macedonia for the Period 2008–2020 with a Vision to 2030; the Renewable Energy Sources Strategy of Macedonia to 2020; and the National Strategy for Energy Efficiency in the Republic of Macedonia to 2020.)
- A significant study developed by UNDP–Assessing the Economic Impact of Climate Change: National Case studies–has been published, investigating the economic impacts of climate change in three major areas: the energy demand for heating and cooling, the water resources related to electricity production, and agriculture. The study represents a major breakthrough in moving towards a more climate-resilient path.
- A Law on Climate Change is envisaged to be prepared under an IPA project 2012–2014, which will establish the legal basis for transposing relevant EU legislation arising from climate "acquis".
- The World Bank's Green Growth Program and Climate Change Analytic and Advisory Support Program are assessing the economic costs and benefits of a shift to greener growth, taking into account projected climate change.
- The adoption of country-specific national emission factors and the harmonization of both IPPC and CORINAIR methodology is underway, adding value to the development of GHG inventories in terms of using higher Tier methodology.
- The Government has adopted a National Strategy for Climate Change Adaptation in the Health sector.
- A National Strategy for Climate Change Adaptation in Agriculture is under development.
- Most of the relevant ministries have nominated Climate Change Focal Points.
- There is a Roadmap for introduction of monitoring reporting and verification of GHG emissions under EU ETS in Republic of Macedonia

The position of the Republic of Macedonia in further UNFCCC negotiations depends on the outcome of the EU negotiations process. In case that the Republic of Macedonia enters EU by 2020, it will also start implementing EU mitigation policies and measures, as increase of share of renewables, participation in emissions trading system, obligatory buildings and equipment standards, labelling and certification of equipment and buildings, phasing out of inefficient technologies as incandescent light bulbs and retiring or obligatory retrofitting of inefficient plants. The sum of the measures, together with EU effort sharing scheme, will allow for achieving necessary emission reduction.

In case that the Republic of Macedonia does not enter EU by 2020, it will still continue to participate in Energy Community, with similar targets in renewables, energy efficiency and phasing out of inefficient plants. It will probably choose to continue transposition of other directives, but with slower pace. It will then have choice between joining Annex I and offering QELRC type of target, or to stay in the position of developing non-Annex I country and offer target in form of baseline deviation.

In all cases similar type of policies and measures will be implemented, but with different speed and intensity. Actually, in all cases it makes sense to implement EU type of policies and measures, since they are well balanced, but the Republic of Macedonia may put accent on those measures that would be most beneficial for its development.

Possible future GHG targets/limitations in case Republic of Macedonia

Taking into account assumption that Republic of Macedonia will become member of EU in 2020, it will have to follow the example of the two previous non-Annex I countries, Republic of Cyprus and Republic of Malta, and request its inclusion into Annex I by an amendment. It will most probably be asked to do that during negotiations of the Environment chapter, best with planned entry into force on January 1, 2021.

EU *acquis* commitments are defined as decrease of end year (non-LULUCF) emissions compared to a base year, while UNFCCC based pledges are defined as average yearly emission level in a given budget period compared with a base year. Numerically they are very different, and they could be related by a simplified equation:

QELRC = first year emissions + (End year target – first year emissions) / 2

If then one wants to compare 20% end year commitment to 2020 (voluntary commitment, no Doha amendment ratified), with 2013-2020 budget period commitment, one has to assume which was reduction in 2013. If EU commitment was 8% for the first budget period 2008-2012, and since the trajectory is not known it is assumed that in 2012 the reduction was 8% (in reality it was more, but this calculation is about commitments). If it is assumed that in the 8 years between 2012 and 2020 there is linear trajectory, each year emissions reduction will increase by 1.5% percentage points. Thus, in start year of 2013-2020 period the reductions would be 9.5%, and the average reduction on the budget period base would be 15% (rounded from 14.8% - but more correct calculation would use compounded growth calculation, with negligible differences at this level of percentage points), see Figure 2.

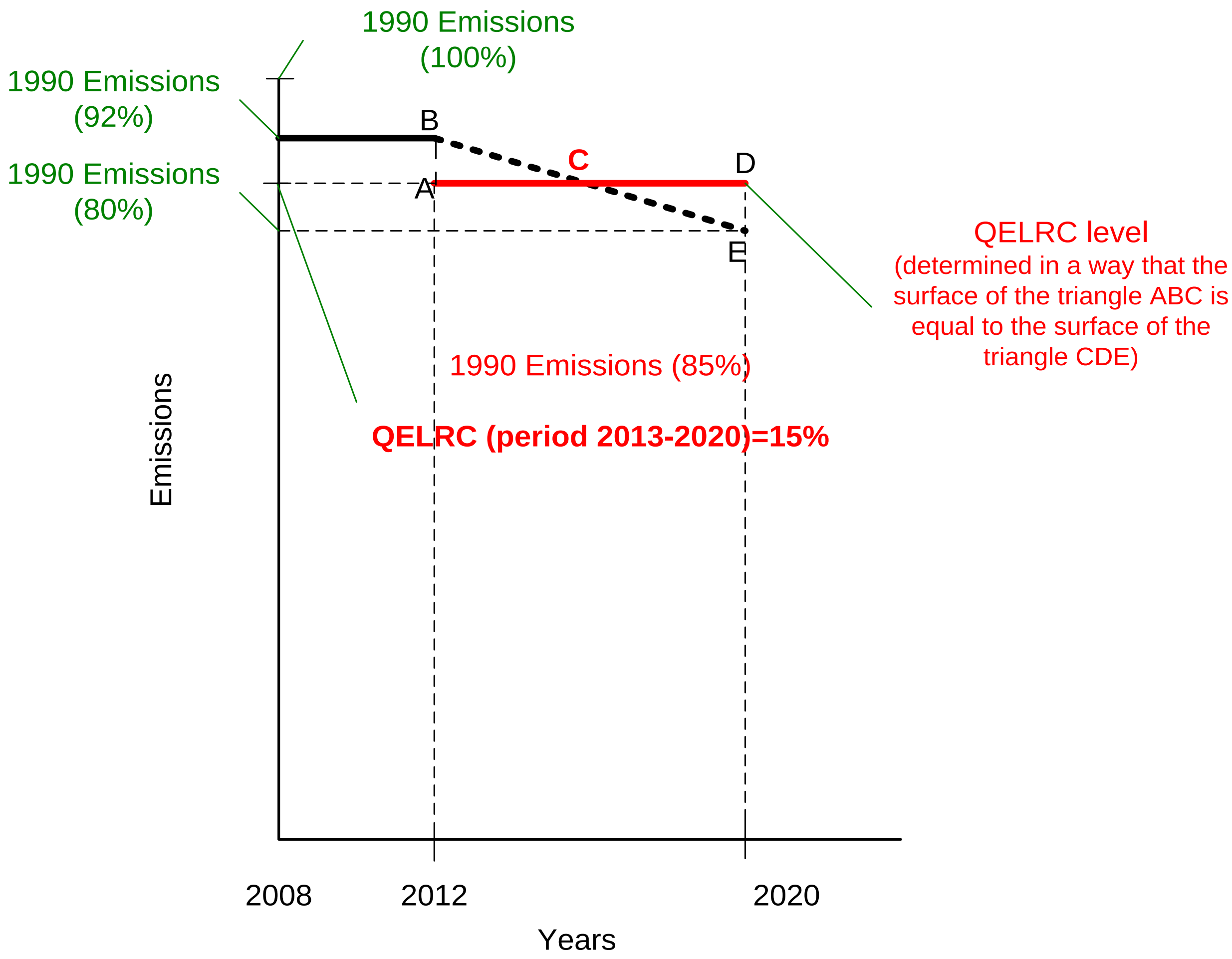

Figure 2. End year GHG targets and budget period QELRC in case of no deal (voluntary, no Doha amendment)

Equally, the calculation can be done backwards:

End year target = 2 * QELRC - first year emission

Or for example if taking EU second budget period QELRC of 20% (Doha amendment), 2*20%-9.5% = 30% rounded.

One should also take into account that LULUFC is not taken into account in EU 20% commitment.

Once the negotiations start, Republic of Macedonia will fully align its Climate change policy with EU, having the same negotiation position as EU on the new platform of the UNFCCC, which is planned to enter into force in 2015. Such a new platform will commit countries to new quantified emission limitations and reduction objectives and commitments. EU member states will most probably commit to a reduction of GHG emission between 30% and 40%. The proposed 40% GHG reduction by 2030 converts to average reduction of emission in the period 2021-28 by 29%, compared by 1990, resulting in a voluntary pledge without international deal to probably 30%. On the other hand, EU has offered to reduce GHG emissions by 30% by 2020, in case there is major agreement. Such an agreement stems from Doha amendment, in which EU has committed to 20% GHG emissions reduction in the period 2013-2020. If Doha amendment enters into force, and if there is an agreement by 2015 about the post 2020 period under UNFCCC, the linear trajectory would point to a QELRC of 38% in the period of 2021-28 (as consistent with fourth phase of EU ETS), or a 47% GHG emission reduction target for 2030.

Table 1 summarizes different reductions and conversions. In case of no international deal EU will go with its end year reduction pledge of 20% not including LULUCF. That is consistent with QELRC type commitment of 15% during second budget period. If the deal (Doha amendment) is ratified, it will commit to 20% QELRC, consistent with 30% end year reduction but including LULUCF. Also, the green paper 2030 end year commitment is consistent with 29% QELRC for the third budget period, and a trajectory consistent with Doha amendment and 2050 goals suggest QELRC of 38% or end year reduction commitment by 2030 of 47%. The later numbers are hypothetical and based on trajectories.

Table 1 Conversion between EU end period reduction pledges and QELRC (QELRC are average reduction during the commitment period) with linear trajectories

	Year	Reduction by the end period	Commitment period	QELRC during the period
No deal[3]	2020	20%	2013-2020	15%
Deal (Doha amendment)	2020	30%	2013-2020	20%
Green paper	2030	40%	2021-2028	29%
Trajectory consistent with Doha amendment	2030	47%	2021-2028	38%

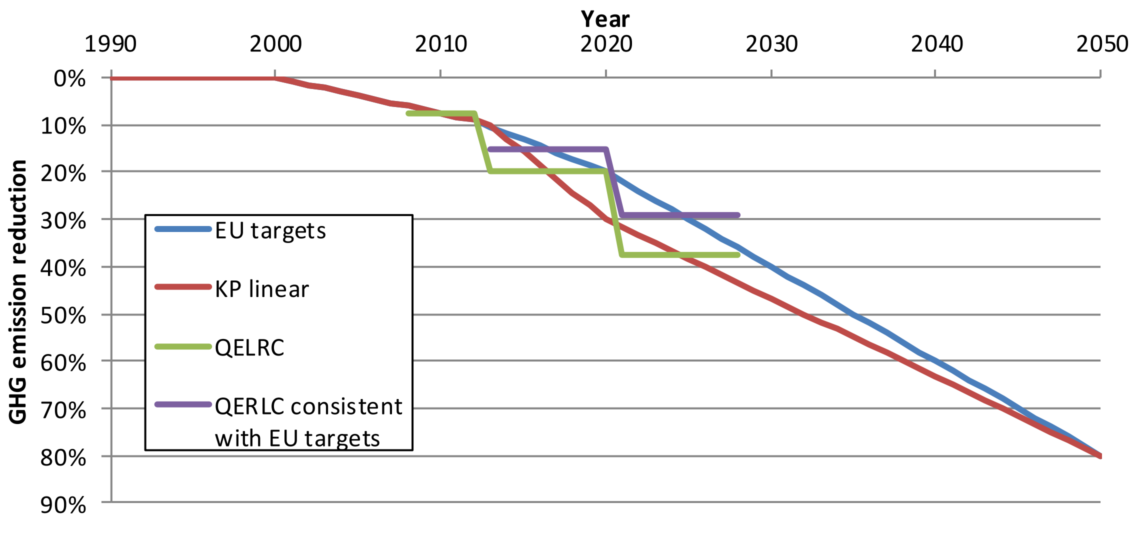

Figure 3. Trajectory of EU emission targets. EU targets without an international deal (0% by 2000, 20% by 2020, draft 40% by 2030 and roadmap 80% by 2050). Linear KP trajectory stemming from EU QELRC. EU QELRC (8% by 2008-12, 20% by 2013-20, consistent with trajectory 2021-28 38%). EU QELRC consistent with the EU targets without international deal (15% 2013-20, 29% 2021-28)

Thus, the best possible guess at the moment is that EU would offer at least 30% to be their QELRC for the third commitment period and at most 40%, also covering Republic of Macedonia.

[3] No LULUCF

Under the EU system, a part of the emissions reduction would be done at EU level through ETS IV, and the rest would be left as national effort under effort sharing scheme, setting larger reductions for EU member states with higher GDP per capita and only limitations for those with lower GDP per capita. The Green Paper "A 2030 framework for climate and energy policies" proposes to reduce the amount of international certificates to be allowed into ETS (leaving only CER mainly from projects in Least Developed Countries, LDC and Small Island Developing States, SIDS, but with coupling with other ETS like Australian one, that may actually increase the supply of international certificates), as well as to include more sectors in ETS, like for example fuel for households.

EU27 GHG emissions have decreased by 7.9% in 2005 compared to 1990 level. EU ETS covering around 50% of EU27 GHG emission is committed to decrease emissions by 21% by 2020 compared to 2005 levels, and other non-ETS emission should be decreased by further 10% in an effort sharing scheme by 2020 compared to 2005 levels. That means that two thirds of the effort is made on EU level through ETS while one third is made on national level in non-ETS sectors. It could be reasonable to expect that such a share may be continued post-2020, since it is generally considered to be easier to reduce GHG emissions in power generation and other installations, while it is more difficult to do it quickly in buildings and transport. So, the emission reduction of 40% by 2030 compared to 1990 level would mean probably 47% emission reduction in ETS by 2030 compared to 2005 level and 22% emission reduction in non-ETS sectors by 2030 compared to 2005 level, without significant increase of the ETS sector.

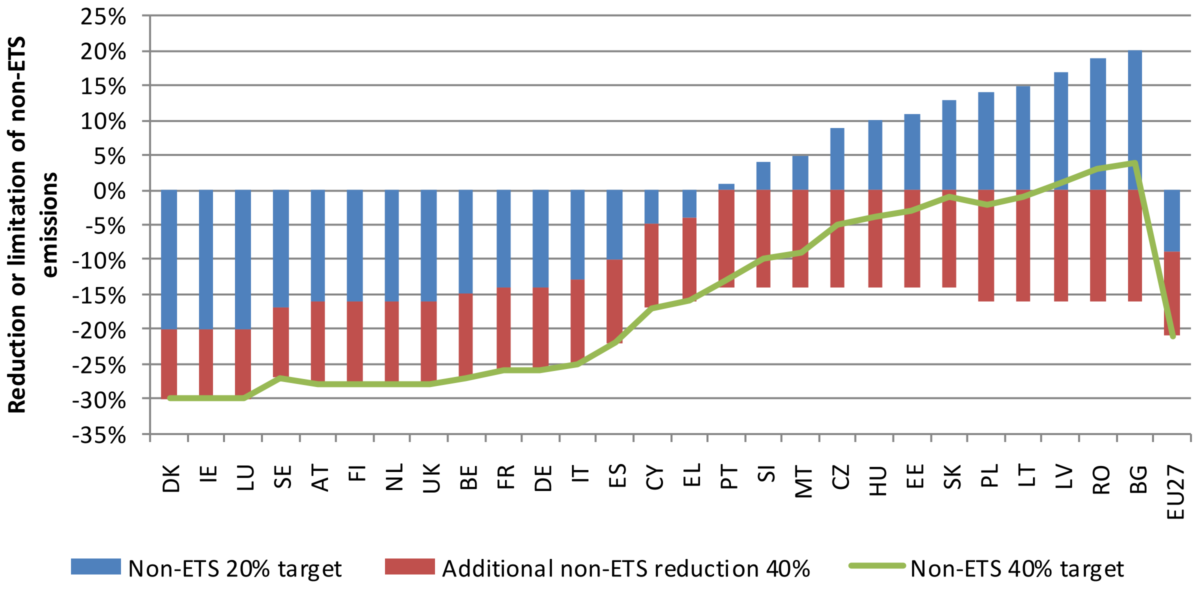

Figure 4. Emission reduction and limitation in non-ETS sectors

According to the Commission decision proposal[4] the effort sharing beyond 10% in non-ETS sectors would be calculated in a straightforward way by multiplying the total additional non-ETS reduction

[4] CEC (2008) Proposal for a Decision of the European Parliament and the Council on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. Brussels, 23.1.2008

for the EU27 in the 30% case by the share of each Member State's non-ETS emissions in 2020[5]. If the same approach is used for 40% GHG emission reduction by 2030, with non-ETS emissions being reduced by 22% than individual members states effort would be as shown on Figure 2.

Since the Republic of Macedonia has lower GDP per capita than Bulgaria, the poorest of the EU member states, and since limitation of non-ETS sectors emissions is limited to 20% increase, it would most probably, due to equitability, as a 2020 baseline has 20% higher emissions than it had in 2005. This could be negotiated differently if actual 2020 non-ETS emissions were significantly different from the 20% increase.

There is a need for survey to be made of the emissions from the Macedonian future ETS sector. It may be assumed that all of the 50% emissions coming from the energy industries and some 80% of the energy and process emissions from industry (adding to 14% of the total emissions) would make Macedonia ETS sector. Thus, ETS sector would cover 64% of emissions without LULUCF and non-ETS sector 36% of emissions. Having in mind that Macedonian emissions in 2005 were 13 MtCO2eq[6], of which then some 4.7 MtCO2eq of non-ETS emissions. With 20% growth limitation by 2020 that would make 5.6 MtCO2eq limit to non-ETS emissions. Having in mind that total non-ETS EU27 wide emission will be 2700 MtCO2eq, Macedonian would represent 0,2% of the total.

The reduction by 2030 would then be proportional to Macedonian 0.2% the total EU non-ETS emissions, and the effort would thus be 0.7 of 356 MtCO2eq, which is 15% of non-ETS sector emissions in 2005. Therefore, Macedonia would have to limit its non-ETS emissions to 5% above the 2005 level, or at 4.9 MtCO2eq.

The ETS sector on the other hand has no national targets, but the emission allowances are auctioned to installations participating in the markets. Power sector has to buy all its allowances, while other industries get for free part of allowances. The reduction of GHG emissions in ETS sector will thus depend on relative price of CO2 emission reductions in Macedonian ETS sector compared to EU ETS sector. Since by 2020 EU ETS sector will already invest significantly into GHG emission reduction, newly entering Macedonian installations will be under strongest pressure to reduce emissions. On the other hand, absolutely that pressure may be small, if the carbon price continues low. But if the price increases significantly, which is predicted for post-2020 period, Macedonian ETS sector will be disproportionately under pressure. It is thus impossible to convert the predicted situation in targets, but it could be assumed that the Republic of Macedonia may have to reduce their emissions by 2030 by 20-40%, entirely in its ETS sector. The scenarios should then continue towards 2040 with 35%-60% reduction and towards 2050 with 50%-80% reduction of GHG emissions.

In case of not acceding to the EU, The Republic of Macedonia would have a choice of either offering QELRC compared to base year, possibly 1990, or compared to the baseline/business as usual scenario. In case of base year QELRC all of effort should come from power sector.

The main difference between EU based targets and non-EU based targets is that EU based targets are relating in a different way to ETS and non-ETS sectors. ETS sector is handled by a market system, so

[5] Pernille Schiellerup, Sean Healy, David Baldock, Hauke Hermann, Jakob Graichen, Vicki Duscha, ACHIEVING MORE CLIMATE AMBITION IN THE EU: DISTRIBUTION OPTIONS, A discussion paper by IEEP and the Öko-Institut for WWF, Greenpeace and CAN-Europe, 10 June 2011

[6] http://unfccc.org.mk/content/InventoryHtml/InvetoryApplication.html accessed on July 12, 2013

country has only obligation to organise a registry and monitor implementation, while in non-ETS sector it has obligation for actions and measures (which are only partially governed by *acquis*). Under UNFCCC process country is fully responsible for actions and measures over all the emissions. It is then actually more complicated, since it has to either decide or calculate which actions and measures in which sectors would be more macro-economically viable. It is highly advisable that a country has a macroeconomic model for those purposes, but it is clearly out of scope of this project.

Since the Republic of Macedonia is economy in transition it could decide to be treated as others and offer significant decrease of emissions under UNFCCC process. But it was also part of Yugoslavia which had much more efficient energy system than ex-COMECON countries and as other ex-Yugoslav countries its emissions are not much lower than pre-transition emissions. If offering QELRC based on 1990, The Republic of Macedonia should take into account that it needs to develop but in the same time that energy processes will be more efficient. Therefore, for the purpose of this study, it would be suggested to model wide range of QELRC for 2021-28, starting from -20% going up to +20%. In order to be able to model scenarios up to 2050, for each next budget period, assuming that the same approach will be used and 8 year periods, the QELRC should be reduced by 10 percentage points at each end of the spread.

If the baseline scenario (business as usual, BAU) is taken as the basis of offer, than the Republic of Macedonia may offer more ambitious goals numerically, although their absolute value is depending on the definition of the scenario. The targets to evaluate should be baseline deviation of -20%, -30% and -40% for period 2030-2050.

Proposed methodology for setting national GHG targets/limitations

In order to propose the national GHG target/limitations consistent with its EU accession, the Republic of Macedonia should do the following:

- Follow EU negotiating position, while keeping Macedonian position pending on the actual start of negotiations
- Revisit and confirm the existing list of Macedonian ETS installations.
- Applying the methodology used in preparation of National Allocation Plans for EU ETS estimate the following emissions:
    - Analyze the share of EU ETS installations emission in the Energy sector within the categories:
        - Fuel Combustion activities (Energy industries and manufacturing industries);
        - Fugitive emissions;
    - Analyze the share of EU ETS installations emission in the Industrial processes sector within the categories:
        - Mineral industries;
        - Metal industries ;
        - Chemical industries;
        - Other industries;
    - Analyze the share of EU ETS installations emission in the Waste sector within the categories:
        - Industrial waste disposal;
- Calculate the share of non-ETS emissions;

- Develop time series for EU ETS emissions and EU non-ETS emissions starting with 2005 till the latest available year.
- Regarding ETS emissions, they will depend on the cost of allowances in the EU market (EUA). It is expected that these will stay low priced until 2020, and that only after that, in case that significant reduction is agreed in EU, will increase. Do the sensitivity analysis of the different ETS sectors based on the cost of EUA.
- Perform sensitivity analysis of the non-ETS targets depending on the various policy decisions by EU and the Republic of Macedonia.
- In case that it is expected that non-ETS emissions might significantly exceed the 2020 emissions calculated based on adding 20% on top of 2005 emissions in non-ETS sector, propose 2020 as base year for non-ETS emissions.
- Prepare Communication Strategy for Acceptance of Possible GHG emissions targets/limitations.
- Set up EU ETS compatible monitoring, reporting and verification (MRV) system at the latest by 2017, since it takes time to have the system functioning, as proposed in the Roadmap[7].
- Prepare a long-term national low-emission development strategy as a separate national planning document (with targets for 2020, 2030, 2040, 2050), converging with EU climate policy and legislation with measurable objectives, targets and action plans.
- Set up stronger administrative capacity following recommendations of the Roadmap.
- Start putting in place legislative framework.
- Foster investments in innovation, research and technology transfer.

Social and economic aspects

The greenhouse gas emission reduction or limitation has long term positive social and economic impact since it helps mitigate the climate change and its negative consequences. Meanwhile, in the short and medium term it fosters transition to the economy and way of life, which may have also negative social and economic impacts.

Since Macedonian energy sector is based significantly on locally produced coal, adding the cost of emission allowances to the economic costs of electricity, the price of electricity will consequently increase. That will necessarily force investment into energy efficiency and fuel substitution, which will have also additional benefits in creating more employment in the green economy. Meanwhile, the retail price of electricity will increase more due to other reasons like phase out of cross-subsidies, liberalization of markets etc.

The emissions in non-ETS sectors will be influenced also by other measures, especially energy efficiency legislation tackling buildings, lightning, equipment, vehicles, which will generally bring more benefits to the society since they will mostly function as fostering the technology replacement in normal life time cycles, and only maybe in case of buildings faster than that. These measures will have spill over effect into Macedonia even if it does not get into EU as assumed by this report, due to huge clout that EU legislation has over technology offered at the markets.

[7] Roadmap for introduction of monitoring reporting and verification of GHG emissions under EU ETS in Republic of Macedonia

On the other hand, convergence of standard of living and economic activity between EU and the Republic of Macedonia will have strong impact on the end use of energy, which will mean that the carbon intensity will have to be decreased accordingly.

Interesting best practice that could be interesting to Macedonia due to similarities can be found for example in Velenje, Slovenian coal mine and thermal power plant (TPP) community. The community has decided to search for sustainable solutions together with the mining and power companies, developing many development schemes that have enabled employment of ex-miners in other sectors, while keeping the production at the same level. It has invested in sustainable landscape management, energy efficiency, PV production and installation, free public transport, waste recycling and many other businesses, which allowed for reducing number of miners employed in underground mines to minimum necessary, while in the same time not creating a social problem, and actually improving the future prospects of the region. In the construction with EU funds is a new block of TPP which would replace 5 old ones reducing the need for coal for 25%.

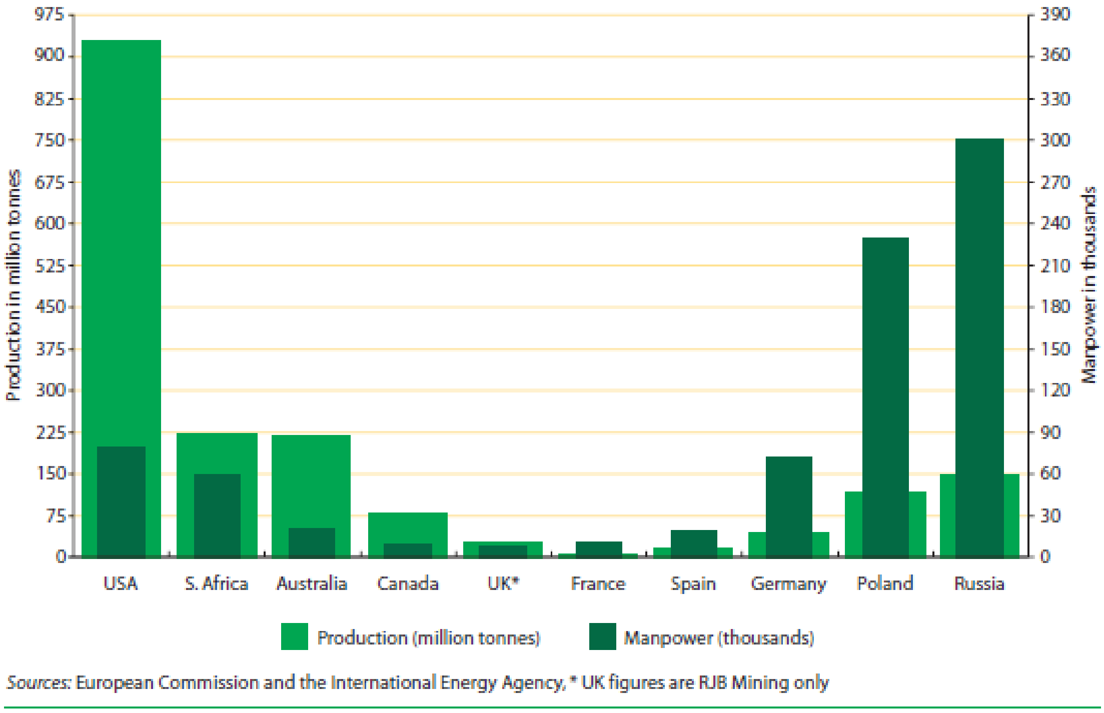

Figure 5. Production and labour costs in the coal industry[8]

European Commission in its Green Paper "Towards a European strategy for the security of energy supply"[9] states that European coal is generally non-competitive with imported coal, due to overemployment, use of old technology, lack of investment. Figure 5 shows clearly why European coal lacks viability.

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[8] EUROPEAN COMMISSION, GREEN PAPER Towards a European strategy for the security of energy supply, http://ec.europa.eu/energy/green-paper-energy-supply/doc/green_paper_energy_supply_en.pdf, aqccessed on July 16, 2013

[9] Commission Green Paper of 29 November 2000 Towards a European strategy for the security of energy supply [COM(2000) 769 final

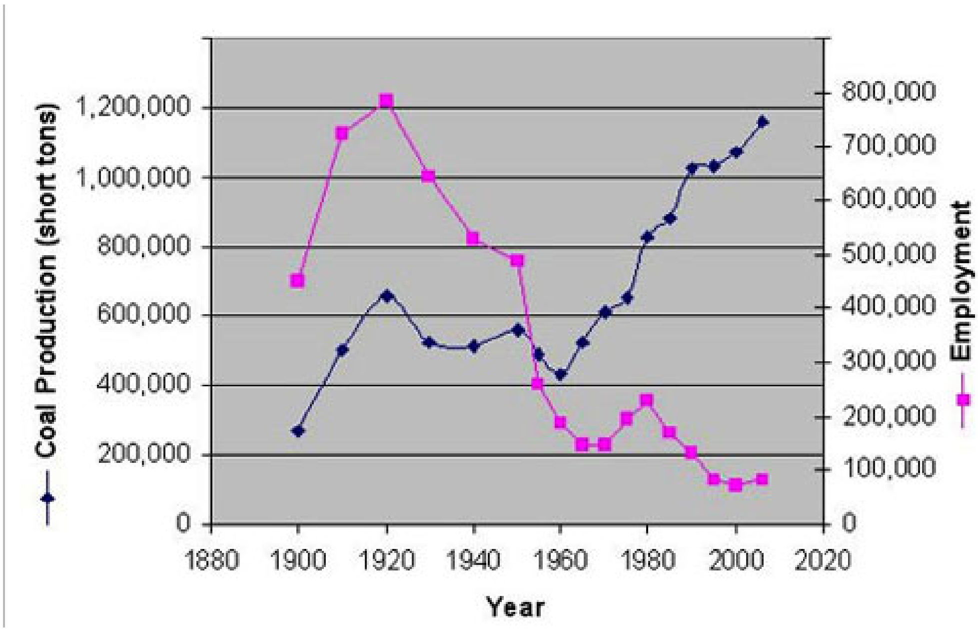


Figure 6. US Coal mining employment[10]

The coal sector in the United States (US) shows the way to go, reducing employment in coal sector by 90% while increasing production 5 times, as shown in Figure 6. Even with these huge gains in productivity, coal in US is having problems competing against cheap shale gas (the price of gas in US markets are 80% lower than in EU markets).

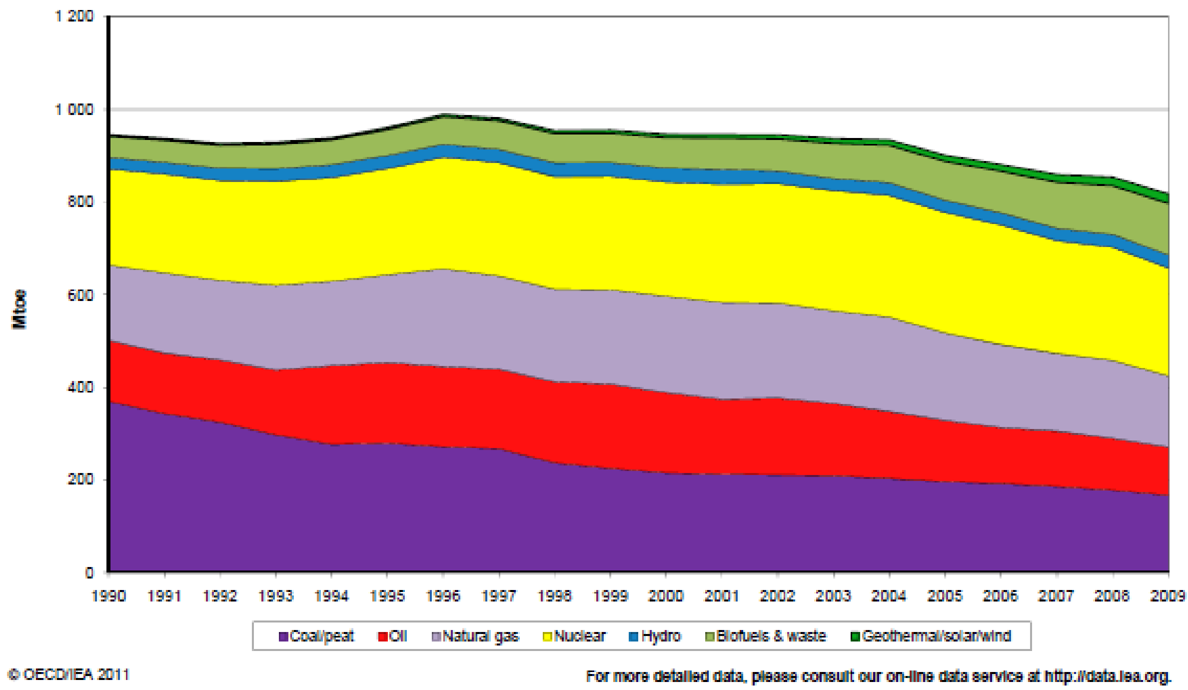


Figure 7. Energy production in European Union 1990-2009[11]

[10] http://oilprice.com/Alternative-Energy/Renewable-Energy/Renewable-Energy-And-Job-Creation-Everything-You-Have-Read-Up-Until-Now-Is-Wrong.html, accessed on July 16, 2013

[11] IEA Stats 2009, https://www.iea.org/stats/regionresults.asp?COUNTRY_CODE=30&Submit=Submit, accessed on July 16, 2013

It has generally proved to be difficult to improve the viability of coal in European industry and coal production has fallen to half between 1990 and 2009, mainly in the period till 2000, as shown in Figure 7. Its use is currently increasing due to a spill over effect of US gas shale which has brought cheaper US coal to European markets. The effect will probably last until the end of 2015, which is the date for retiring 32 GW[12] of old EU coal power plants under Large Combustion Plant Directive (LCPD). It will then be exacerbated by The Industrial Emissions Directive (IED) which will close many more by 2013.

Manpower in the European coal industry 2008 and 2010

	2008			2010		
	Hard Coal	Lignite	Total	Hard Coal	Lignite	Total
Bosnia	-	1,500	1,500	-	1,300	1,300
Bulgaria	4,700	8,600	13,300	4,600	8,200	12,800
Czech Republic	17,000	13,000	30,000	13,700	10,200	23,900
Germany	31,200	16,500	47,700	24,200	16,700	40,900
Greece	-	8,400	8,400	-	8,400	8,400
Hungary	-	3,100	3,100	-	2,400	2,400
Poland	118,800	17,400	136,200	114,100	16,300	130,400
Romania	11,500	14,400	25,900	8,800	13,500	22,300
Serbia	-	12,500	12,500	-	12,500	12,500
Slovakia	-	4,500	4,500	-	3,900	3,900
Slovenia	-	2,100	2,100	-	1,800	1,800
Spain	8,200	-	8,200	5,400	-	5,400
Turkey	17,500	36,000	53,500	18,500	37,000	55,500
Ukraine	287,300	-	287,300	271,000	-	271,000
UK	6,100	-	6,100	6,000	-	6,000
Total	**502,300**	**138,000**	**640,300**	**466,300**	**132,200**	**598,500**

Source: EURACOAL

Figure 8 Manpower in the European coal industry 2008 and 2010[13]

EU coal sector is also shedding labour by a recent rate of 3% per year, as shown in Figure 8. This is slowed down by significant subsidies to the coal sector, which are planned to be phased out by 2018. It is thus crucial to establish programmes for reemployment of coal sector labour, whichever direction is taken, since even without environmental considerations most of those jobs will disappear due to market forces.

According to UNEP Green Economy Report and other sources renewable energy sources are generally competitive with fossil fuels, although due to various open and hidden subsidies to fossil fuels (direct, tax waivers, cross-subsidies, non-internalization of external costs, incumbent monopoly position, higher entrance barriers, etc.) they are often not competitive for investors and often still have to be supported directly by governments. Figure 9 shows ranges of levelized costs for various renewable sources. While larger unit technologies have to be competitive with large scale generation, small scale technologies as PV may only have to reach grid parity, meaning being competitive with the cost of the grid electricity. That threshold has been reached in many countries, most of those where electricity is not subsidised.

[12] Sylvie Cornot-Gandolphe, The European Coal Market: Will Coal Survive the EC's Energy and Climate Policies? IFRI, 2012, www.ifri.org/downloads/noteenergiescornotgandolphe.pdf, accessed on July 16, 2013
[13] Coal industry across Europe 2011, EUROCOAL, 2011, http://www.euracoal.org/pages/medien.php?idpage=917, accessed on July 16, 2013

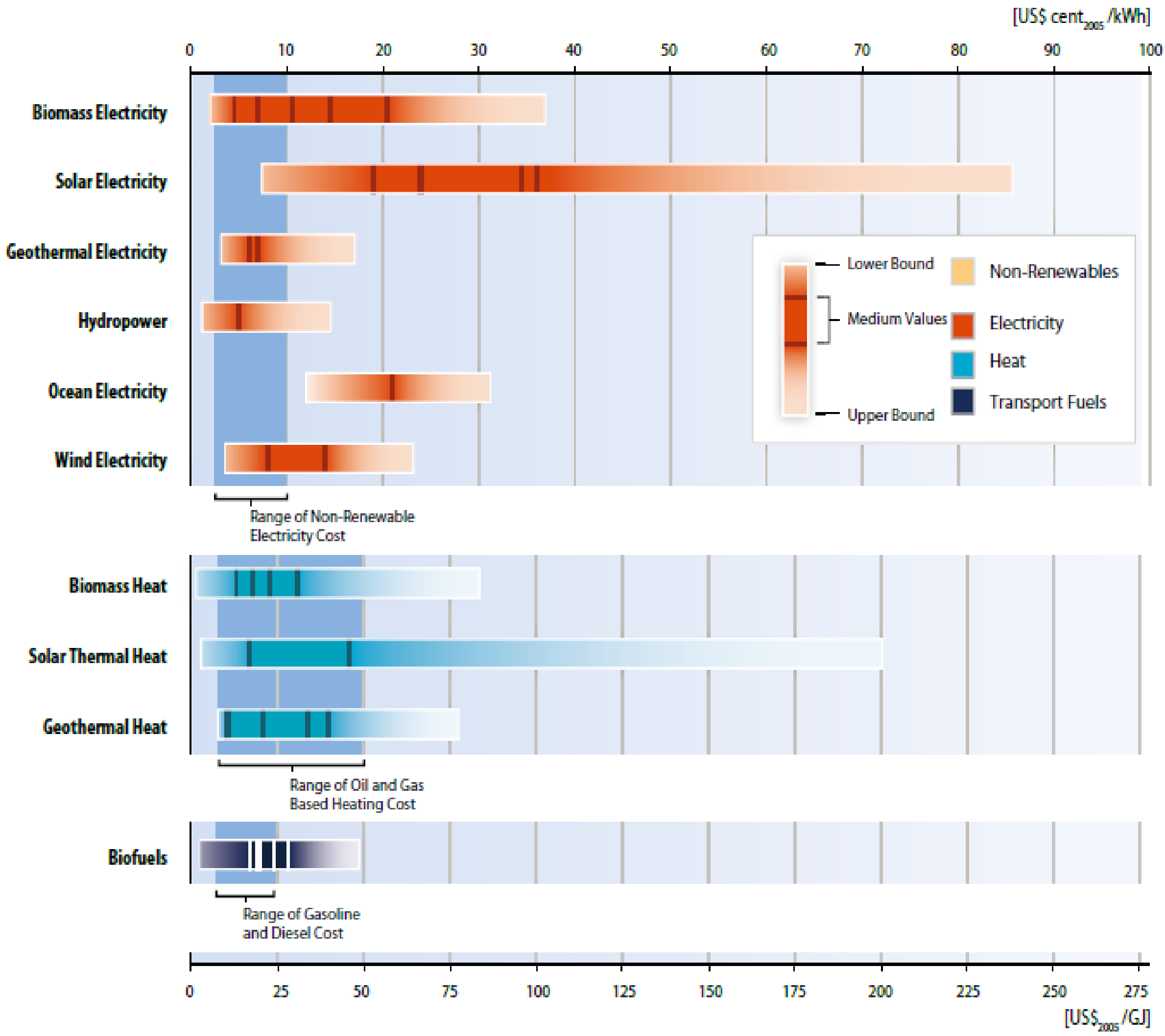


Figure 9 Range in recent levelised cost of energy for selected commercially[14]

The same report gives also estimate of jobs per megawatt of average capacity (Figure 10), showing that some of the renewable technologies are much better in terms of sustainable development, since more of the costs of technology go into labour costs, while still keeping those technologies competitive. That is even so if the equipment production is not done in the country since many of the jobs created are in construction, installation, operating and maintenance, as well as fuel processing for biomass are strictly local. Such employment may create sustainable value chains in the local economy, but only if properly implemented. The most important issue is to create continuous and dependable flow of bankable projects, which will foster local employment, instead of boom and bust way of implementation as done by Czech Republic in PV sector, which did not benefit local economy much. The total estimated direct and indirect jobs are shown in Figure 11.

[14] UNEP, Green Economy Report, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, Chapter Renewable energy, Investing in energy and resource efficiency, 2011, http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/29846/language/en-US/Default.aspx as accessed on July 11, 2013

	Average emplyment over life of facility (Jobs per megawatt of average capacity)		
	Manufacturing, construction, instalation	Operating & maintenance/ fuel processing	Total
Solar PV	5.76-6.21	1.20-4.80	6.96-11.01
Wind power	0.43-2.51	0.27	0.70-2.78
Biomass	0.40	0.38-2.44	0.78-2.84
Coal-fired	0.27	0.74	1.01
Natural gas-fired	0.25	0.70	0.95

Note: Based on findings from a range of studies published in 2001-04. Assumed capacity factor is 21% for solar PV, 35% for wind, 80% for coal, and 85% for biomass and natural gas.

Figure 10 Average employment over life of facility (jobs per MW of average capacity)[15]

It is also pointing direction towards Velenje type of sustainable development, using new energy sectors (and environmental protection sector) to bring the coal sector to competitiveness and also to increase its efficiency in order to decrease the negative environmental impact. By doing so, there may be future for the coal sector even within the emission trading system for foreseeable future.

Meanwhile, IEA Energy Technology Perspectives predict that investing in technologies necessary to keep the temperature increase at 2°C relative to 6°C would be economically viable even with discount rate of 10%, as shown in Figure 12.

Conclusion. The pressures to reduce GHG emissions will have strong impact on energy industries, but if the transition to low carbon economy is implemented gradually and cleverly, it will increase the viability of the energy system, increase employment and help the sustainable development. Postponing the transition will increase the risk of later hasty change, under pressure of some higher political goal. It may also cause that the new emerging economy sectors bypass the country and when it finally starts the transition, it will enter into the period of diminishing returns.

At least 138 countries have defined renewable energy targets while 127 have support policies in place[16].

[15] UNEP, Green Economy Report, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, Chapter Renewable energy, Investing in energy and resource efficiency, 2011, http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/29846/language/en-US/Default.aspx as accessed on July 11, 2013

[16] REN21, Renewables 2013, Global Status Report, Key findings, 2013, http://www.ren21.net/REN21Activities/GlobalStatusReport.aspx as accessed on July 11, 2013

Technologies	Global	China	EU-27	Brazil	United States	India	Germany	Spain
	Thousand Jobs							
Biomass[a]	753	266	274		152[f]	58	57	39
Biofuels	1,379	24	109	804[e]	217[g]	35	23	4
Biogas	266	90	71			85	50	1
Geothermal[a]	180		51		35		14	0.3
Hydropower (Small)[b]	109		24		8	12	7	2
Solar PV	1,360	300[d]	312		90	112	88	12
CSP	53		36		17		2	34[i]
Solar Heating/ Cooling	892	800	32		12	41	11	1
Wind Power	753	267	270	29	81	48	118	28
Total[c]	**5,745**	**1,747**	**1,179**	**833**	**611**	**391**	**378[h]**	**120**

a Power and heat applications. b Employment information for large-scale hydropower is incomplete, and therefore focuses on small hydro. Although 10 MW is often used as a threshold, definitions are inconsistent across countries. c Derived from the totals of each renewable energy technology. d Estimates run as high as 500,000. e About 365,000 jobs in sugarcane and 213,400 in ethanol processing in 2011; also includes 200,000 indirect jobs in manufacturing the equipment needed to harvest and refine sugar cane into biofuels, and 26,000 jobs in biodiesel. f Biomass power direct jobs run only to 15,500. g Includes 173,600 jobs for ethanol and 42,930 for biodiesel in 2012. h Includes 9,400 jobs in publicly funded R&D and administration; not broken down by technology. i 2011 estimate by the Spanish Renewable Energy Association (APPA); Protermosolar offers a somewhat lower figure for the same year (28,850 jobs) and finds that the number fell to 17,816 in 2012.

Note: Data are principally for 2009–2012, with dates varying by country and technology. Totals may not add up due to rounding.
Source: IRENA, *Renewable Energy and Jobs* (Abu Dhabi: 2013).

Figure 11 Estimated direct and indirect jobs in renewable energy worldwide, by industry[17]

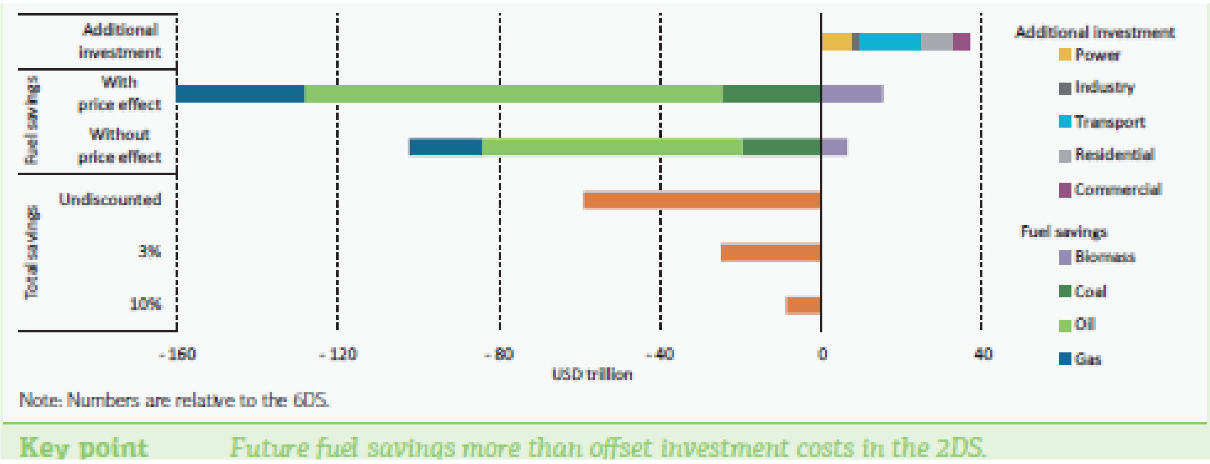


Figure 12 Investment and savings in 2°C temperature increase scenario (2DS) relative to 6°C temperature increase scenario (6DS)[18]

[17] REN21, Renewables 2013, Global Status Report, Key findings, 2013, http://www.ren21.net/REN21Activities/GlobalStatusReport.aspx as accessed on July 11, 2013

Scenarios for reducing GHG emissions

Proposed are 3 groups of scenarios, depending on the outcome of future integration processes and in order to better prepare the government to make offers. Group 1 scenarios are EU type scenarios, which are consequential to Macedonian presumed accession to EU in 2020. Group 2 scenarios are assuming Macedonian accession to Annex I to the UNFCCC but not EU and taking QELRC. Group 3 are scenarios in case the Republic of Macedonia does not decide to enter Annex I and are baseline or BAU deviation type scenarios.

Group 1 scenarios: EU and UNFCCC annex I accession assumed by 2020. Targets are given for 2030 compared to 1990. Three scenarios are proposed:

Table 2 Group 1 scenarios (EU)

Group 1 scenarios	2020	2030	2040	2050
EU_Low		-20%	-30%	-40%
EU_Medium	0%	-30%	-45%	-60%
EU_High		-40%	-60%	-80%

Group 2 scenarios: UNFCCC annex I accession assumed by 2020. Targets are given as QELRC for 2021-28 period, for end year 2028 and for end year 2030 assuming linear change between 2028 and 2030. Five scenarios are proposed:

Table 3 Group 2 scenarios (QELRC)

Group 2 scenarios	2021-28	2029-36	2037-44	2045-52
Kyoto_Low	+20%	+10%	0%	-10%
Kyoto _MediumLow	+10%	0%	-10%	-20%
Kyoto _Medium	0%	-10%	-20%	-30%
Kyoto _MediumHigh	-10%	-20%	-30%	-40%
Kyoto _High	-20%	-30%	-40%	-50%

Group 3 scenarios: BAU deviation type target, given for period 2030-2050. Three scenarios are proposed:

Table 4 Group 3 scenarios (BAU deviation)

Group 3 scenarios	2020	2028	2036	2044	2052
BAUdev_Low	-10%	-15%	-20%	-25%	-30%
BAUdev_Medium	-15%	-20%	-25%	-30%	-35%
BAUdev_High	-20%	-30%	-40%	-50%	-60%

[18] IEA Energy Technology Perspectives, 2012

Baseline scenario should be based on the expected improvements of technology efficiencies, already implemented legislation or legislations that are expected to be implemented in the foreseeable future. Also, spill over effects like increased efficiency of new cars sold should be taken into account.

In case of all mitigation scenarios carbon pricing would be used in the model. Following values are suggested:

- until 2020: 0 EUR/tCO2
- 2021 – 2024: 15 EUR/tCO2
- 2025 – 2027: 20 EUR/tCO2
- 2028 – 2030: 25 EUR/tCO2
- 2030 – 2050: 30 EUR/tCO2

Actions and measures

In order to reduce GHG emissions the Republic of Macedonia has many available actions and measures. Some of the actions and measures are already being implemented, some will have faster phase in, some slower, some will happen because of technological spill over effect from equipment producers, some will have to be enacted in future.

The actions and measures will be described here by sector, including power, heating, industry, transport and others.

Power (electricity generation) sector:

– renewable electricity target as part of National Renewable Energy Action Plan (NREAP)
– carbon pricing through ETS
– phasing out of old power plants through LCPD and IED
– power exchange (day ahead, intraday)
– measures for increasing efficiency of transmission and distribution
– smart metering for demand side time management

Heating and cooling sector:

– buildings directive
– renewable heating target as part of NREAP
– heating equipment efficiency improvement
– resistance heater replaced by heat pumps
– increased use of waste heat in district heating
– increased use of heat pumps in district heating
– increased use of waste to energy in district heating
– carbon tax on fuels

Industrial sector:

- carbon pricing through ETS or carbon tax on fuels
- phasing out of old boilers through LCPD and IED
- equipment efficiency improvement
- fuel conversion to gas, biomass and waste (from fuel oil and coal/coke)

Transport sector:

- renewable transport fuel target as part of NREAP
- reduced CO2 emissions per km
- hybrid cars
- modal shift
- improved public transport

Others:

- phase out of incandescent light bulbs
- higher efficiency of electric appliances
- higher efficiency of electronic equipment
- labelling

Actions and measures in the power sector

It is considered to be cheapest and easiest to reduce GHG emissions in power sector, since the electricity can be generated using different technologies, which emit less or does not emit GHG during generation process. Replacing old and inefficient power plants with new and more efficient may significantly decrease emissions. For example, old **coal power plants** will have efficiencies of less than 30%, while most modern plants will have 43-46%, which will decrease emissions by 50%, Figure 13. Replacing coal with gas, a fuel that emits half of the CO2 emissions emitted by coal, has also huge potential for reduction. Since gas can be used in combined cycle (coal can also be used in a system called integrated gasification combined cycle, IGCC, but that system is still being developed), the efficiencies can be increased up to 55-60%. Thus, replacing old coal power plants with new gas operated **combined cycle gas turbine** (CCGT) can decrease emissions by factor of 4. That is why US is recently very successful in reducing GHG emissions, since they are replacing old coal power plants with new CCGT.

These new CCGT are more flexible power plants, so more adapted to working in liberalized markets and with many uncertainties of the new energy systems. That is the reason why the net increase of the installed capacity in EU between 2000-12 was 121 GW.

Reducing GHG emissions further has to be done either with GHG-free technologies like renewables or nuclear, or CO2 emissions have to be captured and sequestrated. **Nuclear energy** is very efficient in reducing GHG emissions in power sector (although they may increase in mining and processing sectors) but nuclear energy is not cheap and is depending on political acceptance. According to an audit of EDF, the electricity from old nuclear power plants will cost 40-45 EUR/MWh after refurbishment necessary to prolong their life for the next 20 years, and from a new one in Flamanville between 60-90 EUR/MWh[19]. The centre of nuclear energy seems to be moving to large Asian countries, with their strong energy demand growth and command power systems, while in EU the net decrease of installed power between 2000-12 was 15 GW. Nuclear energy is disproportionately more expensive in small energy systems, due to one off costs of the first power plant in building education and monitoring system. It catches economies of scale when 10 power plants are built, which means that in Macedonian case it would only make sense if the regional

[19] *Cour des comptes*, The costs of the nuclear power sector, Paris, January 2012, http://www.environmental-auditing.org/Portals/0/AuditFiles/France_f_eng_Costs-of-the-Nuclear-Sector.pdf, accessed on July 23, 2013

power system were entirely integrated. The integration of the Energy community will probably happen, but not on the regulatory, educational and monitoring level in near future. Even EU countries transpose directives, do not implement them directly. That means that the only viable way to use nuclear energy in the Republic of Macedonia would be to own and operate a plant or a part of a plant in one of already nuclear countries in the region, Bulgaria and Romania. Such an option can be modelled in scenarios by allowing certain import band of electricity, taking into account the cost of such electricity coming from a new nuclear power plant.

Carbon capture and storage (CCS) is technology that is able to reduce GHG emissions by 80-90% in coal power plants, Figure 13, but with significant loss of efficiency. It is still not properly tested technology, and it will not be viable with the cost of CO2 emissions under 30 EUR/tCO2. Only in case that higher emission prices are modelled it makes sense to model the influence of CCS.

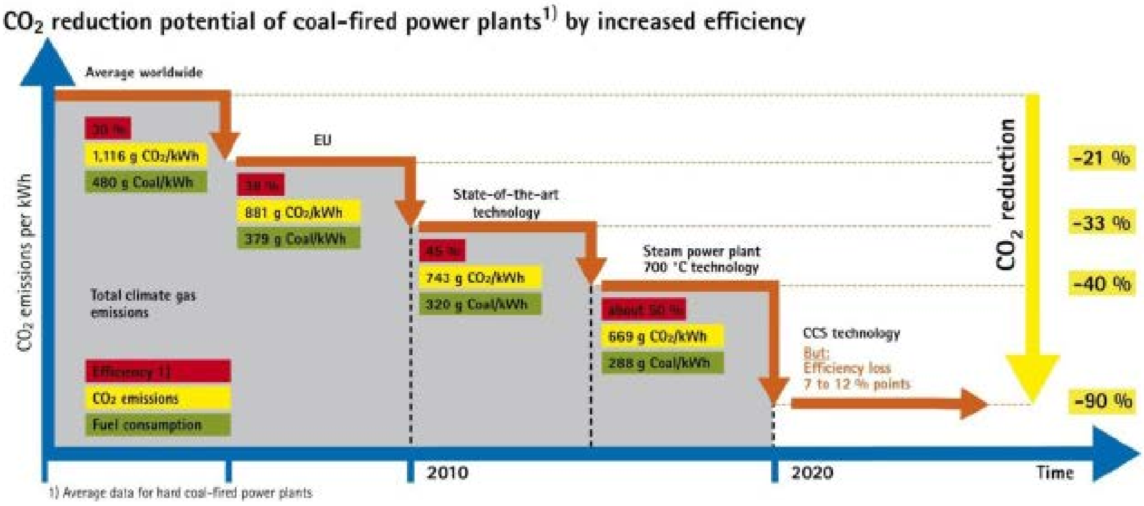


Figure 13 CO2 reduction potential of coal-fired power plants[20]

Renewable electricity is the oldest technology but it is also the new one. Hydro energy is renewable energy no matter the size of the power plants. It is sometimes confusing that some definitions limit the renewable label only to **hydro power plants** (HPP) to less than 10 MW. Actually, the Renewables Directive only limits subsidies to HPP smaller than 10 MW, and when calculating renewable share it takes them into account. Meanwhile, the problems with hydro power plants are economic and environmental. Most of cheap large HPP have already been built in the wider region and the remaining projects cost more than 100 EUR/MWh, which makes them unviable. Also, dam HPP do have significant environmental impact on nature through habitat destruction and population through raising water table. Al these reasons resulted in net increase of installed hydro capacity in EU between 2000-12 of only 4 GW, Figure 14.

The most viable renewable power comes from **wind power plants** (WPP) and that is the reason why the net increase of installed wind capacity in EU between 2000-12 was 97 GW, Figure 14, more than all other renewables put together. The cost of onshore wind electricity is relatively low, 45-90

[20] Sylvie Cornot-Gandolphe, The European Coal Market: Will Coal Survive the EC's Energy and Climate Policies? Institut français des relations internationales (Ifri), Paris, October 2012

EUR/MWh, and if only small amount of it is integrated into the power system, up to 15% on the yearly basis, the increased cost of the system will not be high. Wind will of course need replacement capacity, which is best provided by cheap CCGT and accumulation hydro. Contrary to general belief, wind will need only small increase of secondary reserve, since most of unpredictability of wind, in well planned and well run system will be covered with balancing power and tertiary reserve. Only when wind penetration is increased above 15-20% on the yearly basis will this become more complicated and costly. It is thus considered that increasing the penetration of wind to 15-20% is the most viable and easy option and most of the national renewable energy action plans (NREAP) are pointing into that direction. Denmark has already reached 30%. It is often considered that there are no viable winds in southeast Europe apart from Greece, but the wind resource is very local, and without detailed measurement it is impossible to state that there is no wind. Usually, even in non-windy countries, there are windy locations, on hilltops and along rivers. The wind is not the best technology for building the local sectors since apart from developing projects everything else can be done from outside. A good way may be to negotiate a large project which would be accompanied with setup of production of parts for wind turbines. Building own wind turbine industry would not be viable with less than 10 GW of future projects in pipeline but becoming a production site for one of the main wind turbine producers for some of the parts may be the most sustainable way.

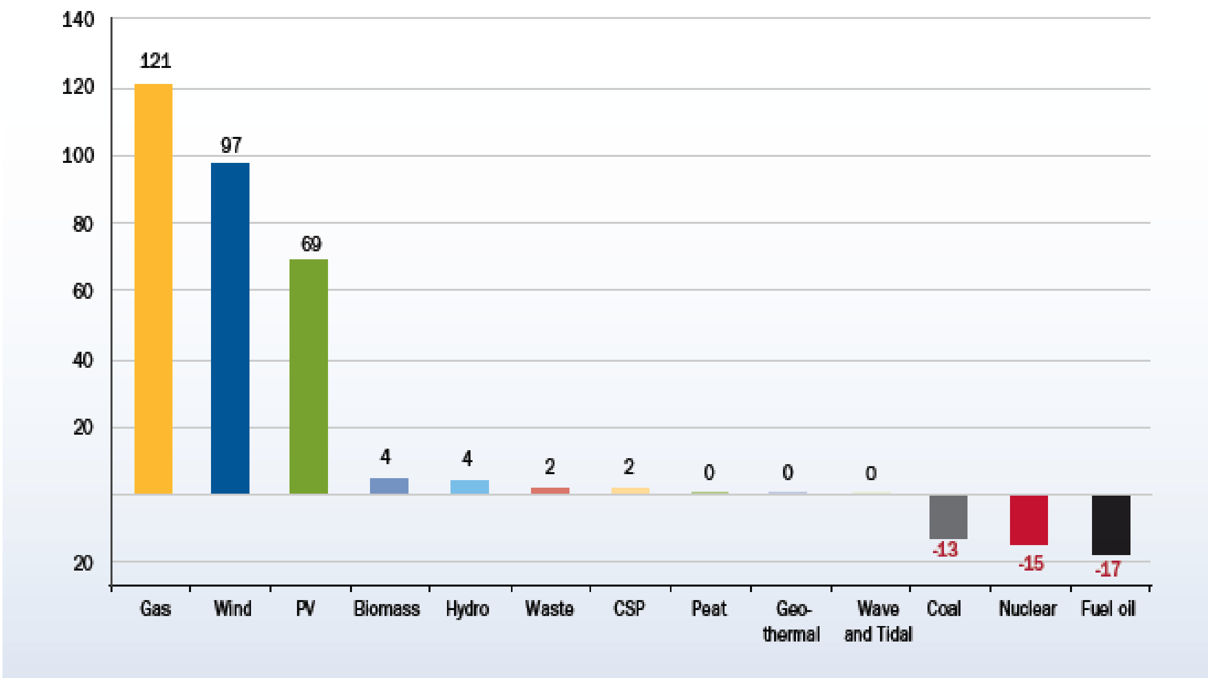


Figure 14 EU electricity generation installed capacity net change, 2000-2012 [GW][21]

Biomass energy is renewable energy that actually produces GHG emissions, but in case that more new biomass is planted each year than it is consumed, one can consider that biomass is renewable and carbon neutral. Only in such cases biomass can be considered for GHG emissions reduction. If

[21] EWEA, Wind in power: 2012 European statistics, February 2013, http://www.ewea.org/fileadmin/files/library/publications/statistics/Wind_in_power_annual_statistics_2012.pdf, accessed on July 23, 2013

that is the case of the Republic of Macedonia, meaning that it has sink in its LULUCF emissions, only then it can be considered as mitigation technology. The biomass waste (from forestry, wood industry and agriculture) is then fully viable carbon neutral renewable energy, while using land for biomass production (first generation biofuels, firewood, plantations forests etc.) should be limited by food production and environmental protection needs and the potential should be thoroughly studied. One has to have in mind that efficiency of photosynthesis is no more than 2%, which makes it a very inefficient way to produce energy from solar energy. Nevertheless, biomass can be important in sustainable development of less developed regions, employing significant number of rural people, Biomass can then be used for power generation, but also heat generation and production of biofuels and biogas, which should be optimised based on local circumstances. It is necessary to carefully find the right balance of land and biomass use. If it is used for power generation, it should be used in combined heat and power (CHP) plants and never as condensing power only (since it will have efficiency of only 20%), or it could be used to co-fire in coal power plants or in industrial processes, if there are no other ways to reduce GHG emissions. Co-firing with coal will use large amounts of biomass with relatively low impact on GHG emissions and employment. CHP plants should thus be placed in places with high and relatively constant heat demand, like in wood industry. Also, it may be advisable to build CHP plant as part of district heating systems in smaller towns where biomass is locally available, more as job generating activity, since district heating will have only relatively short heat demand. Due to all this reasons although biomass is the biggest renewable resource in EU the net increase of installed biomass capacity in EU between 2000-12 is only 4 GW, Figure 14.

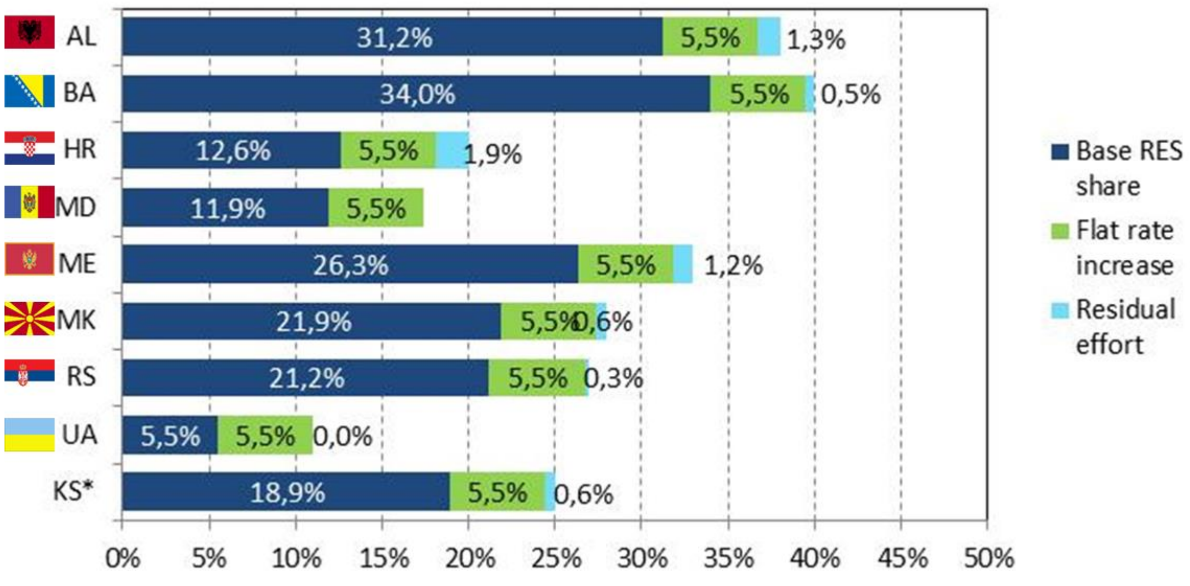


Figure 15 Western Balkan countries RES obligations by 2020

Solar energy can be used in much more efficient way than through biomass (2% efficiency of photosynthesis times 20% of condensing Rankin cycle gives 0.4% versus 17% of direct photovoltaic conversion, PV). The solar **PV electricity** is often considered expensive but due to rapid 4-5 times fall in price since 2008, the technology has reached residential grid parity in up to 50 countries in the world. Grid parity is reached when the cost of producing own electricity from PV is lower than price of electricity bought from the grid. It generally happens when the residential electricity price is higher than 10-20 EURc/kWh, depending on the installation costs. That is not yet the case in the Republic of Macedonia, but it can be predicted that by 2020-25 grid parity will be reached due to further decrease in PV prices and imminent increase of residential electricity prices, so it should probably be taken into account in scenarios after 2025. It is not easy to model grid parity in most of market penetration model. One could also point that PV has its additional costs on the distribution grid, so that pure grid parity is only reached when the energy part of the residential electricity price is reached. But in order to implement that in practice the pricing of electricity and grid connection should be decoupled, which will not be that easy to do. If not done, the perception of grid parity will lead to huge private investment in PV, without any need for subsidies. The net increase of installed PV capacity in EU between 2000-12 was 69 GW, Figure 14, second best among renewables after wind, with especially strong growth since 2008. PV sector is very good in creating jobs of the type which is especially good in the region, white collar non-high tech service jobs, which can sustain many small firms if the sector is built sustainably. One normalized MW of PV power will employ 7-11 times more people than 1 MW of normalized coal power. Even if the PV wafers would be imported it still employs 3-7 times more people than domestic but efficient coal, and even more than imported coal (equipment for coal power plants is usually imported, as well as more and more coal itself, in which case not much local employment is left). In order to build sustainable PV sector it is crucial to put a yearly quota which is in size around 5% of the long term goal for PV installations, in order to allow for continuation of the sector in repowering after the targeted amount of installations has been build. The targeted amount consistent with the simple integration of PV into the system should be in order of magnitude of the summer midday demand, which will mean yearly share of 7-10% of electricity.

Concentrated solar power (CSP) may also be considered. The technology currently being developed mainly in Spain has advantages over PV since it is better controllable and with co-firing gas or thermal storage it may be made to produce power longer hours. On the other hand it is not scalable to the residential level, so it is quite expensive at the moment. Due to all these reasons, the net increase of installed CSP capacity in EU between 2000-12 was only 2 GW, Figure 14, although starting from zero.

Waste to energy should definitively be considered as a way of disposing of waste only after all that is recyclable is already recycled. Since putting the waste recycling into function takes many years, the quantities of waste available for incineration will be slowly falling. That means that building dedicated waste incineration plants may create a very long lock effect that could either slow down the recycling process or may make plants unviable when the waste quantities decrease. Therefore, it may be more viable to incinerate waste in cement plants, which are very flexible and may easily adapt to varying supply of incinerable waste. In case that waste to power is considered it should be CHP, since waste to power efficiency of 20% is too low. Since the waste quantities are limited and will start falling the net increase of installed waste power capacity in EU between 2000-12 was only 2 GW, Figure 14.

Geothermal power may be also considered if there are significant high temperature geothermal sources, at least 120°C. It would also be better to use CHP technology instead of condensing power only. **Low temperature organic Rankin cycle** (ORC) may also be considered where there is relatively high temperature waste heat, as in cement, lime and brick industry.

The Republic of Macedonia is under obligation by Energy community to increase its share of renewables in gross energy consumption from 21.9% to 28%, Figure 15. There are several ways how to push renewables into the power system, but they most often involve some **subsidies**. The most efficient way to do it, at least at lower shares of intermittent renewables (wind and PV) and before the establishment of the power exchange/pool, is feed-in tariff (FIT), Figure 16. Such a system guarantees return of investment to investor, and helps remove the barriers that will be impossibly high at the beginning of the transition process. The barriers are mostly because the incumbent utility company will not be interested in allowing competitors, and in new technologies they will generally see threat to their old power plants. Also, there is lack of knowledge, and many administrative barriers. All these are best solved by imposing a FIT. Some countries have opted for quota system, in which every supplier must have certain share of renewables in its portfolio, which it can produce by itself or buy from other producers, either as electricity or just as green certificates. Unless there is huge penalty on non-compliance, it will generally mean that this approach will be too risky and investors will enter into it only if there is much higher return on investment then in case of FIT, therefore making it more expensive. There are also other ways, as investment support, tax credit etc. In all cases the subsidy should not be paid by the tax payer but by customers. The cost of the subsidy should be fully charged on the retail price. It is cheapest if it is charged to all customers proportionally to their consumption, but that may make some producers less competitive. It may make sense to have special arrangement for installations participating in emission trading scheme.

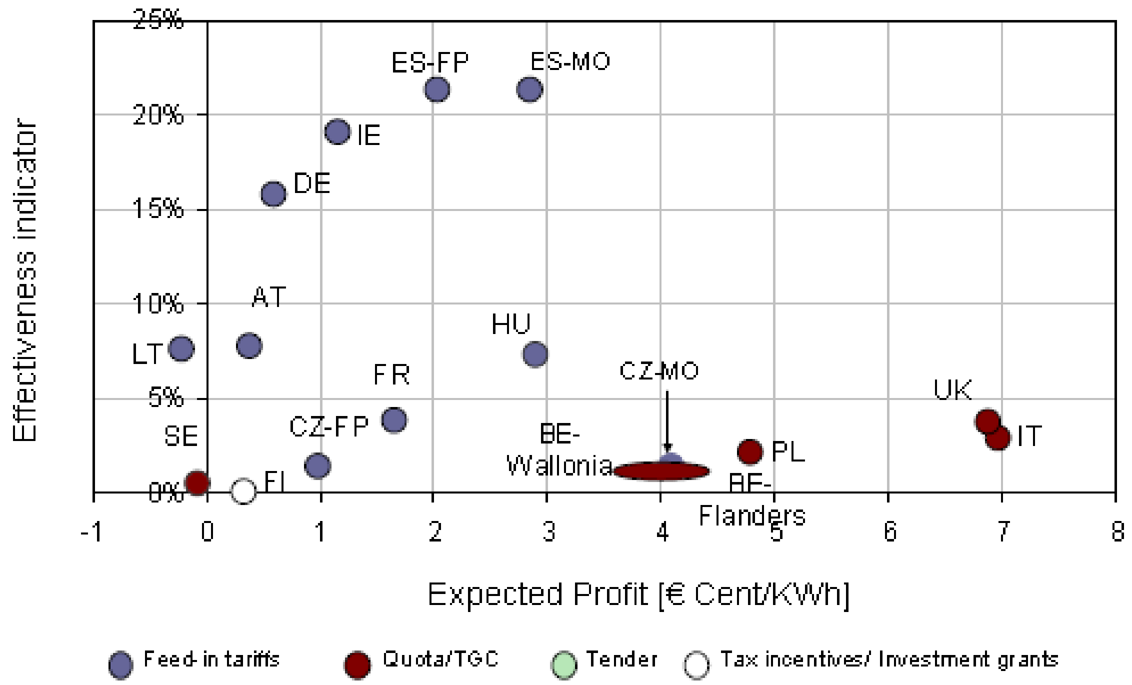


Figure 16 Effectiveness of promotion policies for onshore wind[22]

[22] OPTRES - Assessment and optimisation of renewable energy support shemes in the European electricity market, 2007, http://ec.europa.eu/energy/renewables/studies/doc/renewables/2007_02_optres.pdf, accessed on July 23, 2013

The other way to force decrease of GHG emissions in power sector is by implementing **emission trading system** (ETS) involving all power, but also big industry and heating plants. Power plants should buy their allowances on auctions from the state, or on secondary market. If the amount of available allowances is lower than the needed one by all installations the reductions will be made where it is cheapest. This system is very economic, but it may not give such a good result in creating jobs like FIT. The Republic of Macedonia will have to join EU ETS once it enters EU. It will be invited to join even before it joins EU, as part of negotiating process. For example, Croatia found that it would be best to join EU ETS 6 months before joining EU, while starting full monitoring ETS type 3 years before. It can be easily modelled by pricing carbon.

If implementing **excise tax for electricity** it should be also calculated on the basis of GHG emissions. That will not be very important to general electricity customer, since it will consume mix, but it may be important for auto-producers and also it can help creation of the market in green electricity.

The overall aim of the **Large Combustion Plants Directive** (LCPD)[23] is to reduce emissions of acidifying pollutants, particles, and ozone precursors. Control of emissions from large combustion plants - those whose rated thermal input is equal to or greater than 50 MW - plays an important role in the Union's efforts to combat acidification, eutrophication and ground-level ozone as part of the overall strategy to reduce air pollution. LCPD entered into force in 2001 with following provisions:

- Plants licensed after 26 November 2002 have to comply with the (stricter) emission limit values for SO2, NOx and dust fixed in part B of the Annexes III to VII.
- Plants licensed on or after 1 July 1987 and before 27 November 2002 have to comply with the (less strict) emission limit values fixed in part A of the Annexes III to VII.
- Significant emission reductions from "existing plants" (licensed before 1 July 1987) are required to be achieved by 1 January 2008:
    a) by individual compliance with the same emission limit values as established for the plants referred to in point 2 above or
    b) through a national emission reduction plan (NERP) that achieves overall reductions calculated on the basis of those emission limit values.
- The Commission considers that it is possible to adopt a "combined approach" (combination of points a) and b)) for these "existing plants". A NERP must address all three pollutants covered by the Directive for all the plants covered by the plan.
- Plants not able to comply will be able to run for 20000 hours until 2015.

This basically means that some 35 GW[24] of old coal power plants will be retired in EU by 2015.

The LCPD will also apply as part of Energy Community with 2017 as compliance deadline. The Republic of Macedonia reported that according to their scoreboards, 97% of the LCPD is transposed and they already have national ELVs and a NERP. The main outstanding question is how it will be implemented in practice. A feasibility study supported by the Japanese government was carried out for the desulphurization of REK Bitola, but due to the economic crisis, the project will be delayed

[23] http://ec.europa.eu/environment/air/pollutants/stationary/lcp/legislation.htm accessed on July 23, 2013
[24] Sylvie Cornot-Gandolphe, The European Coal Market: Will Coal Survive the EC's Energy and Climate Policies? Institut français des relations internationales (Ifri), Paris, October 2012

until 2014. According to the NERP, all plants will be covered and the authorities will negotiate with each operator the individual levels of contribution to the implementation.[25]

The LCPD is one of the seven existing EU directives on industrial emissions that were recast under the **Industrial Emissions Directive** (IED), endorsed by the European Parliament in July 2010. The IED proposes a further tightening of emissions limits, in comparison to the LCPD for SOx and NOx and particulates. For NOx in particular the limits will be significantly tightened. All coal plants which have opted into the LCPD (and which will therefore remain open from 2016 onwards) have already installed Flue Gas Desulphurization (FGD) equipment. For this reason, it is the need to comply with the NOx limits in the IED (from 2016 onwards) which will be the major reason for further expenditure in Selective Catalytic Reduction (SCR) equipment. Plants which opt-out of the IED will be allowed to run a limited number (17,500) of hours between 2016 and 2023, without complying with the new Emissions Limit Values (ELVs). Although plants which opt-out can exceed the IED ELVs, they will continue to be subject to the ELVs limits defined in the LCDP. Plants which opt-in to the IED will be required to comply with the new ELVs. However some flexibility in early years is allowed through a Transitional National Plan (TNP), which gives power plants until July 2020 to meet the requirements. Member States must communicate their draft TNP to the Commission by 31 December 2013. For the oldest coal-fired power plants, this will result in more closures, as investment in SCR is not justified. [26]

The Energy Community has set up an Environmental Task Force that will also analyse the opportunity of adoption the IED in the Energy Community *Acquis*. Therefore IED should also be taken into account, together with LCPD, when retiring old plants in the model.

[25] Conclusions of the 4th Meeting of the Energy Community Task Force on Environment, 30 October 2012

[26] Sylvie Cornot-Gandolphe, The European Coal Market: Will Coal Survive the EC's Energy and Climate Policies? Institut français des relations internationales (Ifri), Paris, October 2012

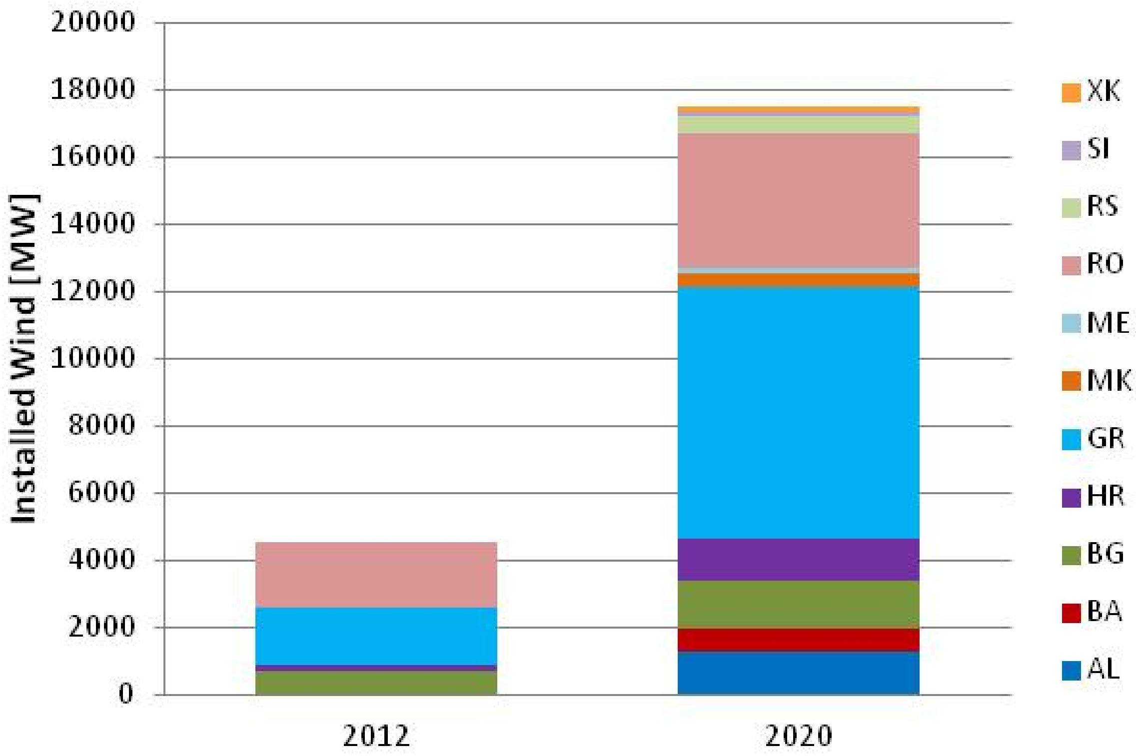
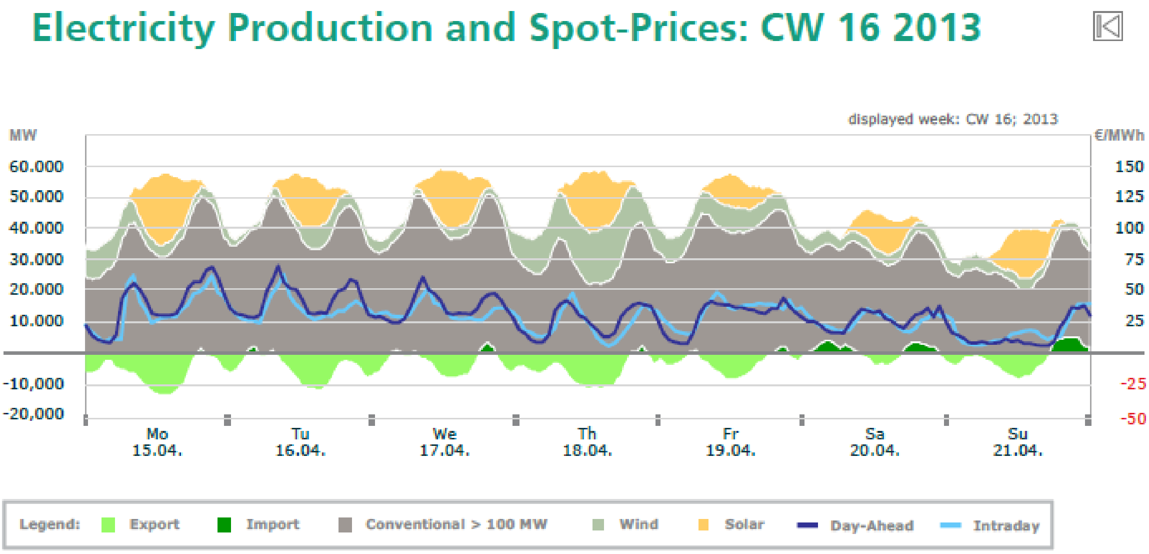


Figure 17 Wind energy in SEE

The Energy Community has obliged its members to set up **power exchanges** or pools with Day Ahead Markets (DAM) by 2012 and have them coupled with other EU markets by 2015. It is not happening as fast as planned but it will happen sooner or later. Coupled DAM with demand-supply balancing on hourly basis will bring several important consequences. The wholesale price of electricity during night will fall compared to the current band trade, prices in the morning and evening will increase and the daily price is currently difficult to predict, but in the medium term it will also fall. That will be detrimental to coal power plants, while being beneficial to more flexible power plants. Currently there is 4 GW of wind power plants installed in the Southeast Europe[27] (SEE) region, which will grow to 18 GW according to NREAPs, Figure 17. After the establishment of DAMs, Intraday Markets (IM) will be established, which will even further improve the market position for flexible power like gas and hydro and will also decrease the systemic cost of balancing, especially wind. The power exchanges influence should be modelled by including the market hourly price on one of the European power exchanges (EEX or Nordpool) and allow for export and import of electricity from the system, Figure 18.

[27] Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo*, Macedonia, Montenegro, Romania, Serbia, Slovenia



€ / MWh	Period Mean	Period Min	Period Max	Std Deviation
Day-Ahead	32.25	7.60	70.70	14.54
Intraday	30.74	6.80	63.70	12.11

Source: Johannes Mayer, Bruno Burger, Fraunhofer Institute for Solar Energy Systems; Data: EEX, Entso-e

Figure 18 Electricity production and day-ahead and intraday spot prices, calendar week 16, 2013

Measures for **increasing efficiency of transmission and distribution** should also be taken into account when modelling. Especially, non-technical losses should be phased out in medium term.

The influence of **smart metering for demand side time management** should also be taken into account, especially if electric heating, heat pumps and electromobility is included. The influence of smart grids should be significant after 2025.

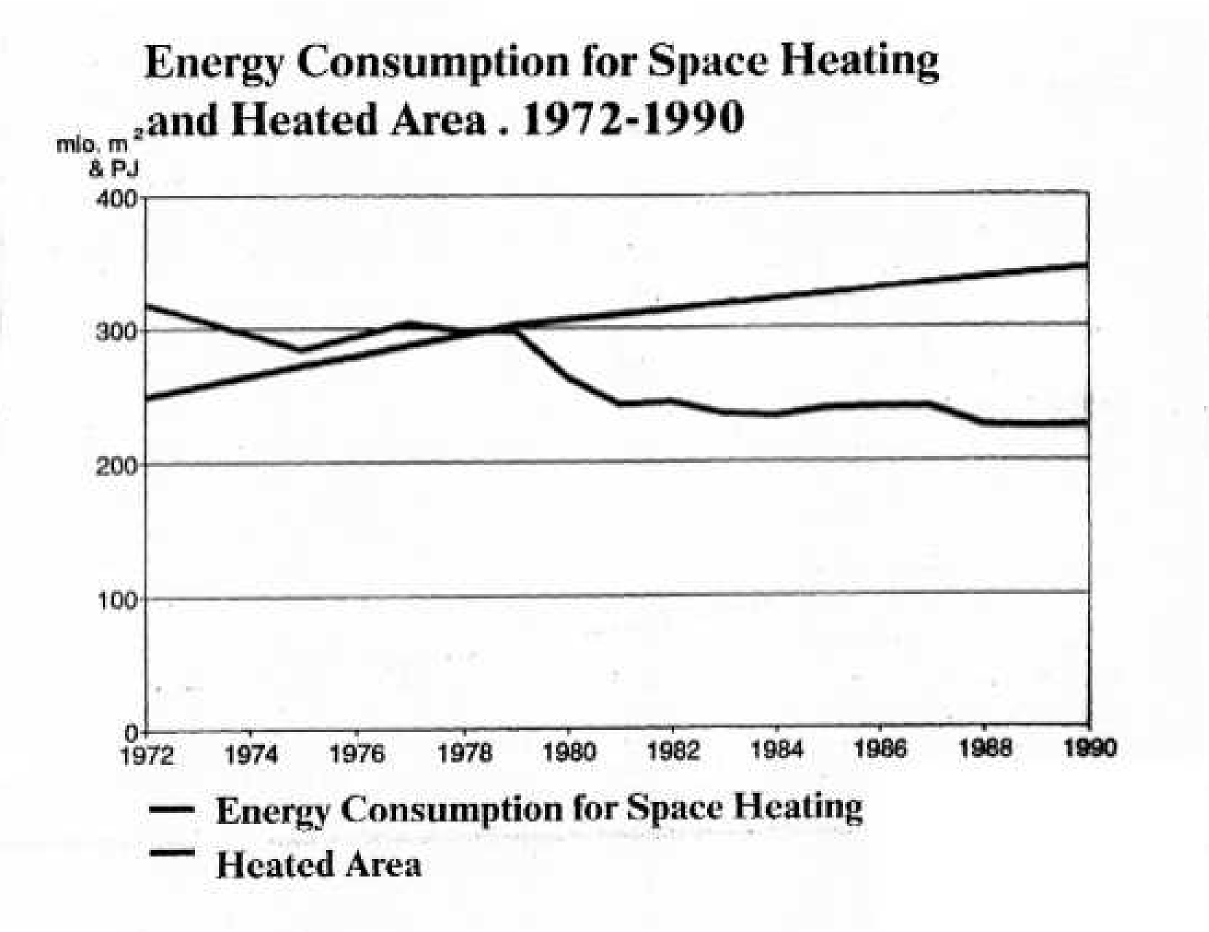


Figure 19 Energy consumption for space heating and heated area in Denmark, 1972-1990

Actions and measures in the heating and cooling sector

Space heating is consuming 30-40% of primary energy, although it is at least partially avoidable by building passive houses. Denmark has managed to decrease use of energy for heating by quarter and in the same time increasing heated area by half in 20 years after the oil shock, Figure 19. Based on such a positive experience the first Buildings Directive (BD) has set up efficiency rules for new and reconstructed buildings and for energy certifications of all. The Recast BD (RBD) has set much more stringent rules for new and reconstructed buildings, obliging them to be nearly zero energy buildings from 2018 for public and 2020 for all buildings. It has thus started transition of the buildings sector towards positive heat and power plants. Coupled with the Energy Efficiency directive, which has stipulated the rate for obligatory refurbishment of public buildings, that will create significant new construction and renewable equipment markets.

This will not have short term effect as NREAP, which will before the RBD enforce increased share of **renewables in heating and cooling**. Technologies that will benefit from NREAP the most are biomass, heat pumps, solar hot water and heating, and to lesser extent geothermal heat.

Biomass in heating can mean use of wood logs, wood chips, wood pellets, wood waste, agricultural waste bales, biofuels or biogas, either in house installation, building installation, industrial installation or through district heating system. Biomass (logs-firewood) is traditionally used in SEE and energy statistics rarely cover precisely that usage, since only a minor part of firewood trade will be fiscalized and thus included in the statistics. It is necessary to perform special surveys to be able to estimate the firewood use. Firewood will often be used as the fuel of last resort, when others are too expensive, thus limiting the potential for increasing the prices of other heating fuels. Such uncontrolled supply of firewood is also limiting investment in energy efficiency. This is not simple to improve, and probably the only way to go is to slowly increase the requirements of stoves and chimneys sold and used, eliminating them from cities and towns altogether.

Heat pumps may come as different systems, ground-water, water-water, air-water and air-air. They pump heat from lower temperature to higher heating the hotter side and cooling the colder side, using electricity and converting it into heat or cold with coefficient of performance (COP, in range of 2-6). The energy pumped above the electricity invested is renewable energy, either from ground, water or air, since it can be replenished. Warmer climates with temperature rarely under 0 can be fully supplied with air-water or even air-air systems while for colder climates ground-water or water-water systems are must. Using heat pumps will mean converting heating system to low temperature one, using floor heating and convection heaters which will be anyway good for energy efficiency purposes. Those using **resistance electric heating** should be persuaded to replace it with heat pumps, which may include resistance electric heating for lower temperature.

Solar heating, solar hot water (and solar cooling) will be a relatively easy way to increase share of renewables in heating. Solar hot water is especially simple technology and good for local employment. The local production of components is possible. Solar cooling, although expensive, has excellent correlation between demand and supply. On the other hand, solar heating is counter-cyclical. In order to increase the solar heat supply in cold weather, vacuum collectors may be used.

Geothermal heating other than heat pumps may be used where there are such low temperature geothermal sources, especially for spa, pools, hotels, shopping centres etc.

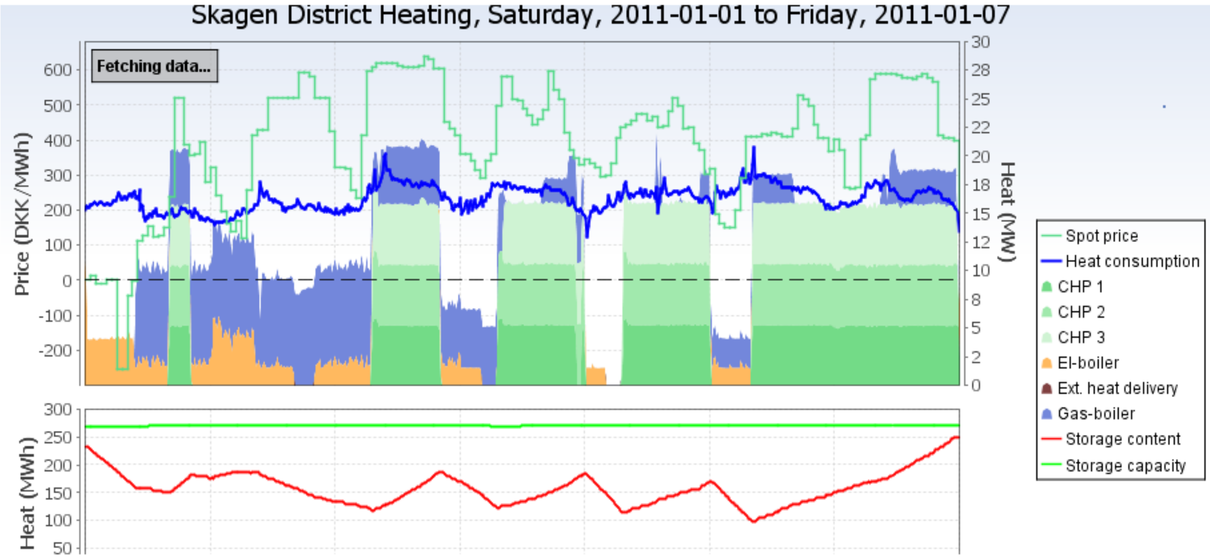


Figure 20 Skagen district heating - one week operation, flexibility depending on market prices

District heating could be an excellent way to deliver efficiently heat to settlements, which would be flexible and adaptable to switch to renewables, playing in markets, and increase of flexibility much better than individual house systems. The problem is use of non-fiscalized firewood which does not allow for proper cost based pricing for competing fuels. The use of waste heat from industry should be supported wherever feasible, as well as the use of heat from waste incineration plants if ever built should be supported. District heating plants could then also integrate the use of biomass, solar thermal, geothermal energy as well as heat pumps (and electric heaters) which could convert very cheap electricity into heat when market circumstances allow. Such district heating plants may also include a CHP unit and gas boilers. In order to increase flexibility they should include significant heat storage (up to 4 m2 per customer). All the equipment should be efficient, boilers should be condensing, with addition of absorbers. So called 4th generation district heating should be low temperature with outgoing temperature of 60-70°C. Even for **home installations** only best available technology should be installed, enforcing **condensing gas boiler** instead of non-condensing and **heat pumps** instead of resistance electric heaters. Having in mind coming provisions of RBD, home installations based on fossil fuel, including gas should be avoided and only renewables should be supported. Instead, district heating should be supported since it allows for more flexibility in transition later on, Figure 20.

It would be beneficial to implement **carbon tax on fuels** used in heating, either as carbon tax on CO2 emissions on bigger installations or as excise tax paid with the fuel. Such way of taxation would be beneficial to investment in energy efficiency, in other technologies that emit less GHG and would also be good from budget perspective.

Actions and measures in the industrial sector

Industrial sector involves two types of GHG emissions, one stemming from use of energy which is easier to tackle, since there is way for fuel replacement, and the other type which is result of chemical processes. Much can be done in industrial sector by insisting on investment in best available technologies, in performing energy audits periodically, integrating various energy and resource flows in the most efficient way and using waste heat and other waste in the most appropriate way. By applying only efficiency measures emissions may sometimes be reduced by 50%. The **fuel conversion** from coal and coke to natural gas, biomass and waste is a way how to reduce emissions even further. Integration of renewables into energy flows is an efficient way to go, with biomass, biogas and waste for high temperature processes and solar thermal and heat pumps for low temperature heat. Sometimes high temperature processes may be converted to electricity, which will by 2050 become emission free. The waste heat may be used in ORC for producing electricity if no other use of heat is available. Process emissions (cement, lime, brick industry) should come from the redesign of products, following best available technologies.

All these should be enforced mainly through **carbon pricing** through ETS for larger installations and carbon tax on GHG emissions or fuels for smaller ones. The old installations will be retired or refurbished through application of **LCPD and IED**, implemented through Energy Community. The **equipment efficiency improvement** should be further enforced through obligatory periodical audits.

Actions and measures in the transport sector

It is usually considered that a country that does not produce cars cannot influence the technology used in transport much. It certainly cannot force car producer to change technology, but it may award more efficient models with lower excise taxes or other positively discriminating measures like free parking, annual excise tax waiver, road toll waivers etc. if country is allowing imports of used cars (which are made in older technology) it is even more important to discriminate according to vehicle efficiency. That can also bring a handy income for the budget.

The **renewable transport fuel target** as part of NREAP enforces that 10% of transport fuels should be **biofuels** by 2020, but first generation (food displacing, biofuels produced from cereal and other starch rich crops, sugars and oil crops) of biofuels may only take 5%. The rest of the quota has to be taken by second and third generation of biofuels or **renewable electricity** and hydrogen. Second generation biofuels (used cooking oil; animal fats; non-food cellulosic material; ligno-cellulosic material except saw logs and veneer logs) are awarded factor 2 in quota calculation. Renewable electricity and hydrogen is awarded factor 2.5. Some second generation biofuels, third generation biofuels and synthetic fuels (algae; biomass fraction of mixed municipal waste; biomass fraction of industrial waste; straw; animal manure and sewage sludge; palm oil mill effluent and empty palm fruit bunches; tall oil pitch; crude glycerine; bagasse; grape marcs and wine lees; nut shells; husks; synthetic fuels - renewable liquid and gaseous fuels of non-biological origin) shall be considered to be four times their energy content in the quota. Biofuels not meeting the sustainability criteria will not be eligible for target counting, obligation schemes, tax exemptions or other support. New installations will have to prove reduction of CO2 emissions, while old installations will have to show 35% reduction by 2017, and 50% reduction by 2018, taking also into account indirect land use change factor. Renewable electricity is already used by railway, but it will slowly start to be used also by **hybrid** (only hybrid plug in vehicle can be accounted for in the target) **and electric cars**. Only renewable portion of the electricity mix may be used for the target accomplishing. Since the share of renewable electricity will increase in time, its importance in transport will also increase.

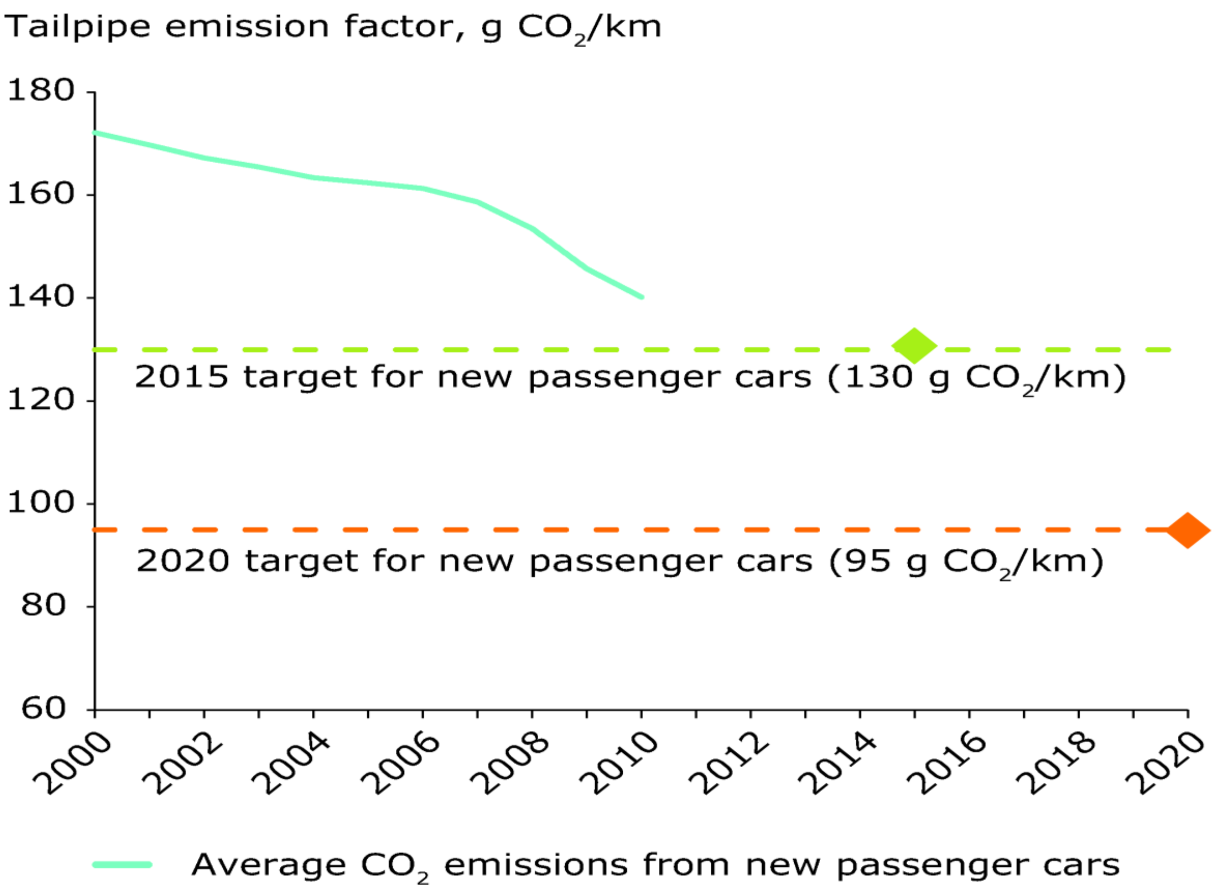


Figure 21 Average CO2 emissions for new passenger cars

The expected **improvement in fuel economy** (CO_2 emissions per km) will have a spill over effect in the Republic of Macedonia even without entering EU since EU has enough leverage to enforce new standards on car producers, which will then sell such cars in other countries too. Also, since the Republic of Macedonia is importing significant amount of used vehicles, with 3-6 years delay (typical life with first car user in Western Europe) there will be spill over effect. Even if old technology vehicles are used for 20 years it will only mean delayed and slowed replacement rate, but eventually the new and more efficient vehicles will reduce demand for motor fuels in the Republic of Macedonia, even with increase of demand for passenger-kilometres. Average CO_2 emissions from new passenger cars per company will reach in EU 130 gCO_2/km by 2015, 95 gCO_2/km by 2020 and 70 gCO_2/km by 2025, Figure 21.

The **modal shift** towards increased use of **public transport**, train, bicycles and walking should be planned. The culture of passenger cars has reached its maximum in the West, although it will continue to grow in the Republic of Macedonia for some time. Meanwhile, the new planning approach, with more mixed residential-business town quarters, with more and better public transport, with more car and bike sharing schemes, more park and ride schemes, and with more space for pedestrians, has already started to decrease use of passenger cars in Western Europe and North America. Together with demographical change of increasing population average age, it will result in converging and then decreasing of average passenger-km per vehicle per year.

Other actions and measures

Other actions and measures, not classified above, include phasing out of incandescent light bulbs, higher efficiency standards of electric appliances and electronic equipment, as well as labelling. The **phase out of incandescent light bulbs**, implemented in EU in 2012, and for special purpose bulbs in 2015, will bring quick fall in electricity demand, since the transition will be relatively short, only several years. **Improvements of efficiency of electric appliances** and **electronic equipment**, either through obligatory minimum standards or through **labelling** has made significant improvements in electricity demand in relatively short time since such equipment has short life time. These measures have very quick response and are relatively cheap to implement.

Conclusions

The Republic of Macedonia is a party to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I country and party to the Kyoto Protocol without quantified emission limitation and reduction commitment (QELRC). The Republic of Macedonia is a candidate country to European Union (EU) and, for the purpose of this report, it is assumed that it could become a member in 2020. Assessing from the accession of Cyprus and Malta, two EU members that were also non-Annex I parties to UNFCCC, the Republic of Macedonia will be asked to request becoming an Annex I country as a part of EU negotiation process.

This report has come up with suggesting three groups of scenarios, one group in case of acceding to EU and Annex I with end year targets, the other group in case of acceding to Annex I only with QELRC, and the third group with BAU deviation targets.

Group 1 scenarios assume that the Republic of Macedonia may have to reduce their emissions by 2030 by 20-40%. The scenarios should then continue towards 2040 with 35%-60% reduction and towards 2050 with 50%-80% reduction of GHG emissions.

Group 2 scenarios suggest modelling QELRC for 2021-28, from -20% to +20%. In order to be able to model scenarios up to 2050, for each next budget period, assuming that the same approach will be used and 8 year periods, the QELRC should be reduced by 10 percentage points at each end of the spread.

Group 3 scenarios suggests modelling BAU deviation of -10% to -20% for 2020, -15% to -30% for 2028 and -30% to -60% for 2050..

Proposed are 3 groups of scenarios, depending on the outcome of future integration processes and in order to better prepare the government to make offers. Group 1 scenarios are EU type scenarios, which are consequential to Macedonian presumed accession to EU in 2020. Group 2 scenarios are assuming Macedonian accession to Annex I to the UNFCCC but not EU and taking quantified emission limitation and reduction commitment (QELRC). Group 3 are scenarios in case the Republic of Macedonia does not decide to enter Annex I and are baseline or business as usual (BAU) deviation type scenarios.

In order to reduce GHG emissions the Republic of Macedonia has many available actions and measures. Some of the actions and measures are already being implemented, some will have faster phase in, some slower, some will happen because of technological spill over effect from equipment producers, some will have to be enacted in future.

Possible actions and measures in power sector include renewable electricity target as part of NREAP, carbon pricing through ETS, phasing out of old power plants through LCPD and IED, implementation of power exchange (day ahead, intraday), measures for increasing efficiency of transmission and distribution and smart metering for demand side time management. In heating and cooling sector, these are the measures included in buildings directive and recast of the same directive, renewable heating target as part of NREAP, heating equipment efficiency improvement, resistance heater replaced by heat pumps, increased use of waste heat in district heating, increased use of heat pumps in district heating, increased use of waste to energy in district heating and carbon tax on fuels. In industrial sector, possible measures and actions include carbon pricing through ETS or carbon tax on fuels, phasing out of old boilers through LCPD and IED, equipment efficiency improvement, obligatory periodical auditing, and fuel conversion to gas, biomass and waste (from fuel oil and coal/coke). In the transport sector, possible measures and actions are increased use of renewable transport fuel target as part of NREAP, reduced CO2 emissions per km, hybrid and electric cars, modal shift and improved public transport. Also, other measures and actions include phasing out of incandescent light bulbs, higher efficiency of electric appliances and electronic equipment, as well as labelling.