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Prevention of Climate Changes beyond the Year 2012

Review paper
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The world is experiencing serious challenge of climate changes significantly influenced by the energy sector. Existing strategies of energy and transportation sectors development foresee growth instead of necessary reduction of the emission of greenhouse gasses that cause mentioned changes. Contrary to existence of possible doubts and uncertainties related to climate changes in 1992, when United Nations Framework Convention on Climate Changes is adopted, and even in 1997, when Kyoto Protocol is formulated, today, its' more than ever obvious presence around the world made the necessity of serious response to this challenge unquestionable. Being aware of the fact that the global consensus on the measures related to global warming is required for the post Kyoto period, world leaders are going to meet at the end of this year in Copenhagen in order to formulate new measures that should be applied beyond 2012. This paper illustrates the challenges related to this event.

Key words: *climate changes, energy, greenhouse gases, Kyoto protocol*

Introduction

The natural production and absorption of carbon dioxide (CO_2) is achieved through the Earth's biosphere and oceans. However, mankind has altered the natural carbon cycle by burning coal, oil, natural gas, and wood and each of these activities has increased in scale and distribution. CO_2 was the first greenhouse gas (GHG) demonstrated to be increasing in atmospheric concentration. Atmospheric levels of CO_2 have risen well over 30% from pre-industrial levels of 280 parts per million (ppm) to 2008 levels of 385 ppm. Evidence suggests this observed rise in atmospheric CO_2 levels is due primarily to expanding use of fossil fuels for energy. Predictions of global energy use by the end of this century suggest a continued increase in carbon emissions and rising concentrations of CO_2 in the atmosphere unless major changes are made in the way the energy is produced and used.

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Over the last century, human activity had a profound impact on the environment. Fossil fuel consumption, deforestation, and other unsustainable land use practices have resulted in a fast increase of CO_2 and other GHG emissions into the atmosphere, and thus created the human-induced climate warming conditions that are currently affecting the globe. If this trend continues, climate change will be the inevitable result. The long-term effects of global temperature change are largely unknown yet, but many of the adverse effects can already be seen in all parts of the world in the form of droughts, increased severity of storms, ice melting, and flooding. Science clearly shows that anthropogenic GHG emissions are provoking dangerous climate change, putting at risk the living environment and prosperity of mankind [1].

Challenges of the COP-15 in Copenhagen

Limiting the GHG emissions

There is a broad scientific consensus, initiated by the UN Intergovernmental Panel on Climate Change (IPCC), that the increase in global average temperature above pre-industrial levels ought not to exceed 2 °C. The IPCC concludes that limiting the temperature increase to 2 °C will require that CO_2 emissions be reduced by at least 50% by 2050 [2]. Also, the International Energy Agency (IEA) concludes that the emissions would need to be limited to a maximum 26 gigatonnes (Gt) by 2030 (compared with expectation that they will reach 41 Gt if no action is taken) and then decrease under a series of different measures. As evident from fig. 1, the improvements in energy efficiency in the longer term would account for 54% of this emissions reduction, followed by more renewable energy and nuclear power, as well as by the use of carbon capture and storage (CCS) and other technologies [1].

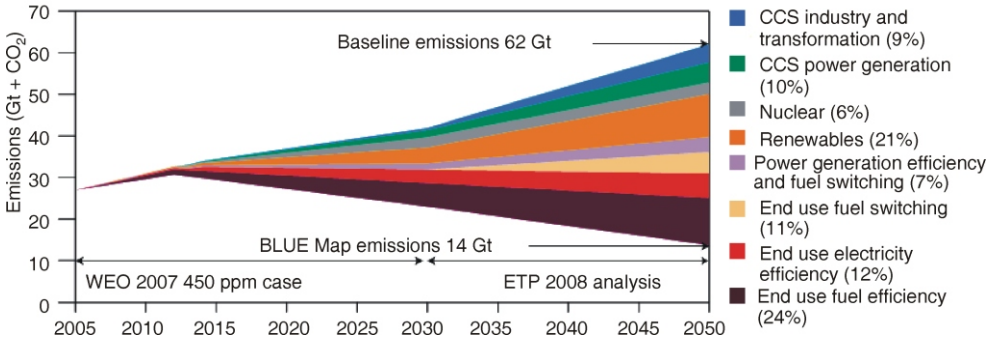

Figure 1. Technologies for reducing energy related CO_2 emissions

Because the global challenge to achieve at least a 50% reduction of global emissions by 2050 can only be met by a global response, all countries must be involved. As part of this, the goal of developed countries is at reducing emissions of GHG in aggregate by

80% or more by 2050 compared to their 1990 levels, but the major emerging economies need also to undertake actions to reduce their emissions below "business-as-usual" by a specified year [2].

Expectation from the COP-15 in Copenhagen

This (2009) is a crucial year for taking rapid and effective global action to combat climate change. Within the UN Framework Convention on Climate Change (UNFCCC) a decision is taken to enter a negotiating process, in order to shape a global and comprehensive post-Kyoto agreement in Copenhagen. This 15th Conference of the Parties (COP-15) to the UNFCCC is expected to be a decisive opportunity to achieve global consensus, with a strong commitment needed for the successful conclusion of a new global post-2012 Protocol, involving all countries, based on the principle of common but differentiated responsibilities and capabilities. Despite the severity of the current financial and economic crisis, it cannot be allowed to distract world from addressing critical climate change challenges seriously.

A key issue for policy makers there will be to choose a climate change policy that recognises the uncertainties in the costs and benefits of abatement actions, which will vary over time. Currently, there is no scientific or political agreement about exactly what concentrations of GHG could prevent dangerous interference with the climate system. However, the costs of inaction far outweigh the costs of moving towards low-carbon economies [3]. At the same time, stable and secure energy availability is indispensable for social and economic development, and thus a resolute action is needed by all countries to build on existing and new technologies and to deliver economic, environmental, and energy policies.

It is therefore expected that COP-15 next December will establish a solid framework agreement that will benefit from the current commitments under the Kyoto Protocol and provide the start of a new period in 2013, which will put the world economies on the path to decarbonization. Also, many issues remain to be resolved such as the level of action of developing countries, technology transfer, reform of the clean development mechanism (CDM), land use and avoided deforestation. Nevertheless, all five sectors would have be covered, proportionally to their share of total emissions: electricity generation and imports, industrial combustion sources, industrial process sources, other fuels serving buildings, and transportation fuels. Emissions of CO_2 and other GHG – nitrous oxide (N_2O), methane (CH_4), chlorofluorocarbons (CFC), hydrofluorocarbons (HFC), and sulfurhexafluoride (SF_6) – would have to be regulated more stringently, but CO_2 emissions from the combustion of biomass or biofuels would probably be exempted, and biogenic emissions of CO_2 from industrial fermentation processes will be considered carbon neutral.

Obviously, financing is central to achieving an agreement at Copenhagen and requires mobilisation of significant financial resources, both public and private. To promote concerted efforts on technology and financing of an ambitious goal, striving is required for international support and affirmation of a fair share of developed countries. Nevertheless, all countries (except, probably, the least developed ones) should participate in

the financial effort to tackle climate change, according to criteria to be agreed, which calls for the elaboration and implementation of an effective financial arrangement to support the post-2012 regime. The development and deployment of technologies and know-how in developed and developing countries will play a crucial role both in mitigation and adaptation to climate change and in moving towards low-carbon growth models. This implies an increase of investment in basic and applied clean technology research and development to enhance global technology cooperation, with a need to promote further national and international fundamental research on the Earth's climate. Such provisions on financing technology research, development, deployment, and diffusion should form an integral part of the post-2012 agreement.

Recognising that even implementing ambitious mitigation steps will not avoid further climate impacts, effective adaptation and capacity building policies will have to be defined and implemented, being aware of the consequences of climate change on development, ecosystem services, water and food security, agricultural output, forests, health, and sanitation. Possible security implications of the adverse impact of climate change and the potential for increased conflicts over scarcer resources call for these issues to be addressed in a spirit of partnership between developed and developing countries. Adaptation is expected to be to effectively addressed in the Copenhagen agreement.

Challenges for the energy sector

The energy sector produces 60% of global GHG emissions and so it must also be a key part of any strategy to reduce them to limit the temperature rise [4]. Current trends in energy supply and use are economically, environmentally, and socially unsustainable, and , without decisive action, energy-related emissions of CO_2 will more than double by 2050 and increased oil demand will heighten concerns over the security of supplies. One way to manage emissions of CO_2 is to use energy more efficiently to reduce the need for fossil fuel as a major energy source, while another way is to increase the use many types of renewable energy, carbon capture and storage, nuclear power, and new transport technologies. To meet the 60-80% emission reductions necessary to stabilize atmospheric CO_2 concentration at 450 ppm, limiting the temperature increase to 2 °C, the power sector of the OECD countries would have to be virtually carbon free by 2050. Meeting a 50% reduction within the 27 EU member states, for example, the European power sector would have to reduce its carbon intensity from the current 0.45 tonnes CO_2/MWh to 0.10 tonnes CO_2/MWh, fig. 2 [2].

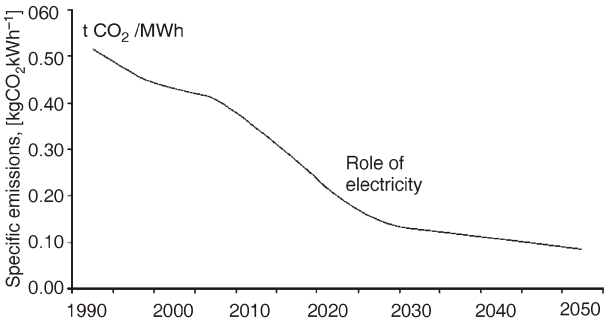

Figure 2. Carbon intensity in the EU-27 power sector with a 50% CO_2 reduction goal

A key issue for the electricity industry is the scale and timing of the investments companies will need to make in order to move to a "decarbonized" power generation by 2050. The commercial availability for the deployment of major low-carbon technologies will not come much before 2020. Therefore, the reduction target under Kyoto protocol plus the impact of more stringent emissions limits in the future means that the sector may well face a plant availability crunch in the middle of the next decade. This could pose significant risks to supply security and a concomitant move to invest in gas plant, as being the only serious short-term solution. This in turn brings a double risk of locking carbon emitting plant into the system for several decades and increasing dependence on external sources of fossil fuels.

Given the choice to invest in gas or coal plants, or to retrofit these plants with CCS, the best strategy for investors in a short commitment period is to wait for the next policy change that is expected at the end of the period. In order to reduce the effects of uncertainty, and set incentives for investments in abatement technologies, the policy should be set over a longer time scale. Different parallel commitment periods may be appropriate to account for different sets of countries with different forms of action.

Actually the overall discussion from an ecology point of view currently is heavily focused on the CO_2. In fact this is only one but a very important part. To have an overall best possible result, the life cycle analysis (LCA) of all production units form the raw material for the power plant to the production of power up to the dismantling of the power plant. It is therefore of utmost importance that the recommended LCA method should be developed for all alternative technologies and all places in the same manner and should be made available to all those who take part in the energy discussion [5].

Economic instruments to combat the climate change

Trade-off between economic costs and climate gains

There is a fundamental issue of uncertainty that surrounds climate policy beyond Kyoto, implying a trade-off between short-term economic costs of taking action and the expected longer-term climate gains. As a consequence, it is difficult to create longer-term predictability. However, even if the Copenhagen agreement would take longer-term commitment periods, economy may still be subject to uncertainties. Nevertheless, the investment decisions taken now may not use sub-optimal technologies in the long run. Therefore, the choice of the economic instruments that could be used to mitigate climate change in context of uncertainty is extremely difficult task. If benefits grow faster than mitigation costs when more abatement is undertaken, quantitative instruments (quotas) are more efficient, as they minimise costs and maximise environmental benefits. But, if costs grow faster than benefits, emission taxes may be more efficient. Hybrid instruments that combine quotas, and price margins may be more efficient than either simple taxes or quotas.

The longer commitment periods provide appropriate incentives for investors to plan longer-term decisions and investments in climate-friendly technologies. These technologies are usually characterised by high costs and thus are economically attractive only

if a longer time perspective is adopted. In the context of the Kyoto Protocol, the emission reduction target was agreed over a five-year commitment period (from 2008 to 2012), but the time when it was decided in 1997 implied a 15-year time horizon. However, if a second commitment period to be decided in Copenhagen in 2009 would also last only five years (from 2013 to 2017), then this would imply a time horizon for investors of only eight years. In addition, any delay in the implementation of domestic policies of many more countries involved for meeting the commitments could imply a further time lag, thus making decisions more risky.

Different investors in energy sector have different attitudes toward risk. CO_2 price risk is one of many risks affecting their investment decisions. The short term setting of price is in conflict to the long term planning of production and transmission systems. The strategic interests of a country in a situation of power shortage can be in conflict with the mechanism a liberalised market. The goal of the liberalised market is to get economically the lowest possible cost, but the society often have additional targets, such as security of supply, high ecological standards, no impact on the landscape and independence. There might be the temptation to intervene by countries as country specific short term interests may raise sharply. Low short-term power prices are tempting some groups of interest to oppose the liberalised power market even this is long term counterproductive.

The price of carbon should be reflected through the value chain of sectors concerned, and auctioning should be the main method of allocating emission allowances from 2013, provided it is applied to all countries and sectors. The compromises to insulate several industrial sectors from the impact of the carbon price burden, and thus from the incentive to reduce emissions, will place a greater burden on the power sector, inevitably leading to substantial increases in electricity prices for all customers who will essentially be paying for the decarbonization, not just of electricity, but of several energy-intensive sectors as well. These compromises will tend to reduce cost effectiveness and may lead to overall problems in the provision of a secure electricity supply. The transition between the current situation and a progressively decarbonised future will require a well-timed and optimized investment programme to cope with the closure and replacement of a considerable amount of capacity, while ensuring the all important security of supply.

Investments in energy efficiency and clean technologies would need to increase fourfold in order to keep the atmospheric CO_2 concentration at 450 ppm and preserve the rise in global average temperature under 2 °C, which far exceed the additional investments that are expected to occur as a result of the stimulus packages so far in place or announced worldwide.

In order to reach the levels of CO_2 concentration of 550 ppm with 3 °C global temperature rise and preferably to 450 ppm as suggested by the IPCC policy scenarios, huge investments are necessary both in the power sector and in the energy efficiency that translate into additional costs ranging from 0.25 to 0.6% of GDP, fig. 3 [6].

In addition, stabilising the emissions is complicated by the slow capital-stock turnover rates of energy infrastructure. Low turnover rates mean that existing energy infrastructure and its associated emissions are “locked in” for decades, barring expensive early retirement. This is especially true in the power sector where existing generation ca-

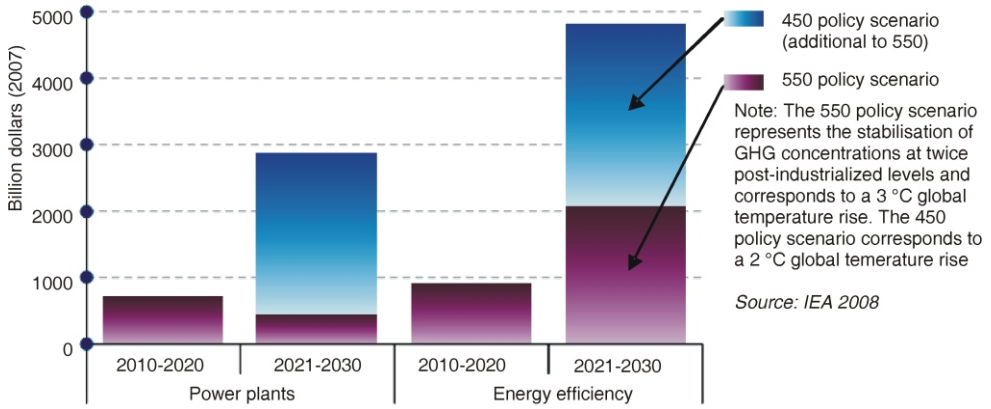

Figure 3. Investment in energy sector

pacity will account for over 75% of energy-related CO_2 emissions in 2020 and 50% in 2030 [4].

Role of renewable energy sources

A comprehensive strategy to ensure sustainable development and long-term energy security must envisage a portfolio of different energy sources. In the context of diversification of the energy mix, renewable energies will play an essential role, as these meet the dual challenge of reducing emissions and lowering fossil-fuel consumption and dependence on imports. Despite effective diversification strategies, fossil fuels will continue to be an essential component of the energy mix in many countries, at least in the medium term. This requires to improve policy and regulatory frameworks in order to boost investments in renewable energies, and promote their deployment and diffusion also in emerging and developing countries and to continue to support international cooperation and partnerships on development and implementation of the renewable energy sources.

The financial support systems of promoting renewable energy leads also to the reduction of CO_2, but it is interlinked with the CO_2 market. Every renewable technology has a specific price for omitting CO_2, and the omitting costs of various technologies are very different. These costs now have to be compared to the CO_2 cost of the CO_2 market. Most renewable technologies are actually higher or significantly higher than the price of the CO_2 market. This means that it would be more sensible to reduce the CO_2 with those technologies and processes which are below or at the current CO_2 price and not promote through heavy subsidises some renewable technologies. Evidently, the subsidizes for renewable energies are in contradiction to the CO_2 market. In fact, from an economic point of view, the CO_2 market and the feed in tariffs for renewable energies are in conflict with each other. The feed in tariffs ensure that CO_2 is omitted. As the CO_2 market defines the overall limit the omitted CO_2 through feed in tariffs has not to be omitted by someone

else. Or in other words, with more energy produced from renewables, the less CO_2 will be reduced in other sectors. The subsidizes for renewable energies are in contradiction to the CO_2 market.

When a country pays high feed in tariffs and ensures that more CO_2 is omitted, then it has more CO_2 allowances than it actually needs, and can sell them on the market and by that someone else does not have to reduce its CO_2 position. All direct measures to reduce CO_2, such as feed in tariffs, are not helping to reduce the CO_2 as the market always overrides the country specific interventions. In fact, all feed in tariff do not help to reach the target, but the cost are higher. To further reduce the CO_2 burden there are two ways. Either all countries agree on lower overall emission allowance or, if this is not feasible, they have to ensure that the additionally saved CO_2 are not receiving CO_2 allowances.

Amongst the GHG abatement technologies, a crucial role is played by the CCS that refers to the provision of long-term storage of carbon in the underground, or in oceans. There are plans for at least 20 fully integrated industrial-scale CCS demonstration projects worldwide by 2010, with implementation by 2020. If these plans fail, the world will not be able to deploy the CCS technology in time to prevent CO_2 levels from exceeding allowable limits. Then, the only alternative would be to develop novel technologies to remove CO_2 from the air, which would be enormously expensive and may not succeed.

Conclusion

One of the primary goals of the forthcoming UNFCCC global gathering in Copenhagen would be to address the critical relationship between energy infrastructure investments and climate change because both, infrastructure and GHG emissions, experience a strong inertia. Therefore, both the new GHG emissions target and the new commitments period should be in focus. Improvements in energy efficiency can deliver some of the largest and cheapest CO_2 reductions, and will also delay the need for new supply capacity, giving more time for other, new low-carbon technologies to mature, thus lowering the overall costs of deployment. Use of renewable energy sources in this conext requires particular attention due to many controversis.

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Апстракт

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Енергопројект – ЕНТЕЛ, Београд, Србија

Спречавање климатских промена после 2012. године

Свет је суочен са озбиљним изазовом климатских промена, у којима енергетика има највећи допринос. Садашње стратегије развоја енергетике и саобраћаја предвиђају раст, уместо нужног смањења емисија гасова са ефектом стаклене баште који те промене изазивају. За разлику од могућих сумњи и неизвесности у погледу климатских промена у 1992. години када је донета Оквирна конвенција УН о климатским променама, па и у 1997. години када је формулисан Кјото протокол, данас је њихово све евидентније присуство широм света учинило неспорном потребу озбиљног одговора на тај изазов. Свесни чињенице да је нужан глобални консензус о мерама за спречавање климатских промена за период после истека Кјото протокола, светски лидери се састају крајем ове године у Копенхагену да формулишу нове мере за примену после 2012. године. Рад приказује изазове који су везани за тај важан догађај.

Кључне речи: *климатске промене, енергија, гасови са ефектом стаклене баште, Кјото протокол*

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