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Title: Has the Kyoto Protocol reached its main goal? A brief review

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Keywords: climate change; GHG emissions; greenhouse gases; UNFCCC; United Nations Framework Convention on Climate Change; Kyoto Protocol; black liquor burning; Kraft pulp mills; carbon emissions; CO2; carbon dioxide; biomass; environmental pollution; environmental risks; forest exploitation.

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Has the Kyoto Protocol reached its main goal? A brief review

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1 Introduction

1.1 Objectives

The aim of this study is to make a critical review of the international environmental policy related to Climate Change, the Kyoto Protocol in particular. The revision is an approach from a multidisciplinary scientific view and does not include the analysis of legal issues, application procedures or international agreement mechanisms. The international environmental legislation is a body of laws, regulations and directives, a construct created basically by politicians, officials and corporations. It is a complex matter, especially when viewed from a multidisciplinary perspective different from the law and international relationships.

Climate Change and Global Warming are topics of an outstanding relevance and deserve an ample and detailed analysis. For the sake of brevity, we cannot consider other rules and regulations available on Climate Change (i.e. Environmental Protection Agency, Environment Canada and others). However, the situation in key countries like USA and China – as well as the future role of developing countries as a whole – will be mentioned.

Finally, information dealing with the state of the art will be reviewed and discussed. The key question is: Has the Kyoto Protocol reached its main goals? Considerations relevant to the main objectives of the work will be shown and fully debated, also taking into account the Rio + 20 Conference on Sustainable Development.

This research is based on many contributions, but particularly on the official website of the Kyoto Protocol (i.e. http://unfccc.int/kyoto_protocol/items/2830.php) and the website of the Intergovernmental Panel on Climate Change (IPCC) (i.e. http://www.ipcc.ch/). The use of abbreviations and acronyms has been reduced to a minimum. Additionally, a list of acronyms has been included at the end of the reference list.

1.2 Climate change problem

Over the last 200 years, i.e. from the beginning of the industrial revolution, deforestation and the burning of fossil fuels (mainly coal and petroleum derivatives) have caused the accumulation of 'greenhouse gases' (GHG) in our atmosphere, causing global warming. These 'heat-trapping gases' prevent heat radiation, reflected or emitted by the earth, from escaping into outer space.

Today there is international consensus about the direct responsibility of human activity in the increase of the concentration of greenhouse gases. The curve of this anthropogenic concentration is superimposed clearly above the historical trend due to natural phenomena and fitting well with global temperature (UNFCCC, 1998; WHO, 2009; EPA, 2010). In the present study the terms 'Global Warming' and 'Climate Change' are referred to disturbances originated by human, non-natural activities.

The major anthropogenic sources of GHG emissions are energy generation and industrial activities, especially those which use the massive combustion of coal, oil, biomass, minerals and by-products or waste from industry (Hammons, 2006).

The most important GHG are CO_2, N_2O, CH_4, fluorocarbons (HFCs, PFCs) and sulphur hexafluoride (SF_6), all of them are part of the Kyoto Protocol Annex A. The first two are inevitable (expected) products of combustion. The major man-made source of NO_2 emissions is high-temperature fuel combustion in motor vehicles and in industrial and utility boilers. These emissions are primarily in the form of NO which is oxidised in the atmosphere to NO_2. Methane (CH_4) is a fossil fuel gas, also produced from the microbial activity over organic substrates (industrial fermentation and livestock). Fluorocarbons are very harmful gases produced by industrial synthesis for refrigeration units, aerosol propellant and solvents. They were banned in 1977–1978 (EPA, 1978) and should not be released today.

From all these, CO_2 is being released in greater quantities into the atmosphere, and therefore nowadays it causes a very high impact. Its atmospheric accumulation is further increased by the continued reduction of green areas and forests which capture CO_2 and retain it. To fully satisfy this requirement, the green area must be kept intact over time (long-term forest), defining a 'permanent area' that holds CO_2 both in plants and soil. Permanent or long-term forests produce more oxygen and less CO_2, and carbon capture into land is also greater than 'harvested' forests.

The report of the Intergovernmental Panel on Climate Change shows a global increase in CO_2 emissions close to 80% in the period 1970–2004 and a 28% increase from 1990 to 2004. The emission of CO_2 in 2004 accounted for 77% of total anthropogenic GHG emissions (IPCC, 2007).

The following paragraph from the EPA (USA) regarding the projections on Climate Change and from the WHO about the connection of this issue and the health of the population sets forth the problem:

"*At the current rate, the Earth's global average temperature is projected to rise from 3°F to 7°F by 2100, and it will get even warmer after that. As the climate continues to warm, more changes are expected to occur, and many effects will become more pronounced over time. For example, heat waves are expected to become more common, severe, and longer lasting. Some storms are likely to become stronger and more frequent, increasing the chances of flooding and damage in coastal communities*" (EPA, 2010).

"*The changing climate will inevitably affect the basic requirements for maintaining health: clean air and water, sufficient food and adequate shelter…A warmer and more variable climate threatens to lead to higher levels of some air pollutants, increase transmission of diseases through unclean water and through contaminated food, to compromise agricultural production in some of the least developed countries, and to increase the hazards of extreme weather. Climate change also brings new challenges to the control of infectious diseases…In the long run, however, the greatest health impacts may not be from acute shocks such as natural disasters or epidemics, but from the gradual build-up of pressure on the natural, economic and social systems that sustain health, and which are already under stress in much of the developing world…Health effects are expected to be more severe for elderly people and people with infirmities or pre-existing medical conditions. The groups who are likely to bear most of the resulting disease burden are children and the poor; especially women…Climate change can no longer be considered simply an environmental or developmental issue. More importantly, it puts at risk the protection and improvement of human health and well-being*" (WHO, 2009).

2 The Kyoto Protocol and its mechanisms

In May 1992, the United Nations launched in New York (USA), the 'United Nations Framework Convention on Climate Change' (UNFCCC, 1992), hereinafter referred to as 'the Convention', specifically oriented to manage the Global Warming and the Climate Change.

The goal of the Kyoto Protocol is to limit and reduce greenhouse gas emissions, in agreement with the recommendations of the Intergovernmental Panel on Climate Change (IPCC) established in 1988 jointly by the World Meteorological Organization and the United Nations Environment Programme.

The Convention provides updates called 'Protocols', the third – and more relevant – of which was held in Kyoto (Japan) in 1997. It came into force on 16 February 2005 (UNFCCC, 1998).

Signatory Country Parties are separated into two groups, called 'Annex I Parties' and 'Non-Annex I Parties'. The former are 40 members of industrialised countries and countries with economies in transition, including Germany, Spain, Italy, England and the USA, all voluntarily committed to reducing greenhouse gases included in Annex A.

'Non-Annex I Parties' are 153 developing countries. Therefore, in order not to hamper their economic growth, the Kyoto Protocol has not demanded any commitment on emissions.

The members listed in 'Annex I' agree to limit and reduce emissions "*in order to promote sustainable development*". They are not required to implement a particular policy, but rather they can "*implement or elaborate policies and measures in accordance with its national circumstances*".

The allowable level of emissions is called the Party's 'assigned amount'. Each Annex I Party has a specific 'emissions target', which is set relative to its emissions of GHG in its 'base year'.

The 'emissions target' is a factor of 0.92 (or a reduction/limitation of 8%) for nearly all European countries, with an average little less than 6% counting all Annex I Parties (Annex B). For most countries, 1990 is the 'base year'. However, five European Parties have chosen to use an alternative base year in the interval 1986–1989 (UNFCCC, 2008).

In general, a Party's initial 'assigned amount' for the five year period 2008–2012 should be calculated by multiplying its emissions in the base year by its emissions target, and then multiplying that value by five.

Different GHG are expressed in a 'CO_2 equivalent', with a relative weight that is set according to their estimated impact on Climate Change. The quantity of the initial assigned amount is referred to as 'Assigned Amount Units' (AAUs), each of which represents an allowance to emit one metric tonnes of carbon dioxide equivalent (t CO_{2eq}).

The Kyoto Protocol develops its policy of reducing emissions by the 'Land-Use, Land-Use Change and Forestry' (LULUCF), that are actions to be made in the field of land use and changes in land use and forestry, in order to preserve the function of carbon uptake in terrestrial ecosystems.

Activities in the LULUCF sector can provide a relatively cost-effective way of offsetting emissions, either by increasing the removals of greenhouse gases from the atmosphere (e.g. by planting trees or managing forests) or by reducing emissions (e.g. by reducing deforestation). In 2001, new activities were adopted in Marrakesh, including forest management, reforestation, agricultural soil management and management of grassland. However, the application of these mechanisms does not always represent a real improvement, as it will be discussed further.

The Kyoto Protocol does not define scientifically or in detail the concepts of 'forest', 'afforestation', 'reforestation and other issues of importance. Instead, the Protocol has as default reference "Revised 1996 IPCC Guidelines for LULUCF", which was later supplemented by "The Good Practice Guidance for Land use, Land-use Change and Forestry", adopted by the IPCC Plenary in 2003 (IPCC, 2003).

Under the Kyoto Protocol, afforestation and reforestation refer to the conversion of non-forested land to a forested condition. Afforestation means the human-induced conversion to forest of land that has been non-forested for at least 50 years at the time of conversion. Reforestation refers to the conversion to forest of land that has been non-forested for a shorter period of time. Harvesting and replanting of forested land are considered forest management. These actions do not sink CO_2 and are not covered by Article 3, because the carbon cycle is affected by harvesting (UNFCCC, 2008); consequently none of this generates emission allowances.

Also the "IPCC Good practice guidance" of 2003 insisted on emphasising the fact that harvested wood, used for various 'wood products' (HWP) and particularly for pulp and paper, does not generate any allowance (IPCC, 2003). Despite this reiteration, for instance, the pulp industry continues to insist that its forest plantations represent a way of carbon accumulation (Bracelpa, 2008; Bracelpa, 2009).

The IPCC continues to study new alternatives, one of which allows the inclusion in national inventories of real and documented growth of long standing forests as carbon storage (Cadman, 2008).

Furthermore, the UNFCCC (1992), established different instruments called 'flexible mechanisms'. Flexible mechanisms are not defined as activities supplement (e.g. LULUCF) but real economic instruments to make contributions to reduce emission where it is economically advantageous.

The International Emission Trading (IET), under this mechanism, an Annex I Party may transfer (or acquire) Assigned Amount Units from another Annex I Party. Emission trading does not affect the total assigned amount of Annex I Parties collectively; rather, it re-distributes the assigned amount among them. However, the number of units that a Party may transfer to other Parties is limited by other rules.

The Joint Implementation (JI) is a project-based mechanism by which one developed country can invest in a project that reduces emissions or enhances sequestration in another developed country, and receives credit for the emission reduction/removal enhancements. The credit is called an 'Emission Reduction Unit' (ERU). The Joint Implementation, like IET, does not affect the total assigned amount of Annex I Parties collectively.

The Clean Development Mechanism (CDM) is a project-based mechanism, the credits of which are generated from emission reduction projects or from afforestation and reforestation projects in developing countries that have ratified the Kyoto Protocol. It is worth noting that the LULUCF can be also a part of the CDM. At present there are 4000 registered power projects in Maharashtra state (India) with the aim to reduce GHG emissions by 21,807 tonnes a year (UNFCCC, 2012).

The number of CDM projects increased noticeably since 2004. In 2011, 2740 projects were registered (50% more than those of 2010). In February 2012, 256 CDM projects were registered and this is the second highest monthly number CDM of registered projects (UNFCCC, 2012).

Unlike the IET and JI mechanism projects, the CDM "creates new Kyoto units and their acquisition by Annex I Parties increases both the total assigned amount available for those Annex I Parties collectively and their allowable level of emissions" (UNFCCC, 2008). Consequently, CDM projects implementation and approval procedure follow strict rules.

The CDM: In brief, the Protocol is basically an agreement among developed countries, a commitment whose primary purpose is to reduce the atmospheric concentration of greenhouse gases. This is achieved primarily by reducing emissions of GHG, which can be complemented with the removal of CO_2 from the atmosphere by sink. Removal does not cancel the obligation to reduce emissions and for now, the only permissible form of removal is by means of the proper management of agriculture, afforestation and reforestation. Through these activities, Parties may generate, cancel, acquire or transfer emission allowances, which will raise or lower their assigned amount. These emission allowances are collectively called Kyoto units, commonly called 'carbon credits'. These credits (units) can be traded, resulting in a 'carbon market' among developed countries. The Protocol has stimulated this market only to help Country Parties to fulfil the primary objective of the Convention.

2.1 Statistics on GHG Emissions

Based on the evolution of the flexible mechanisms above described, data on GHG emissions (1990–2009) show that industrialised countries like USA and Canada still have high emission levels with respect to those of the UE.

The UE (27 members) reduced their emissions by 20.25%; UE (15 members) reduced their emissions by 15.00%; while USA and Canada increased their emissions by 5.60 % and 29.78 %, respectively (UNFCCC, 2011a).Global data on GHG emissions, showed that for the Kyoto Protocol, the system without LULUCF emissions decreased by 11.5 %, while including the LULUCF they decreased by 17.6 %. (UNFCCC, 2011a). For countries with 'no-party' system emission (i.e. China, USA, India, etc.) emissions increased by 2.1 % without considering LULUCF, but increased by 0.6 % considering LULUCF (UNFCCC, 2011b). From these data we can infer that the effects of the LULUCF system in reducing emissions were limited.

Data regarding CO_2 emissions from energy consumption in 2008 shows a worldwide level of 30,400 million CO_2 tonnes (with 4.39 CO_2 tonnes/capita). China is the major CO_2 emitter worldwide, i.e. 6800 million CO_2 tonnes (4.92 CO_2 tonnes/capita), followed by the USA with 5800 million CO_2 tonnes (18.38 CO_2 tonnes/capita) and Europe ($n = 27$) with 4600 million CO_2 tonnes. It must be noted that Russia and India are next on the list with 1670 and 1460 million tonnes, respectively. The global trend in this category is the continued growth, with a higher slope for countries like China, Russia, India and South Africa, which are BRICS countries (IEA, 2010a; IEA, 2010b). There is similar information about China being at the top of CO_2 emitters for 2005–2009 (Garnaut, 2011) and responsible for two thirds of the worldwide increase in anthropogenic CO_2 emission of 31% in 2007 (Chen and Zhang, 2010; Yan and Yang, 2010).

The latest bad news arrived when according to the International Energy Agency (Custers, 2011), the global annual CO_2 emissions during 2009–2010 increased exponentially, reaching their highest level ever in 2010.

3 Discussion

3.1 Kyoto Protocol: emerging issues

Taking into account the environmental policies proposed in the Kyoto Protocol we could today highlight some positive aspects. Firstly, the Kyoto Protocol is the first serious attempt to solve climate change by addressing anthropogenic emissions of GHG from developed countries. Secondly, Country Parties are committed to an almost equitable reduction, proportionate to their own emissions. Thirdly, the inclusion of developing countries as beneficiaries in various proposed activities, including access to credit for improvements, research and economic projects, counting the LULUCF area is encouraging, but it has some limitations. Also, with regard to differentiating among reservoirs of CO_2 (forests, natural forests and HWP), it is commendable that the Convention and the Protocol have supported up to date the recommendation of the Panel of Experts (UN IPCC), avoiding the attempts of abuse by corporations, especially in developing countries. Furthermore, the acknowledgment that some measures or standards used by developed countries are "*…inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries*" (Convention, page 1, last paragraph) is very positive. It would be very encouraging for developing countries if other international legislations – namely the EU IPPC, the World Bank Environment Guideline and the Code of Procedure of the International Court of Justice among others – also incorporate this concept.

Finally, the establishment of 'flexible mechanisms' and the carbon market are valid initiatives, beyond the particular ways in which different actors are handling them.

However, the Kyoto Protocol also presents questionable aspects. The first alarming issue is the tendency to promote the necessary actions to reduce climate change as long as they do not affect the 'sustainable economic development'. This is stated or implicit in both texts, the Protocol and the Convention. The result of this attitude is the scarce 'emission reduction' commitment negotiated and finally approved by the Parties. If the objective was to achieve a consensus, the minimum at least, it failed. The refusal of the USA to endorse the Protocol is enough proof.

Moreover, the Canada's withdraw announcement from the Kyoto Protocol and the news that Japan and Russia confirmed they would not renew their commitments to the Protocol is not a good news (Climatico Analysis, 2011).

The main concern of science about this 'sustainable economic development' that currently dominates the global scene is this insatiable appetite for resources and energy. There is no technology that can meet the 'needs' of this economic model and deal with their emissions and their waste. There will be no credible solutions for the foreseeable future. Leaders and economists must take on responsibility for this reality. It is imperative to start thinking about a different economy, more respectful of human beings and nature; an economy based on the premises that energy is and will remain scarce, at least for what remains of this century. The Rio + 20 Conference should give responses to these issues; but the situation seems not to be good because the levels of the Kyoto protocol were not achieved (UNCSD, 2012).

The planned average reduction is 'exiguous', compared to the magnitude of the problem of climate change and the required urgency to solve it. The risks and potential harms that were envisioned in the 1990s have become major damages in 2011 and are also an unpredictable threat to the near future.

Very little or none of the globally expected GHG reduction has materialised just few months before the end of the first commitment period (December 2012). On the contrary, emissions of CO_2 reached historical record levels in 2010. Nobody trusts a radical change on the short-term tendency, a sensible emission reduction, considering the worldwide economic growth. Minor exceptions in Europe cannot save the target proposed by the Protocol.

The second issue of concern is the fact that all developing countries were enrolled in a single category, where none of them has any commitment to reduce or limit GHG emissions. This includes several booming economic giants, especially China and India, today among the major polluters. Since 2008 China has been the biggest emitter of CO_2 from energy consumption, accounting for 22% of global emissions. Possibly the major and most unfortunate consequence of this situation is the refusal of the USA to ratify the protocol, expressly mentioning the absence of limitation and reduction commitments for developing countries (US Embassy, 2001; US Embassy, 2005; Fletcher and Parker, 2007).

The USA, the world's largest economy and second biggest CO_2 emitter after China is no doubt concerned about the potential loss of competitiveness against China. Both countries maintain an active bilateral trade, while competing in other markets.

The fact that the USA, China and India have announced their own emission reduction targets (China, 2004; China, 2005; US Embassy, 2005; India, 2010) seems not to be an appropriate solution. These promises are not legally binding commitments, nor enforceable by the international community. On the contrary, it calls into question the attitude and behaviour of these actors in future negotiating rounds.

The third hot spot of the Protocol is related to the acceptance of biomass in general as 'renewable fuel alternative' to fossil fuels. This is implicit or explicit in the original text and its latest updates, and is commonly established by the companies and the public. It was a comprehensible but questionable notion in the early 1990s, but totally unjustifiable to date, considering the weight of scientific evidence accumulated over the last twenty years.

Probably some special cases can be tolerated a few more years. But most of the huge projects of biomass utilisation should be discouraged immediately, considering the global and regional damage they are causing. Among the latter lies the combustion of Black Liquor (BL) generated in the production of Kraft pulp, with or without bleaching.

3.2 Biomass is not a green fuel alternative

3.2.1 Combustion of clean wood and woody biomass

The combustion of wood or clean woody biomass is not 'carbon neutral'. The massive use of biomass from forest exploitation in short cycles of planting and cutting accelerated the loss of soil carbon (Shanin et al., 2011). The result is the release of more CO_2 than captured by the tree during its development, in addition to other GHG, especially N_2O. The same is true for periodically harvested crops. An inevitable side effect due to the loss of organic matter is the general deterioration of the soil, including structural changes and defeat of microorganisms.

Moreover, even the combustion process at high-efficiency biomass boilers emits to the atmosphere a large quantity of non-GHG and many categorically toxic compound (Chandrasekaran et al., 2011): CO, VOCs, PAH, NO_x, SO_2, heavy metals, particulate matter and PCDD/F, among others. Partitioning factors control the level of volatile contaminants at gas, particle or vapour phase (Shrestha et al., 2010).

The emission of several congeners of PCDD/F is always present at increasing concentrations, dependent upon the chlorine and PAH content of the fuel. To a lesser extent on the relationship Cl/S present during the combustion and the facilities available to remove particulate matter (Beauchemin and Tampier, 2008; Chandrasekaran et al., 2011). In woody materials, the PAH emitted is directly related with its lignin content.

In the last years, biomass burning aerosols (particles less than one micron) are suspected of strong human health risks: potential cytotoxicity, mutagenicity and carcinogenicity (Iinuma et al., 2010).

Other groups of aerosol and black carbon (BC) can influence the environment at local, regional and global scales in different ways: from pulmonary-respiratory health effects (Löndahl et al., 2009) and cardiovascular disease (AHA, 2010) to relevant impact on climate, Climate Change and Global Warming (Shrestha et al., 2010). Recently, a letter to *Nature* brings more evidence about the influence of anthropogenic combustion (biomass burning aerosol) on long-term changes in sea surface temperatures, "as a prime driver of twentieth-century North Atlantic climate variability" (Booth et al., 2012).

Despite all these arguments, some UN agencies – like FAO, still promote biomass as a substitute for fossil fuels for power generation. The refreshing recently good news is the "Proposed Final Regulation", published by the State of Massachusetts (USA) intended "two years of evaluation, public input, and careful considerations of how best to utilise our woody biomass resources for energy" (DOER, 2012).

3.2.2 The burning of Kraft black liquor

The combustion of black liquor is among the worst and most serious environmental events, usually justified as an inevitable stage in the production of Kraft pulp, which additionally 'generate available electric energy, in excess over the needs of the mill'.

The main portion of BL that burns in the recovery boiler consists of 'biomass', an aqueous residue of the wood that retains all of its components, except for 75–80% of the original cellulose, separated from the whole as 'pulp'. The second fraction of BL is the inorganic and organic (additives) compounds incorporated to the process (at digester) as pulping chemicals, mostly sodium and sulphur compounds.

The rest are soluble inorganic compounds: SO_4Na_2 (incorporated to the liquor as make-up of S and Na), chlorine (Cl) and potassium (K) and others 'dead load' compounds. As a result, the ratio 'organic waste biomass/inorganic material' in BL entering the recovery boiler is about 1.8–2.2% (Cardoso et al., 2009).

Chlorine and potassium enter the liquor cycle with wood and make-up chemicals. Both Cl and K can reach high concentrations in the liquor, creating corrosion issues, increased particulate matter (in the boiler and the fly ash) and other problems in the chemical recovery circuit. For these reasons, most mills have today specific equipment for the removal of Cl and K (Tran and Earl, 2004).

To complete the picture it should be mentioned that modern mills also burn together with BL, a significant fraction of the secondary treatment of effluents biosludge. This fraction contains important proportions of nutrients (nitrogen mainly), heavy metals, chlorinated compounds from bleaching effluents and very frequently, rest of process additives like EDTA, nonylphenol and its ethoxylates as well its metabolites.

The above description allows us to understand why the emissions resulting from the combustion of BL in the recovery boiler of Kraft mills (Tomlinson type) are much more dangerous and polluting than those from the combustion of wood and woody biomass, comparing on the same basis of dry weight burned: a larger emission of sulphur compounds, mostly SO_2 and SH_2 (NCASI, 2005; Jawjit et al., 2006), and also of carbon disulfide (CS_2), much more toxic than SH_2 (Borrás et al., 2012); a comparatively larger emission of NO_x (Salmenoja, 2009), VOCs, PAH and particulate matter, PM2.5 in particular (Adams et al., 1997). Differences are also surely substantial in the case of PCDD/F, considering the higher proportion of Cl, lignin and PAH present during combustion. This differences are not clearly reflected by well known Emissions Factors (Uloth and van Heek, 2002), but those factors do not give a true picture, because they were measured on different type equipment and capacity, with very dissimilar facilities.

In 2010, total worldwide consumption of chemical market pulp, only a roughly 40% of the total Kraft pulp production, was approximately 49 million air-dried tonne (CANFOR, 2011). This implies that during 2010 were burned worldwide, in Kraft Recovery Boilers, approximately 83 million tonne of dry BL, of which 54 million are 'organic waste biomasses'. Numbers are not necessary to get an idea of the enormous amount of toxic emissions that these figures imply, as well as the local and global impact being generated.

There is the possibility of new technologies that eliminate the Tomlinson boiler in the future. The gasification is one of them, but still not developed enough to have some security on its success.

3.2.3 The issue of Kraft pulp mills

When writing about the combustion of BL, it is impossible evade the context, the Kraft pulp production mills and its other sources of heavy pollution. First the pulpwood forest, where clear cutting crop in short-rotation can be so frequently as 4–6 years. This forest requires nutrients, pesticides and other chemical supplies necessary for the growth of young trees, of up to two years of age.

The processing of pulpwood (pulping, bleaching and chemical recovery) also generates a large volume of risky emissions to atmosphere and dirty effluents, considered between the most pollutant industrial wastes.

Everything described above is also valid for some kind of 'bio-refinery' projects, heavily promoted in the USA and the EU as 'a sustainable energy solution for the future'. These new industries expect to produce ethanol, bio-diesel and other fuels from cellulosic material, but energetically they will depend entirely on the production of chemical pulp and black liquor combustion (Ragauskas et al., 2006; SEA, 2008).

It can be argued that these supplies and pollutants are not the subject of the Protocol, but the Protocol should clearly promote distinctions between different uses of biomass fuels. Thus, the Protocol must differentiate between the simple burning of wood or wood waste and the polluting fuel that flows into a Kraft Recovery Boiler. There is a huge difference in environmental impact in each case. The Kyoto Protocol should make a difference and avoid granting support to this kind of polluting industry. It cannot be argued, 'this issue is not a Protocol concern', because ultimately all member states are involved in programmes to reduce or eliminate similar emissions that pollute the air and water.

These gaps in regulations are promoting practices and changes in the forest industry, which are totally negative for the environment and collide with the specific objectives of the Convention and the Protocol, in particular the explicit commitment with developing countries.

Dramatic examples of these contradictions are the mills installed in the Southern Cone of America, Mega Bleached Kraft Pulp Mills owned by European companies, so huge and highly pollutant industries that none of them could operate today in the Old Continent (Böhm and Brei, 2008). A single plant on the Rio Uruguay produces 1,200,000 tonnes of Eucalyptus chemical pulp, operates about 160,000 forested hectares and consumes 300,000 tonnes of chemical supplies annually. Over 1,100,000 tonnes of biomass and at least 240,000 tonnes of chemicals are burned together every year in boilers and furnaces (AMEC, 2007; EcoMetrix, 2007).

As expected, producing little less than one million tonnes in 2008, the plant declared a total annual emission to the atmosphere of around 3000 tonnes, distributed into NO_2, SO_2, CO, Total Reduced Sulphur (TRS) and particulate matter, PM10 and PM2.5 basically (EcoMetrix, 2009, Matta, 2009). Considering fuel oil consumption, the estimation gives 156,000 tonnes of CO_2 generated by fossil auxiliary fuel annually (EcoMetrix, 2007). There is no information concerning the CO_2 generated by the combustion of the mixture of biomass and inorganic chemicals, neither about dioxins and furans released to the atmosphere.

There are two more mills with the same or bigger capacity operating in Brazil, and currently there is a similar one under construction over Rio de la Plata (Aracruz, 2011; RISI, 2011; Veracel, 2011). There are other huge projects waiting for governmental

authorisation and several '500,000 tonnes/year mills' producing in the region: Alto Parana (Argentina), Celulosa Araucoy Constitución (Valdivia, Chile) and Aracruz Celulosa (Guaiba, Brazil) (Böhm and Brei, 2008) among others.

Most of these facilities and projects are generated by direct European investments or joint ventures with local companies, confirming the strong trend to transfer heavily polluting plants to developing countries (Lang, 2008).

Very few seem to notice the contradiction that involves so many hectares in operation generating 'renewable fuel' and so much emission of GHG and non-GHG gases to the atmosphere. Even worse, these plants are awarded with Kyoto CDM allowances, due to power generation from 'biomass', which the company kindly traded on the European 'carbon market' (Lang, 2008; UNFCCC 2011c). These companies are not really concerned about additional revenue. What they seek is the approval and applause from the economic community. They look for an "authority" that allows them to continue emitting without restrictions, to obtain bank loans and expand their forest and industrial operation.

The following are recent and not good examples of the above mentioned contradictions, officially promoted by recognised United Nations organizations:

> "*Wood energy from renewable and sustainable biomass sources causes no emissions, and when substituting fossil fuels, it can 'save' emissions*" (Haupt, 2011).
>
> "*What makes forest industry special is its ability to neutralise manufacturing-level greenhouse gas emissions with carbon sequestration (in sustainable management of forests), in product carbon storage (product sinks) and in the generation of bio-energy (fossil fuel replacement)*" (FAO, 2011).
>
> "*FAO and the International Council of Forest and Paper Associations (ICFPA) commissioned this study at the request of the 49th session of the Advisory Committee on Pulp and Wood Products (ACPWP), held in Backubung, South Africa in June 2008. It outlines the global roundwood production, pulp and paper, and wood processing industry's contribution to climate change mitigation and aims to raise the industry's profile in international negotiations on global warming. Over the years, climate change has become a priority issue for the global environment*".
>
> *Recently, the focus of the global climate change agenda has started to shift from carbon sequestration to low carbon emission products and technologies, in which forest industries should play a crucial role. Stable demand for forest products is one of the most important factors in avoiding forest land-use change and maintaining stable forest cover to withstand global warming.*
>
> *FAO does not necessarily share or support all of the statements in this report. However, we think it is an important attempt to present the climate profile of modern forest management and industries impartially, based on solid facts and figures*" (FAO, 2010).

The transfer of polluting industries to the southern American hemisphere or the Asian countries for whatever reason will not reduce the concentration of GHG and will not mitigate Climate Change on earth. That movement will only generate ephemeral profits for developed countries and regional irreversible damage in freshwater, land and clean air of developing countries.

4 Conclusions

At present, we can conclude that the objectives for the first commitment period, which ends in 2012, as stated by the Kyoto Protocol and the Convention, have failed. It can neither be stated that the global targets 'have been partially fulfilled', because the reductions in a few Country Parties represent non-significant quantities compared with the worldwide emissions growth. Even if the reduction objective for Annex I Country Parties had been reached, the fact that global emissions grew beyond control is regrettable.

It is absolutely evident that a total renegotiation is required, involving all major emitters in the world, with a higher purpose and a consensus mechanism to monitor and ensure compliance.

Amongst the specific aspects that should be considered in the new agreement and emerging from the previous analysis, the following topics stand out:

- The explicit recognition by Country Parties of the worsening of Climate Change, in the light of scientific evidence as already described by the IPCC, as well as the new risks, which are likely to be expected, including a new calendar of forecast events.
- It is imperative to reach an agreement so that the USA, Canada, Japan and Russia endorse and lead future commitments. Similarly, it is essential to re-categorise the non-Annex I Country Parties – China and India at least, and reach consensus on basic commitments.
- The Kyoto Protocol should strongly promote the growth of long-term forests and protected forest reserves in the world. This will bring well known multiple benefits, in addition to reducing the atmospheric concentration of GHG.
- The Convention should not accept any pressure from corporations that seek to equalise the harvested forest (exploited industrially) with long-term forest, claiming they have the ability to sink CO_2. This issue was defined by science and therefore it can be subject to no negotiation whatsoever.
- The combustion of biomass for electric power should be limited, discriminating those situations where a clear environmental gain can be guaranteed, from those where there is no certainty of GHG emission reductions, as a minimum. A leading case is the Kraft pulp industry, which massively consumes dangerous chemicals, burns black liquor mixed with risky wastes and emits a large volume of pollutants, including persistent organic pollutants.
- It is crucial to promote scientific and technological research to develop alternative sources of energy which leave no doubt as to their efficiency, and that reduce GHG emissions, mainly CO_2. All necessary measures should be taken to ensure that new developments generate net positive energy, preventing damage to the environment.

Finally, it is essential that new commitments to reduce GHG also include a serious review of the economic models currently in use, through mechanisms that the UN already have, like the Economic and Social Council and the Economic Commissions and Committees. If there are no changes in the way we produce and consume goods and services, there will be neither energy consumption reduction, nor GHG emission drop, and it will be impossible to avoid a worsening of the Climate Change.

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Acronyms

AAUs: Assigned Amount Units

BRICS: Brazil, Russia, India, China and South Africa

CERs: Certified Emission Reductions

CDM: Clean Development Mechanism

ECF: Elemental Chlorine Free

EAUs: European Union Allowances

EPA: Environmental Protection Agency

ERU: Emission Reduction Unit

EU-ETS: European Union – Emission Trading System

EU-IPPC: European Union – Integrated Pollution Prevention and Control

FAO: Food and Agriculture Organization of the United Nations

GHG: Greenhouse Gases

HWP: Harvested Wood Products

LCERs: Long-Term Certified Emission Reductions

LULUCF: Land Use, Land-Use Change and Forestry

IEA: International Energy Agency

IET: International Emission Trading

IPCC: Intergovernmental Panel on Climate Change

RMUs: Removal Units

$tCER_s$: Temporary Certified Emission Reductions

t CO_{2eq}: Tonnes of Carbon Dioxide equivalent

TRS: Total Reduced Sulphur

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

JI: Joint Implementation

WHO: World Health Organization

WMO: World Meteorological Organization