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Comparative analysis of carbon dioxide emission factors for energy industries in European Union countries

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ABSTRACT

Strategies for mitigating climate change require accurate estimates of the greenhouse gas (GHG) emissions. Estimates of the amounts of carbon dioxide (CO_2) and other GHGs emitted into the atmosphere are crucial for planning and analyzing mitigation efforts. Emissions factors are the fundamental tool in developing national emissions inventories. The quality of GHG inventories has been a long-standing issue among the scientific community and its importance has more recently risen on the policy agenda because national inventories are now the basis of legally-binding commitments. According to the IPCC Good Practice Guidance comparison with the recommended IPCC default values may be informative in establishing the comparability of the country-specificity of the emission factors used. Such comparison may help to identify data outlier where uncertainty ranges do not overlap. The main objective of this article is to assess comparability of CO_2 emissions factors between EU countries for energy industries and to evaluate whether the reporting of emissions from energy industries is good enough to monitor progress towards the emission reduction targets set under international agreements according to the quality criteria of transparency, consistency, comparability, completeness and accuracy. Performed analysis of CO_2 emission factors showed that almost all EU countries seeking to reduce uncertainty apply country-specific CO_2 emission factors for major sources of emissions from energy industries. Application of country-specific emission factors ensures greater accuracy and lower uncertainty of GHG inventory. Comparative analysis showed that country-specific CO_2 emission factors applied in EU countries for the main fuels combusted in the energy industries have been established in a comparable way taking into account uncertainty ranges defined in the IPCC Guidelines. Seeking to ensure more accurate estimates of CO_2 emissions it is important further improve knowledge on emission factors at individual plant level that allow estimating GHG emissions with lower uncertainty applying higher level tier methods.

Contents

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1. Introduction

Climate change is one of the most challenging issues of our times. Over the past century, human activities have released large amounts of greenhouse gas (GHG) into the atmosphere. Stern [16] found that in order to minimize the most harmful consequences of climate change, concentrations would need to be stabilized below 550 ppm CO_2 eq. and any delay in reducing emissions would be costly and dangerous.

In order to stabilize the GHG concentration and to reduce global warming, 196 countries in the world agreed to the United Nations Framework Convention on Climate Change [17]. In 1998, a number of countries approved the Kyoto Protocol [18] too. Under the Kyoto Protocol Annex I countries agreed to reduce GHG emissions at least 5% below 1990 levels in the commitment period 2008–2012.

The Intergovernmental Panel on Climate Change (IPCC) in the Fourth Assessment Report states, that since 1970, GHG emissions from the energy supply sector have grown by over 145%, while those from the transport sector – by over 120%. As such these two sectors show the largest growth in GHG emissions [9]. Therefore the limitation of GHG emissions in the energy sector represents the highest priority in most of the countries in order to achieve the national commitments for GHG reduction.

Under the UNFCC Convention and under the Kyoto Protocol, the Annex I countries are annually reporting their national GHG emissions inventories to the UNFCCC. The estimates of GHG emissions are based on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [6], although the IPCC has already approved the 2006 Guidelines at the 25th session of the IPCC in April 2006 in Mauritius. The new reporting tables based on the 2006 Guidelines will be mandatory from 15 April 2015. Currently GHG emissions inventories are submitted for the years 1990–2010 and are available on the UNFCCC website [20].

The analysis of developments of GHG emissions (see Fig. 1) shows that, although total GHG emissions were decreasing by 1.6% a year during 1990–1994, however, they have started increasing by 0.4% a year since 1995. The global economic recession during 2008–2009 impacted on a reduction of consumption of various fuels. As a result GHG emissions reduced by 6.1% in 2009. Recovery from the global economic crisis was followed by an increase of GHG emissions. In 2010, GHG emissions increased by 3.1% compared to 2009.

As it is evident from Fig. 1, energy industries (they include electricity and heat generation, petroleum refining and manufacturing of solid and other energy industries) are the most important source of GHG emissions that are being generated during the combustion of fossil fuel in Annex I countries. During 1990–2010 GHG emissions from energy industries accounted to about 30% in the structure of total emissions (see Fig. 1). GHG emissions from the energy industries amounted to 5.77 Pg CO_2 eq. in 2010 and they had almost been at the same as level as in 1990 (5.80 Pg CO_2 eq.).

CO_2 emissions contribute to about 99% of total GHG emissions CO_2 eq. in energy industries of Annex I countries (see Fig. 2) and EU has the second largest contribution of CO_2 emissions (29.4% in 1990; 25.1% in 2010).

Strategies for mitigating climate change require accurate estimates of the GHG emissions. Estimates of the amounts of CO_2 and other GHG emissions emitted into the atmosphere are crucial for planning and analyzing the mitigation efforts and for the development scenarios of future emissions. The quantity and distribution of current emissions as well as the path of future emissions are very important therefore it is critical that estimates of emissions would be accurate and deal with uncertainty in best estimates [12].

Thus, strict requirements for reliable estimations of CO_2 emissions when analyzing efficiency of being implemented strategies for climate change mitigation and evaluation of progress towards the CO_2 emissions reduction targets; as well considering to the importance of EU energy industries in emitting CO_2 induced to concentrate on the issue of quality of CO_2 emissions estimations in EU energy industries.

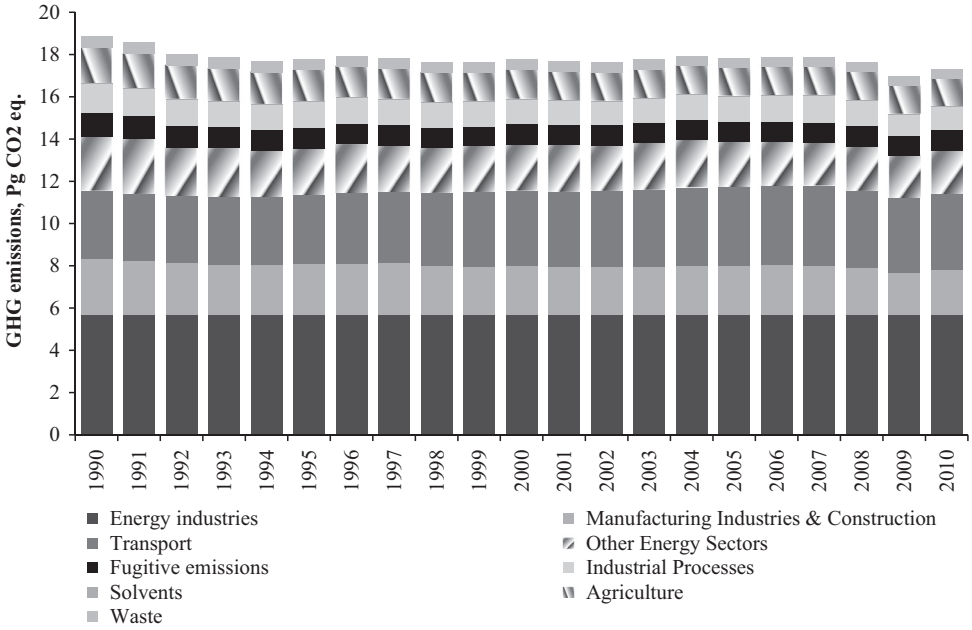

Fig. 1. Total GHG emissions in Annex I countries, Pg CO_2 eq.[20].