# *assessment of Global mitigation progress: a Decomposition of co2 Emissions for the World’s Top emitting countries*

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#### **Overview**

According to the International Panel on Climate Change (IPCC), fossil fuel combustion is the single largest human influence on climate. While emissions have doubled in the period between 1971 and 2005, real GDP has reached three times the value of the base year (see fig. 1). But although declining global CO2 emissions per unit of gross domestic product (GDP) could be observed, strong economic growth – especially in China and India –has led to a worrying rise in global CO2 emissions in the last years.

One possibility to analyze the relationship between emission growth and changes in underlying factors in this context is the use of decomposition analysis. This work provides a breakdown of the change in carbon dioxide emissions between 1971 and 2005 to five effects: the emissions per unit of fossil fuel, the change in the share of fossil fuels in total energy, the change in energy intensity, the change in GDP per capita and the change in population. It covers the biggest carbon dioxide emitting countries and regions that together account for over 80% of total emissions worldwide.

#### **Methods**

This empirical study uses the Log Mean Divisia Index methodology proposed by Ang (2005) to decompose the changes in fossil fuel CO2 emissions between 1971 and 2005 for the biggest emitting regions of the world with a special focus on European countries.

The change in each country’s carbon dioxide emissions between the base year and target year is decomposed into the following effects:

* the coefficient effect, i.e. the change in the emissions per unit of fossil fuel
* the substitution effect, i.e. the change concerning the share of fossil fuels in total energy,
* the energy intensity effect, i.e. the change in the ratio of total primary energy supply and GDP
* the income effect, i.e. the change in GDP per capita and
* the population effect, i.e. the change in population.

#### **Results**

When looking at the aggregated results for the countries analyzed it becomes evident that the largest contributor to the rise in emissions between 1971 and 2005 is the change in GDP per capita. This income effect is almost three times higher than the effect arising from a growing world population.

The positive income and population effects (in a numerical sense) can only partly be offset by a negative change in energy intensity. On a global scale neither the change in emissions per unit of fossil fuel nor the changing share of fossil fuels in total energy supply could add significantly to a mitigation of global CO2 emissions.

On a regional level the picture looks similar. A strong positive income and population effect is partly compensated by energy productivity gains. Only Korea, Iran, Mexico, South Africa and Saudi Arabia exhibit a positive energy intensity trend. In Europe a relative shift to lower emitting fuels can be observed, whereas in the United States and China this effect is positive due to the rising share of coal in energy supply. The change in the ratio of fossil fuels to total energy supplied is positive for the low income countries China, India and Indonesia as the share of combustible renewables and waste (e.g. biomass for cooking) declines with the level of GDP per capita and a decreasing importance of the agricultural sector.

The European countries together have been able to compensate the income effect in emissions through large cuts in energy intensity but also negative substitution and coefficient effects.

#### **Conclusions**

#### The developments in CO2 emissions from fuel combustion illustrate the need for a more sustainable energy system through implementing measures of energy efficiency and reducing carbon intensity of energy supply by shifting from fossil fuels to renewable energy sources.

#### How countries fare in terms of emission levels is generally related to their availability of natural resources and their economic structure. However, whether or not global and regional climate change targets will be met is mostly dependent on the development of the world’s economy in the years to come. A worldwide recession within the next years could slow down the acceleration rate of CO2 emissions in the short run. But falling oil prices and rising unemployment rates could also lead to a shift of priorities away from a sound environmental policy in order to unburden households and industry in the short-run. This could have substantial medium and long term effects for the climate.

#### **References**

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