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Implementing the EU Climate and Energy Package with the Economic Crisis

How does the crisis change EU's Greenhouse Gas Emission scenarios by 2020?

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Introduction

In March 2007, the European heads of state and government agreed at their European Council upon a 20% greenhouse gas (GHG) emission reduction target compared to 1990-levels[1] and a 20% share of renewable energies in EU's final energy consumption by 2020. To implement these commitments, the European Commission prepared a set of legislative proposals – the so-called "Climate and Energy Package" - which was jointly endorsed by the European Parliament and the European Council in December 2008 and formally adopted in April 2009. This new policy will run from 2013 to 2020.

Hence, the reinforcement of European Union's energy and climate policy in the decade to come was decided and prepared in 2007-2008. But in the meantime, the economic conditions worldwide and in Europe more particularly have radically changed compared to what they were in 2007-2008 when the package was designed. From the end of 2008, the global economy has indeed experienced a major crisis unseen since the great depression in 1929.

The European Commission has drafted its proposals for the Climate and Energy Package following the outcomes of an impact assessment based on several modeling tools (the most important being PRIMES and GAIN). These modeling tools were not used for determining the 20-20 in 2020 targets or checking their feasibility – those were political targets decided by the European Council in March 2007. The models served to assess the effects and costs of different allocation methodologies (i.e. burden sharing among member states and sectors). In its drafting proposals, the Commission projected an annual Gross Domestic Product (GDP) growth of 2.2% on average until 2010 in the EU and a 2.4% growth between 2010 and 2020 (European Commission 2008a).

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[1] The European Council decided even upon a 30% emission reduction target, provided that other developed countries commit themselves to comparable emission reductions in the framework of a global and comprehensive agreement for the period beyond 2012 (to replace the Kyoto Protocol that ends in 2012) and provided that economically more advanced developing countries contribute adequately according to their responsibilities and respective capabilities: Council of the EU (2007), *Brussels European Council 8/9 March 2007, Presidency Conclusions*,7224/1/07REV1.www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/93135.pdf

But because of the economic crisis, the European Union has on the contrary seen a sharp fall of its GDP in 2009: according to the latest forecast by the International Monetary Fund (IMF), which is quite similar with forecasts from other organizations, such as the European Commission (Directorate-General for Economic and Financial Affairs) or the Organization for Economic Cooperation and Development (OECD), the EU-27 should see its GDP decrease by 4.2% in 2009. Opinions are divided when it comes to the question of when and how fast the economy recovers. The IMF has predicted a rather flat GDP growth in 2010 (+0.04%), followed from 2011 by a growth at a slower pace than was predicted before the crisis (IMF, October 2009).

The aim of our study is to analyze how the economic downturn in Europe will affect the EU's greenhouse gases emissions and its ability to reach the 20% emission reductions by 2020 compared to 1990. Using the knowledge available at the end of 2009 (in particular concerning the contraction of GDP volumes) and drawing lessons from the past emissions trends in Europe from 1990, we will assess the progress towards the 20% reduction target over the period (from 1990 to 2020).

A discourse often heard at this time of recession is that the EU climate policy is now out of place: because of the crisis the fight against climate change is said to be too costly and nothing should be required from European industries already coping with a worldwide slowing down of demand for goods and products and huge financial restrictions. Another similar discourse argues that, with the downturn in economic and industrial activities, GHG emissions will automatically decrease, so no effort is required to comply with the EU-wide targets. The economic slowdown will do the trick. Our analysis aims at putting these arguments into perspective. What does the economic downturn really change in EU's emissions future profile up to 2020?

The EU Climate and Energy Package is composed of four legislative acts (plus some communications and other non binding documents): A Directive amending the current EU-Emission Trading Scheme (EU-ETS); A Decision on GHG Reduction Effort Sharing (that deals with the share of emissions reductions from sectors not covered by the EU-ETS); A Directive on Renewable Energies (that sets specific national targets for member states to achieve the EU-wide target for a 20% energy share from renewable sources by 2020); A Directive on the Geological Storage of Carbon dioxide (that sets out the legal framework for the geological storage, detailing administrative processes for dealing with requests for exploration and storage and the procedures to follow after the closure of storage sites).

The main elements of the package addressing climate change (and the ones our study will focus on) are the first two pieces of legislation mentioned above, that limit GHG emissions in the EU by

2020: the directive reviewing the EU-ETS for the period 2013-20 and the decision limiting emissions in the non-ETS sectors. One important difference between these two pieces of legislation is that the target for the ETS sector is community-wide, whilst for the non-ETS sectors separate national targets have been agreed upon to share the burden among the 27 member states (WERRING 2009).

The scope of EU climate legislation has been considerably extended by these recent developments: it includes now nearly all major emitting sectors, while it previously targeted only ETS sectors in the framework of 2005 EU-ETS (representing around 45% of European CO_2 emissions). The ETS today covers sectors such as power plants, mineral oil refineries, coke ovens, metalworking and steel factories, cement industries, ceramic products, pulp, paper and board, glass and leather products. It will be extended to aviation from 2012 and to carbon capture and storage, aluminium, and petrochemical industries from 2013 in the framework of the ETS review directive. The non-ETS sectors now included in the EU climate legislation in the framework of the decision on the effort of Member States to reduce their GHG emissions are the following: transport (except aviation), farming, waste and households. Another major extension of the scope of EU climate legislation concerns the gases covered: the EU-ETS previously addressed essentially carbon dioxide: it will now include two new gases from 2013 besides CO_2 (N_2O and PFCs). The decision on non-ETS sectors covers six greenhouse gases (CO_2, CH_4, N_2O, SF_6, HFCs, PFCs[2]), in keeping with the nomenclature used by the international climate regime. In theory, most greenhouse gases emitted in Europe are now covered by binding reduction targets as from 2013. The 20% reduction objective set up for 2020 concerns all these greenhouse gases beyond the sole CO_2.

Our study will be subdivided as follow: firstly we will assess past GHG emissions trends in the EU before 2007 (2007 being the latest year for which we can rely on consolidate data from official institutions); then a methodological part will focus on the link between GDP and GHG emissions; finally we will apply this methodological debate to the current economic crisis and set up several scenarios forecasting the effect of the economic downturn on European GHG emissions profile both in 2013 and 2020. All the data used in our study are gathered in the appendices at the end of the report.

[2] Carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydro fluorocarbons, per fluorocarbons.

Pre-crisis GHG emission trends in the EU, 1990-2007

A reviewed dataset

What was the EU's GHG emission profile before the economic crisis showed up at the end of 2008? The latest official data available were published by the European Environment Agency (EEA) in May 2009 and cover the period 1990-2007. The European Community, as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on GHG inventories for the year t-2. In the framework of this reporting exercise, the EEA published in May 2009 the European Community GHG inventory which represents the direct sum of the national inventories compiled by the member states (EEA 2009). Our analysis of the pre-crisis GHG emission trends in the EU is based on this inventory since its data are not only the most recent ones but also the most accurate ones. Indeed, the EEA undertook a recalculation of its dataset since 1990 and as a result, the figures published in May for the period 1990-2007 are slightly different from those previously reported by the European institutions themselves and by the Secretariat of the UNFCCC. The recalculation is the result of inventory improvements, which member states were required to undertake for the whole time series to ensure consistency[3]. *EEA data are particularly relevant for our study as they enable us to rely on a homogeneous series of data for the period 1990-2007.*

Another reason why the EEA reporting exercise under the UNFCCC is useful is because *the EU climate legislation, with the adoption of the Climate and Energy Package, is now consistent with the UNFCCC definition of greenhouse gases* and covers the six gases listed in the Kyoto Protocol (CO_2, CH_4, N_2O, SF_6, HFCs, PFCs[4]) and not solely carbon dioxide as was the case before[5]. The

[3] The recalculations were mainly due to the revised energy balance in Germany and the use of a revised emission factor for agriculture (nitrogen leaching) in Germany.
[4] Carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydro fluorocarbons, per fluorocarbons.

data submitted by the EEA to the Secretariat of the UNFCCC therefore not only give a picture of how the EU and its member states score with their international emission reduction obligations but also of how far they are from their own new domestic target of a 20% emission reduction by 2020 (compared to 1990-levels) set in the Climate Package.

EEA data consider only domestic emissions taking place within European territory (i.e. excluding emission reductions obtained through international offsets such as the Kyoto Clean Development Mechanisms (CDM) and Joint Implementation (JI) schemes). In addition, emissions from international aviation and international maritime transport are not taken into account in EEA's report, in keeping again with Kyoto Protocol's nomenclature[6]. The figures presented below exclude changes in emissions and removals from land-use, land-use change and forestry (LULUCF), as the reviewed EU climate legislation does not yet take into account the LULUCF sector's potential for absorbing GHG emissions[7]. This is the only difference with Kyoto Protocol coverage of emissions (the Kyoto Protocol partially addresses LULUCF[8]). The figures we present below are thus on the whole consistent with the UNFCCC and the Kyoto Protocol framework.

A downward trend for EU's emissions…

Total GHG emissions decreased by 9.3% in the EU-27 from 1990 to 2007. But this overall positive path hides disparate results over time, in the different European countries and upon examination of various GHG.

[5] Directive 2009/29/EC, Article 1; Decision 406/2009/EC, Article 2. The EU Emission Trading Scheme in particular will include two new gases from 2013 besides CO_2: N_2O and PFCs.

[6] Contrary to the Kyoto Protocol, the EU climate legislation will cover the aviation sector from 2012. A Directive including the aviation into the EU Emissions Trading Scheme (ETS) was published in the Official Journal on 13 January 2009. All intra EU flights and all flights leaving the EU (but not those incoming from outside the EU) will have to buy greenhouse gas emission permits after 2012. In 2012, permits allocated will be capped at 97% of average emission levels in 2004-2006, and at 95% after 2013. 15% of allowances will be auctioned and the rest allocated free of charge.

[7] Under the Climate Package, the use of international offsetting credits generated by afforestation and reforestation projects in developing countries is allowed under certain conditions. In the event that no international agreement has been approved by the EU by the end of 2010, member states may specify their intentions for the inclusion of land use, land use change and forestry in the EU reduction commitment.

[8] For instance, harvested wood products are not included in the Kyoto Protocol. For the activities covered (such as afforestation-reforestation, deforestation, forest management and cropland), different accounting rules apply. It is widely acknowledged that the current Kyoto Protocol regime for LULUCF has still scope for improvement. For certain activities, countries can opt to include and account for them or not for the period 2008-2012. These rules are likely to be further developed for the period after 2012.

With some reversal in-between

Over the last two decades, European emissions did not follow a continuous downward trend: the 27 member states now composing the EU had already reduced their total emissions by 9.2% in 2000 compared to 1990-levels (5564 million tonnes CO_2-equivalents emitted in 1990; 5063 Mt CO_2-eq in 2000). But then releases went up again in the early 2000's. The decline in European emissions started again from 2005. The year 2007 was the third consecutive year of drop in EU-27 emissions which decreased from 5111 Mt CO_2-eq in 2005 to 5045 Mt CO_2-eq in 2007. Emissions barely decreased between 2005 and 2006 but then declined by 1.2% between 2006 and 2007.

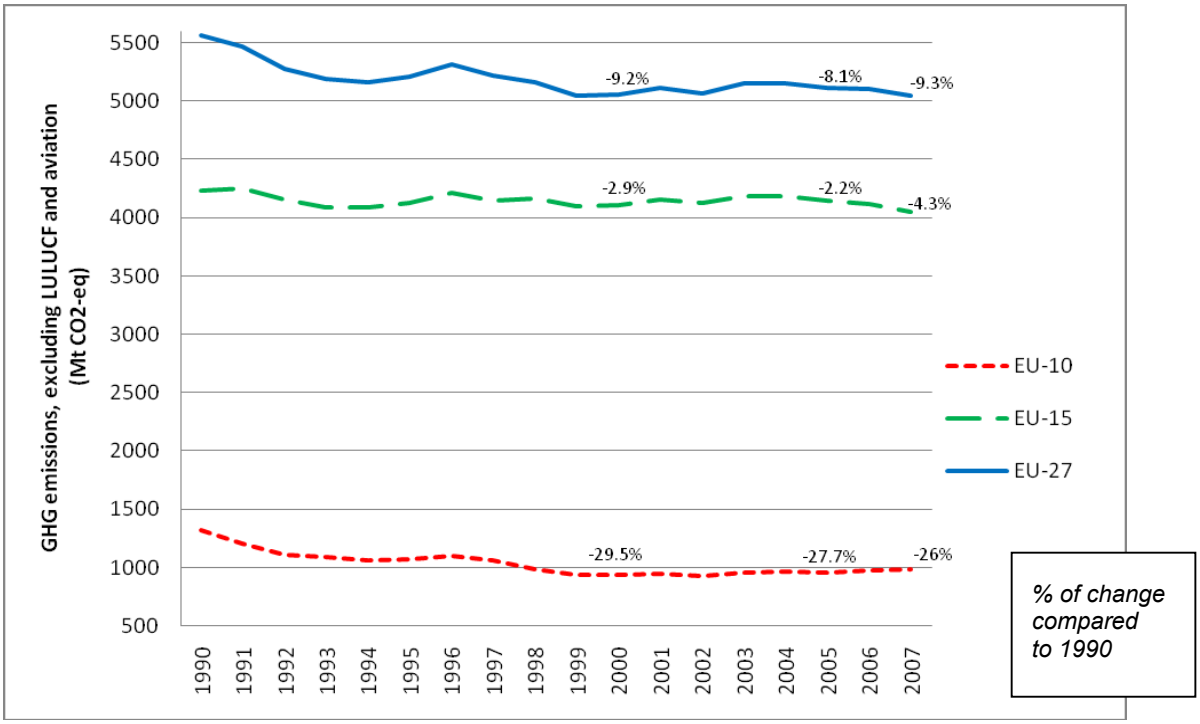
Hiding national discrepancies

The drop in emissions achieved in the EU since 1990 resulted in large measure from the collapse in the 1990's of Eastern and Central European economies that used to rely on overdeveloped heavy industries and an inefficient use of cheap energy. The reduction in emissions was much less significant in Western Europe, except for Germany that "benefited" from the drop in emissions in its five Eastern Länder after reunification.

The decline in European GHG emissions occurred mainly in the 10 Central and Eastern European countries (EU-10[9]) that joined the Union in 2004 and 2007. Their releases decreased by an impressive 26% between 1990 and 2007, whereas EU-15 only achieved a 4.3% reduction of their own emissions in the meanwhile. Even though the new member states barely accounted for 20% of the EU's overall emissions in 2007, the drop in their emissions was the main driver for the EU-27 downward trend over the period. EU-10 emissions collapsed in the 1990s due to the shutdown of the Soviet-era industry which was highly carbon-intensive. It is what some experts refer to as "hot air" since the emission reductions were caused by an economic and industrial downturn and not proactive climate-related policies. The hot air effect only lasted for a decade: Central and Eastern Europe's emissions rose on the whole by 5% between 2000 and 2007, which partly explained the EU-27 mixed results in the early 2000's. In the meantime, EU-15 emissions decreased slightly by 1.4% from 2000 to 2007 (See Figure 1 for the emission trends for EU-27, EU-15 and EU-10 from 1990 to 2007).

[9] *EU-10* is an aggregation of the 10 new member states from Central and Eastern Europe that joined the EU in 2004 and 2007 (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia). Cyprus and Malta are not included in the aggregation.

Figure 1: GHG emissions trends in the EU, 1990-2007



Source: data from EEA Technical Report n°4/2009, calculation and graph from the author. The data are available in the appendices of our study.
Note:
EU-27: aggregation of the 27 member states of the European Community.
EU-15: aggregation of the 15 oldest members of the European Community which share a common target under the Kyoto Protocol (-8% by 2012 compared to base-year levels) – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU-10: aggregation of the 10 new member states from Central and Eastern Europe – Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

Looking at the trend in individual countries, the EU GHG emission profile over the last two decades has been dominated by 5 large emitters – the most populated older members of the Union – that alone accounted for 62% of the EU-27 overall emissions in 2007. Germany and the United Kingdom are the two largest emitters representing about a third of total EU-27 GHG emissions in 2007 (Germany with a share of 19% and United Kingdom 13%). Italy and France are the third and fourth largest emitters with shares of 11% and 10.5% respectively. Spain is fifth, accounting for 9% of total EU-27 GHG emissions in 2007. Poland comes sixth as the largest emitter by far among the new member states. In 2007, Poland was responsible for 8% of the EU-27 total emissions, but accounted for 41% of greenhouse gases emitted by the Central and Eastern European countries (See Figures 2 and 3 for the share of GHG emissions by country in the EU-27 and EU-10).

The two largest emitters, Germany and the United Kingdom, made most progress in terms of reducing their GHG releases, with respective declines of 21% and 17% between 1990 and 2007. According to the EEA, the main reasons for the favorable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after the German reunification (i.e. the above mentioned hot air effect). Reduced GHG emissions in the United Kingdom were primarily the result of liberalizing energy markets and consequent fuel switching from oil and coal to gas in electricity production[10].

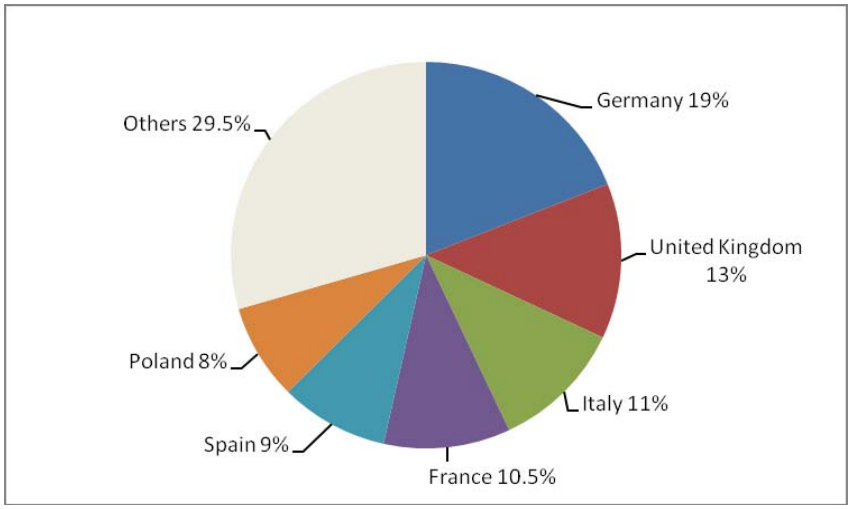
Poland decreased GHG emissions by 13% between 1990 and 2007, first by as much as 15.2% between 1990 and 2000 but then emissions stabilized and even increased by 2.5% from 2000 to 2007. The main factors for decreasing emissions in Poland were the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s (again the hot air effect). But emissions from transport, especially road transport, increased sharply.

France's emissions were 6% below 1990 levels in 2007. In France, large reductions were achieved in N_2O emissions from adipic acid production but EEA data show CO2 emissions from road transport increased considerably between 1990 and 2007.

The reductions achieved in those four countries were partly offset by the boom in GHG emissions in Spain, where emissions rose by 54% over the period, and to a lesser extent by the increase in emissions in Italy (+7%). The emission boost in those two countries was largely generated by road transport, electricity and heat production, petrol refining and manufacturing industries (EEA 2009) (See Figure 4 for the emission trends in these six countries from 1990 to 2007).

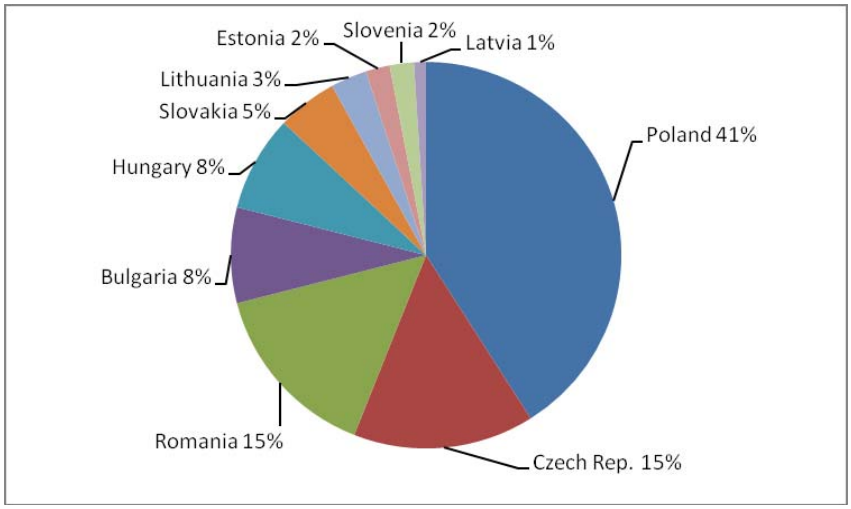
[10] And also of N_2O emission reduction measures taken in adipic acid production

Figure 2: Share of 2007 GHG emissions in the EU-27, by main emitting country



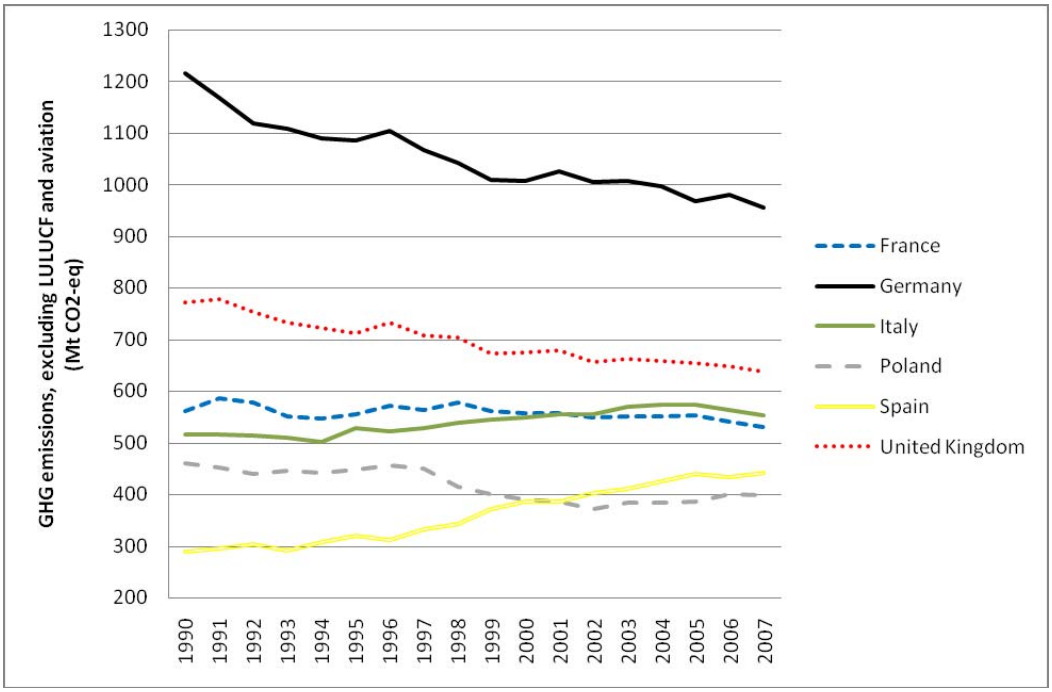
Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

Figure 3: Share of 2007 GHG emissions in the EU-10, by emitting country



Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

Figure 4: GHG emissions trends in 6 largest emitting countries in the EU, 1990-2007

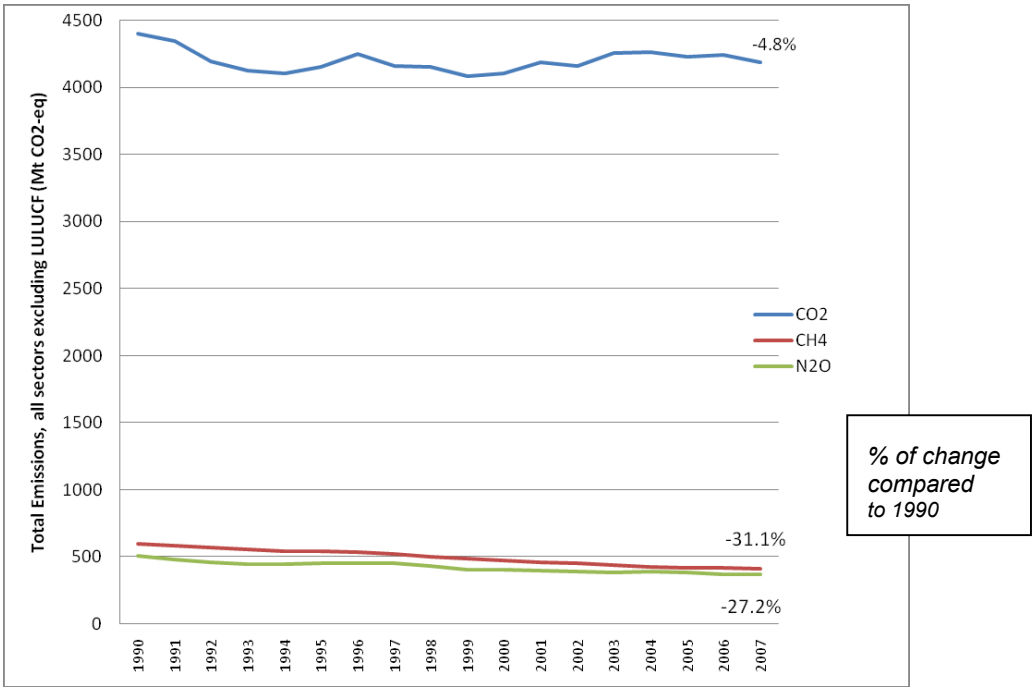


Source: data from EEA Technical Report n°4/2009, graph from the author

Depending on the gases considered

The various gases emitted by the EU over the period have not decreased at the same pace. The figure 5 shows a much more modest decline for CO_2 only in European economies from 1990 to 2007: CO_2 emissions were cut by only 4.8% compared to the 9.3% drop in the three greenhouse gases covered. The much greater declines in methane (-31.1%) and nitrous oxide (-27.2%) are contributing nearly half of the overall decline of 9.3%.

Figure 5: Main GHG Emissions Trends in the EU-27, 1990-2007 (for all sectors excluding LULUCF)



Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

Still a long road to comply with EU's climate commitments

Is the observed slowdown in the greenhouse gases emitted by the EU in line with its political commitments? Today the European Community has two legally binding climate obligations both at the international level and domestically.

The first set of targets was a global EU commitment in the context of the Kyoto Protocol: the 15 older members pledged to cut their collective GHG emissions by 8% by 2012 from the baseline emissions of 1990. Now with the EU at 27 members, 10 of the 12 new member states have individual targets under the Protocol.

The second set of objectives was unilateral and concerns all 27 current members. Here the intent is to reduce greenhouse gases emissions by 20% by 2020 from 1990 baseline. It is clear that 2020 is not very far off and the 1990 baseline is already nineteen years behind us. It is reasonable to ask whether the EU is two thirds of the way to its target of 2020.

The minus 8% target for EU-15 between 2008 and 2012 (Kyoto Protocol)

As a party to the UNFCCC and its additional Kyoto Protocol, the European Community has a target to cut its greenhouse gas emissions by 8 % from the 1990 base-year by 2012, which they can only really measure in 2014. This commitment only concerns the 15 older member states that formed the EU when the Kyoto Protocol was signed. The EU-27 as a whole does not have any Kyoto target. Within this overall -8% target, each EU-15 member state has a differentiated reduction target; some should reduce emissions while others are allowed a limited increase. New Member States from Central and Eastern Europe have individual targets except Cyprus and Malta, which have no targets.

It is important to clarify that the base year is not a 'year' per se, but the emission level from which emission reductions will take place and the starting point for tracking progress. For carbon dioxide, methane and nitrous oxide, 1990 is used as the 'base year' for all EU-15 Member States. But for fluorinated gases, the EU-15 Member States can choose to use the emission levels in 1995 instead. Twelve of the 15 Member States have chosen to use 1995 as their base year for fluorinated gas emissions whereas Austria, France and Italy have chosen 1990. In practice, EU-15 base-year emissions can be considered close to 1990 emissions (EEA 2008).

The Table 1 below summarizes Kyoto targets for the EU-15 as a whole and for the 6 largest emitters in Europe in particular, as well as progress made by 2007. The recent recalculation of emissions as a result of the UNFCCC reviews during 2007 and 2008 now fixes *base-year emissions for the EU-15 at 4 265.5 Mt of CO_2-eq*. This new figure takes into account the EEA's latest official report (EEA 2009) and is the figure our analysis is based on to assess the European Community's progress to comply with its international commitments.

In order to meet its 8% Kyoto target, we calculate that *the EU-15 needs to reduce its GHG em issions by a total of 341 Mt CO2-eq* from 1990 levels (i.e. -8% of 4265.5 Mt CO_2-eq) and hence to *emit no more than 3924,5 Mt CO_2-eq on average by 2012.*

In 2007, the EU-15 had only reduced its emissions by 5% compared to the base year: its GHG emissions reached 4052 Mt CO_2-eq in 2007. *A 127.5 Mt CO2-eq decrease is still needed between 2007 and 2012 to comply with the Kyoto target* (See figure 6).

Among the six largest em itting countries, all but Spain and Italy had already reached their Kyoto target (under EU burden sharing) in 2007.

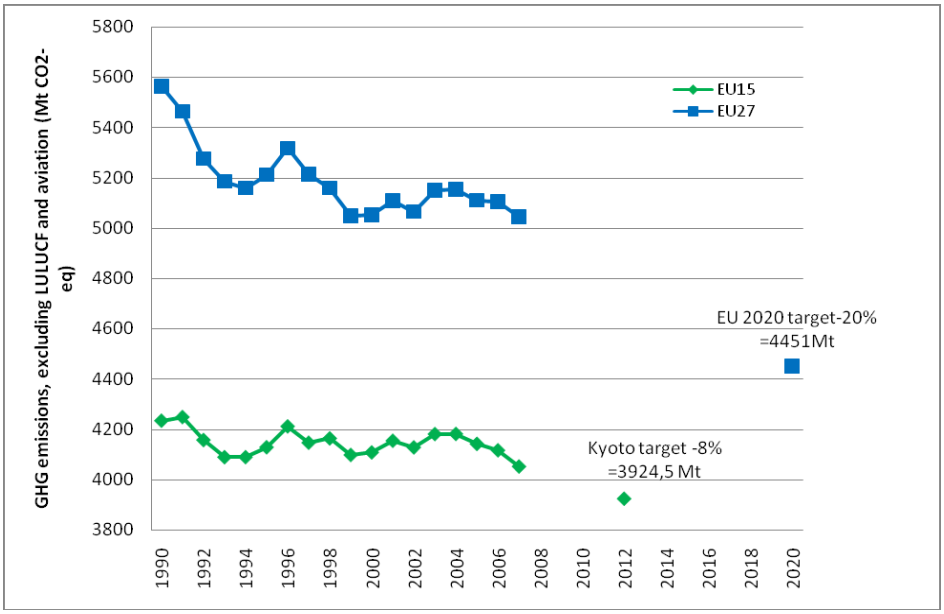
Table 1: GHG emissions in CO_2-equivalents (excluding LULUCF) and Kyoto Protocol targets for 2008-12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base-year (million tonnes)	2007 (million tonnes)	Change 2006–2007 (million tonnes)	Change 2006–2007 (%)	Change 1990-2007 (%)	Change base year–2007 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
France	562,6	563,9	531,1	-10,6	2,00%	-5,60%	-5,80%	0,00%
Germany	1215,2	1232,4	956,1	-23,9	2,40%	21,30%	22,40%	21,00%
Italy	516,3	516,9	552,8	-10,2	1,80%	7,10%	6,90%	-6,50%
Spain	288,1	289,8	442,3	9,3	2,10%	53,50%	52,60%	15,00%
United Kingdom	771,1	776,3	636,7	-11,2	1,70%	17,40%	18,00%	12,50%
EU-15	**4232,9**	**4265,5**	**4052**	**-64**	**1,60%**	**-4,30%**	**-5,00%**	**-8,00%**
Poland	459,5	563,4	398,9	-0,4	0,10%	13,20%	29,20%	-6,00%
EU-27	**5564**	**No target**	**5045,1**	**-59,4**	**1,20%**	**-9,30%**	**No target**	**No target**

Source: data from EEA Technical Report n°4/2009

Note: In the table, the percentage of reduction achieved in the EU-15 in 2007 compared to the base-year (-5%) is slightly different from the percentage measured in 2007 compared to 1990-levels (-4.3%). It is because the base-year chosen for the calculation of the emissions reduction is not 1990 for all the gases and all the member states (1990 is the base-year for carbon dioxide, methane and nitrous oxide; 1995 is the base-year for fluorinated gases in twelve of the 15 Member States except Austria, France and Italy that have chosen 1990).

Figure 6: EU-15 and EU-27 GHG emissions 1990-2007 compared with their political targets



Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

According to the EEA, the Kyoto objective can only be achieved through a combination of existing and planned domestic policies and measures, using carbon sinks (LULUCF sector) and taking into account GHG emission reductions occurring outside the EU territory, by CDM and JI offsets.

Thus the *results of the EU-15 efforts to meet their Kyoto obligation are mixed. The 15 older members of the Union have still to reduce their emissions by 3% in 5 years (between 2007 and 2012)*, that is to say nearly as much as what they achieved in the past 17 years (around -5% between base-year and 2007). They would have to massively intensify their effort. If they continued at the same pace as in the last 17 years (i.e. an average decline in emissions of 0.3% per year), they would only reach a -6.5% cut in 2012 (so 1.5% below what the Kyoto Protocol oblige them to reduce). *Without the help of offsets and without the economic recession – the EU-15 would be unable to comply with its international obligation given the current state of national policies* (the EU Climate and Energy Package will indeed only be implemented from 2013 so after Kyoto's commitment period).

The minus 20% target for EU-27 by 2020 (EU Climate and Energy Package)

An unlikely compliance without a major reversal in trends

According to EEA data, the EU-27 emitted 5564 Mt CO_2-eq in 1990 (EEA 2009). The 20% reduction target in 2020 compared to 1990[11] decided by the European 2007 Spring Council implies a collective reduction of 1113 Mt by 2020 from 1990-levels. *Emissions should not be more than 4451 Mt CO_2-eq in 2020*. The EU-27 emitted 5045 Mt CO_2-eq in 2007 (EEA 2009). So *a 594 Mt CO_2-eq decrease is still needed between 2007 and 2020 to comply with the package's climate target* (i.e. a drop of slightly more than the amount of greenhouse gases emitted in France or in Italy in 2007).

This target looks even harder to achieve than the Kyoto target, as shown in the figure 6. We have just seen that without any reversal of the trend in emissions (thanks to the economic crisis for instance) and without offsets, the EU-15 was unlikely to comply with its -8% Kyoto target (compared to base-year levels). Without the help of the economic crisis, the level of effort required to reach the -20% target in 2020 would have to be much higher. *Without a major reversal in emission trends, the EU-27 is unlikely to comply with its own unilateral target*. Recent talks of a 30% target raises even more questions of credibility.

The structure of the 20% target: emission allowances for ETS-sectors and national reduction targets for non-ETS sectors

The overall 20% emission reduction target was decided by the heads of state and government at the 2007 European Spring Council: it is a political objective aiming at demonstrating EU's leadership in the fight against climate change.

In deciding how to put this objective into practice, and in particular how to share the reduction target among economic sectors and among member states, the European Commission has drafted its legislative proposals in January 2008 based on an impact assessment using several modeling tools, the most important being PRIMES and GAIN (EC 2008a).

The impact assessment used on the most updated verified GHG emission data available at the time of the drafting of Commission's impact assessment and legislative proposals, i.e. for the year 2005 which is also the first year for which detailed emission information is available for EU-ETS. The measurement of European greenhouse gas releases has been refined since then but the state of play in 2008 using 2005 data was the starting point to determine burden sharing across Europe. At the time, the EU-27 total GHG emissions were 6.8% below 1990 levels in 2005 – excluding LULUCF

[11] This time, 1990 is the exact base-year considered to measure the EU-27 effort in terms of reducing its GHG emissions.

removals but including emissions from aviation bunker fuels (outbound flights) as they will be part of EU-ETS from 2012. It was determined that European emissions had to be reduced a further -13.2% compared to 1990 levels from 2005 to 2020 to achieve the -20% reduction target. The document calculated that this was equal to a reduction of -14.2% compared to 2005 emissions excluding aviation.

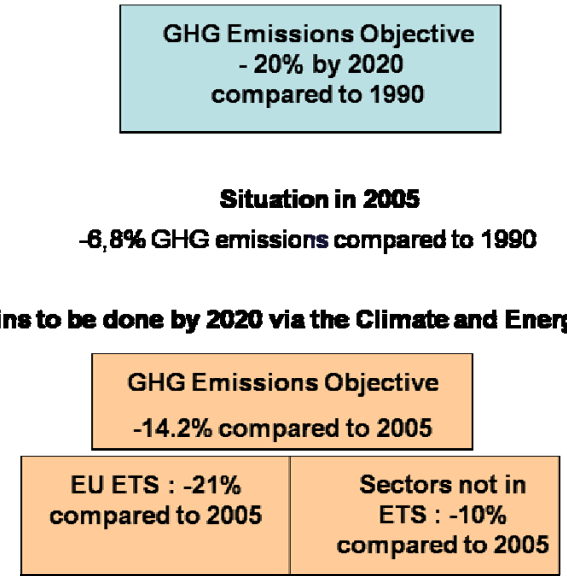
The European Commission's impact assessment concluded that, for the package to be cost-effective, sectors covered by the EU ETS[12] should bear a disproportionate burden of the overall reduction effort compared to the non ETS sectors[13]. In the final package as adopted by the Council of the EU and the European Parliament, a single EU-wide cap for the emissions covered by the EU-ETS was set at 21% lower in 2020 than emissions in 2005 excluding aviation (2009 ETS review directive). By comparison, non ETS sectors had to reduce their GHG emissions by "only" 10% in 2020 compared to 2005 – this overall non ETS emission reduction target was split into 27 national targets according to each country's GDP in 2005 (2009 decision on the effort of Member States to reduce their GHG emissions) (See figure 7 for the distribution of the 20% reduction target among sectors).

It is worth noting that 1990 is still the year of reference for the EU-27 20% reduction target in 2020. The distribution of the effort to achieve this target (-21% for ETS sectors and -10% for non ETS sectors) is measured from 2005-levels for purely technical reasons and is the result of the lack of data for the years before 2005. A coalition of eight Eastern countries, led by Hungary, rejected – without success - 2005 as the reference year for calculating national greenhouse gas reduction targets, instead requesting that it be replaced with 1990. Eastern Europe experienced major economic restructuring in the 1990s and a significant decrease in its greenhouse gas emissions occurred during this period. This decrease is not taken into account in the adopted baselines, increasing the burden on East and Central European countries.

[12] The ETS covers today the following sectors: power plants, mineral oil refineries, coke ovens, metalworking and steel factories, cement industries, ceramic products, pulp, paper and board, glass, leather products. It will be extended to aviation from 2012 and to carbon capture and storage, aluminium, and petrochemical industries from 2013 in the framework of the 2009 ETS review directive.

[13] The non-ETS sectors now included in the EU climate legislation in the framework of the 2009 decision on the effort of Member States to reduce their GHG emissions are the following: transport (except aviation), farming, waste, households.

Figure 7: Distribution of 20% GHG emission reduction target among ETS and non ETS sectors



Source: data from COMMISSION STAFF WORKING DOCUMENT, ANNEX TO THE IMPACT ASSESSMENT, SEC (2008) 85, VOL.II; graph from the author.

In terms of GHG volumes, a specific level for the ETS cap in 2020 was defined in advance in the ETS review directive: the emission allowances available under the European trading scheme will be equal to *1720 Mt of CO_2-eq in 2020 for the sectors already covered by the EU-ETS* . This cap does not yet include aviation and the new gases and sectors included in the scheme from 2013 and will have to be recalculated (2009 ETS review directive). According to the latest data published by the EEA in its EU-ETS data viewer[14], 27 member states' emissions covered by the EU-ETS were equal to *2165 Mt CO_2-eq in 2007*. So emissions will have to further decrease by 445 Mt CO_2-eq by 2020 within the current emission trading scheme to comply with the new ETS cap.

Thus *non ETS sectors' emissions reached 2880 Mt CO_2 eq in 2007* (i.e. total GHG emissions 5045 Mt – 2165 Mt for ETS sectors) and *will have to fall to 2731 Mt CO_2 eq in 2020* (i.e. maximum level of emissions of 4451 Mt in 2020 – EU-wide cap for ETS emission 1720

[14] The main source of information on the EU-ETS at EU level is the Community Independent Transaction Log (CITL). The CITL is a central transaction log, run by the European Commission, which checks and records all transactions taking place within the trading scheme. The EU ETS data viewer provides aggregated data by country, by sector and by year on the verified emissions, allowances and surrendered units of the more than 12 000 installations covered by the EU emission trading scheme. Link to the EU ETS data viewer website: http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=473

Mt), which corresponds to a drop of 149 Mt CO_2-eq between 2007 and 2020 (See table 2).

Table 2: GHG emission still to reduce from 2007 in EU-27 to achieve the 20% reduction target by 2020

	GHG emissions in 2007 (Mt CO_2 eq)	Emission reduction effort to make from 2007 to 2020 (Mt CO_2 eq)	GHG emission targets in 2020 (Mt CO_2 eq)
ETS sectors	2165	-445	1720
Non-ETS sectors	2880	-149	2731
Total	5045	-594	4451

Source: data from ETS data viewer and EEA Technical Report n°4/2009; calculation from the author.

Conclusion: There is a significant gap between political targets and current emissions trends

From the emission reduction trends observed in the EU from 1990 to 2007, one can conclude that a great effort remains for the EU to comply with its climate commitments, both at the international level (*a 127.5 Mt CO_2-eq gap to meet EU-15 Kyoto target*) and domestically (*a 594 Mt CO_2-eq gap to reach the 20% reduction target* from the Climate and Energy Package).

One can wonder whether the economic recession alone (with the automatic drop in GHG emissions) can significantly contribute to bridging this important gap between releases in 2007 and the reduction targets. The third part of our analysis will address this issue.

Before turning to the effect of the current economic crisis on Europe's GHG emission profile, it is important to understand the link between Gross Domestic Product (GDP) and GHG emissions.

Methodological Part

The link between GHG emissions and economic growth

GDP in real terms: a useful indicator

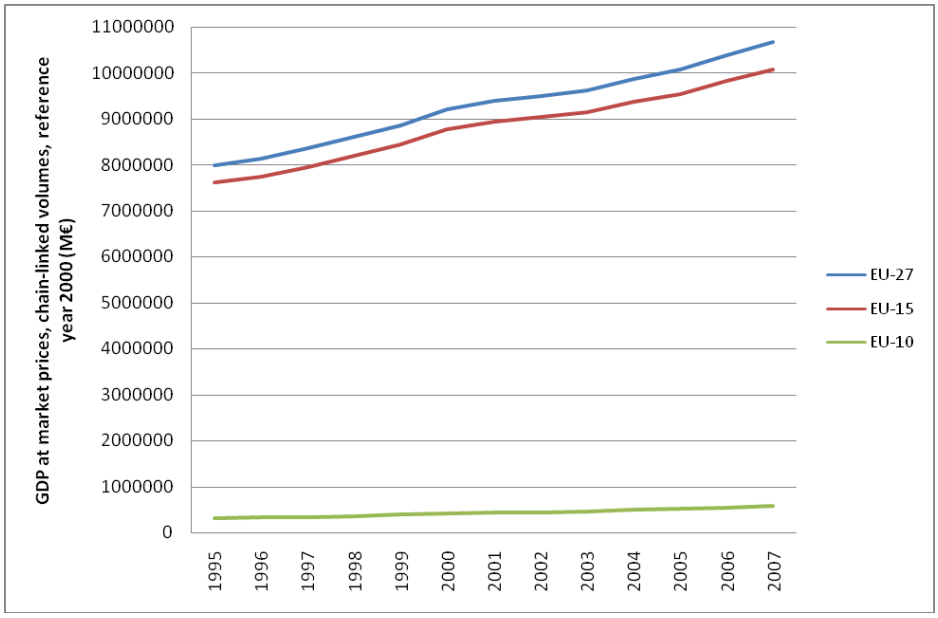
GDP is a measure of the net market value of the output of goods and services generated by a national economy, exchanged through market transactions. It covers production exchanged in national private market and public sector, i.e. a country's economic production. It is a major indicator used to measure a country's economic performance.

The level of GDP has a direct impact on GHG emissions since production activities emit greenhouse gases via the energy products they consume in order to produce goods and services and via the pollutants their industrial processes generate. A slowdown in economic and industrial activities reduces automatically GHG emissions.

For our study, we use EUROSTAT data (for the period 1990-2007) to assess GDP at market prices in the EU and its member countries. EUROSTAT data are expressed in chain-linked volumes, with 2000 as reference year[15]. The inflation impact on the value of GDP is minimized thanks to this method. Price movements put aside, it is possible to analyze the relationship between GDP volumes and GHG emissions in Europe.

[15] EUROSTAT provides for GDP data in chain-linked volumes, with 2000 as reference year (at 2000 exchange rates). For measuring the GDP in terms of volumes, the GDP at current prices is valued in the prices of a reference year and the thus computed volume changes are imposed on the level of the reference year; this is called a chain-linked series. Accordingly, price movements will not inflate the value of GDP. EUROSTAT publishes data for the GDP in the EU member states (in million Euros), starting from different periods (from as early as 1990 and even before for the 15 oldest member states and some new member states to as late as 1999 for Romania). Germany data include ex-GDR from 1991. We have chosen 1995 as starting year in the graph as data are available for almost all the EU member states from this date (except for Romania).

Figure 8: GDP in volume in the EU, 1995-2007

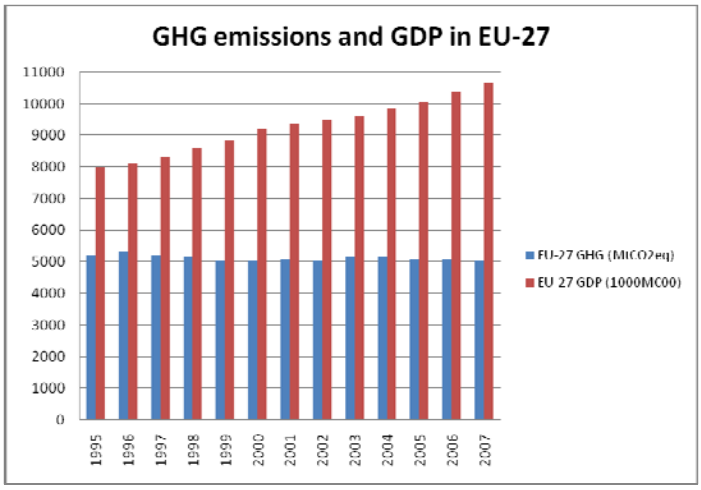


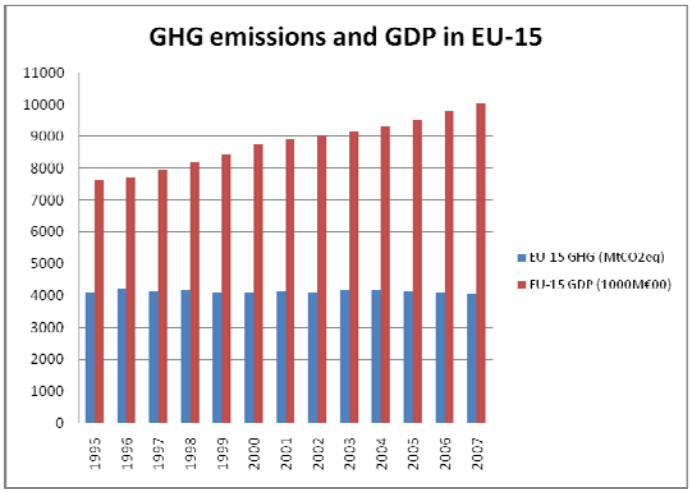
Source: EUROSTAT Statistics Database; graph from the author.

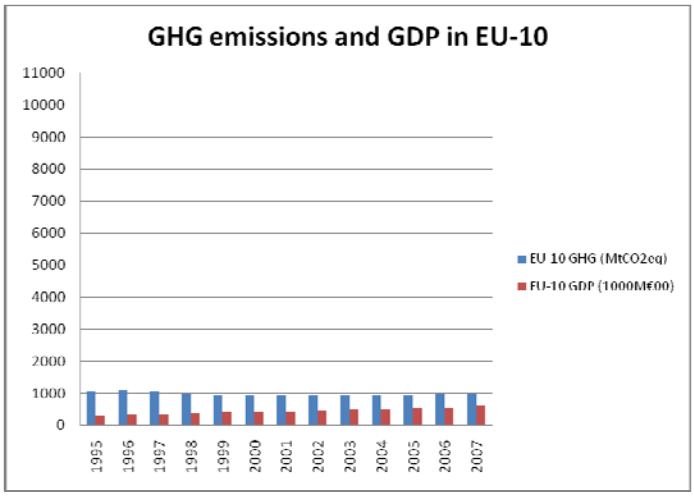
A decoupling of GHG emissions and GDP in some European countries

Looking at the previous trend in Europe from 1990 to 2007, it appears that the relationship between a country's economic performance and the volume of emissions generated is not as simple as that. Figure 9 shows how GHG emissions in EU-27 decoupled from economic growth over the past 12 years. Again the data used on our graphs come from the same latest EEA report on total GHG emissions (EEA 2009).

Figure 9: GDP/GHG emissions relationship in the EU from 1995 to 2007







Source: EEA Technical Report n°4/2009; EUROSTAT Statistics Database; graphs from the author.

Whereas European GDP has increased by 34% between 1995 and 2007, GHG emissions have fallen by 3%. Soaring GDP is striking when compared with the relative stabilization of total GHG emissions in Europe over the period. *The increase in GDP has not resulted in a com parable increase of GHG em issions. There is no doubt that this reflects in part the effort made to reduce emissions.*

This is true both for the old member states – the EU-15 experienced a 32% increase in GDP and a 1.9% decrease in emissions over the period - and for the new Central and Eastern European states - EU-10's GDP volume soared by 87% between 1995 and 2007, while its emissions decreased by 9%.

Even with this decoupling trend and strong growth in the new member states, *the new m ember states still represent a disproportionate share of GHG em issions com pared to their relative weight in European GDP* (see Figure 8 for the GDP volume in EU-27, EU-15 and EU-10 over the last 12 years). The EU-10 accounted in 2007 for only 5.5% of the Union's GDP but almost 20% of greenhouse gases emitted in Europe.

Even am ong the top 5 em itting countries (all from Western Europe), the relative share of em issions does not necessarily follow their rank in GDP . For instance, France came third in 2007 in terms of GDP (after Germany and the United Kingdom) but only fourth in terms of GHG emissions (after Germany, the United Kingdom and Italy).

The link between energy-related CO_2 emissions and economic growth

Focus on CO_2 emissions in the energy sector

Among the many human activities that produce greenhouse gases the use of energy represents by far the largest source of emissions. *In Europe, energy accounted for 79% of total EU-27 emissions in 2007* , with emissions resulting from the production, transformation, handling and consumption of all kinds of energy commodities. The second largest sector is agriculture (9.2%), producing mainly CH_4 and N_2O from domestic livestock, followed by industrial processes not related to energy (8.5%), producing mainly fluorinated gases and N_2O (EEA 2009).

The energy sector is dominated by the direct com bustion of fuels, a process leading to large em issions of CO $_2$[16]. In 2007, we

[16] The energy sector comprises stationary and mobile energy activities. Energy includes emissions from "fuel combustion" (the large majority) and "fugitive

calculate that energy-related CO_2 emissions represented 77% of total GHG emissions in the EU-27 according to the latest data from the EEA (3875.5 Mt out of a total of 5045 Mt CO_2-eq).

In our study, we have chosen to focus only on energy-related CO_2 emissions as they represent the lion's share of emissions across Europe. This approach has the advantage of simplifying the analysis of the link between economic performance and greenhouse gas emissions. The data presented below come from the same latest report by the EEA than the data analyzed so far for total GHG emissions (EEA 2009 which provides official and consolidated data for CO_2 emissions in the energy sector until 2007).

Energy-related CO_2 emissions in the past (1990-2007)

EU-27 carbon dioxide emissions followed the same downward path as total GHG emissions from 1990 to 2007, with the same reversals in-between. *The overall decrease in CO_2 emissions in the energy sector is mainly due to the drop in emissions in the 10 Central and Eastern European countries* (See Figure 10 for energy-related CO_2 emissions past trends in the EU).

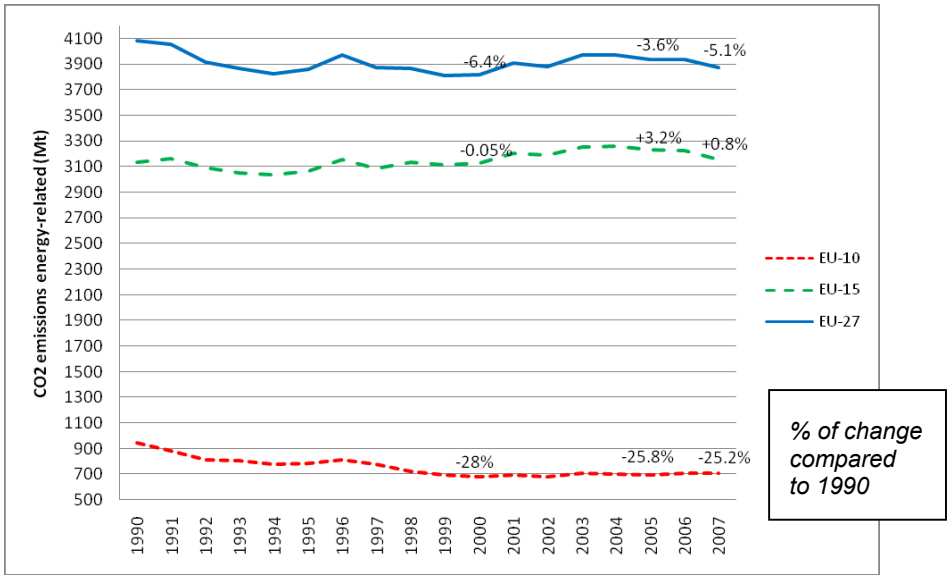
Two differences are worth noting:

1) *Energy-related CO_2 emissions across Europe have decreased much less than total emissions (a 5.1% reduction over the period compared to a 9.3% reduction for total GHG emissions).* The EU-27 has managed to cut relatively less CO_2 emissions in the energy sector than GHG emissions in its whole economy. Reducing energy-related CO_2 emissions has proved to be more difficult than other gases in other sectors of the economy. In the energy sector itself, the 27 members of the Union have experienced much better results in their attempts to cut their emissions of other gases, notably methane (-47% between 1990 and 2007, as shown on the Figure 11).

2) *The 15 older member states have experienced a stabilization of their energy-related CO_2 emissions, with even a slight increase over the period (a 0.8% increase from 1990 to 2007)*, whereas their total GHG emissions in all sectors of their economy have decreased (-4.3%). The decrease of their total GHG emissions is mainly explained by a drop in their releases of two gases from 1990 to 2007: methane (-30.2%) and nitrous oxide (-24.6%) (See Figure 12).

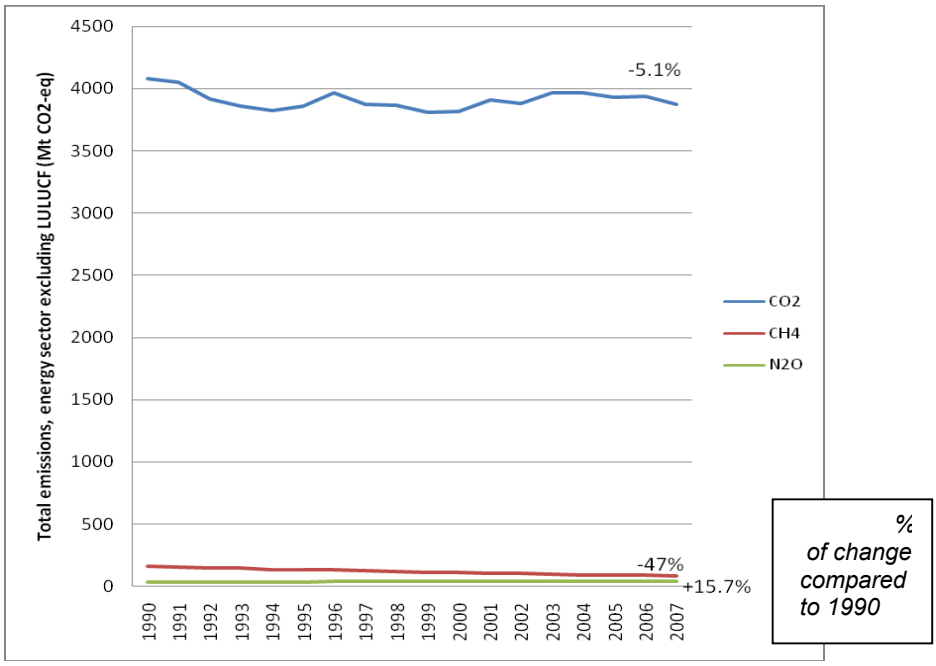
emissions", which are intentional or unintentional releases of gases resulting from production, processes, transmission, storage and use of fuels (e.g. CH4 emissions from coal mining or oil and gas systems).

Figure 10: Energy-related CO_2 emissions trends in the EU, 1990-2007



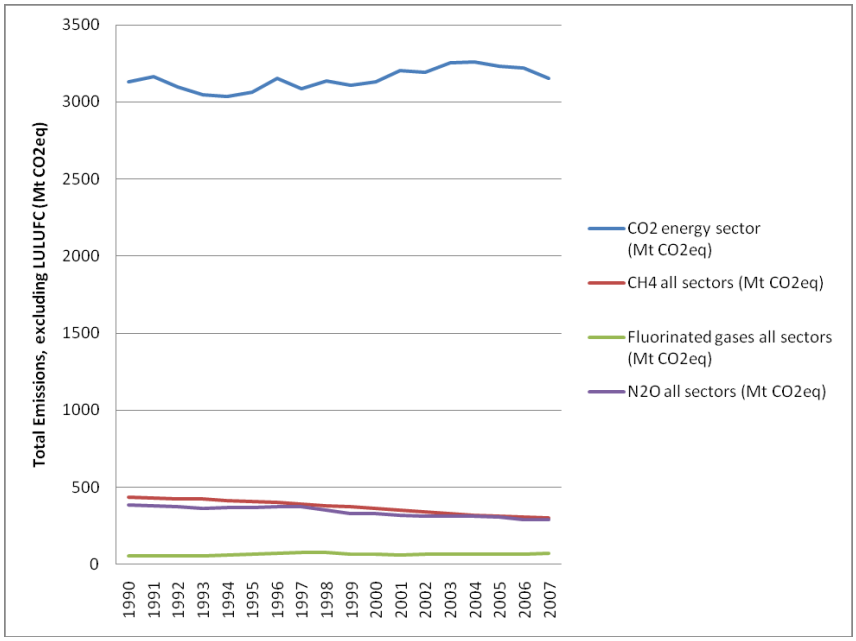
Source: data from EEA Technical Report n°4/2009, calculation and graph rom the author.

Figure 11: Main GHG Emissions Trends in the EU-27, 1990-2007 (for the energy sector excluding LULUCF)



Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

Figure 12: Main GHG Emissions Trends in the EU-15, 1990-2007 (excluding LULUCF)



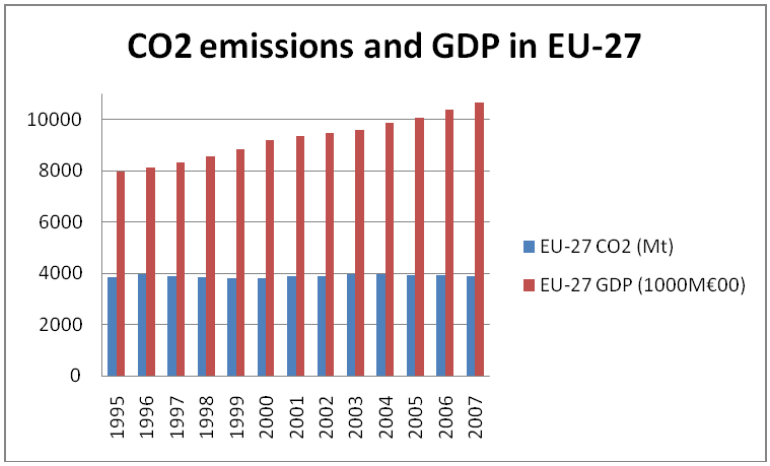
Source: data from EEA Technical Report n°4/2009, calculation and graph from the author.

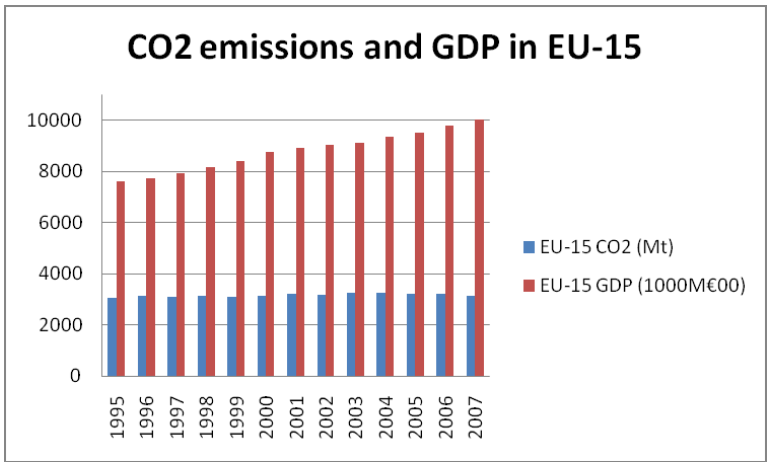
Comparing energy-related CO_2 emissions and GDP: the choice of indicators

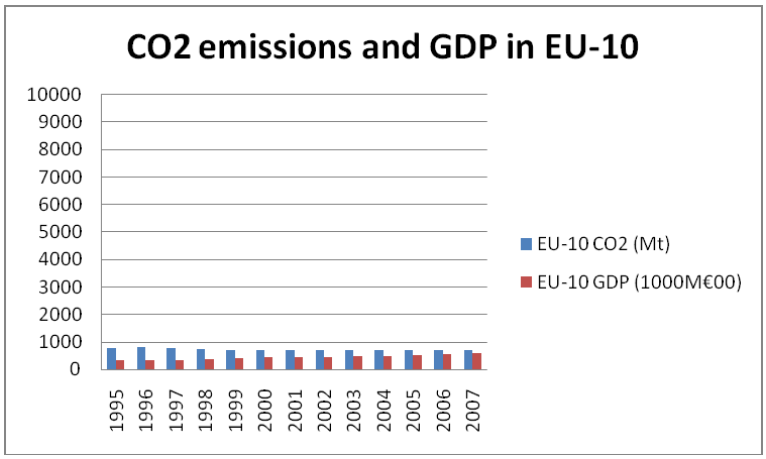
A decoupling of energy-related CO_2 emissions and GDPin the past (1995-2007)

Figure 13 shows *a clear decoupling of GDP volum es from energy-related CO_2 em issions across Europe over the past 12 years*. Not surprisingly, given the trends seen in the previous paragraph, *CO_2 emissions in the energy sector are slightly less decoupled from economic growth than other greenhouse releases*: in the EU-27, carbon dioxide emissions have remained fairly stable from 1995 to 2007 (+0.3%) while GDP has soared by more than a third (total GHG emissions fell by 3% in the meantime); in the EU-15, a slight increase in CO_2 emissions has occurred (+3%) for the same relative increase in GDP volume while total GHG emissions decreased by 1.9% over the period. What is more striking is that Central and Eastern Europe have, on the contrary, experienced a greater decoupling in their energy sectors compared to the one observed for all greenhouse gases in all sectors of their economy: energy-related CO_2 emissions have decreased in the EU-10 by 10% between 1995 and 2007 (and "only" -9% for total GHG emissions), while its GDP volume has soared by 87%.

Figure 13: GDP/energy-related CO_2 emissions relationship in the EU from 1995 to 2007







Source: EEA Technical Report n°4/2009; EUROSTAT Statistics Database; graphs from the author.

Useful indicators: energy and carbon intensities

Economic activity consumes energy and emits carbon dioxide. But some energy-related CO_2 emissions are not GDP-dependent. Some emissions depend on the lifestyle of nationals and cannot be reduced in the short term whatever the state of the economy (such as energy needs in housing, fuel consumption for transportation in rural and suburban sparse areas, etc.). Other variables besides economic growth influence emissions' levels, such as weather, oil price surges (which impact on transport) and the sustainability of a country's energy mix, that is to say the share of carbon-intensive fuels in its consuming and producing patterns (coal and oil versus less emitting energy sources such as renewables, nuclear or even natural gas). As the International Energy Agency stated in its 2008 report on CO_2 emissions from fuel combustion, the socioeconomic and technological characteristics of development paths strongly affect emissions (IEA 2008 p.XIX).

Emissions intensity in economic terms (i.e. CO_2 emissions per unit of GDP) varies greatly around the world. *The ratio of CO_2 emissions per unit of GDP responds to two main variables: energy intensity (i.e. energy per unit of GDP) and CO_2 intensity of the fuel mix (i.e. CO_2 per unit of energy) - often called carbon intensity* (IEA 2008 p. XXII). Energy intensity represents the energy consumed in order to create one unit of GDP (expressed in tonnes of oil equivalent per million Euros). Its level depends mainly on the economic structure and the level of energy efficiency in a given economy. Carbon intensity gives the amount of carbon dioxide emitted per unit of energy consumed (expressed in tonnes of CO_2 per ton of oil equivalent). Carbon intensity varies depending on a country's fuel mix (and the share of low-carbon energy sources such as nuclear energy and hydroelectricity for instance). *These two indicators (energy and carbon intensity) are useful to understand the relationship between economic production, energy consumption and energy-related CO_2 emissions.*

We have calculated energy intensity and carbon intensity in the EU and individual member states, using the latest data provided for by Eurostat and the EEA for GDP, gross inland consumption of energy[17] and energy-related CO_2 emissions (See Table 3).

[17] Gross inland consumption is defined as primary production plus imports, recovered products and stock change, less exports and fuel supply to maritime bunkers (for seagoing ships of all flags). It therefore reflects the energy necessary to satisfy inland consumption within the limits of national territory.

Table 3: Energy and Carbon Intensities in the EU and top 6 emitting countries

	EU-27 aggregated		France		Germany		United Kingdom		Italy		Spain		Poland	
	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe	Energy intensity toe/M€	Carbon intensity tCO_2/toe
1996	211,6	2,31	201,2	1,50	186,3	2,46	164,3	2,43	147,4	2,56	192	2,20	684,1	3,44
1997	204,2	2,27	191,4	1,52	181,1	2,39	155,1	2,39	147	2,55	194,4	2,26	631,7	3,41
1998	200,4	2,24	190,8	1,55	177	2,37	154,8	2,32	149,1	2,54	196,7	2,20	564,6	3,37
1999	193,2	2,23	184,5	1,51	170,5	2,35	148,6	2,30	149,5	2,53	197,3	2,30	526,4	3,34
2000	187,4	2,21	180	1,48	166	2,33	144,7	2,31	145,2	2,53	196,2	2,29	489	3,32
2001	187,8	2,22	182	1,46	169,2	2,32	141,7	2,35	143,2	2,54	194,9	2,25	483,2	3,31
2002	185	2,21	180,2	1,43	165,5	2,33	135,3	2,34	143	2,55	195	2,32	469	3,25
2003	187,2	2,20	181,3	1,43	167,2	2,32	134,1	2,35	150,5	2,50	195,6	2,27	463,4	3,27
2004	184,8	2,18	179,7	1,42	166,1	2,27	131,1	2,33	149,3	2,49	198,1	2,29	442,1	3,25
2005	181,3	2,15	177	1,42	163,3	2,22	128,4	2,32	150,5	2,47	195,4	2,35	432,8	3,16
2006	175,8	2,16	171,1	1,41	159,4	2,25	122,9	2,35	146,5	2,46	187,3	2,29	427,3	3,11
2007	169,1	2,14	165,1	1,39	151,5	2,22	115,6	2,39	142,2	2,44	184,2	2,30	400,1	3,09

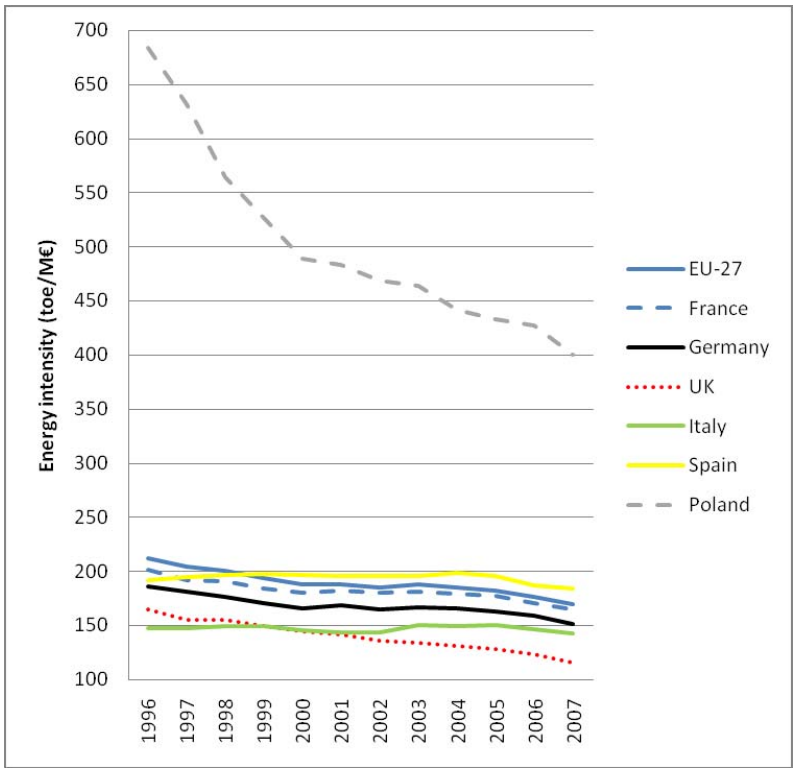
Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database (calculations and figures rounded off by the author).

A significant improvement of energy intensities over time

The table 3 and the figure 14 show the huge progress made in terms of energy intensity over the last decade in Europe. In every European country (even in Central and Eastern Europe), less and less energy is consumed for the creation of one unit of GDP. Over the last decade, the energy intensity of the economy has dropped by 20% in the EU-27 and by 17.8% in the 15 older member states. In Poland the drop has been as high as -41.5%.

The improved structure of most developed European economies enables economic growth to occur without a significant increase in energy consumption. Economic restructuring in new member states as well - with the transition from Soviet Bloc command and control societies to open economies - explains this decoupling of energy consumption from economic performance. Significant gains in energy efficiency have also contributed to improvements in energy intensity.

Figure 14: Energy Intensity trend over time in the EU and top 6 emitting countries (1996-2007)



Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database; calculations and graph from the author.

The resilience of the carbon intensities of European economies

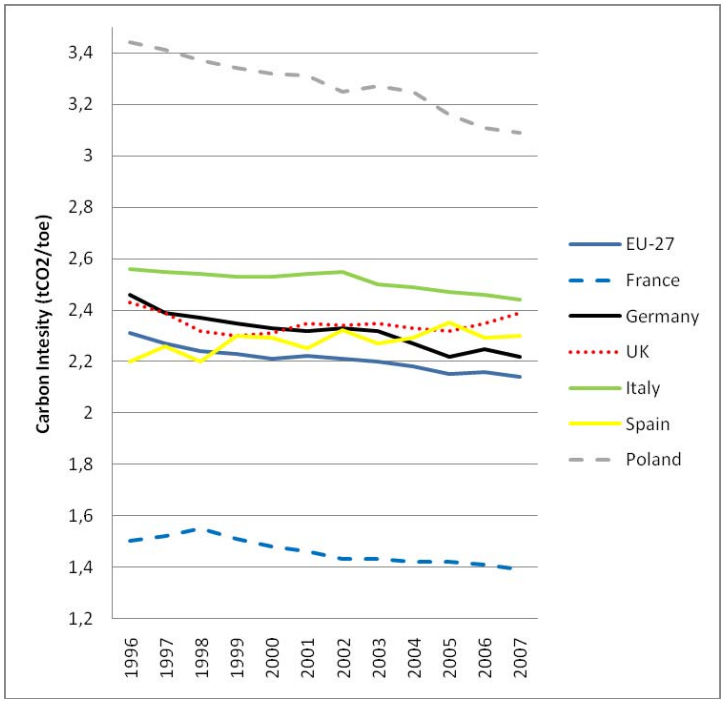
What is more surprising is the resilience of the carbon intensity of European economies. *The rapidly growing GDP and improving*

energy intensity of the EU economy from 1996 to 2007 have not translated into lower carbon intensity. The carbon content of European economies has remained fairly stable in the EU-27 and in the top 5 emitting countries as shown on the figure 15. Even Poland has achieved only a cut of 10% of it carbon intensity over the period, which is much less than the -41.5% obtained for the energy intensity in this country.

There is a clear disjunction between effort made to reduce energy intensity and the impact on energy-related CO_2 emissions. In the EU-27, even though energy intensity has improved by 20% from 1996 to 2007, energy-related CO_2 emissions have decreased only by 2.5% in the meantime. In the EU-15, energy intensity has been reduced by 17.8% but energy-related CO_2 emissions have nevertheless remained stable over the period (+0.1%). The same phenomenon can be observed in Central and Eastern Europe: Poland has only cut its carbon dioxide emissions by 15.1% from 1996 to 2007, while an impressive -41.5% cut in energy intensity had occurred. It is because a revolution in the fuel mix of an economy is necessary to see a significant drop in carbon intensity. But changing a country's energy mix cannot be done overnight but requires a long-term commitment with huge investments, major industrial choices and determined policy measures.

Among the top 6 emitting countries, France had by far the lowest carbon intensity in 2007 (1.39 tCO_2/toe) thanks to its nuclear power plants; followed by Germany (2.22 tCO_2/toe); Spain (2.30 tCO_2/toe); the United Kingdom and Italy (with respectively 2.39 and 2.44 tCO_2/toe); and lastly Poland (3.09 tCO_2/toe).

Figure 15: Carbon Intensity trend over time in the EU and top 6 emitting countries (1996-2007)



Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database; calculations and graph from the author.

Conclusion: methodological hypotheses for the scenarios

Lessons drawn from past trends in energy and carbon intensities in Europe

Important lessons can be drawn for our study from past trends in energy and carbon intensities in Europe. Drawing on observed patterns of carbon and energy intensities, we can indeed project EU carbon and energy intensities until 2020. The projected energy and carbon intensities figures will be used in the following chapter of our study to calculate the impact of the loss of GDP volume following the recession on gross energy consumption and on energy-related CO_2 emissions in the coming years.

Two assumptions can be made:

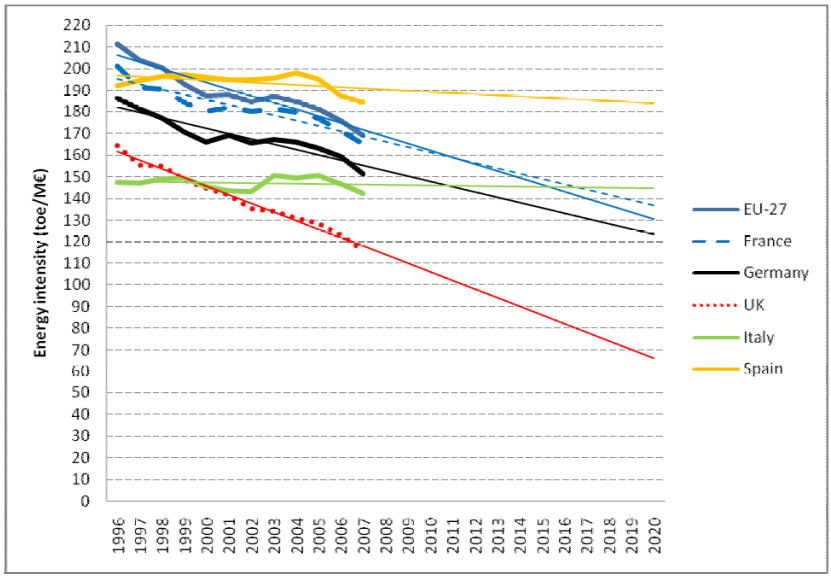
1) *It is likely that energy intensities in Europe will continue to improve in the future as economic restructuring and energy efficiency measures continue*.

But it is difficult to predict the exact pace of this improvement in the future. There is an important margin of uncertainty as to the scale of this improvement by 2020: the economic crisis in particular could influence the evolution of energy intensities in Europe in the years to come.

One logical hypothesis would be to assume that t*he trends observed for energy intensities in Europe over the past decade (from 1996 to 2007) will continue at the sam e rhythm as before in the coming years*. Taking a whole decade into account enables us to minimize short-term hitches in the overall trend. In particular, the acceleration in energy intensities' reduction observed in Europe over the past three years is minimized and put into a longer term perspective thanks to this method. This approach is rather cautious and the real improvements in energy intensities that will happen by 2020 could be even more important than the improvements foreseen by our own projections in the study.

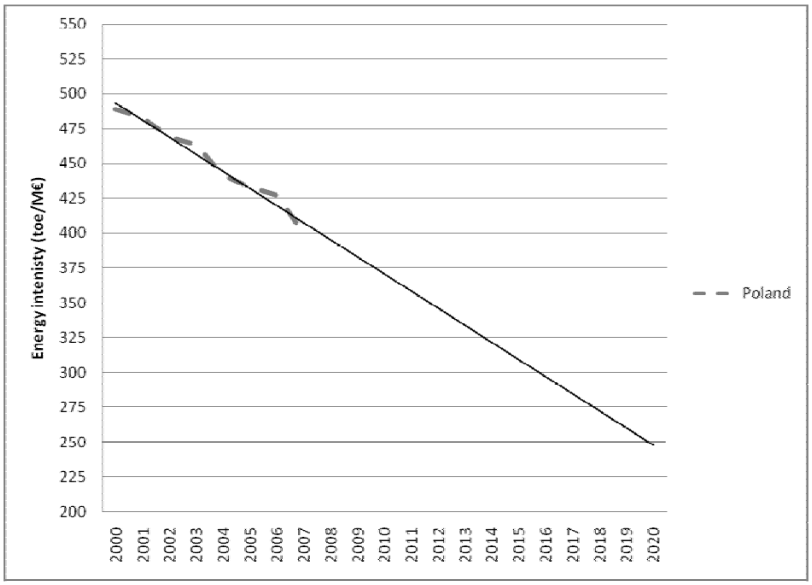
In order to obtain gross energy intensity projections for the years 2013 and 2020, we have used the automatic trend line function in Excel: we have added linear trend lines until the year 2020 to our own charts representing energy intensity lines from 1996 to 2007, for the EU-27 and for the top 5 emitting countries (see figures 16). For the special case of Poland, the linear trend line has been drawn from 2000 only so as to put aside the effect of economic restructuring in the 1990's that greatly accelerated the decrease in Poland's (and Eastern and Central European states more generally) energy intensity. It is indeed more likely that Poland continues to improve its energy intensity in the future at the same rhythm as from 2000 and not as fast as in the 1990s (see figure 17).

Figure 16: Trend line projections for energy intensities in the EU and top 5 emitting countries from 1996 to 2020



Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database; calculations and graph from the author; trend line projection based on Excel.

Figure 17: Trend line projections for energy intensity in Poland from 2000 to 2020



Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database; calculations and graph from the author; trend line projection based on Excel.

Our Excel projections give only a gross indication of what energy intensities could amount to in 2013 and 2020.

According to our graphs, the EU-27 should see its overall energy intensity decrease from 169.1 toe/M€ in 2007 to more or less 155 toe/M€ in 2013 and as low as 130 toe/M€, which represents an impressive cut by almost 25% of the energy intensity of its economy in 13 years.

Great Britain continues to be the champion of low energy intensity over the period: its energy intensity should amount in 2020 to slightly more than half of its level in 2007 (from 115 toe/M€ in 2007 to around 95 toe/M€ in 2013 and around 65 toe/M€ in 2020). Italy's energy intensity should remain rather flat over the period and stabilize at more or less 145 toe/M€ in 2020 (142.2 toe/M€ in 2007 and around 145 toe/M€ in 2013). According to our projections, Germany should overtake Italy as second best country in terms of energy intensity thanks to a continued improvement of its results: its energy intensity should be cut from 151.5 toe/M€ in 2007 to 140 toe/M€ in 2013 and to more or less 125 toe/M€. This trend is to be taken with caution because Germany has experienced an accelerated improvement of its energy intensity in the 1990s thanks to the economic restructuring in its five Eastern Länder after the reunification. This phenomenon will not take place again in the decade to come. So the results of Germany could be slightly worse than the ones predicted by our projections for 2020. France's energy intensity should correspond to the EU average over the whole period

and should decline from 165 toe/M€ in 2007 to around 155 toe/M€ in 2013 and around 135 toe/M€ in 2020. Poland should cut its energy intensity by almost 40% in the 13 years considered, from 400 toe/M€ in 2007 to more or less 330 toe/M€ in 2013 and around 245 toe/M€ in 2020. Its energy intensity should still amount to almost twice Europe's average in 2020 despite major improvements achieved thanks to the continued economic restructuring and energy efficiency gains.

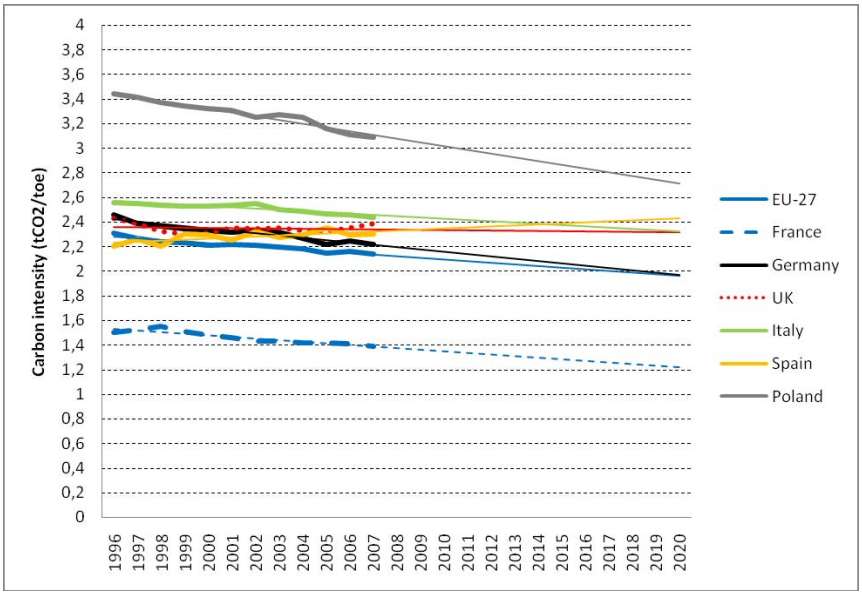
2) *One can expect carbon intensities of primary energy consumption to remain almost flat in the years to come unless significant action is taken to bend that schedule more sharply downward.*

Given the past resilience of European carbon intensities, one can assume that no major drop will occur in the next few years. Measures taken by each member state to implement the Climate and Energy Package from 2013 are indeed not likely to immediately change their carbon intensities as these measures need time to translate into new concrete industrial projects in the energy sector and to change significantly national energy mix.

One logical hypothesis would be to assume that *recent trends observed for carbon intensities in Europe from 1996 to 2007 will continue at the same rhythm in the coming years (so rather stable but nevertheless with a slight improvement over time).* As for energy intensities charts, we have extended on our Excel graphs the trend lines for 1996-2007 for carbon intensities in the EU-27 and in the top 6 emitting countries until the year 2020 (see figure 18). Thanks to this method, we have obtained a projection of likely carbon intensities for the years 2013 and 2020. This time, the same method is applied to Poland, as no major difference has been observed between the 1990's and the 2000's for the carbon intensity's evolution in that particular country.

With these projections, we have obtained the following indicative figures: carbon intensities in the EU-27 should on average amount to 2.05 tCO_2/toe in 2013 and more or less 1.95 tCO_2/toe in 2020. France continues to be the champion of low carbon intensity over the period thanks to the high share of nuclear energy in its energy mix: it should improve from 1.39 tCO_2/toe in 2007 to around 1.3 tCO_2/toe in 2013 and around 1.2 tCO_2/toe in 2020. Germany should remain close to the EU average over the period with a carbon intensity's level at 2.22 tCO_2/toe in 2007, 2.1 tCO_2/toe in 2013 and around 1.95 tCO_2/toe in 2020. The United Kingdom, Italy and Spain should continue to get rather mixed results in terms of the carbon content of their energy mixes with intensities ranging from 2.3 tCO_2/toe to 2.4 tCO_2/toe between 2013 and 2020. Poland should experience the fastest pace of improvement over the period (-13% in 2020 from 2007-levels) but its carbon intensity will still be at 2.9 tCO_2/toe in 2013 and 2.7 tCO_2/toe in 2020 (i.e. more than twice France's carbon intensity at the same time).

Figure 18: Trend line projections for carbon intensities in the EU and top 6 emitting countries from 2000 to 2020



Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database; calculations and graph from the author; trend line projection based on Excel.

Explaining the main hypotheses for our scenarios

The following chapter will develop several scenarios to examine to 2020 the new path in economic growth and CO_2 emissions following recovery from the economic crisis in Europe.

Two time frames will be considered in our scenarios: the period until 2013 and the period from 2013 to 2020, the dates when the EU 15 will be evaluated on their Kyoto target and when the EU 27 can be evaluated on their 2020 target.

Our scenarios rely on *two sets of hypotheses: macroeconomic hypotheses* concerning the path of economic recovery; and *hypotheses concerning trends in energy and carbon intensity* until 2020.

Macroeconomic hypothesis:

For several reasons that we will explain in the following chapter, we have chosen to apply only one hypothesis concerning the return to economic growth in the years to come. This economic recovery forecast will be compared to the forecast that was foreseen had the current economic crisis not occurred.

Energy and Carbon intensity hypotheses:

Drawing on our energy and carbon intensities' projections, three hypotheses will be applied in the following chapter to the new growth path forecast in Europe until 2013:

- Hypothesis 1: Assuming Energy and Carbon intensities remain unchanged until 2013

This reference hypothesis is not likely to happen because it supposes that the economic recession freezes any improvement in energy and carbon intensities in Europe in the five years to come. It is the "worst-case hypothesis" that we will use as a reference point.

- Hypothesis 2: Assuming the same downward trend for energy intensity as before (1996-2007) and an unchanged carbon intensity in 2013

This is an intermediate hypothesis assuming that the recession has no impact on energy intensities trend (so that energy intensities across Europe continue to improve at the same rhythm as before over the last decade) but that carbon intensities remain flat until 2013.

- Hypothesis 3: Assuming the same downward trend for energy and carbon intensities as before (1996-2007)

This is our most optimistic hypothesis which is based on a continuation until 2013 of previous improvement trends for energy and carbon intensities.

Three scenarios will be developed for the time frame until 2013 by applying these three energy and carbon intensities hypotheses to our macroeconomic recovery path hypothesis (and also to the pre-crisis economic forecast so as to compare the results obtained to the ones that would have been seen without recession).

Only one scenario will be analyzed for the time frame until 2020. We will base our scenario on the most favorable energy and carbon intensity hypothesis – the hypothesis 3 "Assuming the same downward trend for energy and carbon intensities as before (1996-2007)" - as it would be unduly pessimistic to apply the two previous hypotheses until the year 2020: it is unlikely that energy and carbon intensities would remain stable that long without any improvement. Indeed some improvement is expected from 2013 in terms of intensities as the EU Climate and Energy Package will start to be progressively implemented on the ground. Again this hypothesis for energy and carbon intensities will be applied to our macroeconomic recovery path hypothesis (and also to the pre-crisis economic forecast so as to compare the results obtained to the ones that would have been seen without recession).

Reviewed EU emissions profile after the crisis: 4 scenarios for the time frame until 2013 and 2020

How does the current economic crisis change the EU's emissions profile? We have adjusted the European Commission's 2020 growth scenario (the one initially used in its impact assessment of the EU Climate and Energy Package) under recent growth assumptions issued by international organizations following the recession. We have then applied to this reviewed economic scenario our various hypotheses of the projected patterns of carbon and energy intensities to 2020 explained in the previous chapter. A range of energy-related CO_2 emissions profiles has been obtained and is presented in the chapter. In the final part of the chapter, our various scenarios are double-checked by comparing them with the results of other scenario-building exercises (notably the latest energy-related CO_2 emissions scenarios published in October 2009 by the IEA – IEA 2009).

A reviewed economic forecast since 2008

Converging forecasts of GDP annual change in 2009-2010

While preparing the Energy and Clim ate package, the Com mission projected an annual GDP growth of 2.2% on average until 2010 in the EU and a 2.4% growth between 2010 and 2020 (European Commission 2008a).

But because of the economic crisis, the European Union has actually seen a sharp fall of its GDP in 2009. The IMF, OECD, DG ECFIN in the Commission, BNP Paribas, etc… have built fairly similar forecasts for GDP annual change in the EU for 2009 (some forecasts are more optimistic than others but there are no major differences)[18].

[18] See: IMF (2009), World Economic Outlook Database, October 2009; OECD (2009), What is the economic outlook for OECD countries? An interim assessment, Paris, 3 September 2009; European Commission, DG ECFIN (2009), Interim

They foresee a fall in GDP annual growth for two years (2009-10) in Europe with a negative growth in some countries. Opinions are divided when it comes to the question of when exactly and how the economy will start to recover. The IMF is one of the few institutions whose GDP forecast goes beyond 2010: it predicts a significant drop in GDP in the EU-27 in 2009 (-4.2% in 2009), followed by a flat GDP growth in 2010 (+0.04%), and then from 2011 by a growth at a slower pace than was predicted before the crisis (IMF, October 2009).

In our study, we have chosen to base our calculations on the GDP annual change forecasts by the IMF, since it is the only institution to provide data for the EU-27 as well as its top 6 em itting countries we focus on until 2014 and since its forecasts until 2014 corresponds to an intermediate scenario as to the shape the recovery will take in the years to come.

Table 4 presents the real GDP growth rate until 2013 as foreseen by the IMF before the economic crisis started at the end of 2008 (IMF 2008). Table 5 summarizes the new forecasts by the IMF until 2014 now that the economic crisis is taken into account (IMF 2009). 2008 is the year from which both forecasts start to diverge. It is worth noting that for the United Kingdom and Italy the post-crisis GDP growth rate (after 2012) is predicted to be higher than was expected in the pre-crisis forecast. Their economies are most deeply affected by the current economic crisis but their recovery path is foreseen to be fast-paced.

Table 4: Real GDP growth rate in the EU - forecast before economic crisis

	2000	2001	2002	2003	2004	2005	2006	2007
EU-27	4	2.1	1,4	1,5	2,7	2,2	3,4	3,1
France	4,1	1,7	1,1	1,1	2,3	1,9	2,4	2,3
Germany	3,2	1,1	0	-0,2	1,2	0,7	3,2	2,5
UK	3,9	2,5	2,1	2,8	2,9	2,2	2,8	2,5
Italy	3,7	1,8	0,4	0	1,5	0,6	2	1,6
Spain	5	3,6	2,7	3,1	3,3	3,6	4	3,6
Poland	4,2	1,2	1,4	3,9	5,3	3,6	6,2	6,8

	2008	2009	2010	2011	2012	2013
EU-27	1,8	1,7	2,6	2,7	2,7	2,8
France	1,4	1,2	2,5	2,6	2,6	2,6
Germany	1,4	1	1,7	2	2,1	2
UK	1,6	1,6	3,3	3,2	2,8	2,7
Italy	0,2	0,2	0,7	1	1,1	1,4
Spain	1,8	1,7	3,1	3,5	3,7	4
Poland	4,9	4,4	4,8	4,8	4,9	4,9

Source: International Monetary Fund, World Economic Outlook Database, October 2009 (for the data from 2000 to 2007 as the latest report by the IMF provides more accurate data on the past GDP growth trend); IMF, World Economic Forecast, September 2009; BNP Paribas (2009), Global Outlook: Bounce Yes, But Can It Fly?, October 2009.

Outlook Database, April 2008 (for the data from 2008 to 2013 that show the GDP growth forecast as foreseen before the economic crisis occurred)
Note: Growth rate of GDP volume – percentage change on previous year. For measuring the growth rate of GDP in terms of volumes, the GDP at current prices are valued in the prices of the previous year and the thus computed volume changes are imposed on the level of a reference year; this is called a chain-linked series. Accordingly, price movements will not inflate the growth rate.

Table 5: Real GDP growth rate in the EU - forecast after economic crisis

	2000	2001	2002	2003	2004	2005	2006	2007
EU-27	4	2,1	1,4	1,5	2,7	2,2	3,4	3,1
France	4,1	1,7	1,1	1,1	2,3	1,9	2,4	2,3
Germany	3,2	1,1	0	-0,2	1,2	0,7	3,2	2,5
UK	3,9	2,5	2,1	2,8	2,9	2,2	2,8	2,5
Italy	3,7	1,8	0,4	0	1,5	0,6	2	1,6
Spain	5	3,6	2,7	3,1	3,3	3,6	4	3,6
Poland	4,2	1,2	1,4	3,9	5,3	3,6	6,2	6,8

	2008	2009	2010	2011	2012	2013	2014
EU-27	1	-4,2	0,4	1,8	2,2	2,4	2,5
France	0,3	-2,3	0,9	1,7	1,9	2,2	2,3
Germany	1,2	-5,3	0,3	1,5	1,7	1,8	1,8
UK	0,7	-4,4	0,9	2,5	2,9	2,9	2,9
Italy	-1	-5,1	0,2	0,7	1,3	1,6	1,9
Spain	0,8	-3,8	-0,7	0,9	1,4	1,7	2,1
Poland	4,9	1	2,2	4	4	3,9	4

Source: International Monetary Fund, World Economic Outlook Database, October 209

Calculation of the loss in GDP volume in Europe by 2013

Applying IMF new forecasts for real GDP growth rate (for 2008 and the years after) to 2007 GDP volumes figures published by EUROSTAT (and expressed in Euros), we have calculated GDP volumes to expect for the EU-27 and the top 6 emitting countries until 2014, taking into account the effect of the economic downturn (see table 7).

An absolute loss of GDP volumes from 2007-levels is foreseen in all countries considered but Poland – there is no decrease in the absolute value of GDP in this country.

In the context of the current crisis, a lot of people wonder what amount of GDP volume will be lost because of the recession, i.e. what will be the difference between the GDP that we will observe in the years to come following the crisis and the GDP that would have occurred without any crisis. In order to quantify the GDP volume loss following the economic crisis, we have calculated the GDP volumes that were expected in the coming five years should the economic crisis not have occurred. We have applied the real GDP growth rates

as predicted by the IMF before the crisis to the same 2007 figures for GDP volumes published by EUROSTAT (see table 6).

Table 6: GDP volumes in the EU – forecast before the economic crisis (at market prices in volume M€2000)

	2007	2008	2009	2010	2011	2012	2013
EU-27	10685068	10877399	11062314	11349935	11656383	11971105	12306296
France	1637360	1660283	1680206	1722211	1766989	1812930	1860066
Germany	2245856	2277298	2300071	2339172	2385956	2436061	2484782
UK	1911990	1942582	1973663	2038794	2104035	2162948	2221348
Italy	1289988	1292568	1295153	1304219	1317261	1331751	1350396
Spain	797052	811399	825193	850774	880551	913131	949656
Poland	244891	256891	268194	281067	294558	308992	324132

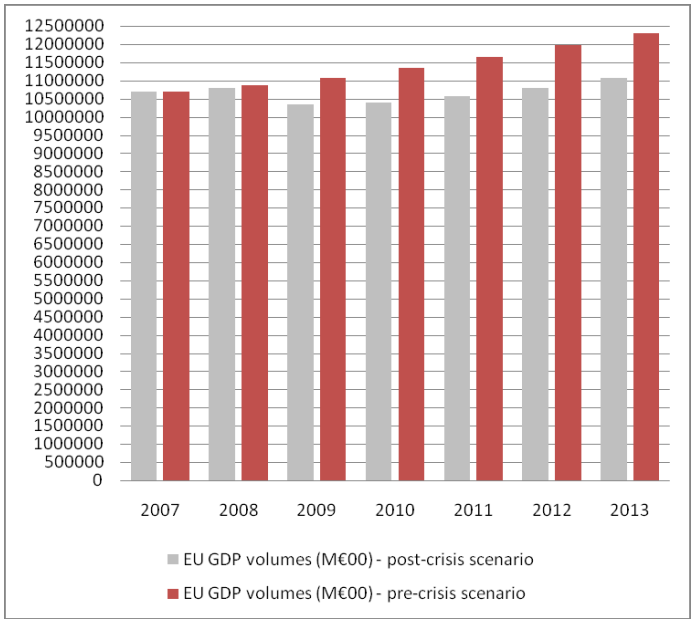
Source: EUROSTAT Statistics Database for 2007 (figures rounded off by the author); from 2008 calculation by the author applying IMF data for annual growth rate (World Economic Outlook Database, April 2008).

Table 7: GDP volumes in the EU – forecast after the economic crisis (at market prices in volume M€2000)

	2007	2008	2009	2010	2011	2012	2013	2014
EU-27	10685068	10791918	10338658	10380012	10566852	10799323	11058507	11334970
France	1637359	1642272	1604499	1618940	1646462	1677745	1714655	1754092
Germany	2245856	2272806	2152347	2158805	2191187	2228437	2268549	2309383
UK	1911990	1925374	1840657	1857223	1903654	1958860	2015667	2074121
Italy	1289988	1277088	1211957	1214380	1222881	1238779	1258599	1282512
Spain	797052	803428	772898	767488	774395	785237	798586	815356
Poland	244891	256891	259460	265168	275774	286805	297991	309910

Source: EUROSTAT Statistics Database for 2007 (figures rounded off by the author); from 2008 calculation by the author applying IMF data for annual growth rate (World Economic Outlook Database, October 2009).

Figure 19: GDP volumes foreseen for the EU-27: Scenarios before and after the economic crisis (2007-13)



Source: calculations and graph from the author.
Note: Similar graphs are provided in the appendices of our report for each of the 6 countries considered (France, Germany, UK, Italy, Spain, and Poland).

Comparing the GDP volumes foreseen in 2013 as predicted by the IMF before the economic crisis occurred (in its World Economic Outlook from April 2008) and after the crisis was taken into account (IMF's World Economic Outlook from October 2009), we have calculated the output gap due to the crisis: *in the EU-27, the GDP volume reached in 2013 would be 10% lower than the one that would have occurred on the same year without the economic crisis. This output gap varies widely depending on the member states: compared to the pre-crisis scenario, Spain should experience a GDP 16% lower than the one initially foreseen by the IMF for 2013; Germany and the UK 9% lower; France and Poland 8% lower; and Italy 7% lower. So the current economic crisis is likely to lead to significant loss in GDP volumes by 2013 across Europe* (see figure 19).

Building scenarios for energy-related CO_2 emissions by 2013

Hypothesis 1: Assuming Energy and Carbon intensities remain unchanged until 2013

We have calculated the level of primary energy consumption and energy-related CO_2 emissions to expect in 2013 in the EU-27 and in the top 6 emitting countries should both energy and carbon intensities remain stable in the next five years (our hypothesis 1). This hypothesis has been applied to the GDP volumes calculated for 2013 when the current economic crisis is taken into account (i.e. post-crisis scenario 1) and when it is not (i.e. pre-crisis scenario 1). Both post-crisis and pre-crisis scenarios 1 for 2013 are summarized in the tables 8 and 9.

Table 8: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming stable energy and carbon intensities – Post crisis scenario 1

Post-crisis scenario 1 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO2/toe)	CO2 emissions energy-related (t)
EU-27	169,1	11058507	1869993534	2,14	4001786162
France	165,1	1714655	283089540,5	1,39	393494461,3
Germany	151,5	2268549	343685173,5	2,22	762981085,2
United Kingdom	115,6	2015667	233011105,2	2,39	556896541,4
Italy	142,2	1258599	178972777,8	2,44	436693577,8
Spain	184,2	798586	147099541,2	2,3	338328944,8
Poland	400,1	297991	119226199,1	3,09	368408955,2

Table 9: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming stable energy and carbon intensities – Pre-crisis scenario 1

Pre-crisis scenario 1 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	169,1	12306296,19	2080994686	2,14	4453328627
France	165,1	1860066,449	307096970,7	1,39	426864789,3
Germany	151,5	2484781,895	376444457,1	2,22	835706694,7
United Kingdom	115,6	2221348,043	256787833,8	2,39	613722922,7
Italy	142,2	1350395,768	192026278,2	2,44	468544118,8
Spain	184,2	949656,3959	174926708,1	2,3	402331428,7
Poland	400,1	324132,3315	129685345,8	3,09	400727718,6

The volume of energy-related CO_2 emissions is foreseen to be 10% lower in 2013 in the EU-27 than the volume that was expected

on that same year should the economic crisis not have occurred. Under the scenario 1, the economic crisis should lead to an emission gap of 451Mt CO 2 (i.e. 4453 Mt CO_2 expected in the pre-crisis scenario; only 4002 Mt CO_2 in the post-crisis scenario)

Compared with the situation in 2007, the volume of energy-related CO_2 emissions in the EU-27 under the post-crisis scenario 1 has nevertheless increased by +3.3% (or +128.5 Mt CO 2 in absolute figures) between 2007 and 2013 (from 3873.5 Mt in 2007 to 4002 Mt in 2013) even when the economic crisis is taken into account.

These results show that the recession has a significant effect on energy-related CO 2 emissions: the slowdown in economic activities limits the growth in emissions compared to the pre-crisis trend. The crisis gives us a little "bonus" in the fight against climate change.

But the economic crisis alone is not sufficient to cut emissions: if both energy and carbon intensities remain stable over the period, energy-related emissions will continue to increase by 2013, even if it is at a slower rhythm thanks to the recession.

Hypothesis 2: Assuming the same downward trend for energy intensity as before and an unchanged carbon intensity in 2013

Table 10: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming stable carbon intensities and improved energy intensities (in line with past trends) – Post-crisis scenario 2

Post-crisis scenario 2 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	155	11058507	1714068585	2,14	3668106772
France	155	1714655	265771525	1,39	369422419,8
Germany	140	2268549	317596860	2,22	705065029,2
United Kingdom	95	2015667	191488365	2,39	457657192,4
Italy	145	1258599	182496855	2,44	74793793,03
Spain	190	798586	151731340	2,3	348982082
Poland	330	297991	98337030	3,09	303861422,7

Applying our hypothesis 2 to the same pre-crisis/post-crisis expected GDP volumes in 2013, we have calculated the impact of the crisis on energy-related CO_2 emissions should energy intensities continue to be improved at the same rhythm as before and should carbon

intensities remain flat over the next 5 years in the EU-27 and in the top 6 emitting countries (See tables 10 and 11).

Table 11: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming stable carbon intensities, improved energy intensities (in line with past trends) – Pre-crisis scenario 2

Pre-crisis scenario 2 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	155	12306296,19	1907475909	2,14	4081998446
France	155	1860066,449	288310299,6	1,39	400751316,4
Germany	140	2484781,895	347869465,3	2,22	772270213
United Kingdom	95	2221348,043	211028064,1	2,39	504357073,2
Italy	145	1350395,768	195807386,4	2,44	80248928,84
Spain	190	949656,3959	180434715,2	2,3	414999845
Poland	330	324132,3315	106963669,4	3,09	330517738,4

The volume of energy-related CO_2 emissions is again foreseen to be 10% lower in 2013 in the EU-27 than the volume that was expected on that same year should the economic crisis not have occurred. Under the scenario 2, the economic crisis should lead to an emission gap of 414Mt CO_2 (i.e. 4082 Mt CO_2 expected in the pre-crisis scenario 2; only 3668 Mt CO_2 in the post-crisis scenario 2)

Compared with the situation in 2007, the volume of energy-related CO_2 emissions in the EU-27 under the post-crisis scenario 2 has decreased by 5.3% (or -205.5 Mt CO_2 in absolute figures) between 2007 and 2013 (from 3873.5 Mt in 2007 to 3668 Mt in 2013).

Without further improvements of carbon intensities across Europe (i.e. change in fuel mix), the combined effects of the *economic slowdown and the continuation of previous effort to reduce energy intensities are not sufficient by themselves to induce a real drop in energy-related emissions* in the EU-27 in the coming years. Economic restructuring and energy efficiency gains can only lead to a certain level of emission cut.

But they are sufficient to cut EU-wide emissions in line with EU's Kyoto commitments. The decrease by 5.3% of EU-wide CO_2 emissions in the energy sector that is foreseen in our scenario 2 by 2013 is beyond what is expected from the 15 older member states alone to comply with their Kyoto target (-205.5 Mt CO_2 achieved in the energy sector in our scenario 2 compared to the drop of 127.5 Mt CO_2-eq in total GHG emissions that the EU-15 has to reach by 2012 from 2007-levels).

Hypothesis 3: Assuming the same downward trend for energy and carbon intensities as before

Applying our hypothesis 3 to the same pre-crisis/post-crisis expected GDP volumes in 2013, we have calculated the impact of the crisis on energy-related CO_2 emissions should energy and carbon intensities continue to be improved at the same rhythm as before over the next 5 years in the EU-27 and in the top 6 emitting countries (See tables 12 and 13).

Table 12: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming improved energy and carbon intensities (in line with past trends) - Post crisis scenario 3

Post-crisis scenario 3 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	155	11058507	1714068585	2,05	3513840599
France	155	1714655	265771525	1,3	345502982,5
Germany	140	2268549	317596860	2,1	666953406
United Kingdom	95	2015667	191488365	2,3	440423239,5
Italy	145	1258599	182496855	2,4	76040356,25
Spain	190	798586	151731340	2,4	364155216
Poland	330	297991	98337030	2,9	285177387

Table 13: Calculation of primary energy consumption and energy-related CO_2 emissions in 2013 assuming improved energy and carbon intensities (in line with past trends) – Pre-crisis scenario 3

Pre-crisis scenario 3 in 2013	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	155	12306296,19	1907475909	2,05	3910325614
France	155	1860066,449	288310299,6	1,3	374803389,5
Germany	140	2484781,895	347869465,3	2,1	730525877,1
United Kingdom	95	2221348,043	211028064,1	2,3	485364547,4
Italy	145	1350395,768	195807386,4	2,4	81586410,98
Spain	190	949656,3959	180434715,2	2,4	433043316,5
Poland	330	324132,3315	106963669,4	2,9	310194641,2

The volum e of energy-related CO_2 em issions is again foreseen to be 10% lower in 2013 in the EU-27 than the volum e that

was expected on that same year should the economic crisis not have occurred. Under the scenario 3, the economic crisis should lead to an emission gap of 396 Mt CO 2 (i.e. 3910 Mt CO_2 expected in the pre-crisis scenario 3; only 3514 Mt CO_2 in the post-crisis scenario 3)

Compared with the situation in 2007, the volume of energy-related CO_2 emissions in the EU-27 under the post-crisis scenario 3 has decreased by 9.3% (or -359.5 Mt CO 2 in absolute figures) between 2007 and 2013 (from 3873.5 Mt in 2007 to 3514 Mt in 2013).

This is our most optimistic scenario, assuming a significant improvement in energy intensities over the period and much slower yet regular progress in terms of carbon intensities. *This scenario puts the EU on track to comply with its 20, 20 target under the Climate and Energy Package* (i.e. a fall by 594 Mt CO_2-eq of the EU-27 overall GHG emissions by 2020 compared to 2007-levels). Indeed, the 359.5 Mt cut in energy-related CO_2 emissions obtained in 2013 under the post-crisis scenario 3 corresponds to almost two thirds of the cut required on the whole by 2020 from 2007-levels – and 2013 corresponds to the point in time when the EU will be almost half of the way to its 2020 target compared to 2007.

The result highlights the importance of a cut (even minor) in carbon intensities to see a significant effect on CO_2 emissions in the energy sector. The slowdown in economic and industrial activities and gains in energy efficiency have their importance but it is the improvement of carbon intensities (i.e. the change in fuel mix towards low-carbon energy sources) that really makes the difference and significantly cuts emissions.

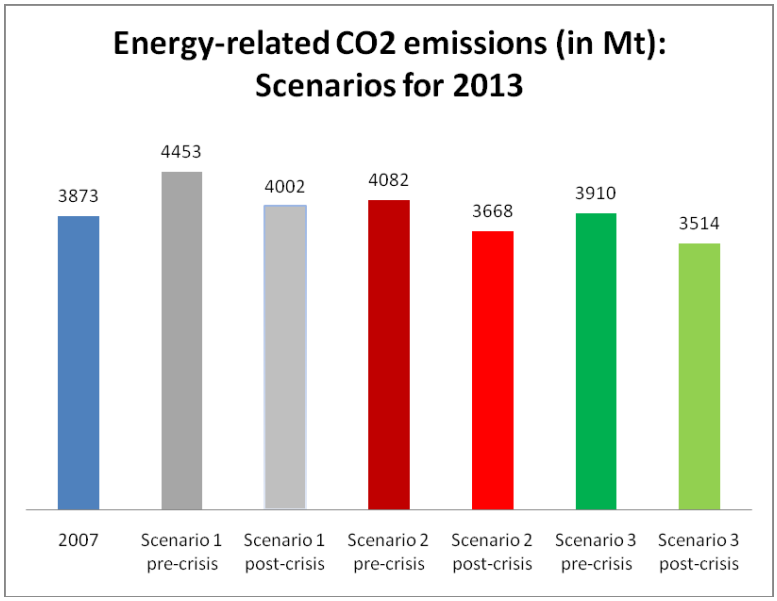
Conclusion: our 3 scenario results for EU-27 CO_2 emissions in the energy sector in 2013

Figure 20 summarizes the results of our 3 scenarios for the EU-27 with pre- and post-crisis GDP forecasts. *In all our scenarios, the economic crisis induces a CO 2 emission gap of around 400 Mt in 2013 compared to the emission reference trend foreseen if no recession had happened.* 400 Mt seems to be the level of "bonus" that the economic crisis gives compared to pre-crisis emission forecasts.

As to the emission trend compared to 2007-levels, the economic crisis itself does not reduce energy-related CO_2 emissions in 2013 compared to their level in 2007. In the post-crisis scenario 1, emissions should increase by 3.3% in 2013 from 2007-levels. The post-crisis scenario 2 shows the combined effect of the economic recession and gains in energy intensities: under this scenario, energy-related CO_2 emissions decrease by 5.3% from 2007 to 2013 in the EU-27. The post-crisis scenario 3 emphasizes the triple effect of economic recession, gains in energy intensities and improvement in carbon intensities. Only in this last case, is a significant drop in

energy-related emissions observed from 2007 to 2013 Europe-wide (-9.3%).

Figure 20: Our 3 scenario results for EU-27 CO_2 emissions in the energy sector in 2013



Source: calculations and graph by the author

A scenario for EU-27 emissions profile by 2020

Applying our hypothesis 3 until 2020

Hypothesis 3 - assuming the same downward trend for energy and carbon intensities as before (1996-2007) - has been applied until 2020 for the EU-27.

To calculate GDP volumes in 2020, we have used GDP annual growth rates foreseen by the IMF from 2007 to 2014; and then from 2014 to 2020, we have relied on the assumptions made by the European Commission while drafting its impact assessment of the EU Climate and Energy Package in 2008 but postponing the Commission figures by 10 years in order to take into account the effect of the economic crisis: we have applied a 2.2% average annual growth rate of GDP between 2014 and 2020 for EU-27 (which was the Commission's forecast for the period 2000-10 in the PRIMES model its impact assessment is based on; the forecast for the period 2010-20 was an annual GDP average change of 2.4% according to PRIMES). Our forecast for GDP annual change from 2014 to 2020 is then slightly more pessimistic than the one expected by the Commission before the economic crisis occurred (See table 14). We obtain a GDP volume in the EU-27 of €12,915 billion in 2020.

Table 14: Calculation of GDP volume in the EU-27 until 2020 assuming a 2.2% annual growth of GDP after 2014

	2007	2008	2009	2010	2011	2012	2013
GDP at market prices in volume (M€00)	10685068	10791918	10338658	10380012	10566852	10799323	11058507

	2014	2015	2016	2017	2018	2019	2020
GDP at market prices in volume (M€00)	11334970	11584339	11839194	12099657	12365849	12637898	12915932

Source: EUROSTAT Statistics Database for 2007 (figures rounded off by the author); from 2008 to 2014 calculation by the author applying IMF data for annual growth rate (World Economic Outlook Database, October 2009); from 2014 to 2020 calculation by the author assuming a 2.2% annual growth of GDP after 2014 (that is to say the pre-crisis forecast by Commission's PRIMES model for the time frame 2000-10 – i.e. slightly more pessimistic than PRIMES pre-crisis forecast for the time frame 2010-20 which was an annual GDP average change of 2.4%). This forecast for GDP growth between 2014 and 2020 is also in line with one of the few reports that already provide long-term forecasts for GDP: the report by BNP Paribas that presents data for the Eurozone until 2019 (BNP Paribas 2009, p. 79).

Table 15: Calculation of primary energy consumption and energy-related CO_2 emissions in EU-27 in 2020 assuming improved energy and carbon intensities (in line with past trends) and a 2.2% GDP average growth from 2014 to 2020

Scenario 3 in 2020	Energy intensity (toe/M€)	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (toe)	Carbon intensity (tCO_2/toe)	CO_2 emissions energy-related (t)
EU-27	130	12915931,6	1679071108	1,95	3274188661

Assuming the same downward trend for energy and carbon intensities as before (1996-2007) until 2020, we foresee that *the primary energy consumption will be 1679 Mtoe in 2020 in the EU-27 and that the volum e of CO_2 emissions will be 3274 Mt in the energy sector* (see table 15).

Taking into account the effect of the economic crisis on emissions, energy intensity gains and a progressive improvement in carbon intensities from 2007 to 2020, *the CO_2 emission cut obtained in the energy sector appears to be in line with what is expected from*

the EU-27 to comply with its 20% reduction target (for total GHG emissions) by 2020. Considering that energy-related CO_2 emissions represent the lion's share of total GHG emissions in the EU, the cut in CO_2 emissions in the energy sector following the crisis will be enough for the EU to reach its target (indeed 3274 Mt CO_2 corresponds to a -599.5 Mt cut compared to 2007-levels, while the EU-27 must cut its total GHG emissions by 594 Mt CO_2-eq over the period). But the economic recession alone cannot do the trick: should energy and carbon intensities remain unchanged over the period 2007-20 in the EU-27, energy-related CO_2 emissions would amount to as high as 4674 Mt in 2020 according to our calculations! It is essential that the EU continues to improve its energy and carbon intensities as fast as before to reach its climate targets.

Double-check with IEA 2009 forecasts

According to IEA's latest World Energy Outlook[19], the level of energy-related CO_2 emissions in the EU-27 should range from 3100 Mt (450 Scenario) to 3600 Mt (Reference Scenario). Its reference scenario takes account of government policies and measures enacted or adopted by mid-2009, although many of them have not yet been fully implemented (so the EU Climate and Energy Package is included in IEA's scenarios).

Our own scenario of a 3274 Mt CO_2 emission profile in 2020 seems to be an intermediate scenario between both scenarios established by the agency.

Our own forecast of primary energy consumption is in line with what is foreseen by the agency: our scenario leads to a primary energy consumption in the EU of 1679 Mtoe in 2020, while the IEA predicts a primary energy demand in 2020 between 1727 Mtoe (in its reference scenario) and 1676 Mtoe (in its 450 ppm scenario). To obtain IEA's estimates of primary energy consumption in 2020, we have multiplied IEA forecasts for primary energy demand per capita (toe) by population (million) in both scenarios (IEA 2009, p. 29).

The main difference with IEA's forecasts is that our energy and carbon intensities forecasts are not very optimistic in the time frame until 2020: we assume a mere continuation of previous trends (which were rather stable in the case of carbon intensities in Europe as we have seen), whereas the IEA, in its 450 ppm at least, expects a major push towards a low-carbon economy thanks to determined measures and investments. For the time-being, we assume in our scenario that energy intensities will continue to improve at the same path as before and that carbon intensities will remain stable with a slight improvement over the period. But we are not expecting any significant downward trend in carbon intensities before 2020, since

[19] To be published in November 2009. An excerpt on energy-related CO2 emissions has been released earlier in October 2009 (IEA 2009).

the effects of the implementation of the EU Climate and Energy Package (in terms of increased share of renewables and nuclear energy in Europe's fuel mix) will be visible only after 2020. Both the new promotion of renewables and the revival of nuclear power plants in some European countries today will have a significant effect in curbing energy-related CO_2 emissions across Europe but that effect will only play in the decade following 2020. It takes time and major investments indeed for alternative energy sources to really impact one country's energy consumption profile and to reduce the share of fossil fuels in it. One cannot expect nuclear power plants in particular to make a huge difference before 2020 because of the time frame needed between the decision-making process and the entering into force of new power plants in the field.

Conclusion

According to the latest data published by the European Environment Agency in 2009, the EU has achieved rather mixed results so far in complying with its two climate commitments, both at the international level with the Kyoto Protocol (-8% of EU-15 GHG emissions by 2012 compared to baseline) and domestically (-20% of EU-27 GHG emissions by 2020 compared to 1990-levels). From 1990 to 2007, total GHG emissions decreased by 9.3% in the EU-27, but only by 4.3% in the EU-15. The bulk of the emissions reduction has occurred in Central and Eastern new member states that have experienced a massive deindustrialization of their economies in the 1990's.

The global economic crisis that has affected Europe since the end of 2008 will have a significant impact on GHG emissions and help the EU bend further its emissions path in the years to come. In order to measure this "reduction bonus" generated by the economic crisis, we have built several scenarios of EU-wide energy-related CO_2 emission profiles until 2013 and until 2020 by adjusting the European Commission's 2020 pre-crisis growth scenario (the one used to prepare the EU Climate and Energy Package in 2007/2008) under a reviewed post-crisis macroeconomic hypothesis that takes into account latest IMF previsions for the recovery that cover the period until 2014 (IMF, October 2009). Our scenarios have also drawn on the patterns of energy and carbon intensities in the past to project EU energy and carbon intensities to 2020 under various hypotheses. We have obtained precise scenarios comparing the pre-crisis emission trend with the post-crisis trend for the period 2007-13. For the period after 2014, the comparison of the post-crisis situation with the pre-crisis one is less systematic as no forecasting agency provides for figures for real GDP annual change for the years after 2014. Our scenario until 2020 is rather a gross assumption of the likely impact of the recession on energy-related CO_2 emissions assuming an intermediate recovery path for Europe.

Our study has quantified the impact of the economic downturn on energy-related CO_2 emissions at around 400 Mt by 2013 in the EU-27 compared to the pre-crisis forecasts under our various scenarios (i.e. -10% of the emissions volume expected in 2013 should the recession not have occurred). It is a significant deviation from business-as-usual future emission trends (without recession). The crisis gives us a "bonus" in the fight against climate change. But the gap in CO_2 emissions that occurs thanks to the economic crisis is not sufficient in itself to cut European emissions compared to pre-

crisis levels (i.e. their 2007-levels): if no progress is made otherwise in terms of energy efficiency and low-carbon energy sources, energy-related emissions will continue to rise from 2007 to 2013 in Europe despite the economic downturn, even if it is at a slower rhythm thanks to the recession.

Two parameters are essential in order to obtain a significant drop in European CO_2 emissions in the energy sector over the next decade: energy efficiency gains and an increased share of low-carbon energy sources in the energy mix. Only if these two parameters are continuously improved over the 11 years to come (besides the "reduction bonus" offered by the recession) can the EU-27 hope to reach its -20% GHG emission reduction target by 2020 compared to 1990-levels (which corresponds to a 594 Mt CO_2-eq cut in its overall GHG emissions from 2007 to 2020). According to our post-crisis scenario until 2020, assuming an intermediate recovery path for Europe (IMF previsions until 2014 and then an average 2.2% real GDP growth rate from 2014 to 2020), energy-related CO_2 emissions should amount to 3274 Mt in 2020, which corresponds to a -599.5 Mt cut compared to 2007-levels. But for that to happen, both energy and carbon intensities should continue to be improved at the same pace as in the previous decade (1996-2007). This is a hard task for the EU-27 to keep up with its previous improvement rhythm for these two indicators.

There are many uncertainties as to whether Europe will achieve this continuous downward trend in its energy and carbon intensities over the next decade. From 1996 to 2007, the EU-27 experienced an impressive decrease in its energy intensity. Major restructuring of European economies in the 1990's (both in Western and Eastern Europe following the end of the Soviet-era) led to most of improvements. The quantity of energy consumed per unit of GDP has dropped rapidly over the last decade. One can wonder whether richer Western European states and Central and Eastern new member states will be able to continue to transform their economic structures at the same pace in the years to come. Energy efficiency gains represent an alternative promising way to bend further energy intensities in Europe as there is still a large room for manoeuvre to improve further energy efficiency in almost all European states (and EU policies are to be sharpened on that matter in 2010 according to the latest European Commission's plans). It is crucial for Europe to use less energy in all sectors per unit of activity if it wants to comply with its GHG emission reduction target. The economic crisis alone has an opposite effect: it reduces the level of activity, not the level of energy consumed per unit of activity.

Carbon intensity (i.e. CO_2 emitted per unit of energy) has decreased far less over the last decade in Europe: it has remained fairly stable with a slight improvement over time. But nevertheless there are uncertainties as to whether the EU-27 will be able to further improve its carbon intensity at the same rhythm over the next decade (which is the first condition for the Union to comply with its -20%

emission target by 2020). Indeed it is very hard for an economy to cut its carbon intensity. It requires determined policies and huge investments to transform the fuel mix and capital stock. Carbon intensity depends on the share of low-carbon energy sources (such as renewables and nuclear energy) in the primary energy demand. Over the last decade, nuclear energy has represented a rather small share of European energy mix (around 14% according to DG TREN's 2008 report "European Energy and Transport – Trends to 2030"). Despite a significant development of wind and solar energy in the 2000's, the share of renewables in European energy consumption remained marginal over the last decade (around 6/7% according to the same DG TREN 2008 report) because the rise of these alternative energy sources occurred from such a low starting point. In order to bend further carbon intensities in Europe in the years to come, a revolution in the energy mix must occur. "Clean" energy sources have to represent a much more significant share of the European energy mix just 11 years from now. But it takes time to translate decisions into power plants on the ground. In order to comply with its -20% reduction target, the EU-27 has to decide now to massively develop (and invest in) its renewables and nuclear power plants to change the profile of its energy mix in the decade after 2020. The objective of a 20% renewables share in the Union's final energy consumption by 2020 that is included in the EU Climate and Energy Package, is in this prospect a major contribution to the -20% emission reduction target. The economic crisis on the contrary is an important obstacle for the transformation of European member states' fuel mix as huge investments are required from energy producing companies.

Some people are asking the European Commission to review the EU Climate and Energy Package in order to take into account the new economic conditions due to the current recession. According to them, the -20% emission reduction target will be too easy to reach thanks to the "reduction bonus" offered by the economic crisis and the Package's targets would have to be sharpened and made more difficult to achieve. Our study has shown that the emission gap obtained thanks to the new economic path in Europe following the crisis will not be instrumental in complying with the Union's target by 2020. It will not be sufficient in itself to cut EU-wide GHG emissions at such a level. The package's requirements are still relevant and tough enough for member states in the context of the economic crisis. The challenge remains as great as before (and even greater for the question of financing) for the EU to find a way to both significantly improve the energy efficiency of its economy and to transform its energy mix to give it a much more low-carbon profile. The battle to achieve its 20% emission reduction target in Europe by 2020 is far from won.

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Appendices:
Main data used in the report

GHG emissions volumes in the EU, 1990-2007

	Year	EU-27	EU-15	EU-10
Total GHG emissions, excluding LULUCF and aviation (Mt CO_2-eq)	**1990**	**5564**	**4233**	**1324**
	1991	5464	4247	1209
	1992	5276	4157	1110
	1993	5186	4089	1087
	1994	5159	4089	1060
	1995	5212	4128	1075
	1996	5318	4210	1098
	1997	5214	4146	1058
	1998	5160	4163	986
	1999	5049	4097	940
	2000	**5053**	**4108**	**934**
	2001	5109	4154	943
	2002	5066	4127	926
	2003	5150	4180	958
	2004	5153	4180	960
	2005	**5111**	**4141**	**957**
	2006	5105	4116	976
	2007	**5045**	**4052**	**980**

Source: data from EEA Technical Report n° 4/2009
(figures rounded off to whole numbers by the author).

GHG emissions volumes in 6 largest emitting countries in the EU, 1990-2007

	Year	France	Germany	Italy	Poland	Spain	United Kingdom
Total GHG emissions, excluding LULUCF and aviation (Mt CO_2-eq)	**1990**	**563**	**1215**	**516**	**459**	**288**	**771**
	1991	586	1169	517	452	295	778
	1992	578	1119	515	439	302	753
	1993	552	1108	510	445	291	732
	1994	548	1090	502	441	307	722
	1995	556	1085	530	446	319	712
	1996	571	1105	523	454	312	733
	1997	564	1067	529	449	333	708
	1998	578	1042	540	413	343	704
	1999	561	1010	545	400	372	671
	2000	**557**	**1008**	**549**	**389**	**386**	**673**
	2001	558	1025	555	385	386	677
	2002	549	1006	556	371	403	656
	2003	552	1007	570	384	410	661
	2004	552	997	574	384	426	658
	2005	**554**	**969**	**574**	**387**	**441**	**653**
	2006	542	980	563	399	433	648
	2007	**531**	**956**	**553**	**399**	**442**	**637**

Source: data from EEA Technical Report n°4/2009
(figures rounded off to whole numbers by the author).

Emissions by main GHG in the EU-27, 1990-2007
(for all sectors excluding LULUCF)

		CO_2	CH_4	N_2O
Total emissions (all sectors excluding LULUCF)	1990	4399,5	597,3	508,4
	1991	4342,6	583,6	480,7
	1992	4190,7	566,6	462,1
	1993	4126,4	557,1	443,3
	1994	4103,1	542,3	449,6
	1995	4150,2	541	450,8
	1996	4251	535,3	455,7
	1997	4162,6	519,4	453,8
	1998	4151,9	499,5	430,1
	1999	4084,3	488,8	407,4
	2000	4105,8	475,3	405,6
	2001	4184,4	461,2	399
	2002	4158,1	451,7	388
	2003	4252,3	440,7	386,8
	2004	4264,4	428,1	390,6
	2005	4231,5	421	385,3
	2006	4243,1	416,4	371,5
	2007	4186,7	411,2	370,4

Source: data from EEA Technical Report n°4/2009
(figures rounded off to whole numbers by the author).

EUROSTAT absolute figures for GDP in volume in the EU, 1995-2007

		EU-27	EU-15	EU-10
GDP at market prices in volume (M€2000)	1995	7981869,3	7612810,1	313669,9
	1996	8127805,4	7744856,6	326978,5
	1997	8348425,5	7951908,3	342253,9
	1998	8595820,4	8186978,8	355640,5
	1999	8857166,6	8436303,5	407319,6
	2000	9202198,4	8763925,5	423973,1
	2001	9384658,6	8933940,6	436084,8
	2002	9501843,1	9037372,8	449170,8
	2003	9629064,8	9143709,8	468805,4
	2004	9869980,9	9357431,1	495116,3
	2005	10067579,7	9529818,6	518670,4
	2006	10384772,9	9809629,4	552807,5
	2007	10679741,5	10066231,6	587124,1

Source: EUROSTAT Statistics Database

EUROSTAT absolute figures for GDP in volume in the top 6 emitting countries, 1995-2007

		France	Germany	Italy
GDP at market prices in volume (M€2000)	1990	1185067,7	:	1017666,3
	1991	1197101,8	1760550	1033274,6
	1992	1213461,3	1799737,5	1041261,2
	1993	1202374,3	1785300	1032012,6
	1994	1229012	1832737,5	1054220,4
	1995	1255031	1867387,5	1084022,8
	1996	1268965,5	1885950	1095897
	1997	1297360,5	1919981,3	1116414,9
	1998	1342808,2	1958962,5	1132059,5
	1999	1387131,6	1998356,3	1148636
	2000	1441372	2062500	1191057,3
	2001	1468101	2088075	1212713,3
	2002	1483171,4	2088075	1218219,6
	2003	1499299,5	2083537,5	1218013,5
	2004	1536336	2108700	1236671,2
	2005	1565464,8	2124993,8	1244782,2
	2006	1600168,3	2187900	1270126,4
	2007	1637359,5	2241731,3	1289988,4

		Poland	Spain	United Kingdom
GDP at market prices in volume (M€2000)	1990	:	468206,2	1247375,6
	1991	:	480114,6	1230006,7
	1992	:	484580,9	1231810,5
	1993	:	479583,3	1259182,7
	1994	:	491011,6	1313078,9
	1995	142685,4	515405	1353158,8
	1996	151587,4	527862,4	1392202,4
	1997	162329,4	548283,8	1438247,3
	1998	170416	572782	1490121,4
	1999	178126	599965,8	1541866,8
	2000	185713,8	630263	1602239,6
	2001	187952,2	653255	1641676,3
	2002	190665,3	670920,4	1676102
	2003	198038,6	691694,7	1723170,2
	2004	208623,4	714291,2	1774019,5
	2005	216169,4	740108	1812568,8
	2006	229631,3	768890,1	1864276,7
	2007	244890,7	797052,4	1911986,6

Source: EUROSTAT Statistics Database

Energy-related CO_2 emissions volumes in the EU, 1990-2007

		EU-27	EU-15	EU-10
CO_2 emissions energy-related (Mt)	1990	4083	3131	947
	1991	4056	3164	886
	1992	3916	3095	814
	1993	3864	3048	809
	1994	3824	3037	780
	1995	3860	3065	787
	1996	3972	3152	812,5
	1997	3875	3088	779
	1998	3868,5	3134,5	726
	1999	3811	3111	691.5
	2000	3821	3129	683
	2001	3908	3203	696
	2002	3881	3191	681
	2003	3970	3254	707
	2004	3972	3259,5	703
	2005	3935	3231	695
	2006	3938	3221	707
	2007	3873,5	3156	708

Source: data from EEA Technical Report n°4/2009
(figures rounded off to whole numbers by the author).

Main GHG Emissions Trends in the EU-27, 1990-2007 (for the energy sector excluding LULUCF)

		CO_2	CH_4	N_2O
Total emissions (energy sector excluding LULUCF)	1990	4082,9	158,8	35,7
	1991	4055,9	152,1	36
	1992	3916,3	144,8	35,7
	1993	3864,1	143,3	36
	1994	3824,1	132,4	36,8
	1995	3859,7	133,5	38,3
	1996	3972	131,3	39
	1997	3874,6	123,5	38,9
	1998	3868,6	116,1	39,6
	1999	3811,4	112,6	39,6
	2000	3820,9	108,8	39,9
	2001	3908,3	104,4	40,7
	2002	3880,8	101,2	40,5
	2003	3970,1	97,52	41,2
	2004	3972,2	92,77	41,4
	2005	3935,2	90,07	41,2
	2006	3938,4	87,69	41,6
	2007	3873,6	84,21	41,3

Source: data from EEA Technical Report n°4/2009

Main GHG Emissions Trends in the EU-15, 1990-2007 (excluding LULUCF)

		CO_2 energy sector (Mt CO_2eq)	CH_4 energy sector (Mt CO_2eq)	N_2O energy sector (Mt CO_2eq)
Emissions in the EU-15	1990	3130,76192	95,7838469	30,1407027
	1991	3163,90451	94,7084294	30,7726747
	1992	3095,25007	91,2626029	30,6963024
	1993	3048,18261	89,9653431	30,8220558
	1994	3036,67885	80,0780814	31,7472368
	1995	3065,41067	79,7317997	32,9445338
	1996	3152,05635	77,186624	33,2607357
	1997	3087,98973	74,0464795	33,1500552
	1998	3134,4913	69,7216013	33,787031
	1999	3110,91214	68,1028662	33,7920629
	2000	3129,04923	64,4211628	34,1467359
	2001	3202,85152	60,8512579	34,8214251
	2002	3190,72471	58,9661078	34,7243601
	2003	3254,12932	53,9769415	35,0721696
	2004	3259,53376	49,7895047	35,2139746
	2005	3230,6368	47,7359305	34,7388151
	2006	3221,24666	44,904706	34,9982628
	2007	3155,622	42,7653609	34,6490892

		Fluorinated gases all sectors (Mt CO_2eq)	CO_2 all sectors (Mt CO_2eq)	CH_4 all sectors (Mt CO_2eq)	N_2O all sectors (Mt CO_2eq)
Emissions in the EU-15	1990	55,7450898	3360,24668	433,579694	383,328303
	1991	54,4473852	3383,48455	430,284678	378,891061
	1992	54,5279563	3305,96012	424,24121	371,884036
	1993	56,8430082	3251,97864	421,408602	358,644155
	1994	61,7177493	3251,94941	409,923597	365,376985
	1995	67,6978913	3286,05493	407,455117	366,633547
	1996	72,9272643	3363,43754	402,298668	371,683012
	1997	76,3281871	3308,03266	391,243073	370,450505
	1998	75,8302178	3355,3324	381,65187	350,095367
	1999	66,5607653	3327,83655	373,426121	329,721002
	2000	64,2308899	3353,53627	362,715912	327,15554
	2001	61,0887971	3422,10546	350,969628	319,581876
	2002	63,844209	3411,15367	341,05781	311,321979
	2003	65,3450915	3476,75077	328,459248	309,508807
	2004	64,6940334	3488,22206	317,507418	310,040208
	2005	66,4456144	3458,89167	311,169242	304,841115
	2006	67,1926279	3452,00852	305,930551	290,830261
	2007	69,1933576	3391,14816	302,507314	289,11507

Source: data from EEA Technical Report n°4/2009

Calculation of Energy and Carbon Intensities in the EU and top 6 emitting countries

EU-27 aggregated	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	8127805,4	1719706	3972	*211,6*	*2,3*
1997	8348425,5	1704473	3875	*204,2*	*2,3*
1998	8595820,4	1722652	3868,5	*200,4*	*2,2*
1999	8857166,6	1711219	3811	*193,2*	*2,2*
2000	9202198,4	1724341	3821	*187,4*	*2,2*
2001	9384658,6	1762887	3908	*187,8*	*2,2*
2002	9501843,1	1757803	3881	*185*	*2,2*
2003	9629064,8	1803034	3970	*187,2*	*2,2*
2004	9869980,9	1823916	3972	*184,8*	*2,2*
2005	10067579,7	1825632	3935	*181,3*	*2,1*
2006	10384772,9	1825523	3938	*175,8*	*2,2*
2007	10679741,5	1806336	3873,5	*169,1*	*2,1*

EU-15 aggregated	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	7744856,6	1428517	3152	*184,4*	*2,2*
1997	7951908,3	1421269	3088	*178,7*	*2,2*
1998	8186978,8	1451991	3134,5	*177,3*	*2,2*
1999	8436303,5	1454530	3111	*172,4*	*2,1*
2000	8763925,5	1469221	3129	*167,6*	*2,1*
2001	8933940,6	1502101	3203	*168,1*	*2,1*
2002	9037372,8	1495882	3191	*165,5*	*2,1*
2003	9143709,8	1530369	3254	*167,3*	*2,1*
2004	9357431,1	1551813	3259,5	*165,8*	*2,1*
2005	9529818,6	1551058	3231	*162,7*	*2,1*
2006	9809629,4	1543825	3221	*157,4*	*2,1*
2007	10066231,6	1525634	3156	*151,5*	*2,1*

France	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	1268965,5	255273	383	*201,2*	*1,5*
1997	1297360,5	248294	378	*191,4*	*1,5*
1998	1342808,2	256272	398	*190,8*	*1,5*
1999	1387131,6	255950	388	*184,5*	*1,5*
2000	1441372	259506	384	*180*	*1,5*
2001	1468101	267168	390	*182*	*1,4*
2002	1483171,4	267344	382	*180,2*	*1,4*
2003	1499299,5	271899	388	*181,3*	*1,4*
2004	1536336	276094	391,5	*179,7*	*1,4*
2005	1565464,8	277086	394	*177*	*1,4*
2006	1600168,3	273801	386	*171,1*	*1,4*
2007	1637359,5	270272	376	*165,1*	*1,4*

Germany	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	1885950	351404	866	*186,3*	*2,5*
1997	1919981,3	347635	830	*181,1*	*2,4*
1998	1958962,5	346727	823,5	*177*	*2,4*
1999	1998356,3	340817	800	*170,5*	*2,3*
2000	2062500	342362	798	*166*	*2,3*
2001	2088075	353268	820	*169,2*	*2,3*
2002	2088075	345590	806	*165,5*	*2,3*
2003	2083537,5	348322	808	*167,2*	*2,3*
2004	2108700	350304	797	*166,1*	*2,3*
2005	2124993,8	347123	772	*163,3*	*2,2*
2006	2187900	348838	784	*159,4*	*2,2*
2007	2241731,3	339568	755	*151,5*	*2,2*

United Kingdom	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	1392202,4	228692	557	*164,3*	*2,4*
1997	1438247,3	223138	534	*155,1*	*2,4*
1998	1490121,4	230715	536,5	*154,8*	*2,3*
1999	1541866,8	229153	526,5	*148,6*	*2,3*
2000	1602239,6	231868	535	*144,7*	*2,3*
2001	1641676,3	232720	548	*141,7*	*2,3*
2002	1676102	226832	532	*135,3*	*2,3*
2003	1723170,2	231157	542,5	*134,1*	*2,3*
2004	1774019,5	232527	542,5	*131,1*	*2,3*
2005	1812568,8	232750	540	*128,4*	*2,3*
2006	1864276,7	229141	538	*122,9*	*2,3*
2007	1911986,6	221092	528	*115,6*	*2,4*

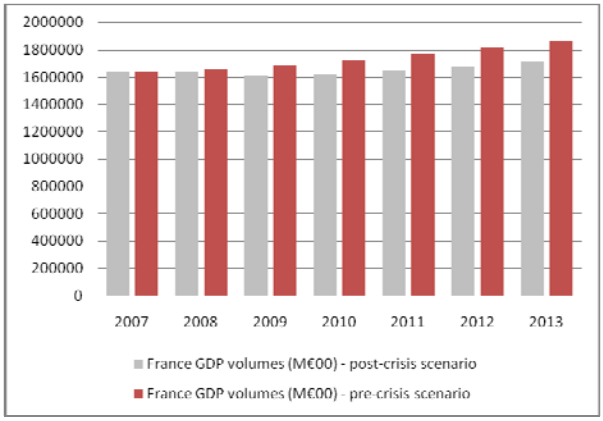
Italy	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	1095897	161551	414	*147,4*	*2,6*
1997	1116414,9	164069	418	*147*	*2,5*
1998	1132059,5	168794	429	*149,1*	*2,5*
1999	1148636	171746	434,5	*149,5*	*2,5*
2000	1191057,3	172955	437	*145,2*	*2,5*
2001	1212713,3	173672	442	*143,2*	*2,5*
2002	1218219,6	174227	444	*143*	*2,5*
2003	1218013,5	183324	459	*150,5*	*2,5*
2004	1236671,2	184698	461	*149,3*	*2,5*
2005	1244782,2	187312	462	*150,5*	*2,5*
2006	1270126,4	186113	457,5	*146,5*	*2,4*
2007	1289988,4	183452	447	*142,2*	*2,4*

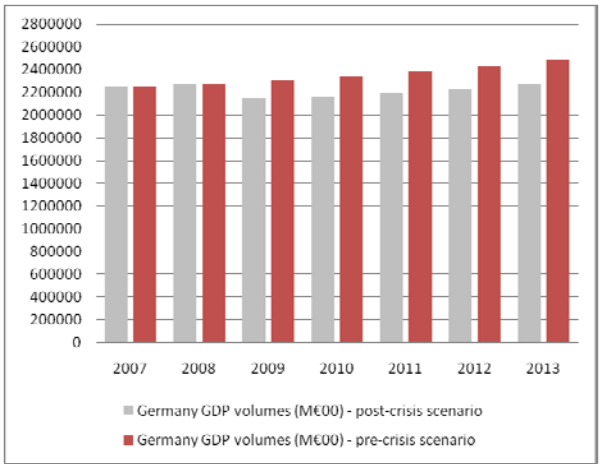
Spain	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	527862,4	101333	223	*192*	*2,2*
1997	548283,8	106613	241	*194,4*	*2,3*
1998	572782	112642	248	*196,7*	*2,3*
1999	599965,8	118405	273	*197,3*	*2,3*
2000	630263	123652	283	*196,2*	*2,3*
2001	653255	127283	286	*194,9*	*2,2*
2002	670920,4	130808	304	*195*	*2,3*
2003	691694,7	135308	307,5	*195,6*	*2,3*
2004	714291,2	141480	324	*198,1*	*2,3*
2005	740108	144588	340	*195,4*	*2,3*
2006	768890,1	144037	330	*187,3*	*2,3*
2007	797052,4	146812	338	*184,2*	*2,3*

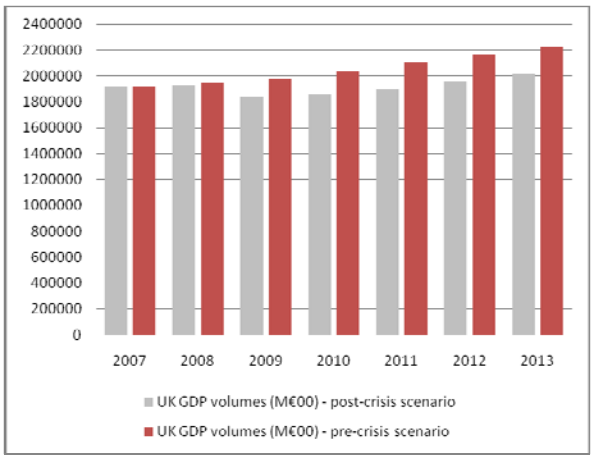
Poland	GDP at market prices in volume (M€2000)	Gross inland consumption of primary energy (1 000 toe)	CO_2 emissions energy-related (Mt)	*Energy intensity (toe/M€)*	*Carbon intensity (tCO_2/toe)*
1996	151587,4	103702	357	*684,1*	*3,4*
1997	162329,4	102540	350	*631,7*	*3,4*
1998	170416	96216	324	*564,6*	*3,4*
1999	178126	93776	313	*526,4*	*3,3*
2000	185713,8	90807	302	*489*	*3,3*
2001	187952,2	90821	301	*483,2*	*3,3*
2002	190665,3	89418	291	*469*	*3,2*
2003	198038,6	91774	300	*463,4*	*3,3*
2004	208623,4	92232	300	*442,1*	*3,2*
2005	216169,4	93556	296	*432,8*	*3,2*
2006	229631,3	98113	305	*427,3*	*3,1*
2007	244890,7	97982	303	*400,1*	*3,1*

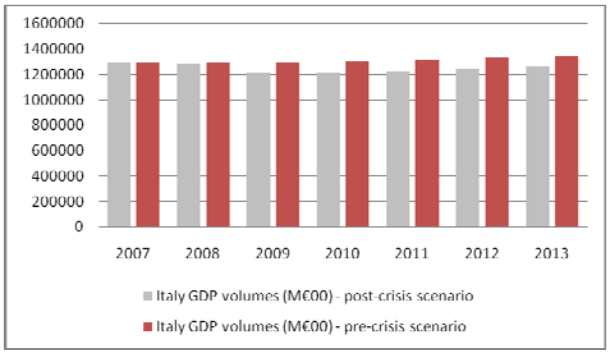
Source: data from EEA Technical Report n°4/2009 and EUROSTAT Statistics Database (calculations and figures rounded off by the author).

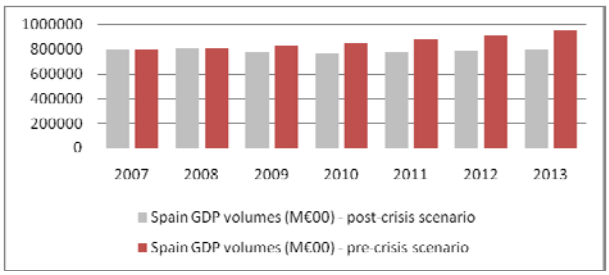
GDP volumes foreseen for the EU top 6 emitting countries: Scenarios before and after the economic crisis (2007-13)

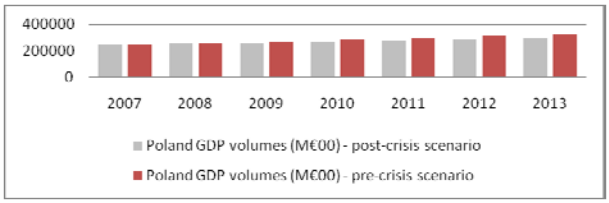












Source: calculations and graph from the author.

Early estimates of EU's emissions profile in 2008

The official 2008 GHG emissions for the EU will be available in June 2010, when the EEA publishes the EU Greenhouse Gas Inventory 1990-2008 to be submitted to the UNFCCC. But in late August 2009, the EEA has published on its website broad estimates of the EU's GHG emissions in 2008. Compared to the 2007 official emissions (mentioned above in our study), the annual reduction is estimated to be about 1.3% for the EU-15 and 1.5% for the EU-27. GHG emissions in 2008 stand approximately 6.2% below the Kyoto base-year emissions for the EU-15 and 10.7% below the 1990 level for the EU-27. According to the same source, total EU-27 emissions in the EU-ETS decreased by 3.9% between 2007 and 2008[20].

Those figures are still questionable as the methodology used for their calculation is not detailed by the EEA press release (except for the precision that the figures presented do not take into account the LULUCF sector). They are based on "the publicly available verified EU-ETS emissions for 2008 and other national and European sources available as of mid-July 2009" – the EEA does not give any further precision as to its sources. However these percentages give an indication of the situation of Europe's GHG profile in 2008 – when the economic crisis started.

The impact of the economic crisis on EU's GHG emissions is not visible yet in 2008. The EU-15 emitted 1.3% greenhouse gases less in 2008 than in 2007 but the drop in emissions was greater between 2006 and 2007 (-1.6%). However, the decrease in emissions for the EU-27 was slightly more between 2007 and 2008 (-1.5%) than between 2006 and 2007 (-1.2%). According to the EEA, the majority of the decline in emissions in 2008 was due to lower CO_2 emissions from fossil fuel combustion in the energy, industry and transport sectors. The agency also attributes some part of the emission reduction to reduced industrial output and reduced energy consumption by industry and correspondingly reduced freight transport – but without specifying the exact share of emission drop that could be explained by the slowdown in economic and industrial activities. Nevertheless, the important drop in emissions covered by the EU-ETS tends to prove that industries suffering from the crisis have reduced their turnover and the emissions linked to output production (essentially through energy consumption).

In terms of emission volumes, we have calculated how this fourth consecutive year of emission cut brings the EU closer to

[20] EEA, « New estimates confirm the declining trend in EU greenhouse gas emissions », *Highlights*, 31 August 2009, available at : www.eea.europa.eu

achieving its political targets as a party to the Kyoto Protocol and in the framework of the EU Climate and Energy Package.

Total GHG emissions (without LULUCF) in the EU-27 represented 4969 Mt CO_2 eq in 2008 (i.e. -1.5% of 5045 Mt in 2007): hence the Union has still to reduce its emissions by 518 Mt CO_2-eq by 2020 to reach its 20% reduction target compared to 1990-levels (i.e. no more than 4451 Mt CO_2-eq in 2020).

Total GHG emissions in the EU-15 accounted for 4010 Mt CO_2-eq in 2008 (i.e. -1.3% of 4052 Mt in 2007): the 15 older member states have to reduce their emissions further by 85.5 Mt CO_2-eq in the next three years to comply with their Kyoto obligations (i.e. less than 3924.5 Mt by 2012).