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An approach with a Business-as-Usual scenario projection to 2020 for the Covenant of Mayors from the Eastern Partnership

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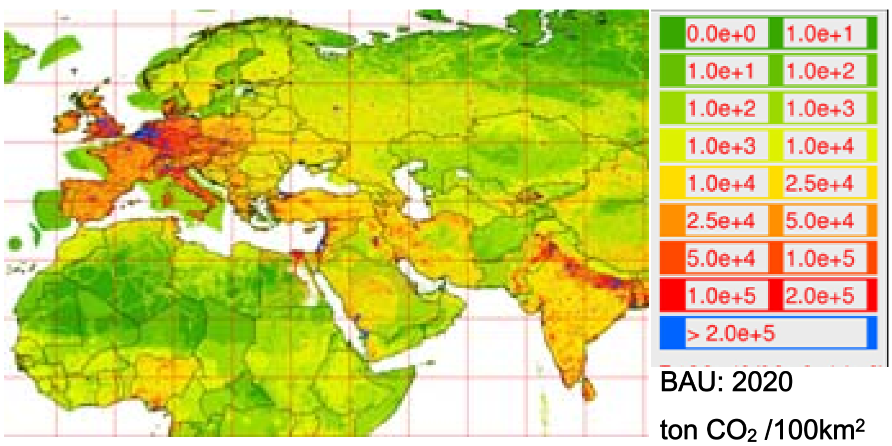

BAU projections for Europe with Eastern and Southern neighbouring countries

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COVENANT OF MAYORS EAST:
AN APPROACH WITH A BUSINESS-AS-USUAL SCENARIO PROJECTION TO 2020 FOR THE EASTERN PARTNERSHIP

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ABSTRACT

The methodology for the Covenant of Mayors – East needed to be extended with a business-as-usual projection of the emissions for 2020, from which national coefficients for the previous years are derived. In this way, signatories will be able to do their emission inventories of the present situation, and estimate which their emissions in 2020 will be. Then they will commit to an emission reduction target based on their projections of emissions for 2020 following the business-as-usual scenario. The factors are country-specific, calculated both for CO2 and CO2eq (CO2, CH4, N2O using the GWP100metric) in order to allow signatories to choose the approach they prefer. Moreover an urban dimension is provided, providing a margin on the projections.

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1. Introduction

1.1 Geocoverage of the Covenant of Mayors East Programme

Within the Covenant of Mayors East programme, aspects need to be revised in the methodology of the original Covenant of Mayors EU, as described in the Guidebook "How to develop a Sustainable Energy Action Plan (SEAP)". This revision aims to tackle in a more appropriate way the specific institutional and economic situation of the 11 post-Soviet countries involved in the initiative, which in particular face lack of resources, absence of national framework, and an aspiration to strong economic growth (recuperating from the recession after the breakdown of the Soviet Union). The countries included in the CoM – East are the following:

- Armenia (ARM)
- Azerbaijan (AZE)
- Belarus (BLR)
- Georgia (GEO)
- Kazakhstan (KAZ)
- Kyrgyzstan (KGZ)
- Moldova (MDA)
- Tajikistan (TJK)
- Turkmenistan (TKM)
- Ukraine (UKR)
- Uzbekistan (UZB)

It should be considered that the situation between these countries is quite different from that of the EU. For these 11 post-soviet countries this reduction should be specified based on a baseline year emission inventory and the signatories will be given the possibility to use a business-as-usual (BAU) scenario to estimate their emissions in 2020. They will be allowed to use their own way to estimate their emissions in 2020 or to use factors provided by JRC. This second option would avoid a burden to the signatories in their economic aspiration. National coefficients are derived the European Commission's Joint Research Centre, based on the energy consumption projections with an in-house EC model for energy-related activity increase. As for the baseline emission inventory (BEI) is recommended a recent year (later than 1990), which is representative for the current economic situation and for which reliable statistical data are available. The BEI should include the key sectors (residential and transport) as defined for the Covenant of Mayors initiative.

1.2 Transferring the origin of the Covenant of Mayors EU initiative

Key of the Covenant of Mayors methodology is the Sustainable Energy Action Plan (SEAP), in which signatories commit to a minimum CO2 emission reduction target of 20% by 2020 and define the actions they need to put in place to reach their commitment. A more specific overview of the original initiative as defined for the Covenant of Mayors 2020 can be found in Covenant of Mayors core text and is briefly described underneath.

A city who signs up the Covenant of Mayors commits to:

- reduce the CO_2 emissions in its territory by at least 20% by 2020.
- prepare a Baseline Emission Inventory (BEI) as a basis for the SEAP.
- submit the SEAP, officially approved by the Local Authority, within the year following the adhesion to the Covenant of Mayors.

To elaborate and implement a successful SEAP, a signatory should also:

- adapt city structures, including allocation of sufficient human resources, in order to undertake the necessary actions to take part in developing the Action Plan;
- mobilise the civil society.

For EU signatories, the recommended baseline year is 1990, or the closest subsequent year for which the most comprehensive and reliable data can be provided. The emission reduction target is set against the baseline year and it can be set either as absolute reduction or per capita reduction.

The Baseline Emission Inventory (BEI) covers the CO_2 emissions that occur due to energy consumption in the territory of the local authority. The following sectors (often referred to as key sectors of activity) are recommended:

- municipal buildings, equipment and facilities;
- tertiary (non municipal buildings, equipment and facilities);
- residential buildings;
- municipal public lighting;
- urban road transportation (including municipal fleet, public transport, private transport).

The energy-related emissions coming from other sectors might be included in the BEI, if the SEAP foresees measures for them (e.g. industry not under the European Emission Trading Scheme, highways not exploited by the city but on its territory).

Some emission sources not related to energy consumption might be also included in the BEI and in the SEAP, for example wastewater and solid waste treatment.

The Local Authority may wish to include actions aiming at reducing the CO_2 emissions also on the supply side (e.g. development of the district heating network, wind farms, PV, etc…). In this case, local energy (electricity, heat/cold) production should be accounted for in the BEI.

The scope of the Sustainable Energy Action Plan (SEAP) is then to define, to describe and to estimate quantitatively energy-related greenhouse gas reduction measures. A large dataset of very different actions proposed by cities has been compiled and can be consulted upon demand. A SEAP should contain both short term actions and mid-long term strategies. The key sectors of activity are the ones, whose inclusion in the BEI is "strongly recommended". Moreover, the local authority is expected to play an exemplary role, by taking outstanding measures on its own buildings, facilities and fleet.

1.3. Proposed adaptation of the methodology for Central Asian Cities

In the specific context of the Eastern Partnership and Central Asian Cities, a new approach is needed in order to allow social and economical progress after the economic collapse in the 1990s. However, the signatories should adopt measures so that this progress occurs in a sustainable manner and that energy efficiency criteria are applied to existing buildings and infrastructures, as well as to all new developments.

The first aspect that needs to be considered is the choice of the baseline year: choosing 1990 (as recommended for the EU countries) is not appropriate because of the drastic economic collapse that followed the fall of the Soviet Union, resulting in a CO_2 emissions reduction of more than 50% in a few years. Therefore, a recent baseline year will be the recommended choice.

On the other side, since the countries covered by this project are recovering from the economic collapse of the 1990s, imposing a reduction of CO_2 emissions in absolute terms may not be feasible. Therefore, the opportunity to calculate a target based on a reference scenario, called business-as-usual (BAU) (defined as a continuation of the current trend) to 2020 will be given to signatories willing to do so (besides the absolute and the per capita reduction options). Starting from present data, the BAU scenario will analyse the evolution of energy and emission levels until 2020, under the hypothesis of continuing current trends in population, economy, technology and human behaviour, without the implementation of a SEAP. The target would therefore be calculated compared to the emission levels forecasted by the scenario for 2020.

National coefficients that allow estimating the energy consumption in 2020 (starting from real present data) are provided in this report. Signatories will thus develop a simplified BAU scenario, accounting for the attainment of a normal level of quality of the services (streets with public lighting, water supplied every day, etc…).

In principle, the key sectors that should be included in the BEI will be the same as in the CoM EU. The same key sectors should be tackled by the set of actions of the SEAP.

In this way, signatories will be able to do their emission inventories of the present situation, and estimate which their emissions in 2020 will be. Then they will commit to an emission reduction target based on their projections of emissions for 2020 following the BAU. The factors will be country-specific, calculated both for CO_2 and CO_2eq (CO_2, CH_4, N_2O using the GWP100metric) in order to allow signatories to choose the approach they prefer.

The factors do account for differences between country evolutions and are based on the sectors which are targeted by the CoM (buildings and transport). A global emission projection with EC in-house data and EC – in-house anthropogenic projection model is thereto used.

1.4 Local projections: an alternative?

From open source information, emission projection tools and results are available for local regions, such as e.g. by UN-Habitat and ICLEI. UN-Habitat launched the Sustainable Cities programme, which has some similarities with the CoM initiative. This is also supported by ICLEI (unifying the Local Governments for Sustainability), who is collecting cities scenarios. However, the collection of local scenarios does not provide a global pool of information that is consistent amongst countries. Such collection can not be labelled impartial, uniform and neutral coverage of all countries from the CoM EU and CoM East. For consistency it is needed to use one single tool, in which the scenarios follow projections set by the European Commission, based on a Commissions model and database for emission growth.

2. Description of the Business-as-usual (BAU) scenario.

The business-as-usual (BAU) scenario indicates that no or just actual measurements are taken into account for the future emission trends and that world energy consumption will be more than doubled in the 2000-2050 period. The emission inventory projections for the coming four decades are calculated, starting from the base year 2005 with the sector-specific growth rates and technology-based emission factors taking into account different abatement measures per regions, in the frame of the FP7 research project CIRCE (www.circeproject.eu), documented by Doering et al (2010). This BAU scenario was also used by the global climate model ECHAM to investigate areas of high air pollution with high health risks for the near future. Pozzer et al. (2012) indicated hot spots with high pollution index per capita for several cities in particular in the Middle East and South East Asia.

2.1 Data and models used

As basis the Emission Database for Global Atmospheric Research (EDGAR-CIRCE) was used, which contains global anthropogenic emissions inventories of various air pollutants and greenhouse gases. Based on the EDGARv4version inventories have been calculated for the CIRCE project providing historical (1990-2005) global anthropogenic emissions of the greenhouse gases CO2, CH4 and N2O (the air pollutants and particulate matter are not of importance for the CoM).

Emissions trends up to the year 2050 were calculated starting from base year 2005. Activity growth rates from the POLES model (Russ et al., 2007) were used to calculate activity data for the energy sector starting from the EDGAR-CIRCE base year dataset (residential, transport, ships, aviation, transformation and refineries). The POLES (Prospective Outlook for the Long term Energy System) model is also an EC in-house macro-economic model based on partial energy equilibrium. It contains technologically-detailed modules for energy-intensive sectors, including power generation, iron-steel, aluminium and cement production, and transportation sectors to simulate the development of energy scenarios until 2050 on world-scale (for 47 different regions) with one single oil market and three regional gas markets.

The growth rates of POLES are differentiated for one power generation sector, three fuel production sectors, three energy consumption sectors, for four transport sectors, for the different fuel types, and for 29 countries and 23 regions. The same growth rates for the fuel consumption were used for the industrial production sector, assuming that the activity/emission trends in industrial production follows the combustion trends in that sector. It should be noted that neither a technology shift nor a fuel shift is explicitly modeled for a given industry sector. The growth rates are entirely based on the economic dynamics of fuel costs and carbon taxes of POLES and the fuel shifts modeled in there.
Trends in agriculture, land use and waste are provided from the IMAGE model that is compatible with the POLES baseline and climate stabilization scenarios (P. Russ, D. van Vuuren, personal communication and van Vuuren et al., 2009) with emission trends given by world region for a baseline scenario. The IMAGE model (Integrated Model to Assess Global Environment) is a model of MNP which comprises an Energy-Industry System, a Terrestrial Environment System and an Atmosphere-Ocean System, of which the model one was the most important to project agricultural land-use change, crop production and animal elevation.
Also sectors such as ‘use other products’ (including solvents) use the population growth rate from IMAGE (van Vuuren et al, 2009) for the growth rates of the emissions. For the sectors ‘solid waste disposal’ (main sector: waste) emissions of all substances are scaled with the population growth rate, while emissions of ‘waste water treatment’ are scaled with growth rates of sewage.
The ‘agriculture’ sectors are treated in different ways. In the sectors ‘agricultural soils’ the emissions of the respective substances are scaled with the specific growth rates of the corresponding emitters, e.g. N2O emissions are scaled with the growth rate of fertilizer combined with the growth rate of crop residues. Emissions of ‘enteric fermentation’ are scaled with the growth rates of the corresponding

animals. Emissions of ‘manure management’ of the respective substances are scaled with the growth rates of animal waste. Emissions of ‘agricultural waste burning’ are scaled with the growth rates of CH4 emissions from agricultural waste burning (IMAGE model). Indirect emissions are assumed constant in time.

The “Business-as-usual” scenario, hereafter referred to as BAU, explores the situation when no further climate and air pollution policies are implemented beyond what is in place since the year 2005. This means that energy consumption from 2005 to 2050 is driven by population and economic growth but not by energy efficiency/climate change policies (POLES baseline scenario).
The combustion technologies/abatement measures are assumed not to change beyond the year 2005 technologies.

2.2 Outcome of the emission projections

Table 1 presents global Greenhouse gas (GHG) emissions excluding sectors as biomass burning, international shipping and aviation. In order to compare greenhouse gas emissions of individual gases (here CO2, CH4 and N2O) were converted into CO2-equivalents based on the conversion using the Global Warming Potential (GWP), which express the contribution to global warming of the specific greenhouse gases in relation to carbon dioxide. Throughout this background document the 100 year GWP values as used in the Kyoto Protocol are applied (IPCC, 1995).
Applying the Business-as-usual (BAU) scenario global emissions of greenhouse gases increase from 37 Pg CO2-equivalents in 2005 to 66 Pg in 2050 with an important growth (+79 %) due to the continuing increase of the energy sector (in particular for the region East Asia and Southeast Asia) but also to a rather strong contribution of N2O and CH4 emissions (see Table 1). Adaptation and mitigation strategies that extremely influence GHG would be needed to reduce the annually emitted over 35 Pg CO2-equivalents globally with 30 %, which would be needed to guarantee that the temperature will not exceed 2 °C above pre-industrial levels. The latter was investigated with a climate change (CC) scenario.

*Table 1: Projections under the BAU scenario for global greenhouse gas emissions. (*The last row (Italics) indicates the GHG totals in Mt CO2 eq.

Scenarios	Substance	2005	2010		2025		2050	
Air pollutants		(kt)	(kt)	%	(kt)	%	(kt)	%
Greenhouse gases								
CIRCE_BAU	CH_4	327088.0	359295.2	9.8	454718.5	39.0	574197.5	75.5
CIRCE_BAU	CO_2	27748365.1	29799038.8	7.4	37927842.8	36.7	50964371.8	83.7
CIRCE_BAU	N_2O	6194.2	6463.1	4.3	7167.3	15.7	8129.8	31.2
CIRCE_BAU	*Total in CO_2 eq. in Mt*	*36537.4*	*39347.8*	*7.7*	*49698.8*	*36.0*	*65542.7*	*79.4*

Under the BAU scenario strong emission increases occur for both the greenhouse gases (e.g. CO2 +84%) (but also for air pollutants that are similarly as CO2 combustion related such as NOx). The trends for the air pollutants, aerosols and GHG start a fastened growth from 2010 onwards under the BAU scenario. From 2010 to 2025 an increase of 10 % to 30 % is demonstrated and the variation is not only region-specific but also substance- and technology-specific increase because of the expanding sector. Under the BAU scenario the increase for the GHG emissions is about +30 % by 2025, and amounts even to about +70 % by 2050. For the air pollutants CO, BC, NMVOC and SO2 emissions, the increase is about +20 % by 2025 and about +45 % by 2050. For OC and NOx a stronger increase is present of about +60 % by 2050.
For the international shipping, all pollutants follow an emission increase for the BAU scenario (2010: +23 %, 2025: +81 %, 2050: +171 %), because mainly of the absence of air pollutant abatement technologies in this sector.

A comparison between CIRCE and other references (IPCC, 2005 and 2007 and van Vuuren et al. (2009)) for the CO_2, CH_4 and N_2O emissions in 2000/2005 and projections for 2050 is shown in Fig. 1.

The base trend for the period 1990-2005 is described by van Aardenne et al, (2009) and presents an increase of 23 % which is in line with the 24 % increase for the period 1990-2004 reported in the IPCC AR4-WG3-TS (2007). However the emissions of the base year 2005 only represents 75 % of the total emissions considered by IPCC-WG3-TS (2007) because of the absence of the land-use, land-use change and forestry sector (LULUCF) and because of differences in biomass burning. The BAU scenario together with a climate change (CC) scenario are compared to the scenarios SRES A1B and B1p as defined by IPCC in AR3 (2005) under similar conditions as considered for BAU and respective CC in this study. The BAU scenario and the IPCC A1B scenario show for each of the three GHG a similar doubling of the emissions in 2050 relative to 2000, whereas the CC scenario and the IPCC B1p scenario significantly differ. The CC scenario indicates a decrease for all GHG with in total 20 % less emissions in 2050 relative to 2000 but the IPCC B1p scenario further projects a slight increase. In the IPCC AR4 the different scenarios are reviewed taking into account the high uncertainty (>50 %) on the projected GWP and the scenario occurrence probability, which both lead to a subdivision into VI categories. The relative growths of GHG emissions in the BAU and CC projections are confronted with scenarios results (SRES I to VI) of the IPCC-AR4-WG3-TS (Table TS.2) (2007). As it is shown in Fig. 1 emissions projections of SRES category V and A1B are in the same range as the BAU CIRCE projections. The same trend of the CC scenario is apparently observed in the emissions projections of SRES category II.

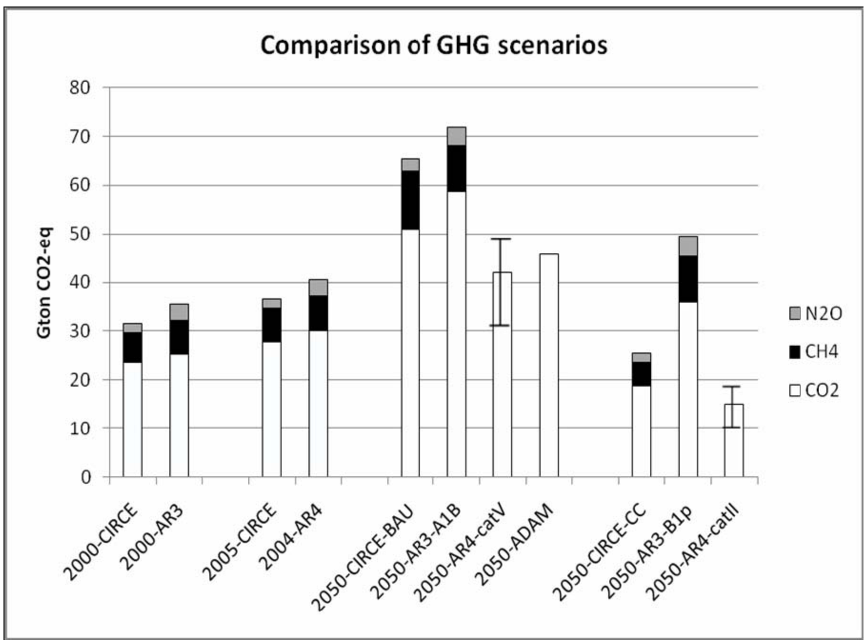


Fig. 1: Total GHG emissions (2000 and 2005/2004) and projections for 2050 under global Business-as-usual (BAU) and Climate Change (CC): CIRCE scenarios compared with other references (IPCC – 2005, IPCC - 2007, van Vuuren et al. (2009).

3. National coefficients derived from a business-as-usual projection for the CoM East countries.

3.1 Results for CO2 and CO2 eq national projections

Based on the study described in section 2 the BAU factors of Table 2 were derived for the CoM-East countries. This results from using the projections done with the POLES model, and selecting the sectors which are relevant for the CoM (buildings and transport). For each country and year of baseline emission inventory, there is the factor for CO2 according to the BAU projections to 2020. Depending of the country and year selected, these factors will lead to emissions in 2020 up to 26% higher than the emissions in 2005. However, for many countries, these factors are < 20%, and as such, still requiring a decrease in emissions under the 20% reduction target.

This will be reasonable for some countries which already have high per capita emissions (Ukraine, Kazakhstan, Turkmenistan) but not that sensible for the ones with important agricultural activities and lower per capita emissions (Georgia, Kyrgyzstan, Moldova, Tajikistan). In the following table you can see the per capita emissions for all these countries (1990, 2005, 2005 and 2008) from the EDGAR database, version 4.2 http://edgar.jrc.ec.europa.eu (this includes all sectors, not only Covenant sectors). There is also an estimation of the emissions in 2020 based on those of 2008 and using the factors we have calculated. The per capita emissions do not change fast over a decade. For those countries with low per capita emissions (<3 ton CO2/cap), the per capita emissions in 2020 will remain low (<3 ton CO2/cap), while Kazakhstan will be allowed to increase their per capita emissions up to 15.6 ton CO2/cap, which is almost the double of the mean EU-27 per capita emission. A further refinement of the national coefficients deemed necessary, looking at the local effects and as such differentiating between rural and urban areas. This is done in the following section 4.

Table 2: Overview of the CO2 per capita for the 11 post-Soviet countries in 1990-2000-2005 and 2008 and the BAU factors which should present a continuation of the trend. These CO2 factors are focused 2020 and the Covenant of Mayors sectors only.

	t CO2/pc				Using BAU factors CoM sectors
	1990	2000	2005	2008	**2020**
ARM	4.72	1.21	1.47	2.6	2.83
AZE	6.66	2.17	3.13	3.26	3.79
BLR	6.72	5.19	6.21	7.34	8.08
GEO	4.02	0.99	1.04	1.21	1.47
KAZ	14.82	9.17	12.48	14.37	15.60
KGZ	5.47	1	1.13	1.27	1.40
MDA	6.48	1.41	1.92	1.67	1.77
TJK	2.46	0.79	1.01	1.16	1.45
TKM	13.32	8.63	9.49	10.87	10.82
UKR	13.59	7.17	7.13	7.35	7.34
UZB	5.68	4.56	4.21	4.44	5.03

Similar to CO2 also projections were done for CH4 and N2O, which yielded CO2eq factors. Figures 2 & 3 underneath represent the Business-as-usual factors which CoM-East signatories could use to estimate their emissions in 2020 based on their current (or recent emissions). These factors have been calculated using the emissions projections from the POLES model for the buildings and transport sectors. The factor for each year and country is calculated from the ratio between projected emissions in 2020 and emissions in each of the other years. These factors are given for inventories of CO2 only (Fig.1) or of inventories of the greenhouse gas (GHG) with CO2-eq.

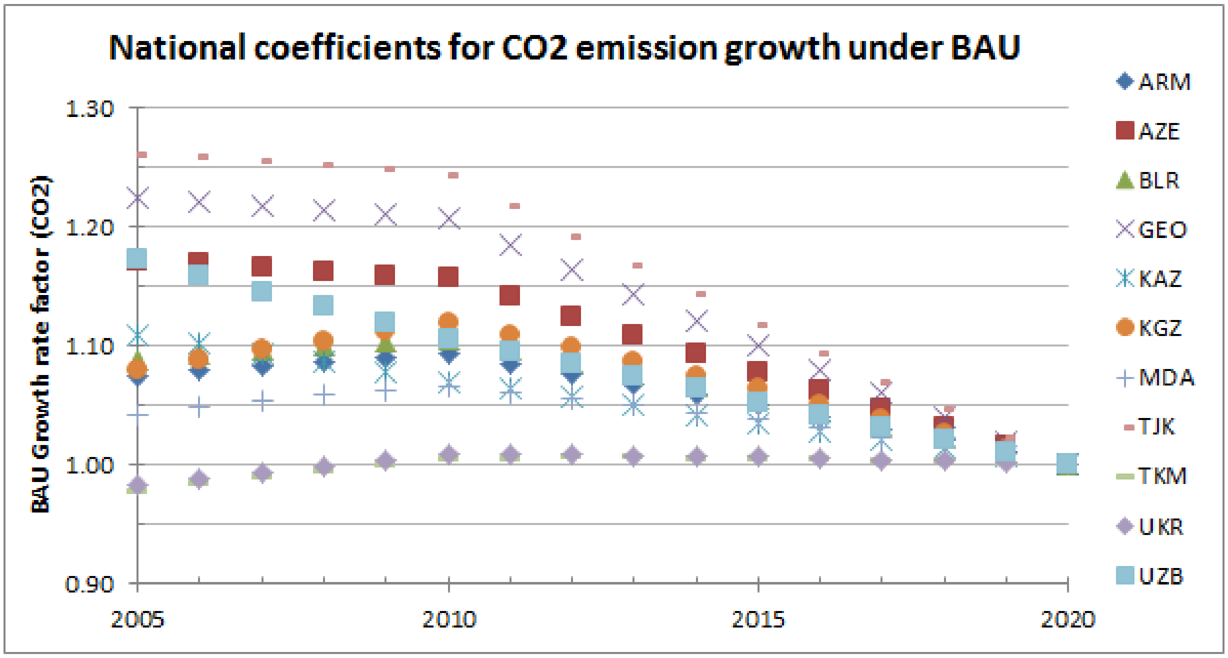


Fig. 2: National coefficients for CoM-East signatories to estimate their CO2 emissions in 2020 based on their current (2005-2020) emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected CO2 in 2020 to the CO2 in a preceding baseyear.

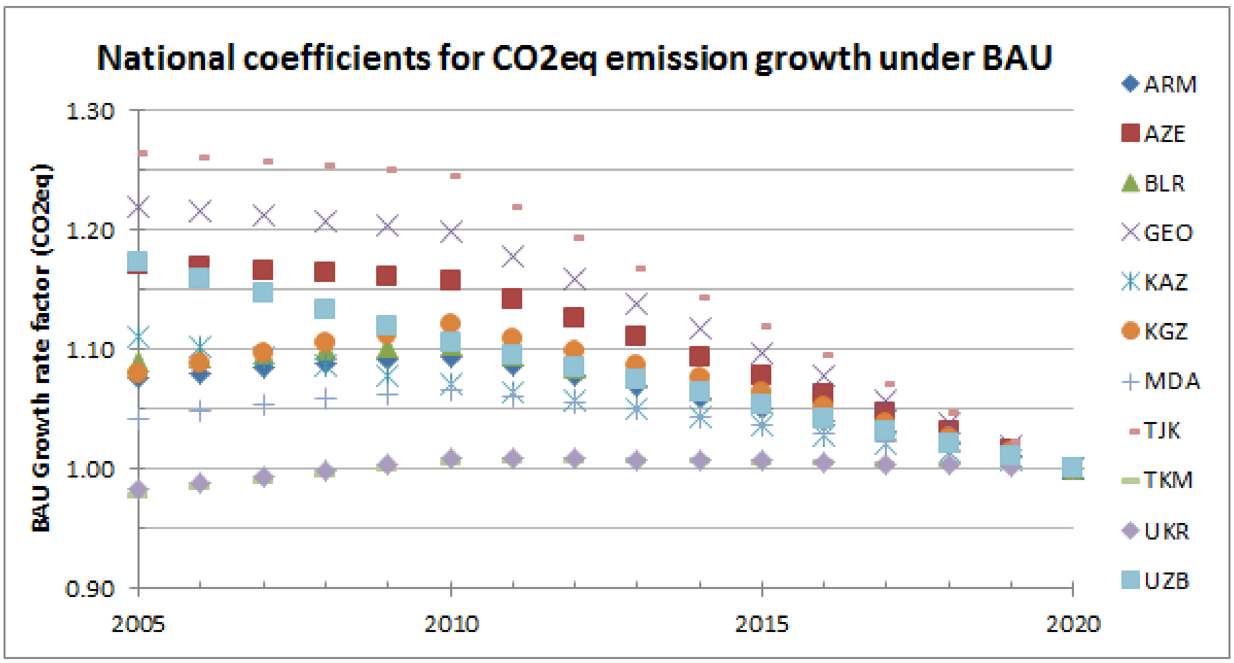


Fig.3: National coefficients for CoM-East signatories to estimate their GHG emissions in 2020 based on their current (2005-2020) emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected CO2-equivalent (considering CO2, CH4 and N2O emissions in the IPCC metric of GWP100) in 2020 to the CO2-equivalent in a preceding baseyear.

3.2 Discussion of the limitations of the projections

It should be noted that the projections are done with global growth rates, taking into account the historical trends in the NIS countries from 1990-2005. The projection is a global one (because of the coupling of fuel markets globally), based on IEA data (2007), following an EC internal scenario (developed by DGENV and JRC-IPTS for the climate-energy package of Europe 2020). The advantage is that the projections can be defended for all countries equally with one single methodology, consistently applied. Therefore the results are not only valid for the 11 countries of the Eastern Partnership but also for EU-27 itself and for Europe's Southern Partnership etc). Moreover the projections are done for all sectors, energy-related and agricultural related sectors (the latter is in particular important when including non-CO_2 gases such as CH_4 and N_2O. Not only all greenhouse gases, but also all other air pollutants and aerosols were considered, this allowing a global assessment of climate and air quality changes on citizen's health and wealth.

The large difference in emission per capita between some countries (e.g. Georgia, only 1.2 tonCO_2 /capita and Kazakhstan 15 tonCO_2 /capita) is inherent to the traditional choice of fuel. In all Newly Independent States the residential sector is burning largely primary solid biomass (wood, wood waste, vegetable waste, ...), which is not contributing to the annual CO_2 emission total. (The CO_2 the plants took up during the growing year, is released at the combustion, resulting in a zero emission release.) In Georgia, a fuel share smaller than 25% is gas and even a smaller one is oil. In Kazakhstan a larger fuel share of about 40% is patent fuel. That explains directly that Kazakhstan in the residential sector is emitting much more and invite for a potential refinement of the allowed BAU growth rate projections with extra criteria based on that CO_2 per capita.

Comparing the national factors from 2005-2010 (result of the first five years projection) with the current IEA energy consumption data for the same period, we recognise significant discrepancies for Georgia. There are several reasons for that: (i) The IEA data are not varying smoothly (e.g. in natural gas for Georgia in the residential sector one sees that the natural gas consumption from 1999 to 2000 doubled and then halved again by 2002); (ii) Recessions cannot be predicted and are known to have an influence, sometimes with some time-lag between countries; (iii) The latest IEA data statistics are subject to revision with corrections backwards in time; (iv) As shown by Paruolo et al (2012), an econometric analysis of the full historical emission trends can neither confirm a direct relation between the levels of emission and levels of income, nor the causality. Finally a global increase of CO_2 with about 10% over 15 years (from 2005-2020) is already a respectable increase. This order of increase is also found back from 1990-2005 (12%) as reported by Olivier et al (2011).

4. The urban dimension

The UNDP provides statistics on their website http://hdrstats.undp.org/en/indicators/default.html addressing human development. One of the human development indicators listed by UNDP, is the CO2 emissions per capita, provided by Boden et al (2009). Their database compares for the CO2 very well with the EDGAR database. The final composite Human Development Index, HDI, is composed of improvements in health (life expectancy at birth), education (years of schooling) and living standards (with income per capita). The HDI facilitates instructive comparisons of the experiences within and between different countries. It is observed that the development starts in the cities, where more human activities are concentrated. The development in the countryside lags behind the development in the city, which is one of the reasons for the urbanisation process that is ongoing in many countries.

In this section we diversify the Business-as-usual growth rate of a country for urban and rural regions. For regions where the economic growth took off considerably, we assume that growth rates apply for the global population, but for countries which are still in the initial phase of economic growth, it is assumed that first the economic growth will take place in the urban areas and that the rural areas are not yet playing a relevant role. The 11 countries of EC's Eastern Partnership have been screened with regard to their economic development and Table 3 lists whether UNDP considers these countries still in the initial phase of economic growth or in a more developed phase.

Table 3: Human development index and GHG emission level per capita for the 11 post-Soviet countries for the period 2005-2011 according to UNDP data and EDGARv4.2

Country	HDI 2005	HDI 2010	HDI 2011	ton CO2eq /cap 2005	ton CO2eq /cap 2008
ARM	0.689	0.714	0.716	2.73	4.04
AZE	x	0.699	0.700	4.86	5.48
BLR	0.723	0.751	0.751	8.83	10.21
GEO	0.707	0.729	0.733	2.38	2.67
KAZ	0.714	0.74	0.745	16.86	19.33
KGZ	0.595	0.611	0.615	2.11	2.24
MDA	0.631	0.644	0.649	3.01	2.72
TJK	0.576	0.604	0.607	1.87	2.11
TKM	0.654	0.681	0.686	16.63	18.58
UKR	0.712	0.725	0.729	9.18	9.35
UZB	0.611	0.636	0.641	6.25	6.61
EU-27	0.857	0.869	0.871	*10.22*	*9.91*
colour index					
very high human devel.	0.876	0.888	0.889		
High human development	*0.716*	*0.739*	*0.741*		
Top-50 polluters				*8.94*	*8.63*

Since the baseyear for the projection is 2005, and Belarus, Georgia, Kazakhstan and Ukraine already were considered to have a high human development index, it is considered less appropriate to apply an urban factor on these 4 countries (BLR, GEO, KAZ and UKR) in a first step. Nevertheless, the evolution from 2005 to 2010 changed considerably, so that the selection of countries based on HDI is quite sensitive to the year of reference. Therefore a more pragmatic consideration of the emission level was opted for and we recommend to leave out BLR, KAZ, UKR and also TKM for the application of the urban factor, but not GEO.

4.1. Distinction rural versus urban population

To distinguish between urban and rural population, information on the population density per gridcell of 0.5km by 0.5 km was used. For a country the changes in population density (from one grid cell to another) was analysed, assuming an S-shaped curve between lowest populated and most dense populated regions. Country-specific thresholds for urban areas are calculated consistently for all world countries applying the same algorithm with optimisation process.

EDGAR uses population data from CIESIN, http://sedac.ciesin.columbia.edu/gpw/global.jsp , to derive proxy data representing globally population density, with a diversification of rural and urban population density. The CIESIN site provides Population grids from 1990 to 2015 (5 years step) at different resolutions. For our purposes the resolution 2.5' (minutes) has been chosen. The re-gridding to 0.1° (degrees) has been performed using ArcMap and ad-hoc PHP programs. In addition, CIESIN provides a Settlements Points grid at a resolution of 30'' (seconds). This grid is the reference for the computation of urban/rural population coefficients.

The method to distinguish between rural and urban population is based on the assumption that the quota of population to be considered as Urban. The quota of Urban population depends on the population density in grid cells following a linear function for densities between specific ranges until a defined saturation point after which the population of the cell is considered completely Urban, while before the low value of the range the population is considered completely rural. This is visualised in Figure 4.

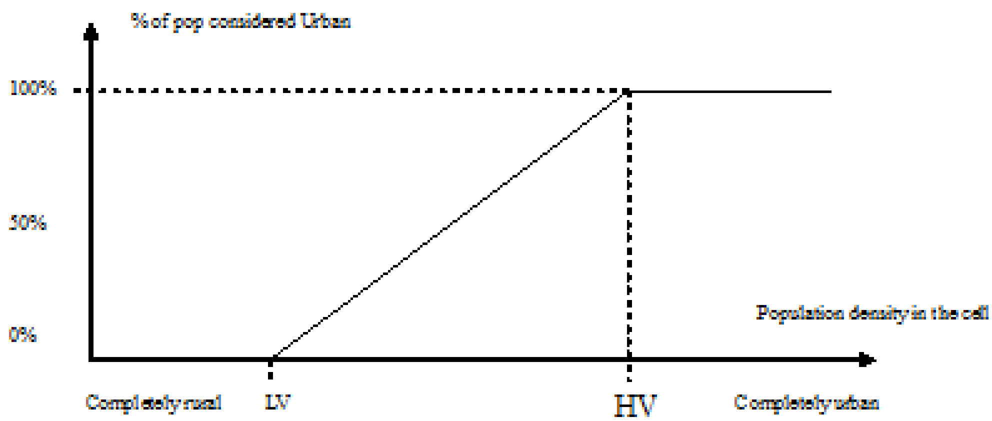


Fig. 4a: The low_value (LV) and high_value (HV) are evaluated country by country using the Urban Extent map for the year 2000 provides by CIESIN. Those HV and LV values give indication of the level of adaptability of the population of a country, i.e. when a cell is assigned an Urban qualifier with a low HV density (say 800 to 1200) then it is normally an industrialized country that provides urban infrastructures even for a scarce population.

The Urban Extent map provided by CIESIN is a set of small cells (30'') indicating the presence or not of settlements in the cell. Using ArcGis this map has been *Resampled* to 0.01° , to be a multiple of our population maps, then mapping 100 settlement cells per each population cell (0.1°) the total number of 'settled' cells gives the percentage of urbanization of the 0.1° population cell. After these operations we have a single urbanization map for the year 2000 that leads to an Urban Population and a Rural Population map for the year 2000.

The method consists in deriving the two function coefficients (LV and HV) for each country by computing the rural population for the year 2000 iterating different combinations of coefficients, until the couple of coefficients leads to the minimum Standard Deviation of the difference between the computed rural population and the rural population obtained from the Urban Extent map. The iteration process is visualised in Fig. 4b. The iteration values for LV are 10 to 600 stepping by 10, while for HV are 500 to 1900 stepping by 50 units of heads/km^2. In order to avoid divergence in the minimization process, the points exceeding 2*sigma are eliminated from the process.

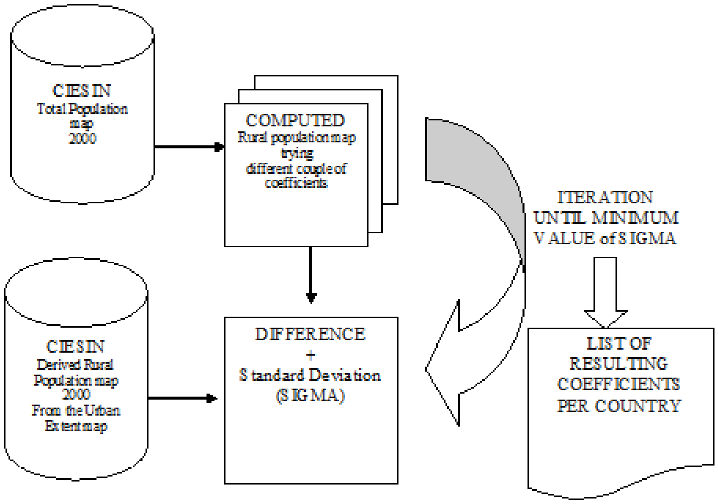


Fig. 4b : Iterative process combinations of coefficients, to find the (LV, HV) couple of coefficients that leads to the minimum Standard Deviation of the difference between the computed rural population and the rural population obtained from the Urban Extent map of CIESIN.

Figure 5 shows the trends of the Standard Deviation of the difference for a country computed for three low_values (LV: 10, 200, 390) and different High_values (HV). The minimum sigma occurs for LV=390 and HV=1300 heads/Km^2 in the case of a country under development (Fig.5.a: China) and at LV=10 in the case of a developed country (Fig. 5.b: USA).

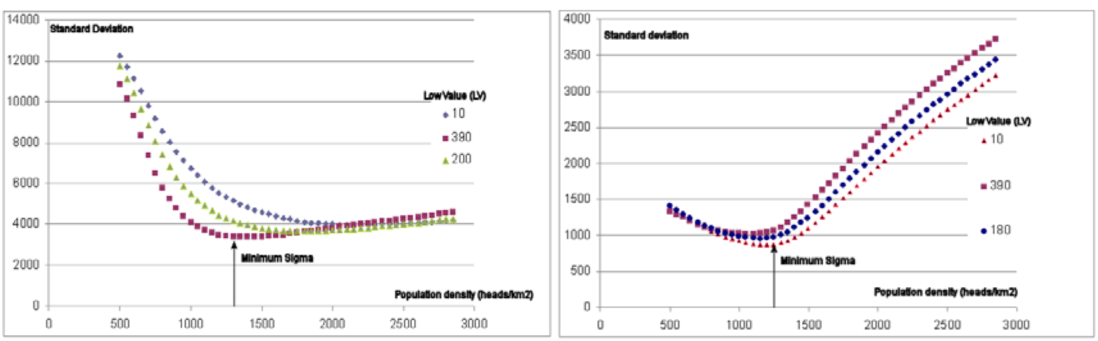
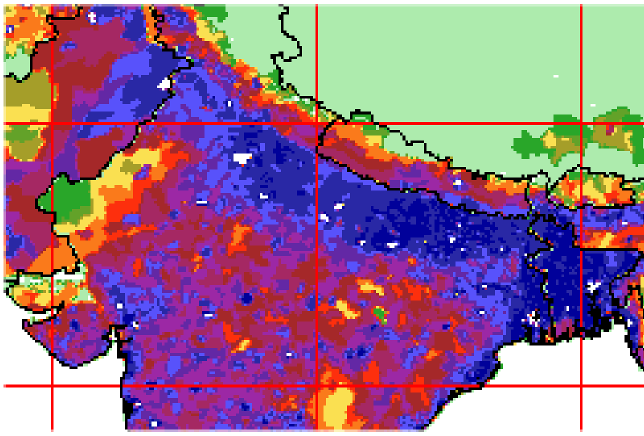
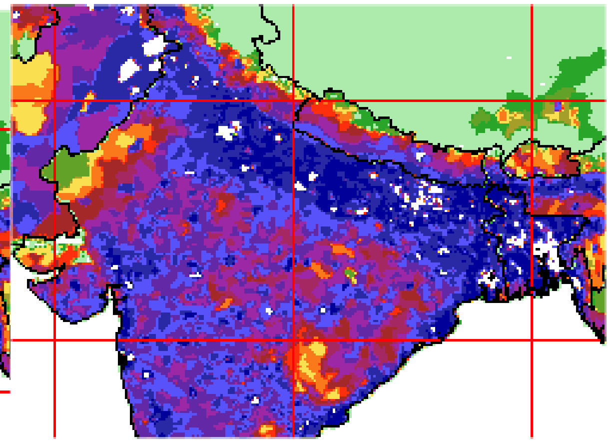


Fig. 5a : Trends of the Standard Deviation of the difference for China computed for three low_values (LV: 10, 200, 390) to derive minimum sigma.
Fig. 5b: Trends of the Standard Deviation of the difference for USA computed for three low_values (LV: 10, 390, 180) to derive minimum sigma.

As a result Figure 6 shows the rural and urban population for northern India and Pakistan. Blank spots are cells where rural population is zero, i.e. cities. The urbanization process can be noticed in northern India and Pakistan.





Rural Population in northern India in 1970 Rural Population in northern India in 2015

Fig. 6: Rural population in northern India and Pakistan in evolution from 1970 to 2015 with a decreasing trend because of the urbanisation process.

4.2. The resulting urban factor for the Eastern Partnership countries

Using the data included in the EDGAR database, in relation to urban and rural population, in 2005, 2010 and 2015 for these countries, urban factors Xcity are derived under the assumption that the economy will further emerge first in the cities and that most of the increase on emission production from 2005 to 2020 will take place in urban places rather than in rural communities. Therefore, we propose to use the following formula to estimate the emission increase which will take place in cities:

X_{city} = ($X_{country}$ * Pop_tot2005 -Pop_rur2005)/Pop_urb2005

where Xcountry is the factor calculated for countries for a certain year, Xcity is the factor adapted for a city in a certain country and Pop_tot, Pop_rur and Pop_urb are total, rural and urban populations for a certain country in a certain year. This formula allocates for each country its business-as-usual growth factor to its urban population, expressed by the criteria that the national factor multiplied with the total population equals the new city factor multiplied with the urban population plus the factor 1 (steady state) multiplied for the rural population. As populations are only available until 2015, these factors have only been calculated for these 3 years, and taking into account the projections of urban to rural ratios until 2015, as presented in Table 4.

Table 4: Overview of the urban factor for each of the 11 post-Soviet countries, based on the origin-nal national factor and the urban/rural population in 2005-2010-2015.

	ORIGINAL FACTOR (Xcountry)				URBAN FACTOR (Xcity)		
	2005	2010	2015		2005	2010	2015
ARM	1.08	1.09	1.05		1.24	1.31	1.17
AZE	1.17	1.16	1.08		1.98	1.86	1.42
BLR	1.09	1.11	1.06		1.53	1.62	1.32
GEO	1.22	1.21	1.10		1.68	1.64	1.32
KAZ	1.11	1.07	1.04		1.60	1.39	1.19
KGZ	1.08	1.12	1.06		1.47	1.71	1.38
MDA	1.04	1.07	1.04		1.17	1.27	1.15
TJK	1.26	1.24	1.12		2.75	2.55	1.70
TKM	0.98	1.01	1.01		0.68	1.07	1.07
UKR	0.98	1.01	1.01		0.95	1.03	1.02
UZB	1.17	1.11	1.05		1.54	1.32	1.15

Those countries having originally high per capita emissions (BLR, KAZ, TKM, UKR) already started with the emerging of their economy and increase in emissions longer time ago. Therefore the assumption that further economic growth is driven by growth in the city is not realistic. Therefore we do not recommend for these countries to use urban factors, but we recommend the national factors instead. (In the case of TKM and UKR, the original factors and the urban factors are very similar and show not greater increases.) For all other 7 countries with the emerging of their economy in a much earlier phase the expectation that the development is greater way in cities rather than in rural areas can be considered realistic.

These ratios from urban to rural population allow us to provide city factors for any year signatories may want to choose as baseline year from 2005 to 2020. They are derived with the annual country factors previously calculated for CO2 and CO2eq, and the urban and rural populations for 2005 for the period 2005-2009, population data for 2010 for the period 2010-2014 and population data for 2015 for the period 2015-2020. The obtained city factors can be seen in the following Table 5 for CO2 and Table 6 for all greenhouse gases.

Table 5: Urban coefficients for CoM-East signatories projecting their CO2 emissions in 2020 based on their current (2005-2020) emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected CO2 in 2020 with the urban population trends 2005-2015 to the CO2 in a preceding baseyear.

CO2 urban factor	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ARM	1.24	1.25	1.26	1.28	1.29	1.31	1.28	1.25	1.22	1.19	1.17	1.14	1.10	1.07	1.04	1.00
AZE	1.98	1.96	1.95	1.93	1.91	1.86	1.78	1.69	1.60	1.52	1.42	1.33	1.25	1.17	1.08	1.00
BLR	1.53	1.55	1.57	1.59	1.61	1.62	1.56	1.51	1.45	1.39	1.32	1.26	1.20	1.13	1.07	1.00
GEO	1.68	1.67	1.66	1.65	1.64	1.64	1.57	1.50	1.44	1.37	1.32	1.25	1.19	1.12	1.06	1.00
KAZ	1.60	1.56	1.51	1.47	1.43	1.39	1.35	1.31	1.27	1.23	1.19	1.16	1.12	1.08	1.04	1.00
KGZ	1.47	1.52	1.57	1.61	1.66	1.71	1.65	1.59	1.52	1.45	1.38	1.31	1.23	1.16	1.08	1.00
MDA	1.17	1.20	1.22	1.24	1.26	1.27	1.25	1.23	1.20	1.18	1.15	1.12	1.10	1.06	1.03	1.00
TJK	2.75	2.74	2.72	2.69	2.67	2.55	2.39	2.22	2.07	1.91	1.70	1.56	1.41	1.27	1.14	1.00
TKM	0.68	0.77	0.86	0.94	1.01	1.07	1.08	1.08	1.08	1.08	1.07	1.06	1.05	1.04	1.02	1.00
UKR	0.95	0.96	0.98	1.00	1.01	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.00	1.00
UZB	1.54	1.50	1.46	1.42	1.38	1.32	1.29	1.26	1.22	1.19	1.15	1.12	1.09	1.06	1.03	1.00

Table 6: Urban coefficients for CoM-East signatories projecting their greenhouse gase emissions in 2020 based on their current (2005-2020) GHG emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected GHG emissions in CO2equivalent in 2020 with the urban population trends 2005-2015 to the CO2equivalent in a preceding baseyear.

CO2eq urban factor	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ARM	1.24	1.25	1.27	1.28	1.29	1.31	1.28	1.25	1.23	1.20	1.17	1.14	1.11	1.07	1.04	1.00
AZE	1.98	1.96	1.95	1.93	1.91	1.87	1.78	1.69	1.61	1.52	1.42	1.33	1.25	1.17	1.08	1.00
BLR	1.53	1.55	1.57	1.59	1.61	1.61	1.56	1.50	1.44	1.38	1.32	1.26	1.19	1.13	1.07	1.00
GEO	1.66	1.65	1.64	1.63	1.62	1.61	1.55	1.49	1.42	1.36	1.30	1.24	1.18	1.12	1.06	1.00
KAZ	1.60	1.56	1.52	1.47	1.43	1.39	1.35	1.31	1.27	1.24	1.19	1.16	1.12	1.08	1.04	1.00
KGZ	1.47	1.52	1.57	1.62	1.67	1.72	1.66	1.59	1.52	1.45	1.39	1.31	1.24	1.16	1.08	1.00
MDA	1.17	1.20	1.22	1.24	1.26	1.27	1.25	1.23	1.20	1.18	1.15	1.12	1.09	1.06	1.03	1.00
TJK	2.78	2.76	2.73	2.71	2.68	2.56	2.39	2.23	2.07	1.91	1.70	1.56	1.42	1.28	1.14	1.00
TKM	0.68	0.78	0.86	0.94	1.02	1.08	1.08	1.09	1.09	1.08	1.07	1.06	1.05	1.04	1.02	1.00
UKR	0.95	0.96	0.98	1.00	1.01	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.00	1.00
UZB	1.54	1.50	1.46	1.42	1.38	1.32	1.29	1.26	1.22	1.19	1.15	1.12	1.09	1.06	1.03	1.00

It is recognised that almost identical factors apply for the CO2 and for the greenhouse gases in CO2 equivalent. For the sake of completeness, the national coefficients for CO2 and CO2-eq from Fig 2 and 3 under section 3 are updated to the city projections of Fig. 7 and 8.

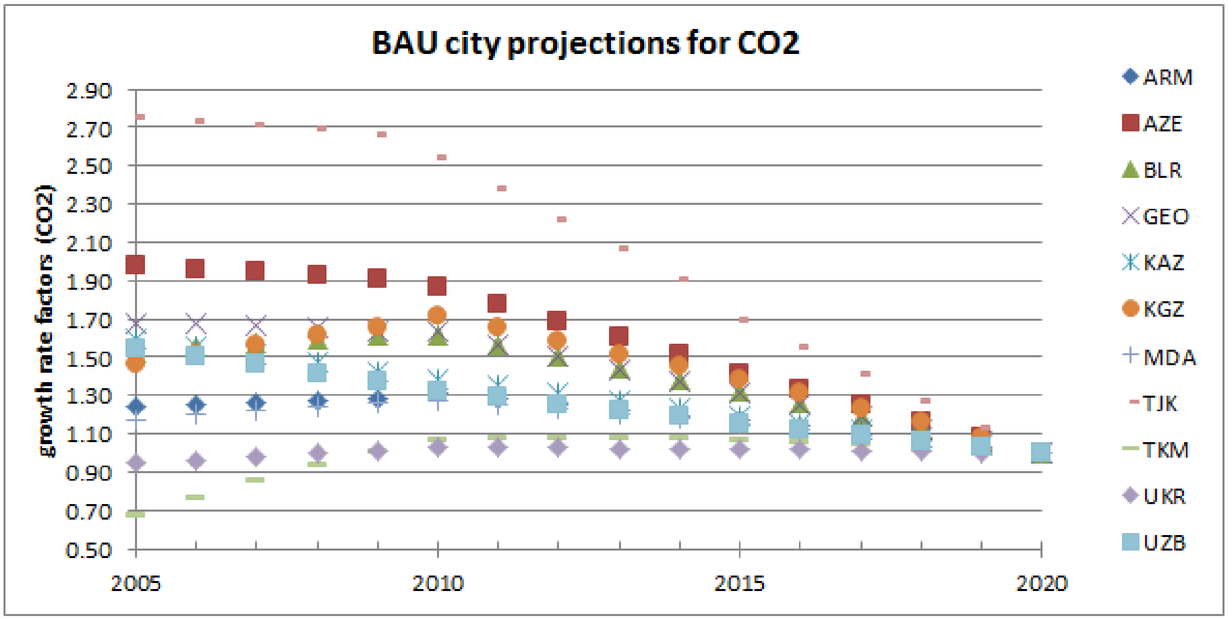


Fig. 7: Country-specific urban coefficients for CoM-East signatories to estimate their CO2 emissions in 2020 based on their current (2005-2020) emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected CO2 in 2020 and the urban population to the CO2 in a preceding baseyear under a business-as-usual scenario.

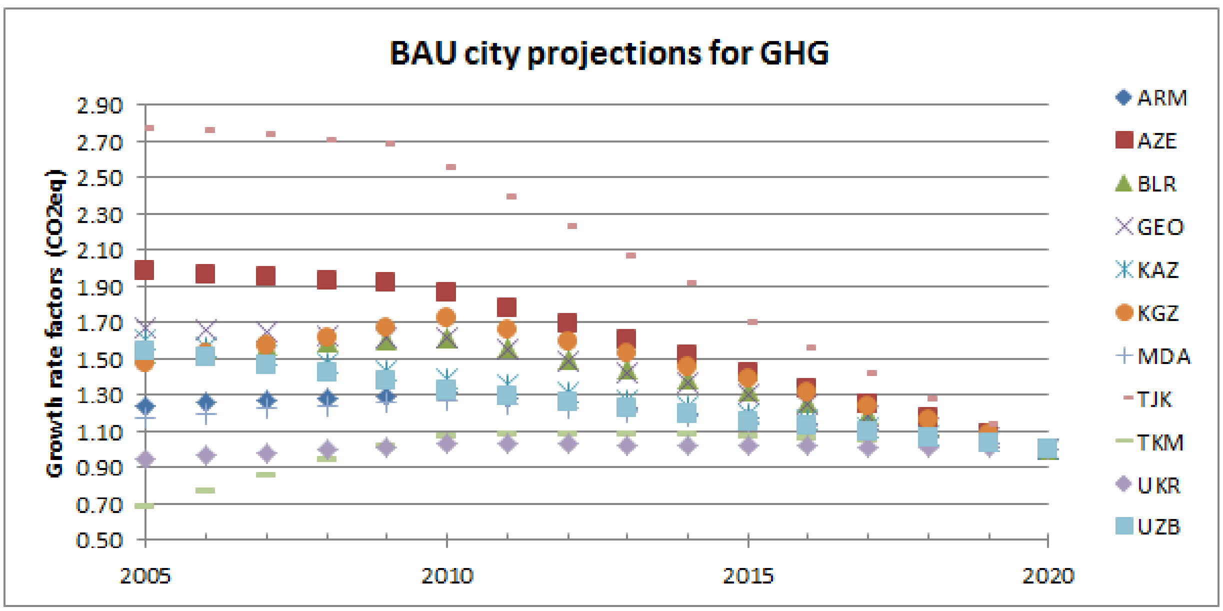


Fig. 8: Country-specific urban coefficients for CoM-East signatories to estimate their GHG emissions in 2020 based on their current (2005-2020) emissions estimates for the buildings & transport sectors. These coefficients are derived as the ratio of the projected CO2eq in 2020 and the urban population to the CO2eq in a preceding baseyear under a business-as-usual scenario.

4.3. Discussion and limitations of the use of the urban factor

The aim of this section is to discuss the use of the urban factor. We first present a comparison of how these business-as-usual projections done on a country basis would look if they were adapted to a certain city (ie. Tbilisi in Georgia) with the aim of comparing the obtained results/factors with those used by the city of Tbilisi to do their SEAP. In a second step a recommendation for using the urban factor for any city from the selected countries of the Eastern Partnership is given.

The Business-as-Usual (BAU) scenario for Tbilisi (capital of Georgia) by NATELI (2011) and its use for the Sustainable Energy Action Plan prepared by Tbilisi City (2011) used a local prospective outlook model for energy scenarios LEAP (Long range Energy Alternatives Planning System). Even though this tool, focusing on Georgia and its capital might give very reliable prediction for Tbilisi, its results can neither be generalised for all cities of the Eastern Partnership countries nor assumed available for any other city without extra funding (such as Tbilisi was receiving from USAID). Its results nevertheless compare within 6% difference with the BAU-scenario coefficient of JRC-IES for Georgia, corrected with the urban factor. Contrary to the LEAP model, the JRC-IES scenario is based on a Commission prospective outlook tool for energy scenarios (POLES) and valid for all world countries.

We conclude this chapter with some more general recommendations:

- Accurate, complete and up-to-date baseyear emissions are primordial: the more complete and recent, the less biases are present at the start of the projections. The inventory making of emissions takes time and a delay of one to two years is common. A baseyear in the period between 2005 and 2010 is therefore considered feasible and recommended.

- A first indication on how much the country contributes to the global warming is obtained by comparing the emission level per capita (cfr. Annex III) with the European mean average of 9.9CO2eq/cap in the case of all GHG and 8.1CO2/cap in the case of only CO2. The emissions levels per capita for Belarus, Kazakhstan, Turkmenistan and Ukraine exceed the mean EU-27 average level. Therefore extra growth for emissions by BAU coefficients, and in particular BAU coefficients multiplied with an urban factor, have to be questioned.

- The country-specific coefficients for CoM-East cities are most coherently derived when using a global prospective outlook model addressing all countries. As such no fast and local variations, such as recessions are perturbing the projections for 2020.

- A distinction between the countries based on their economic growth seems necessary. For those countries which are no longer in the initial phase of economic development (and have higher HDI and high GHG emission levels), the urban factors are not applicable.

- All cities of one single country are allowed to use the same BAU coefficient, eventually corrected with the urban factor, as set for the country, in order to obtain a national consistency.

- This exercise can be repeated for all world countries, to give a more equilibrated view on the cities which are already signatory in the CoM of Western-European countries and on cities which could join a similar CoM designed for countries in other EC Partnerships, such as CoM South.

5. Conclusion

On the basis of the work carried out for the CIRCE project we have obtained projection factors to be used to estimate greenhouse gas emission in 2020 for 11 countries for the Eastern Partnership for the Covenant of Mayors under a business-as-usual scenario. An additional assessment has been carried out to estimate factors which could be adapted for cities, assuming that most of the emission increase in those countries will take place in cities.

It was observed that these factors are very country-specific, but are not very much dependent on the substance. Moreover it was considered that the emission growth is realistically mainly present in cities for these Eastern Partnership countries, except for Belarus, Kazakhstan, Turkmenistan and Ukraine. For the latter 4 countries a national coefficient is recommended instead. Figure 6 provides an overview of the recommended country-specific coefficients for CoM-East signatories to estimate their CO2 or CO2eq emissions in 2020 based on their current (2005-2020) CO2 or CO2eq emissions estimates for the buildings & transport sectors. The values are also summarised in table 7.

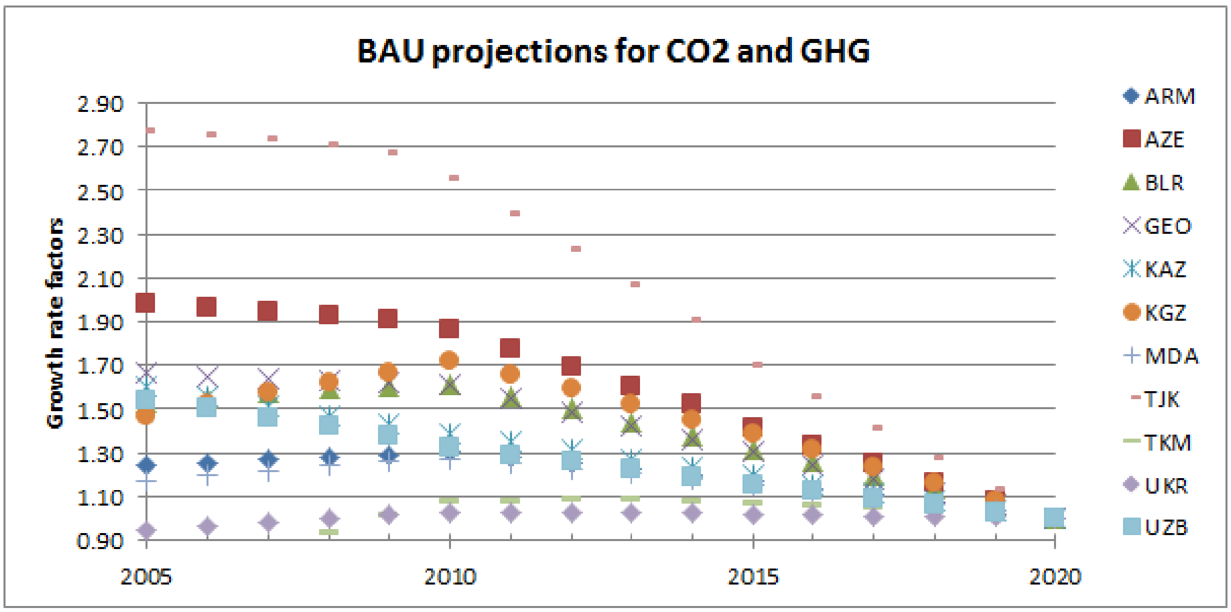


Fig. 6: Country-specific coefficients for CoM-East signatory cities to estimate their CO2 or GHG emissions in 2020 based on baseyear (2005-2020) estimates for the buildings & transport sectors.

Table 7: Summary of the country-specific coefficients for CoM-East signatories to estimate their CO2 or GHG emissions in 2020 based on baseyear estimates for the buildings & transport sectors.

BAU projec-tions	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ARM	1.24	1.25	1.27	1.28	1.29	1.31	1.28	1.25	1.23	1.20	1.17	1.14	1.11	1.07	1.04	1.00
AZE	1.98	1.96	1.95	1.93	1.91	1.87	1.78	1.69	1.61	1.52	1.42	1.33	1.25	1.17	1.08	1.00
BLR	1.09	1.09	1.10	1.10	1.10	1.10	1.10	1.09	1.08	1.07	1.05	1.04	1.03	1.02	1.01	1.00
GEO	1.66	1.65	1.64	1.63	1.62	1.61	1.55	1.49	1.42	1.36	1.30	1.24	1.18	1.12	1.06	1.00
KAZ	1.11	1.10	1.09	1.09	1.08	1.07	1.06	1.06	1.05	1.04	1.04	1.03	1.02	1.01	1.01	1.00
KGZ	1.47	1.52	1.57	1.62	1.67	1.72	1.66	1.59	1.52	1.45	1.39	1.31	1.24	1.16	1.08	1.00
MDA	1.17	1.20	1.22	1.24	1.26	1.27	1.25	1.23	1.20	1.18	1.15	1.12	1.09	1.06	1.03	1.00
TJK	2.78	2.76	2.73	2.71	2.68	2.56	2.39	2.23	2.07	1.91	1.70	1.56	1.42	1.28	1.14	1.00
TKM	0.98	0.98	0.99	1.00	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.00
UKR	0.98	0.99	0.99	1.00	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.00
UZB	1.54	1.50	1.46	1.42	1.38	1.32	1.29	1.26	1.22	1.19	1.15	1.12	1.09	1.06	1.03	1.00

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Annex I: Ranking of world countries by GHGs

EDGARv4.2 provides its results of Greenhouse Gas (GHG) emission totals for all world countries as below. Please consult also http://edgar.jrc.ec.europa.eu/overview.php?v=intro&sort=des8.

Total GHG Emissions (CO2, CH4, N2O, HFCs, PFCs, SF6)

in 1990, 2000, 2005 and 2008

conform UNFCCC excluding short-cycle biomass burning (such as agricultural waste burning and Savannah burning) but including other biomass burning (such as forest fires, post-burn decay, peat fires and decay of drained peatlands), and calculated with the GWP100 metric of UNFCCC (IPCC, 1996).

Source: European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.2. http://edgar.jrc.ec.europe.eu, 2011

Country	1990		2000		2005		2008	
	Mt CO2eq	% world total	Mt CO2eq	% world total	Mt CO2eq	% world total	Mt CO2eq	% world total
World Total	36405	100	38728	100	45807	100	46917	100
Afghanistan	11.6	0.0319	12.33	0.0318	13.46	0.0294	13.99	0.0298
Albania	9.96	0.0274	6.91	0.0178	8.4	0.0183	8.18	0.0174
Algeria	104.77	0.2878	130.93	0.3381	143.63	0.3136	157.98	0.3367
American Samoa	0.02	0.0001	0.05	0.0001	0.05	0.0001	0.05	0.0001
Angola	31.26	0.0859	37.99	0.0981	38.19	0.0834	41.05	0.0875
Antigua and Barbuda	0.34	0.0009	0.37	0.001	0.42	0.0009	0.46	0.001
Argentina	255.49	0.7018	290.5	0.7501	304.03	0.6637	321.41	0.6851
Armenia	20.53	0.0564	6.92	0.0179	8.5	0.0186	12.59	0.0268
Aruba	0.42	0.0012	0.27	0.0007	0.28	0.0006	0.36	0.0008
Australia	452.05	1.2417	566.13	1.4618	606.14	1.3233	627.62	1.3377
Austria	76.64	0.2105	80.16	0.207	95.71	0.209	92.98	0.1982
Azerbaijan	62.33	0.1712	29.64	0.0765	41.85	0.0914	49.09	0.1046
Bahamas	2.85	0.0078	2.73	0.0071	3.17	0.0069	3.59	0.0077
Bahrain	16.38	0.045	18.21	0.047	23.39	0.0511	29.18	0.0622
Bangladesh	120.11	0.3299	135.1	0.3488	151.3	0.3303	162.66	0.3467
Barbados	0.87	0.0024	1.02	0.0026	1.01	0.0022	1.07	0.0023
Belarus	145.19	0.3988	117.4	0.3031	128.28	0.28	140.37	0.2992
Belgium	135.99	0.3735	144.64	0.3735	135.6	0.296	136.76	0.2915
Belize	0.56	0.0015	0.8	0.0021	1.09	0.0024	1.17	0.0025
Benin	44.37	0.1219	31.92	0.0824	28.19	0.0615	43.97	0.0937
Bermuda	0.61	0.0017	0.5	0.0013	0.56	0.0012	0.53	0.0011
Bhutan	0.9	0.0025	3.21	0.0083	1.68	0.0037	2.46	0.0052
Bolivia	184.78	0.5076	168.64	0.4354	272.83	0.5956	134.39	0.2864
Bosnia and Herzegovina	29.95	0.0823	17.43	0.045	20.83	0.0455	24.27	0.0517
Botswana	7.41	0.0204	8.16	0.0211	10.15	0.0222	10.5	0.0224
Brazil	1552.2	4.2637	1421.64	3.6708	2506	5.4708	1437.41	3.0637
British Virgin Islands	0.07	0.0002	0.08	0.0002	0.09	0.0002	0.11	0.0002
Brunei Darussalam	18.37	0.0504	17.12	0.0442	23.05	0.0503	19.24	0.041
Bulgaria	98.04	0.2693	63.75	0.1646	67.71	0.1478	70.95	0.1512
Burkina Faso	8.72	0.024	12.78	0.033	15.46	0.0338	17.31	0.0369
Burundi	1.92	0.0053	1.85	0.0048	3.27	0.0071	3.95	0.0084

Cambodia	14.88	0.0409	19.47	0.0503	55.84	0.1219	159.79	0.3406
Cameroon	89.2	0.245	80.75	0.2085	57.42	0.1254	76.45	0.1629
Canada	588.84	1.6175	726.41	1.8757	773.03	1.6876	732.02	1.5603
Cape Verde	0.21	0.0006	0.33	0.0008	0.36	0.0008	0.36	0.0008
Cayman Islands	0.3	0.0008	0.31	0.0008	0.35	0.0008	0.4	0.0009
Central African Republic	182.04	0.5	152.46	0.3937	148.44	0.3241	402.06	0.857
Chad	8.79	0.0241	10.94	0.0283	12.61	0.0275	14.4	0.0307
Chile	52.13	0.1432	86.43	0.2232	97.83	0.2136	105.87	0.2257
China	3770.52	10.3571	4928.7	12.7265	7703.41	16.8173	9916.46	21.1362
Colombia	170.9	0.4694	175.15	0.4523	159.76	0.3488	184.93	0.3942
Comoros	0.26	0.0007	0.3	0.0008	0.31	0.0007	0.43	0.0009
Congo	61.82	0.1698	56.99	0.1472	50.23	0.1097	37.99	0.081
Congo's Dem. Rep.	1316.74	3.6169	1001.11	2.585	913.07	1.9933	1028.45	2.1921
Costa Rica	8.23	0.0226	9.71	0.0251	9.9	0.0216	10.53	0.0224
Cote d'Ivoire	149.12	0.4096	164.2	0.424	136.37	0.2977	160.31	0.3417
Croatia	30.67	0.0842	24.17	0.0624	27.9	0.0609	30.82	0.0657
Cuba	41.85	0.1149	37.49	0.0968	38.43	0.0839	42.8	0.0912
Cyprus	3.44	0.0095	5.05	0.013	5.48	0.012	5.43	0.0116
Czech Republic	193.24	0.5308	159.79	0.4126	145.94	0.3186	142.15	0.303
Denmark	71.1	0.1953	70.55	0.1822	66.13	0.1444	66.55	0.1419
Djibouti	1.38	0.0038	1.54	0.004	1.66	0.0036	1.94	0.0041
Dominica	0.13	0.0004	0.14	0.0004	0.18	0.0004	0.2	0.0004
Dominican Republic	13.98	0.0384	22.64	0.0584	22.79	0.0497	24.29	0.0518
Ecuador	28.98	0.0796	35.98	0.0929	45.33	0.099	45.07	0.0961
Egypt	115.92	0.3184	173.15	0.4471	227.91	0.4976	251.25	0.5355
El Salvador	6.11	0.0168	8.72	0.0225	9.71	0.0212	9.94	0.0212
Equatorial Guinea	0.19	0.0005	4	0.0103	5.63	0.0123	5.71	0.0122
Eritrea	2.87	0.0079	4.09	0.0106	3.77	0.0082	3.79	0.0081
Estonia	51.77	0.1422	28.34	0.0732	29.75	0.0649	31.03	0.0661
Ethiopia	49.79	0.1368	56.64	0.1462	67.96	0.1484	71.12	0.1516
European Union EU-27	5488	15.0747	5100.81	13.1709	5189.11	11.3283	5098.41	10.8669
Falkland Islands	1.19	0.0033	1.18	0.0031	1.19	0.0026	1.19	0.0025
Faroe Islands	0.05	0.0001	0.05	0.0001	0.06	0.0001	0.06	0.0001
Fiji	2.29	0.0063	1.62	0.0042	1.88	0.0041	2.16	0.0046
Finland	121.71	0.3343	124.24	0.3208	124.3	0.2713	125.98	0.2685
France	540.98	1.486	552.77	1.4273	550.06	1.2008	538.89	1.1486
French Guiana	0.91	0.0025	0.96	0.0025	0.95	0.0021	1.07	0.0023
French Polynesia	0.79	0.0022	0.45	0.0012	0.52	0.0011	0.56	0.0012
Gabon	12.19	0.0335	12.36	0.0319	17.05	0.0372	34.59	0.0737
Gambia	0.85	0.0023	0.96	0.0025	1.02	0.0022	1.1	0.0023
Georgia	29.65	0.0814	10.59	0.0273	10.84	0.0237	11.93	0.0254
Germany	1244.37	3.4181	1043.66	2.6949	1003.38	2.1905	1013.69	2.1606
Ghana	22.3	0.0613	22.01	0.0568	24.58	0.0537	60.63	0.1292
Gibraltar	0.1	0.0003	0.26	0.0007	0.29	0.0006	0.31	0.0007
Greece	90.56	0.2488	107.91	0.2786	114.55	0.2501	111.93	0.2386
Grenada	0.16	0.0004	0.47	0.0012	0.56	0.0012	0.64	0.0014
Guadeloupe	1.23	0.0034	1.64	0.0042	1.96	0.0043	2.06	0.0044
Guam	0.06	0.0002	0.07	0.0002	0.08	0.0002	0.08	0.0002
Guatemala	13.54	0.0372	138.67	0.358	59.15	0.1291	41.08	0.0876
Guinea	59.29	0.1629	52.5	0.1356	59.53	0.13	235.56	0.5021
Guinea-Bissau	1.15	0.0032	1.39	0.0036	1.44	0.0032	1.56	0.0033
Guyana	16.32	0.0448	14.11	0.0364	15.09	0.0329	15.08	0.0321
Haiti	4.41	0.0121	6.29	0.0162	7.08	0.0155	7.25	0.0154
Honduras	12.87	0.0353	13.13	0.0339	14.66	0.032	16.19	0.0345
Hong Kong	36.97	0.1015	45.19	0.1167	46.31	0.1011	51.87	0.1106
Hungary	94.39	0.2593	71.11	0.1836	75.25	0.1643	71.53	0.1525

Iceland	21.47	0.059	21.31	0.055	21.57	0.0471	22.6	0.0482
India	1310.88	3.6008	1802.1	4.6532	2057.07	4.4908	2362.77	5.0361
Indonesia	1129.65	3.103	1416.36	3.6572	2823.32	6.1636	1989.69	4.2409
International aviation	299.25	0.822	362.71	0.9365	431.48	0.942	465.58	0.9924
International shipping	378.47	1.0396	493.17	1.2734	551.44	1.2038	610.27	1.3007
Iraq	88.5	0.2431	108.54	0.2803	111.52	0.2435	121.83	0.2597
Ireland	64.04	0.1759	73.3	0.1893	76.17	0.1663	77.07	0.1643
Islamic Republic of Iran	268.73	0.7382	430	1.1103	557.32	1.2167	511.48	1.0902
Israel	31.87	0.0875	59.72	0.1542	68.65	0.1499	73.89	0.1575
Italy	438.35	1.2041	490.09	1.2655	534.66	1.1672	506.78	1.0802
Jamaica	7.52	0.0207	6.92	0.0179	7.75	0.0169	8.6	0.0183
Japan	1217.3	3.3437	1350.37	3.4868	1381.29	3.0155	1326	2.8263
Jordan	8.98	0.0247	12.87	0.0332	19.73	0.0431	22.28	0.0475
Kazakhstan	348.24	0.9566	186.52	0.4816	256.03	0.5589	302.79	0.6454
Kenya	33.38	0.0917	35.9	0.0927	40.93	0.0894	44.45	0.0947
Kiribati	0.04	0.0001	0.05	0.0001	0.05	0.0001	0.06	0.0001
Kuwait	34.19	0.0939	53.25	0.1375	69.76	0.1523	71.87	0.1532
Kyrgyzstan	32.74	0.0899	10.19	0.0263	11.03	0.0241	12.07	0.0257
Laos' Peoples Republic	25.45	0.0699	21.47	0.0554	45.33	0.099	29.35	0.0626
Latvia	29.26	0.0804	14.77	0.0381	16.68	0.0364	17.49	0.0373
Lebanon	5.12	0.0141	12.72	0.0329	15.25	0.0333	14.1	0.0301
Lesotho	1.54	0.0042	1.32	0.0034	1.44	0.0032	1.52	0.0032
Liberia	1.12	0.0031	1.13	0.0029	1.25	0.0027	1.43	0.0031
Libyan Arab Jamahiriya	55.01	0.1511	55.7	0.1438	62.18	0.1358	64.66	0.1378
Lithuania	48.09	0.1321	24.51	0.0633	28.68	0.0626	32.15	0.0685
Luxembourg	13.07	0.0359	10.26	0.0265	13.43	0.0293	12.68	0.027
Macao	0.56	0.0015	0.62	0.0016	0.62	0.0014	0.72	0.0015
Macedonia	13.65	0.0375	10.3	0.0266	11.14	0.0243	10.99	0.0234
Madagascar	43.29	0.1189	46.93	0.1212	54.61	0.1192	37.97	0.0809
Malawi	4.69	0.0129	5.31	0.0137	6.18	0.0135	6.36	0.0136
Malaysia	185.22	0.5088	249.42	0.644	331.72	0.7242	330.7	0.7049
Maldives	0.13	0.0004	0.31	0.0008	0.49	0.0011	0.64	0.0014
Mali	27.41	0.0753	27.27	0.0704	32.47	0.0709	47.94	0.1022
Malta	1.64	0.0045	1.11	0.0029	1.28	0.0028	1.05	0.0022
Martinique	1.49	0.0041	1.41	0.0036	1.68	0.0037	1.91	0.0041
Mauritania	5.55	0.0152	8.82	0.0228	9.8	0.0214	10.19	0.0217
Mauritius	1.34	0.0037	2.08	0.0054	2.8	0.0061	3.06	0.0065
Mexico	433.98	1.1921	489.29	1.2634	578.04	1.2619	608.65	1.2973
Micronesia	0.05	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001
Moldova	34.07	0.0936	9.6	0.0248	11.35	0.0248	9.91	0.0211
Mongolia	55.54	0.1526	63.67	0.1644	62.92	0.1374	68.27	0.1455
Morocco	31.74	0.0872	47.05	0.1215	65.44	0.1429	68.79	0.1466
Mozambique	24.93	0.0685	53	0.1368	48.1	0.105	26.2	0.0558
Myanmar	868.01	2.3843	554.92	1.4329	500.6	1.0929	332.36	0.7084
Namibia	5.76	0.0158	7.61	0.0196	9.7	0.0212	10.95	0.0233
Nepal	23.07	0.0634	26.53	0.0685	28.01	0.0612	29.18	0.0622
Netherlands	219.62	0.6033	225.79	0.583	222.91	0.4866	210.35	0.4483
Netherlands Antilles	2.46	0.0068	5.16	0.0133	5.35	0.0117	5.54	0.0118
New Caledonia	0.94	0.0026	0.88	0.0023	0.87	0.0019	0.93	0.002
New Zealand	65.37	0.1796	77.66	0.2005	86.14	0.1881	85.27	0.1817
Nicaragua	9	0.0247	10.9	0.0281	11.99	0.0262	12.51	0.0267
Niger	5.72	0.0157	7.63	0.0197	6.64	0.0145	7.03	0.015
Nigeria	148.92	0.4091	187.9	0.4852	193.79	0.4231	207.09	0.4414
North Korea	158.92	0.4365	96.07	0.2481	105.31	0.2299	99.72	0.2125
Norway	64.47	0.1771	69.9	0.1805	70.65	0.1542	70.02	0.1492
Oman	35.3	0.097	53.35	0.1378	68	0.1485	76.32	0.1627

Pakistan	161.97	0.4449	217.61	0.5619	278.24	0.6074	309.3	0.6592
Palestinian Territory	0.09	0.0002	0.12	0.0003	0.15	0.0003	0.16	0.0003
Panama	6.25	0.0172	8.11	0.0209	9.22	0.0201	12.2	0.026
Papua New Guinea	27.17	0.0746	40.87	0.1055	39.55	0.0863	38.02	0.081
Paraguay	58.58	0.1609	50.44	0.1303	44.61	0.0974	35.46	0.0756
Peru	57.32	0.1575	70.54	0.1821	65.05	0.142	66.46	0.1416
Philippines	82.63	0.227	124.9	0.3225	135.32	0.2954	143.42	0.3057
Poland	464.95	1.2771	409.61	1.0577	428.84	0.9362	437.35	0.9322
Portugal	50.38	0.1384	75.69	0.1954	79.32	0.1732	70.46	0.1502
Puerto Rico	2.93	0.0081	3.09	0.008	3.21	0.007	3.15	0.0067
Qatar	20.79	0.0571	44.39	0.1146	61.39	0.134	83.15	0.1772
Reunion	1.29	0.0035	2.05	0.0053	2.15	0.0047	2.25	0.0048
Romania	223.51	0.614	124.13	0.3205	134.5	0.2936	132.32	0.282
Russian Federation	3361.43	9.2334	2551.03	6.5871	2521.43	5.5045	2562.18	5.4611
Rwanda	2.79	0.0077	3.38	0.0087	4	0.0087	4.41	0.0094
Saint Kitts and Nevis	0.09	0.0003	0.16	0.0004	0.17	0.0004	0.17	0.0004
Saint Lucia	0.27	0.0008	0.4	0.001	0.47	0.001	0.53	0.0011
St Vincent & Grenadines	0.14	0.0004	0.22	0.0006	0.26	0.0006	0.28	0.0006
Samoa	0.28	0.0008	0.32	0.0008	0.3	0.0007	0.33	0.0007
Sao Tome and Principe	0.09	0.0002	0.2	0.0005	0.16	0.0004	0.16	0.0003
Saudi Arabia	204.1	0.5606	303.03	0.7824	369.88	0.8075	424.64	0.9051
Senegal	7.46	0.0205	10.86	0.028	12.63	0.0276	13.62	0.029
Serbia and Montenegro	78.22	0.2148	55.9	0.1443	38.66	0.0844	62.21	0.1326
Seychelles	0.33	0.0009	0.49	0.0013	0.62	0.0013	0.72	0.0015
Sierra Leone	7.68	0.0211	4.72	0.0122	4.34	0.0095	7.83	0.0167
Singapore	17.99	0.0494	28.78	0.0743	39.42	0.086	42.89	0.0914
Slovakia	70.7	0.1942	49.87	0.1288	48.66	0.1062	48.73	0.1039
Slovenia	19.13	0.0526	20.72	0.0535	22.21	0.0485	23.12	0.0493
Solomon Islands	5.89	0.0162	4.08	0.0105	4.32	0.0094	4.41	0.0094
Somalia	16.46	0.0452	18.06	0.0466	18.48	0.0403	18.23	0.0388
South Africa	338.54	0.9299	385.24	0.9947	446.13	0.974	449.9	0.9589
South Korea	285.83	0.7851	491.28	1.2685	544.07	1.1877	577.51	1.2309
Spain	281.77	0.774	361.84	0.9343	415.73	0.9076	396.12	0.8443
Sri Lanka	17.57	0.0483	20.96	0.0541	23.27	0.0508	24.91	0.0531
Sudan	51.26	0.1408	77.06	0.199	88.15	0.1924	96.6	0.2059
Suriname	9.84	0.027	6.24	0.0161	5.79	0.0126	4.36	0.0093
Swaziland	2.16	0.0059	2.47	0.0064	2.43	0.0053	2.65	0.0057
Sweden	89.28	0.2452	89.65	0.2315	86.73	0.1893	82.29	0.1754
Switzerland	55.81	0.1533	53.17	0.1373	55.85	0.1219	56.46	0.1203
Syrian Arab Republic	44.03	0.1209	59.63	0.154	54.63	0.1193	55.27	0.1178
Taiwan	121.72	0.3344	226.84	0.5857	277.35	0.6055	276.85	0.5901
Tajikistan	20.81	0.0572	9.82	0.0254	12.09	0.0264	14.15	0.0302
Thailand	182.32	0.5008	262.47	0.6777	327.25	0.7144	339.98	0.7246
Timor-Leste	0.44	0.0012	0.6	0.0015	0.86	0.0019	0.89	0.0019
Togo	10.53	0.0289	9.74	0.0251	11.46	0.025	23.8	0.0507
Tonga	0.12	0.0003	0.18	0.0005	0.16	0.0003	0.15	0.0003
Trinidad and Tobago	15.01	0.0412	23.19	0.0599	43.8	0.0956	54.39	0.1159
Tunisia	18.79	0.0516	28.68	0.074	30.48	0.0665	32.41	0.0691
Turkey	215.92	0.5931	306.87	0.7924	340.81	0.744	392.01	0.8355
Turkmenistan	81.25	0.2232	63.24	0.1633	79.23	0.173	91.66	0.1954
Uganda	26.73	0.0734	31.77	0.082	35.58	0.0777	38.05	0.0811
Ukraine	885.18	2.4314	466.6	1.2048	436.27	0.9524	434.85	0.9269
Unit. Rep. Tanzania	73.37	0.2015	83.01	0.2143	106.41	0.2323	60.48	0.1289
United Arab Emirates	71.98	0.1977	114.85	0.2966	143.2	0.3126	181.24	0.3863
United Kingdom	751.97	2.0656	677.53	1.7495	665.46	1.4528	642.55	1.3695
United States	6016.89	16.5275	6893.89	17.8008	6995.73	15.2724	6595.38	14.0575
Uruguay	25.65	0.0705	29.94	0.0773	31.81	0.0695	33.1	0.0706
USA Virgin Islands	0.04	0.0001	0.04	0.0001	0.05	0.0001	0.05	0.0001
Uzbekistan	159.65	0.4385	160.57	0.4146	163.34	0.3566	178.22	0.3799
Venezuela	201.91	0.5546	246.54	0.6366	261.84	0.5716	294.81	0.6284
Viet Nam	90.27	0.248	144.11	0.3721	213.07	0.4652	246.01	0.5243
Western Sahara	0.45	0.0012	0.54	0.0014	0.56	0.0012	0.59	0.0013
Yemen	11.81	0.0324	21.11	0.0545	29.69	0.0648	33.79	0.072
Zambia	170.55	0.4685	131.92	0.3406	147.69	0.3224	73.08	0.1558
Zimbabwe	30.56	0.0839	27.33	0.0706	24.41	0.0533	23.6	0.0503

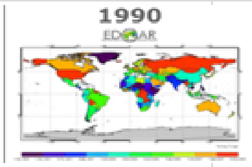
Annex II: Ranking of world countries by CO2/cap

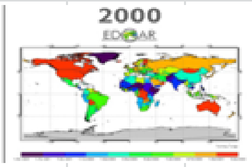
EDGARv4.2 provides its results of CO2 emission totals per capita for all world countries as below. Please consult also online the list on http://edgar.jrc.ec.europa.eu/overview.php?v=CO2&sort=des8

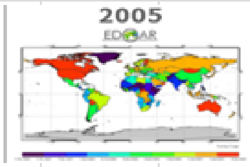
Total CO2 per capita emissions for world countries from 1990 to 2008

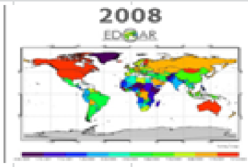
Note that neither short cycle biomass burning nor large-scale biomass burning are taken into account for the per capita emissions, which are calculated with the population data of UNDP Review (2010).

Source: European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.2. http://edgar.jrc.ec.europe.eu, 2011









Country	1990 metric ton CO2/capita	1990 rank out of 205	2000 metric ton CO2/capita	2000 rank out of 205	2005 metric ton CO2/capita	2005 rank out of 205	2008 metric ton CO2/capita	2008 rank out of 205
Qatar	34.28	1	52.24	1	51.55	1	38.96	1
Trinidad and Tobago	9.7	28	13.48	11	24.67	6	30.46	2
Netherlands Antilles	11.84	18	27.63	3	27.8	4	27.47	3
United Arab Emirates	31.45	2	30.51	2	29	2	24.83	4
Bahrain	25.64	4	24.35	4	27.95	3	24.31	5
Luxembourg	30.71	3	20.16	7	25.88	5	22.49	6
Kuwait	13.53	15	21.59	5	24.4	7	22.45	7
Brunei Darussalam	13.68	13	16.12	10	15.11	11	21.82	8
Australia	15.99	8	18.59	8	20.29	8	20.26	9
United States	19.38	6	20.53	6	19.77	9	17.82	10
Canada	15.81	9	17.75	9	17.5	10	16.83	11
Oman	7.93	39	10.83	18	13.46	12	14.65	12
Kazakhstan	14.82	11	9.17	29	12.48	14	14.37	13
Estonia	21.03	5	10.42	21	12.38	16	13.76	14
Saudi Arabia	10.25	24	12.6	13	12.81	13	13.66	15
Falkland Islands	14.32	12	9.76	24	11.62	18	13.06	16
Iceland	9.23	30	10.14	22	10.47	24	12.65	17
Russian Federation	15.21	10	10.89	16	11.66	17	12.34	18
Czech Republic	16.1	7	13.45	12	12.39	15	11.88	19
Taiwan	5.5	64	9.64	26	11.47	19	11.22	20
Finland	10.54	22	10.83	17	10.83	22	11.07	21
South Korea	5.57	63	9.35	28	10.38	25	10.98	22
Belgium	11.49	19	12.03	14	11.05	20	10.9	23
Turkmenistan	13.32	16	8.63	34	9.49	31	10.87	24
Ireland	8.93	32	10.59	19	10.63	23	10.57	25

Netherlands	10.77	21	10.92	15	10.95	21	10.32	26
Germany	12.82	17	10.51	20	10.17	26	10.31	27
Gibraltar	3.29	83	8.95	32	9.37	32	9.94	28
Bahamas	9.91	26	7.94	38	8.65	38	9.46	29
Austria	7.94	38	8.2	37	9.92	28	9.43	31
Japan	8.85	33	9.72	25	9.95	27	9.43	30
Israel	6.07	56	8.86	33	9.26	33	9.27	32
Norway	8.95	31	9.62	27	9.56	30	9.24	33
Slovenia	7.38	40	8.35	35	8.88	36	9.22	34
New Zealand	6.73	46	9.02	31	9.82	29	9.13	35
Denmark	10.17	25	9.76	23	9.01	35	8.95	36
United Kingdom	9.88	27	9.17	30	9.16	34	8.67	37
Greece	7.27	42	8.28	36	8.81	37	8.61	38
Poland	8.04	36	7.49	41	8.02	39	8.37	39
European Union EU-27	8.782	33	8.19	37	8.339	39	8.09	39
Seychelles	4.2	73	5.81	52	6.88	48	7.86	40
Singapore	5.37	67	5.09	59	7.97	42	7.72	41
Slovakia	11.22	20	7.79	40	7.56	45	7.55	42
Bermuda	9.49	29	7.23	43	8.01	40	7.47	43
South Africa	7.31	41	6.89	46	7.5	46	7.42	44
Ukraine	13.59	14	7.17	44	7.13	47	7.35	45
Belarus	6.72	47	5.19	57	6.21	54	7.34	46
Libyan Arab Jamahiriya	8.51	34	7.91	39	7.69	44	7.34	47
Italy	6.29	55	7.11	45	7.78	43	7.27	48
Spain	5.7	61	7.29	42	7.98	41	7.21	49
Bulgaria	8.3	35	5.79	53	6.61	50	7.21	51
Malaysia	2.52	94	5.18	58	6.56	51	7.21	50
Hong Kong	5.98	59	6.17	50	6.3	52	6.97	52
Cayman Islands	10.32	23	6.81	48	5.95	57	6.48	53
France	6.84	45	6.85	47	6.65	49	6.32	54
Switzerland	6.66	48	6.15	51	6.26	53	6.15	55
China	2.12	99	2.7	89	4.37	69	5.76	56
Hungary	7.07	44	5.38	56	5.82	58	5.7	57
Grenada	1.26	118	4.21	66	4.92	62	5.61	58
Venezuela	5.36	68	5.7	54	5.33	60	5.51	59
Sweden	6.58	50	6.41	49	5.97	56	5.38	60
Croatia	4.99	69	3.92	72	4.7	63	5.28	61
Islamic Republic of Iran	3.48	81	4.97	60	6.13	55	5.17	62
Bosnia and Herzegovina	5.45	66	3.7	74	4.38	68	5.13	63
Portugal	3.67	77	5.69	55	5.82	59	4.91	64
Chile	2.7	89	4.12	68	4.47	67	4.77	65
Lithuania	8.01	37	2.92	83	3.79	75	4.61	66
Mongolia	6.41	53	4.66	62	4.1	73	4.6	67
Equatorial Guinea	0.27	161	4.48	64	5.12	61	4.5	68
Antigua and Barbuda	4.59	72	4	69	4.23	71	4.45	69
Uzbekistan	5.68	62	4.56	63	4.21	72	4.44	70
Romania	7.09	43	3.99	70	4.51	65	4.44	71
Macedonia	5.92	60	4.14	67	4.48	66	4.37	72
Argentina	3.16	85	3.97	71	3.88	74	4.2	73
Serbia and Montenegro	6.03	58	3.89	73	2.18	97	4.19	74
Cyprus	3.61	78	4.41	65	4.25	70	4.01	75

Martinique	3.28	84	2.97	82	3.51	79	4	76
Gabon	4.73	70	4.75	61	4.58	64	3.99	77
North Korea	6.41	52	3.45	75	3.56	77	3.95	78
Turkey	2.69	90	3.45	76	3.56	78	3.95	79
British Virgin Islands	3.16	86	2.63	91	3.15	86	3.86	80
Guadeloupe	2.44	97	3.07	79	3.64	76	3.77	81
Mexico	3.08	87	3.05	80	3.48	80	3.71	82
Latvia	6.07	57	2.82	84	3.38	81	3.65	83
Barbados	2.61	91	3.14	78	3.18	85	3.36	84
Jordan	2.25	98	2.26	94	3.22	84	3.3	85
Thailand	1.45	111	2.62	92	3.29	83	3.28	86
Azerbaijan	6.66	49	2.17	96	3.13	87	3.26	87
Aruba	6.38	54	2.76	85	2.59	92	3.2	88
Iraq	3.46	82	3.3	77	3.08	88	3.1	89
Algeria	2.75	88	2.71	88	2.84	89	3.09	90
Lebanon	1.39	114	3.02	81	3.37	82	2.99	91
French Guiana	3.55	79	2.74	87	2.78	90	2.96	92
Belize	1.53	109	2.07	99	2.77	91	2.86	93
Saint Lucia	1.52	110	2.08	98	2.41	94	2.68	94
Armenia	4.72	71	1.21	121	1.47	118	2.6	95
New Caledonia	3.77	75	2.75	86	2.42	93	2.56	96
Saint Kitts and Nevis	1.58	106	2.41	93	2.35	95	2.49	97
Jamaica	2.53	93	1.98	100	2.17	98	2.43	98
Tunisia	1.6	105	2.1	97	2.17	99	2.31	99
Botswana	1.09	120	1.61	108	2.18	96	2.3	100
Cuba	1.82	101	1.62	107	1.81	108	2.25	101
Egypt	1.38	115	1.78	104	2.14	101	2.23	102
Reunion	1.57	107	2.21	95	2.14	100	2.15	103
Panama	0.95	123	1.39	115	1.42	123	2.12	104
Brazil	1.45	112	1.94	102	1.93	105	2.09	105
St Vincent & Grenadines	0.87	129	1.54	113	1.88	107	2.08	106
Dominica	0.91	128	1.16	123	1.68	111	2.05	107
Suriname	2.5	95	1.96	101	1.98	104	1.98	108
Guyana	0.77	135	1.66	106	1.79	110	1.9	109
Syrian Arab Republic	2.58	92	2.66	90	2.03	103	1.87	110
Maldives	0.44	151	0.95	138	1.45	121	1.86	111
Ecuador	1.43	113	1.55	111	1.8	109	1.81	112
Mauritius	0.95	126	1.38	116	1.6	114	1.74	113
Indonesia	0.82	134	1.36	118	1.55	115	1.71	114
Dominican Republic	0.83	131	1.75	105	1.6	113	1.69	115
Moldova	6.48	51	1.41	114	1.92	106	1.67	116
Morocco	0.73	137	1.11	127	1.61	112	1.64	117
French Polynesia	3.48	80	1.37	117	1.54	116	1.62	118
Costa Rica	0.95	124	1.33	120	1.42	122	1.54	119
Uruguay	1.16	119	1.55	112	1.49	117	1.54	120
Namibia	0.82	133	1.11	128	1.46	119	1.51	121
Colombia	1.56	108	1.57	110	1.38	124	1.48	122
Malta	3.76	76	1.93	103	2.08	102	1.45	123
Viet Nam	0.3	160	0.66	149	1.17	127	1.38	124
Albania	1.78	102	1.01	133	1.45	120	1.33	125
India	0.75	136	1	134	1.12	130	1.31	126
Djibouti	1.36	116	1.04	132	1.05	133	1.3	127

Kyrgyzstan	5.47	65	1	135	1.13	128	1.27	128
Saint Helena	1.95	100	1.61	109	1.24	125	1.26	129
Peru	0.92	127	1.07	130	1.1	131	1.26	130
Bolivia	0.97	122	1.05	131	1.13	129	1.23	131
Georgia	4.02	74	0.99	136	1.04	134	1.21	132
Fiji	1.72	103	0.63	152	0.91	141	1.19	133
Tajikistan	2.46	96	0.79	143	1.01	135	1.16	134
Macao	1.3	117	1.14	125	1	136	1.1	135
Congo	0.95	125	1.33	119	1.18	126	1.07	136
St Pierre & Miquelon	0.004	204	1.21	122	1.07	132	1.03	137
Yemen	0.5	146	0.7	147	0.91	140	0.98	138
El Salvador	0.46	150	0.84	142	0.92	139	0.94	139
Angola	1.05	121	1.09	129	0.95	137	0.89	140
Samoa	0.83	132	0.94	139	0.78	146	0.89	141
Philippines	0.53	143	0.89	141	0.87	142	0.88	142
Zimbabwe	1.64	104	1.13	126	0.92	138	0.87	143
Solomon Islands	0.57	141	0.65	150	0.61	153	0.84	144
Pakistan	0.51	145	0.57	155	0.75	147	0.82	145
Guatemala	0.44	152	0.75	144	0.84	144	0.81	147
Honduras	0.48	148	0.64	151	0.67	150	0.81	146
Mauritania	0.35	156	0.91	140	0.86	143	0.78	148
Sao Tome and Principe	0.5	147	1.15	124	0.83	145	0.77	149
Swaziland	0.54	142	0.74	145	0.68	149	0.74	150
Paraguay	0.53	144	0.7	148	0.66	152	0.69	151
Tonga	0.47	149	0.97	137	0.72	148	0.64	152
Bhutan	0.33	157	0.62	153	0.51	156	0.61	153
Sri Lanka	0.24	162	0.52	156	0.57	154	0.58	154
Nigeria	0.7	138	0.72	146	0.66	151	0.57	155
Papua New Guinea	0.43	153	0.37	161	0.47	157	0.56	156
Nicaragua	0.36	155	0.48	157	0.53	155	0.55	157
Togo	0.21	168	0.27	168	0.24	171	0.45	158
Benin	0.086	184	0.24	169	0.35	161	0.44	159
Western Sahara	0.63	139	0.61	154	0.44	158	0.42	160
Senegal	0.23	165	0.33	163	0.4	159	0.41	161
Ghana	0.22	167	0.33	164	0.33	164	0.35	162
Kiribati	0.32	158	0.31	165	0.29	167	0.34	163
Cote d'Ivoire	0.22	166	0.41	160	0.35	162	0.33	164
Cameroon	0.62	140	0.41	159	0.36	160	0.33	165
Vanuatu	0.85	130	0.42	158	0.31	165	0.32	166
Cape Verde	0.23	163	0.37	162	0.35	163	0.32	167
Bangladesh	0.12	179	0.19	171	0.24	170	0.3	168
American Samoa	0.23	164	0.28	166	0.29	166	0.29	169
Kenya	0.31	159	0.27	167	0.26	169	0.28	170
Comoros	0.16	176	0.16	176	0.13	183	0.27	171
Myanmar	0.11	180	0.19	170	0.29	168	0.27	172
Sudan	0.19	170	0.14	181	0.23	173	0.26	173
Burundi	0.06	193	0.046	198	0.2	175	0.25	174
Haiti	0.14	178	0.18	174	0.24	172	0.24	175
Zambia	0.38	154	0.19	172	0.2	176	0.2	176

Guinea-Bissau	0.19	171	0.18	173	0.17	178	0.17	177
Puerto Rico	0.18	174	0.16	175	0.18	177	0.16	178
Mozambique	0.086	186	0.088	188	0.13	182	0.15	179
Gambia	0.17	175	0.15	179	0.14	179	0.15	180
Sierra Leone	0.19	172	0.15	178	0.13	180	0.14	181
Tanzania	0.082	187	0.088	187	0.12	185	0.13	182
Nepal	0.056	194	0.14	180	0.12	184	0.13	183
Laos	0.054	195	0.1	185	0.1	189	0.12	184
Liberia	0.2	169	0.12	184	0.13	181	0.12	185
Central African Republic	0.094	182	0.12	182	0.11	187	0.12	186
Guinea	0.18	173	0.12	183	0.11	186	0.11	187
Madagascar	0.068	191	0.091	186	0.093	190	0.1	188
Eritrea	0.074	190	0.16	177	0.11	188	0.09	190
Cambodia	0.042	199	0.055	197	0.21	174	0.09	189
Lesotho	0.076	189	0.086	189	0.078	191	0.08	192
Ethiopia	0.035	202	0.056	196	0.076	192	0.08	191
Rwanda	0.086	185	0.074	190	0.065	193	0.07	193
Guam	0.063	192	0.063	192	0.063	195	0.06	194
Malawi	0.053	196	0.06	193	0.064	194	0.06	195
Niger	0.08	188	0.063	191	0.058	196	0.06	196
Somalia	0.1	181	0.058	195	0.055	197	0.06	197
Burkina Faso	0.053	197	0.059	194	0.053	198	0.06	198
Congo's Dem. Rep.	0.093	183	0.041	199	0.047	199	0.05	199
Uganda	0.035	201	0.04	200	0.046	200	0.05	200
Mali	0.043	198	0.04	201	0.039	201	0.04	201
Faroe Islands	0.031	203	0.036	202	0.038	202	0.04	202
Chad	0.037	200	0.016	204	0.016	204	0.02	204
Afghanistan	0.15	177	0.031	203	0.02	203	0.02	203
Timor-Leste	0.001	205	0.001	205	0.001	205	0.001	205

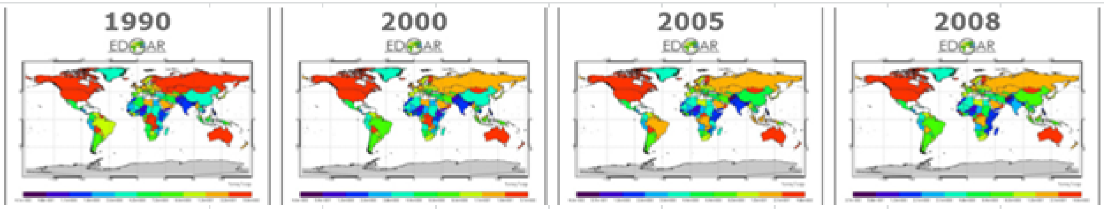
Annex III: Ranking of world countries by CO2eq/cap

EDGARv4.2 provides its results of GHG emission totals per capita for all world countries as below. Please consult also list on http://edgar.jrc.ec.europa.eu/overview.php?v=CO2eq&sort=des8

Total GHG per capita emissions for world countries from 1990 to 2008

Note that neither short cycle biomass burning nor large-scale biomass burning are taken into account for the per capita emissions, which are calculated with the population data of UNDP Review (2010)

Source: European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.2. http://edgar.jrc.ec.europe.eu, 2011



Country	1990 metric ton CO2/capita	1990 rank out of 205	2000 metric ton CO2/capita	2000 rank out of 205	2005 metric ton CO2/capita	2005 rank out of 205	2008 metric ton CO2/capita	2008 rank out of 205
Qatar	43.88	2	75.11	1	74.77	1	59.56	1
Falkland Islands	85.29	1	55.06	2	55.11	2	56.1	2
Trinidad and Tobago	12.35	32	17.95	13	33.29	4	40.86	3
Brunei Darussalam	26.58	6	28.66	5	27.52	10	35.2	4
United Arab Emirates	39.8	3	37.86	3	35.19	3	29.2	5
Australia	24.85	7	27.2	8	28.62	9	28.51	6
Netherlands Antilles	12.92	29	28.69	4	28.79	8	28.41	7
Kuwait	16.38	18	27.44	7	30.81	6	28.2	8
Bahrain	33.23	5	28.54	6	32.27	5	27.73	9
Luxembourg	34.26	4	23.54	10	29.36	7	26.04	10
Canada	20.28	12	22.78	11	22.51	12	21.81	11
United States	23.39	9	24.18	9	23.4	11	21.51	12
Oman	11.41	36	15.62	15	19.76	14	20.9	13
Kazakhstan	20.01	13	12.44	26	16.86	15	19.33	14
New Zealand	17.86	16	19	12	19.77	13	18.89	15
Turkmenistan	22.06	10	13.99	22	16.63	16	18.58	16
Russian Federation	20.33	11	14.72	19	15.9	18	16.77	17
Saudi Arabia	12.65	31	15.12	18	15.39	19	16.23	18
Iceland	15.11	22	13.14	24	13.37	24	16.1	19
Estonia	24.14	8	12.35	27	14.5	21	16	20
Ireland	15.17	21	16.85	14	16.25	17	15.82	21
Norway	15.2	20	15.56	16	15.28	20	14.65	22
Finland	13.79	24	14.02	21	13.99	23	14.18	23
Czech Republic	18.71	15	15.55	17	14.23	22	13.65	24
Belgium	13.63	25	14.18	20	12.99	26	12.87	25

Netherlands	14.15	23	13.78	23	13.29	25	12.4	26
South Korea	6.65	70	10.68	31	11.56	31	12.1	27
Taiwan	6.11	72	10.33	35	12.26	27	12.05	28
Germany	15.28	19	12.27	28	11.76	28	11.9	29
Denmark	13.24	27	12.67	25	11.69	29	11.61	30
Slovenia	9.84	44	10.35	34	11.01	32	11.37	31
Austria	9.95	42	9.98	37	11.59	30	11.11	32
Poland	11.56	33	10.07	36	10.62	36	10.83	33
Libyan Arab Jamahiriya	12.68	30	10.64	32	10.77	35	10.51	34
Gibraltar	3.64	100	9.46	41	9.88	39	10.47	35
Japan	9.89	43	10.69	30	10.89	34	10.44	36
Bahamas	10.67	39	8.78	47	9.54	41	10.41	37
Israel	7.05	66	9.91	39	10.38	37	10.4	38
United Kingdom	12.98	28	11.35	29	10.9	33	10.33	39
Belarus	10.1	41	7.54	58	8.83	51	10.21	40
European Union EU-27	11.24	37	10.22	35	10.22	38	9.91	41
Greece	8.89	50	9.81	40	10.23	38	9.9	41
Uruguay	8.12	54	8.9	46	9.45	42	9.77	42
Ukraine	16.98	17	9.41	42	9.18	46	9.35	43
Bulgaria	11.09	38	7.94	53	8.73	52	9.32	44
South Africa	9.13	47	8.55	49	9.24	44	9.11	45
Singapore	5.92	73	7.31	61	9.21	45	8.96	46
Slovakia	13.36	26	9.18	44	8.94	50	8.91	47
Malaysia	3.94	95	6.74	63	8.24	54	8.88	48
Spain	7.24	64	8.98	45	9.58	40	8.77	49
France	9.49	46	9.31	43	8.97	49	8.63	50
Equatorial Guinea	0.49	196	7.67	55	9.24	43	8.62	52
Solomon Islands	18.99	14	9.96	38	9.17	47	8.62	51
Mongolia	11.41	35	10.38	33	7.9	57	8.61	53
Italy	7.7	60	8.59	48	9.11	48	8.46	54
Seychelles	4.64	84	6.24	67	7.37	64	8.38	55
Bermuda	10.12	40	7.87	54	8.69	53	8.2	56
Venezuela	8.09	55	8.44	51	7.88	58	8.02	57
Argentina	7.26	63	7.62	56	7.61	59	7.92	58
Lithuania	11.42	34	5.3	72	6.64	66	7.78	59
Hong Kong	6.38	71	6.66	64	6.8	65	7.49	60
Switzerland	8.04	56	7.36	59	7.49	62	7.42	61
China	3.25	106	3.83	91	5.84	72	7.41	62
Sweden	8.71	51	8.49	50	8.01	55	7.35	63
Cayman Islands	11.26	37	7.6	57	6.62	67	7.18	64
Hungary	9.02	49	6.89	62	7.39	63	7.07	66
Islamic Republic of Iran	4.89	82	6.58	65	7.99	56	7.07	65
Croatia	6.79	68	5.36	70	6.28	68	6.98	67
Portugal	5.07	80	7.32	60	7.52	60	6.62	68
Uzbekistan	7.73	59	6.44	66	6.25	69	6.61	69
Gabon	8.3	53	8.08	52	7.51	61	6.42	70
Bosnia and Herzegovina	6.87	67	4.63	79	5.42	75	6.35	71
Chile	3.88	98	5.59	68	5.99	71	6.28	72
Grenada	1.61	145	4.65	78	5.43	74	6.16	73
Romania	9.59	45	5.55	69	6.13	70	6.08	74
Serbia and Montenegro	7.64	61	5.14	74	3.63	100	5.89	75

Latvia	9.06	48	4.27	85	5.36	77	5.87	76
Guyana	3.89	97	5.15	73	5.41	76	5.52	78
Turkey	3.98	94	4.82	76	5	81	5.52	77
Azerbaijan	8.63	52	3.64	97	4.86	83	5.48	79
Macedonia	7.12	65	5.1	75	5.44	73	5.33	80
Antigua and Barbuda	5.42	76	4.78	77	5.05	80	5.29	81
Mexico	4.68	83	4.47	81	4.93	82	5.18	82
Botswana	5.07	79	4.41	83	5.2	79	5.16	83
Brazil	3.81	99	4.47	80	4.83	84	5.07	84
Cyprus	4.49	85	5.35	71	5.3	78	5.05	85
British Virgin Islands	4.41	87	3.78	94	4.27	90	4.98	86
Namibia	4.05	92	3.99	90	4.64	86	4.96	87
Thailand	2.96	112	4.03	89	4.71	85	4.78	88
Martinique	4.12	91	3.66	96	4.22	91	4.73	89
Algeria	4.14	90	4.29	84	4.37	88	4.59	90
Guadeloupe	3.17	107	3.82	93	4.39	87	4.51	91
Central African Republic	3.131	109	2.4	122	2.32	127	4.44	92
Armenia	5.76	74	2.21	126	2.73	117	4.04	93
North Korea	7.76	58	4.09	88	4.33	89	4.03	94
Iraq	4.92	81	4.42	82	3.96	92	3.97	95
Barbados	3.35	105	3.82	92	3.74	96	3.92	96
Bolivia	3.38	104	3.32	101	3.72	98	3.88	97
New Caledonia	5.55	75	4.16	87	3.76	95	3.85	98
Jordan	2.63	120	2.67	112	3.69	99	3.81	99
Belize	2.71	118	3.01	108	3.73	97	3.78	100
Paraguay	4.27	89	4.17	86	3.87	93	3.69	101
Cuba	3.58	101	3.07	106	3.13	106	3.53	102
French Guiana	4.33	88	3.31	102	3.29	103	3.5	103
Panama	2.42	123	2.61	115	2.72	118	3.46	104
Suriname	5.16	78	3.42	98	3.5	101	3.45	105
Aruba	6.79	69	3	109	2.82	115	3.44	106
Saint Kitts and Nevis	2.31	126	3.41	99	3.37	102	3.42	107
Lebanon	1.74	140	3.4	100	3.76	94	3.38	108
Colombia	3.45	103	3.29	104	3.12	108	3.23	109
Egypt	2.04	131	2.56	117	3.07	110	3.21	110
Tunisia	2.29	127	3.03	107	3.07	109	3.16	111
Ecuador	2.73	116	2.85	110	3.21	104	3.15	112
Jamaica	3.15	108	2.65	114	2.85	113	3.12	113
Saint Lucia	1.99	132	2.55	118	2.84	114	3.1	114
Mauritania	2.72	117	3.29	103	3.18	105	3.05	115
Dominica	1.75	139	1.99	136	2.49	121	2.93	116
Indonesia	1.9	135	2.35	123	2.69	119	2.81	117
Syrian Arab Republic	3.57	102	3.73	95	2.96	112	2.81	118
Viet Nam	1.26	161	1.75	144	2.45	123	2.78	119
Moldova	7.8	57	2.33	124	3.01	111	2.72	120
Georgia	5.39	77	2.19	128	2.38	125	2.67	121
Reunion	1.97	133	2.66	113	2.61	120	2.63	122
St Vincent & Grenadines	1.29	156	2.04	134	2.38	126	2.58	123
Malta	4.46	86	2.8	111	3.13	107	2.54	124
Dominican Republic	1.87	136	2.6	116	2.44	124	2.5	125
Fiji	3.04	111	1.9	138	2.19	130	2.46	126
Congo	3.12	110	3.21	105	2.75	116	2.45	127

Albania	2.84	114	2.06	133	2.49	122	2.4	128
Mauritius	1.27	158	1.74	145	2.23	129	2.38	129
Costa Rica	2.67	119	2.47	120	2.29	128	2.32	130
Kyrgyzstan	7.33	62	1.97	137	2.11	135	2.24	131
Sudan	1.78	137	2.14	130	2.19	131	2.24	132
Morocco	1.28	157	1.63	148	2.15	133	2.2	133
Swaziland	2.37	124	2.2	127	2.07	136	2.19	135
Djibouti	2.34	125	2.02	135	1.97	140	2.19	134
Nicaragua	2.09	129	2.07	132	2.14	134	2.15	136
French Polynesia	4.03	93	1.89	139	2.04	137	2.12	137
Tajikistan	3.92	96	1.59	149	1.87	143	2.11	138
Peru	1.67	143	1.86	140	1.93	142	2.1	139
Maldives	0.57	193	1.11	170	1.64	151	2.08	140
Myanmar	1.5	150	1.58	151	1.94	141	2.03	141
Somalia	2.46	122	2.414	121	2.186	132	2.02	142
India	1.46	152	1.67	147	1.78	146	1.96	143
Vanuatu	2.93	113	2.48	119	2.04	138	1.95	144
Honduras	1.55	149	1.57	152	1.74	148	1.89	147
Bhutan	1.62	144	1.79	141	1.69	149	1.89	146
Saint Helena	2.59	121	2.16	129	1.83	145	1.89	145
Angola	2.29	128	2.27	125	1.97	139	1.86	148
Pakistan	1.45	153	1.51	154	1.75	147	1.85	149
Zimbabwe	2.84	115	2.11	131	1.86	144	1.82	150
Samoa	1.71	141	1.76	143	1.67	150	1.78	151
Cambodia	1.561	147	1.287	165	1.59	152	1.69	152
El Salvador	1.13	164	1.45	156	1.59	153	1.61	153
Philippines	1.26	159	1.59	150	1.56	154	1.58	154
Laos	1.587	146	1.41	159	1.54	155	1.51	155
Yemen	0.99	170	1.19	167	1.44	158	1.49	156
Tonga	1.26	160	1.78	142	1.52	156	1.43	157
Guatemala	1.07	166	1.52	153	1.46	157	1.41	158
Macao	1.56	148	1.43	158	1.29	163	1.39	159
Chad	1.459	151	1.329	162	1.286	162	1.35	160
St Pierre & Miquelon	0.211	205	1.47	155	1.36	159	1.33	161
Mali	1.247	162	1.289	164	1.297	161	1.28	162
Madagascar	1.779	138	1.367	160	1.176	166	1.26	163
Sri Lanka	0.96	171	1.09	172	1.16	169	1.2	164
Guinea	0.95	173	0.83	181	0.92	177	1.2	165
Western Sahara	2.05	130	1.71	146	1.27	164	1.19	167
Nigeria	1.42	154	1.44	157	1.33	160	1.19	166
Cameroon	1.7	142	1.33	163	1.18	165	1.17	168
Senegal	1.03	168	1.14	168	1.16	168	1.15	169
Burkina Faso	0.914	174	1.023	175	1.075	170	1.1	170
Bangladesh	1.04	167	0.98	176	1.02	174	1.08	171
Guinea-Bissau	1.12	165	1.1	171	1.04	173	1.06	172
Kenya	1.34	155	1.05	174	1.05	172	1.05	173
Nepal	1.199	163	1.08	173	1.02	175	1.01	174
Benin	0.615	187	0.75	184	0.87	180	1	175

Sao Tome and Principe	0.71	183	1.36	161	1.05	171	0.99	176
Zambia	1.92	134	1.23	166	1.17	167	0.94	178
Faroe Islands	0.86	178	0.961	177	0.93	176	0.94	177
Ethiopia	1.023	169	0.857	179	0.908	178	0.889	179
Togo	0.68	184	0.66	191	0.63	191	0.87	180
Papua New Guinea	0.73	182	0.63	193	0.76	185	0.86	181
Tanzania	0.958	172	0.916	178	0.91	179	0.85	182
Timor-Leste	0.587	191	0.721	187	0.852	181	0.825	183
American Samoa	0.43	200	0.83	180	0.84	183	0.82	184
Puerto Rico	0.78	180	0.78	183	0.82	184	0.81	185
Eritrea	0.908	176	1.12	169	0.84	182	0.77	186
Haiti	0.62	186	0.73	186	0.76	186	0.74	187
Cape Verde	0.59	190	0.75	185	0.75	187	0.74	188
Ghana	0.57	194	0.67	190	0.66	190	0.74	189
Lesotho	0.91	175	0.644	192	0.673	189	0.69	190
Cote d'Ivoire	0.61	188	0.81	182	0.72	188	0.68	191
Gambia	0.8	179	0.68	189	0.62	192	0.62	192
Comoros	0.58	192	0.54	195	0.48	197	0.61	193
Uganda	0.606	189	0.56	194	0.571	193	0.58	194
Kiribati	0.49	197	0.5	198	0.48	198	0.53	195
Mozambique	0.459	198	0.399	200	0.49	195	0.5	196
Niger	0.734	181	0.697	188	0.508	194	0.48	197
Sierra Leone	0.65	185	0.51	197	0.45	200	0.48	198
Burundi	0.33	204	0.264	205	0.42	201	0.47	199
Guam	0.419	201	0.448	199	0.451	199	0.46	201
Afghanistan	0.88	177	0.532	196	0.482	196	0.46	200
Malawi	0.372	202	0.366	201	0.388	202	0.37	202
Rwanda	0.334	203	0.339	202	0.353	203	0.36	203
Liberia	0.45	199	0.32	203	0.33	204	0.31	204
Congo's Dem. Rep.	0.502	195	0.289	204	0.269	205	0.28	205

List of Abbreviations

AZE	*Azerbaijan*
ARM	*Armenia*
BLR	*Belarus*
GEO	*Georgia*
KAZ	*Kazakhstan*
KGZ	*Kyrgyzstan*
MDA	*Moldova*
TJK	*Tajikistan*
TKM	*Turkmenistan*
UKR	*Ukraine*
UZB	*Uzbekistan*

ADAM	*ADaptation And Mitigation Strategies project*
BAU	*Business-As-Usual*
BEI	*Baseline emission inventory*
BC	*Black carbon*
CC	*Climate Change*
CIRCE	*Climate Change and Impact Research in the Mediterranean Environment*
CO2eq	*CO2 Equivalent*
CoM	*Covenant of Mayors*
CoM East	*Covenant of Mayors Eastern Partnership*
DGENV	*Directorate General for the Environment*
EDGAR database	*Emission Database for Global Atmospheric Research*
EC	*European Commission*
GWP	*Global Warming Potential*
GWP100	*Global Warming Potential calculated for a period of 100 years*
GHG	*Greenhouse Gas*
IEA	*International Energy Agency*
ICLEI	*International Council for Local Environmental Initiatives*
IMAGE	*Integrated Model to Assess Global Environment*
IPCC	*Intergovernmental Panel on Climate Change*
IPCC A1B	*IPCC Scenario type A1B*
IPCC B1p	*IPCC Scenario type B1p*
IPCC AR3	*IPCC Third Assessment Report*
IPCC AR4-WG3-TS	*IPCC Fourth Assessment - Technical Support Unit of Working Group III*
IPCC-WG3-TS	*IPCC - Technical Support Unit of Working Group III*

JRC-IPTS	*Joint Research Centre - Institute for Prospective Technological Studies*
LULUCF	*Land-Use, Land-Use Change and Forestry Sector*
MNP	*Netherlands Environmental Assessment Agency*
NIS countries	*Newly Independent States*
NMVOC	*Non-methane volatile organic compounds*
OC	*Organic carbon*
POLES	*Prospective Outlook for the Long Term Energy System*
SRES	*Special Report on Emissions Scenarios*
SEAP	*Sustainable Energy Action Plan*

2000-AR4	*Projections according to IPCC SRES Fourth Assessment Scenario for 2000*
2000-CIRCE	*Projections according to CIRCE Scenario for 2000*
2004- AR4	*Projections according to IPCC SRES Fourth Assessment Scenario for 2004*
2005-CIRCE	*Projections according to CIRCE Scenario for 2005*
2050-ADAM	*Projections according to ADAM project for 2050*
2050-AR3-A1B	*Projections according to IPCC SRES Third Assessment Scenario Type A1B for the year 2050*
2050-AR3-B1p	*Projections according to IPCC SRES Third Assessment Scenario Type B1p for 2050*
2050-AR4-catII	*Projections according to IPCC SRES Fourth Assessment Scenario cat II for 2050*
2050-AR4-catV	*Projections according to IPCC SRES Fourth Assessment Scenario for 2050*
2050-CIRCE-BAU	*Projections according to CIRCE Business as Usual Scenario for 2050*
2050-CIRCE-CC	*Projections according to CIRCE – Climate Change Scenario for 2050*

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