

Bridging the greenhouse-gas emissions gap

Supporting online material - Details on the calculations

For the quantification of the total impacts of the initiatives on global GHG emissions, we applied three steps. (1) Quantification of the impact on GHG emissions of each initiative separately, (2) Calculation of the effect additional to pledges by assuming factors of overlap between the individual initiatives and pledges, and (3) Calculation of the cumulative effect of the initiatives by assuming factors of overlap between initiatives.

The quantification of the effect of individual initiatives is based on simple assumptions, see below. The overlap of the initiatives to the pledges is made assuming overlap factors, see table below. Pledges of countries are only in rare cases specified by sector, so it is not apparent from the pledges how exactly they will overlap with the initiatives. Based on our knowledge of the pledges, we assumed the overlap factors given in the last columns in the table below.

The overlap between initiatives is also estimated assuming overlap factors, see last column of the table below. Moving from top to bottom of the table, we assumed, which share of the effect of the initiative is additional to all of the initiatives above. Summing this additional effect from top to bottom gives the total effect of all initiatives.

Top-1,000 companies; emission reduction

- Energy-related greenhouse gas (GHG) emissions of top 1,000 companies in 2010: 10 GtCO₂e (own analysis based on public data including from the Carbon Disclosure Project). Consists largely of energy companies and energy intensive industry.
- Assumed growth of energy related emissions from 2010 to 2020: 20% based on (Bernstein *et al.* 2007)
- Assuming 30% of the companies participate each with a 10% reduction below business-as-usual in 2020 for energy related emissions
- Reduce non-CO₂ greenhouse emissions by 50%, i.e. by 0.3GtCO₂e, which is possible at a cost below 20 \$/tCO₂e (Bernstein *et al.* 2007)

Supply chain emission reductions:

- Energy-related greenhouse gas emissions of top 1,000 companies in 2020 from above
- Assumed share of supply chain emissions: 50%
- Assumed that 30% of companies to require their supply chains to reduce emissions 10% below business-as-usual in 2020

Green financial institutions:

- Average carbon footprint of Canadian banks: 1100 kgCO₂/10000C\$ (Barkley 2008)
- Assets of the 20 largest global banks in 2011: 43,325 billion US\$ (<http://www.relbanks.com/worlds-top-banks/assets-2011>)
- Assumed increase by 2020: 10%
- Assumed that 20 largest banks to reduce the carbon footprint of 10% of their assets by 80%

Voluntary offset companies

- Direct energy related CO₂ emissions and emissions from electricity consumption in light industry and commercial sector in 2008 are 6.2 GtCO₂e (IEA 2010)
- Assumed growth of emissions from 2008 to 2020: 27% based on global growth rate from (UNEP 2011)
- We assume that 20% of the companies offset their emissions

Major cities initiative

- Cities grouped in the C40 currently emit 2.9 GtCO₂e (C40 Cities 2011)
- Assumed growth of emissions from 2010 to 2020: 27% based on global growth rate from (UNEP 2011)
- Cities included in C40 or an equivalent sample reduce their emission 20% below BAU in 2020, a value based on existing commitments of some example cities as reported in (Arikan *et al.* 2011)

Sub-national governments

- Action in the active states in the USA could lead to reductions of 0.6 GtCO₂e (World Resource Institute 2010)
- Actions in provinces in Canada is negligibly small compared to the reductions in the USA

Voluntary offset consumers

- Average per capita emissions from developed countries (Annex I) excluding land use change and forestry in 2009: 14 tCO₂e (Höhne *et al.* 2011)
- Projections for emissions of developed countries as a group are usually stable until 2020, so we do not assume a growth or decrease from 2010 to 2020.
- Share of emissions directly influenced by consumers, i.e. their electricity consumption, heating and road and air transport: roughly half of total per capita emissions, i.e. 7 tCO₂e
- Assuming 50% more consumption by individuals with high income compared to average: 10.5 tCO₂e
- We assume that 10% of the 20% richest global population offset these 10.5 tCO₂e.
- Compensating 10.5 tCO₂e at 20US\$/t results in 210 US\$

Building heating and cooling

- Mitigation potential from buildings: 1.8 GtCO₂e in 2020 (average from Blok *et al.*, 2011)
- Assumed that 30% of the full reduction potential is achieved

Ban of incandescent lamps

- Mitigation potential from globally ban incandescent lamps by 2016: 0.23 GtCO₂e (www.enlighten-initiative.org)

Electric appliances

- Electricity saved by use of efficient appliances in 2030: 1,800 TWh/a (SEAD 2011), linearly scaled for 2020
- Emission factor of electricity replaced: 741g/kWh (fossil fuel average for 2008 from IEA 2010)

Cars and trucks emission reduction:

- The emissions of new cars in Europe dropped by almost 20% in the last decade (Eurostat 2011)
- Number of cars in 2020: 1bln with average distance travelled of 15000 km per year (WEC 2011)
- Assuming to save globally one additional litre per 100 km in 2020 leads to 0.34GtCO₂e
- Due to lack of data we assumed the same amount of reduction potential for trucks
- The resulting 0.69 GtCO₂e compare well to the emission reduction potential of 0.7 GtCO₂e from ICCT (forthcoming)

Boost solar photovoltaic energy

- Global potential for installed PV capacity in 2020 of 600 – 1600 GW is estimated by Breyer (forthcoming). We assumed the top of the range

- Full load hours: 1200h/a
- Emission factor of electricity replaced: 741g/kWh (fossil fuel average for 2008 from IEA 2010)

Boost wind energy

- Additional 650 GW of wind capacity could be by 2020 compared to a reference scenario (GWEC 2010)
- This would result in additional 1609 TWh of electricity produced compared to the reference scenario (GWEC 2010)
- Emission factor of electricity replaced: 741g/kWh (fossil fuel average for 2008 from IEA 2010)

Access to energy through low-emission options

- Number of people lacking access to electricity in 2009: 1441 million (source)
- Assumed to increase linearly with population to 1589 million by 2020
- Assumed electricity use per additional person by 2020: 600 kWh (own assumption)
- Assumed that 50% of the additional electricity is provided by low carbon fuels
- Emission factor of electricity replaced: 741g/kWh (fossil fuel average for 2008 from IEA 2010)

Phasing out subsidies for fossil fuels

- Total emission reductions potential from phasing out fossil fuel subsidies: 1.8 GtCO₂e (IEA 2011)
- Assumed that countries to phase out half of all fossil fuel subsidies

International aviation and maritime transport

- Reduction potential in aviation in 2020: 0.1 GtCO₂ (Blok *et al.* 2011)
- Reduction potential in shipping in 2020: 0.3 GtCO₂ (average of Blok *et al.* 2011)
- Assumed implementation: 50%

Fluorinated gases (hydrofluorocarbons, perfluorocarbons, SF₆)

- Mitigation potential: 0.5 GtCO₂ (Meinshausen *et al.* 2010)
- Assumed that half of the technical mitigation potential

Reduce deforestation

- Total global deforestation emissions in 2010: around 1 GtC or 3.6 GtCO₂ (Global Carbon Project 2011, which is consistent with Nabuurs 2007)

Efficient cookstoves

- 560 million households rely on traditional biomass for cooking (WEO 2006)
- Potential to reduce emissions per cook stove: around 2 tCO₂e per year, where 0.5 tCO₂ is from reduction of non-renewable biomass and 1.3 tCO₂e from black carbon using a GWP of 680 from Bond 2005 and the rest from methane (Persoon 2010). Note that there is debate about the use of GWPs for black carbon due to its short lifetime and large uncertainties. Also note that there is additional overlap, as UNEP 2011 assumes that some black carbon emissions are reduced *in addition* to closing the 12 GtCO₂e gap in order to reach the limit of 2°C.
- We assume that by 2020, half of the cook stoves can be replaced.

Table. Assumptions on the overlaps

	Initiative	Emissions reductions (GtCO ₂ e)	Assumed overlap factors		
			Additional to low ambition pledges	Additional to high ambition pledges	Additional to all initiatives above
Actors	Top-1000 companies emission reduction	0.7	70%	50%	
	Supply chain emission reductions	0.2	70%	50%	50%
	Green financial institutions	0.4	70%	50%	30%
	Voluntary offset companies	2.0	70%	50%	70%
	Voluntary offset consumers	1.6	70%	50%	70%
	Major cities initiative	0.7	70%	30%	70%
Sectors	Sub-national governments	0.6	100%	0%	70%
	Building heating and cooling	0.6	50%	30%	50%
	Ban of incandescent lamps	0.2	50%	30%	30%
	Electric appliances	0.6	70%	50%	30%
	Cars & trucks emission reduction	0.7	70%	50%	70%
	Boost solar photovoltaic energy	1.4	70%	50%	50%
	Boost wind energy	1.2	70%	50%	50%
	Access to energy through low-emission options	0.4	100%	50%	100%
	Phasing out subsidies for fossil fuels	0.9	70%	50%	50%
	International aviation and maritime transport	0.2	100%	100%	70%
	Fluorinated gases initiative (HFCs, PFCs, SF ₆)	0.3	90%	70%	50%
	Reduce deforestation	1.8	100%	50%	70%
	Agriculture	0.8	90%	70%	70%
	Enhanced reductions methane and air-pollutants (excl. SO _x)		100%	100%	100%
	Efficient cookstoves		100%	100%	100%
Total		*9.6			

*: Accounting for overlaps

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