China and the US: how does their climate action compare?

Climate Action Tracker

Policy Brief

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Summary

- Together, China and the US emit about 35% of today's greenhouse gas emissions. Current global climate change action is insufficient to limit warming below 2°C. By improving action of China and the US to global best practice, these two largest emitters could decrease domestic emissions to a level compatible with 2°C and together close 23% of the 2020 emissions gap. For 2030, this would mean a decrease in emissions below current global policy projections by 10%.
- Comparing activity levels and greenhouse gas emissions per unit of output and respective policies of China and the US we find:
  - **Electricity production:** The average US citizen currently consumes four times more electricity than an average Chinese citizen. Both countries achieved significant reduction in emissions per kWh for produced electricity; both reduced the use of coal, but China started from a higher intensity level. Future policy will continue that trend in China but not in the US. Holding warming below 2°C means rapidly decarbonising the electricity production. Both countries are expected to deploy more coal capacity in the future than is compatible with the 2°C objective. According to the IEA (2013), 80% decarbonisation is needed in the US by 2030, and 60-70% decarbonisation in China.
    In a 2°C world, total primary energy coal use/CO2 emissions from coal need to drop rapidly, reaching mid-1990 levels by 2030. Present policies in the US and China, where the US is reducing coal by around 20%, and where China is stabilising coal use by the 2030s, are far from the deep reductions indicated for both countries in coal use by that time.
  - **Industry:** Industrial activity is still growing significantly in China, while it is stagnating or declining in the US. China has more efficient cement plants, while the US is leading in efficiency of iron & steel plants. China has a generally more

rigid policy framework, but is still growing absolute emissions due to expansion.

- **Buildings:** Floor space per inhabitant is roughly twice in the USA compared to China. Energy use per square metre of floor area in the residential sector is three times higher in the US than in China. The difference is decreasing as floor space and specific energy consumption is significantly increasing in China. Both employ building codes and appliance standards.
- **Transport:** Car ownership is ten times higher in the USA compared to China, but the difference is declining. In addition, China has still lower emissions per car. Both countries implement vehicle emissions standards; those of China are slightly stronger.

- In each category, if China and the US were to move to the more ambitious policy area of the two, they could achieve additional reductions below current policy projections of 170/3200Mt in China and 220/1100Mt in the USA in 2020/2030. In relative terms these are reductions of 1.2% in 2020 and 20% in 2030 below current policy projections for China and 3.2% and 16% for the US.
- If China and the USA were to both apply the most ambitious policy level found anywhere in the world (global best practice) in each area, they would both overachieve their 2020 pledges and be on a pathway compatible with the agreed 2°C warming limit. Our explorative scenarios show that under global best practice:
  - Emissions in the US would be in the order of 18% below 2005 in 2020 and 32% in 2030 (excl. LULUCF).
  - Emissions in China could peak below 12 GtCO2e/a in the early 2020s[1] and then drop.
  - Together the countries would reduce emissions in 2020 by 2.8 GtCO2e/a below current policy projections and thus close 23% of the emissions gap.[2] In 2030, the reductions would be of 6.7 GtCO2e/a, or 10% below the Climate Action Tracker global current policy projections.

[1] We only evaluate emissions in 2010, 2020 and 2030. Emission in 2020 are higher than those of 2010 and 2030.

[2] Defined as 12 GtCO2e/a in 2020 (this briefing)

Introduction

Together, the US and China emit more than 35% of global GHG emissions (Climate Action Tracker 2013). Both play a central role in climate negotiations, and progress is not possible without them.

Cognisant of their roles, China and the US have lightly coordinated their actions on climate change (for example, making announcements on mitigation in the same week in Bonn, June 2014, and an agreement on HFCs). However, there are huge differences in their economic and political systems, their culture, and their stages of development.

This policy brief provides a way to compare the mitigation activities of China and the US, despite those very different circumstances. We illustrate how sectoral indicators compare and describe the governments' main actions in those areas. Lastly, we explore how emissions would develop if (for selected policy areas) both were to apply the same ambition level, in one case the better of the two, and in the other, the global best practice.

This briefing also analyses whether these scenarios are compatible with holding global temperature increase below 2°C, specifically highlighting the necessary decarbonisation of the energy supply.

Sectoral considerations

Greenhouse gas emissions are usually driven by an "activity rate" (e.g. how much floor space is used and how many kilometres are travelled) and a "greenhouse gas intensity" (emissions per m^2 floor space or per travelled kilometre). Both, together, determine the level of greenhouse gas emissions.

Electricity sector

The electricity generation per capita (a proxy for activity) is quite different in China and the US. In 2011, China generated 3.5 MWh per capita, while US power plants produced 13 MWh per capita.[3]

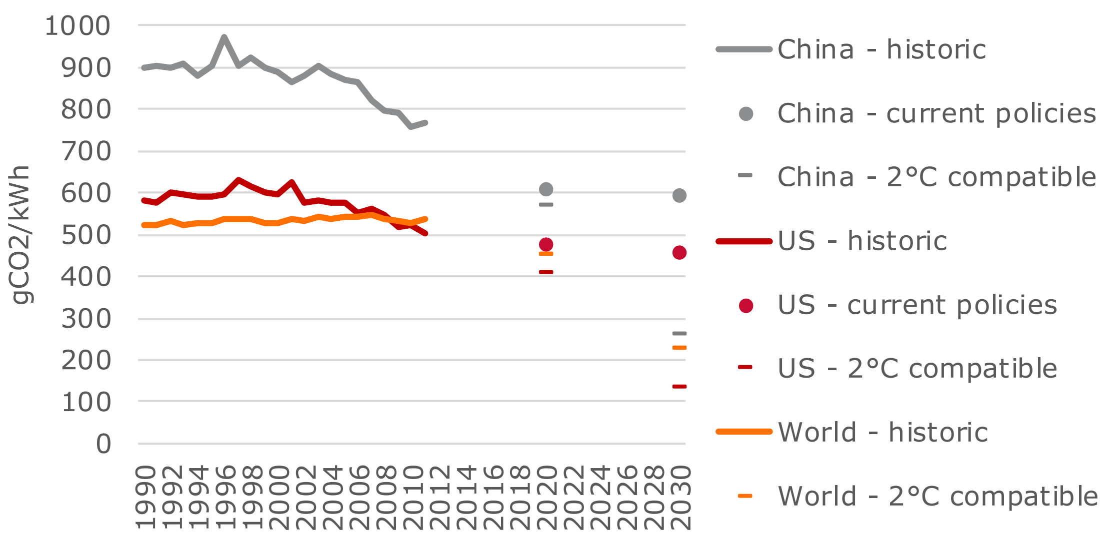

Figure 1. Recent and future development in GHG intensity of electricity production. (Data sources: historic: IEA emissions database (IEA 2013a); future: CAT implemented policies scenario, WEO 2013 450ppm scenario used for 2°C compatibility (IEA 2013b))

[3] Own calculations based on (IEA 2013b) and (National Bureau of Statistics of China 2013) for China, and (US EPA 2014a) and (Anon 2012) for US.

The Chinese and US electricity sectors both depend on the emissions-intensive fuel, coal, but for both the direct emissions for each kWh electricity produced (intensity) is declining due to increased use of gas and renewables (Figure 1).

- China starts from a higher level due to a higher share of coal, but is likely to accelerate the fast trend of decarbonisation of the electricity sector it has achieved since 2005 of 2% per year by 2020 with of 2.5% per year (CAT implemented policies scenario).
- The US also achieved a decarbonisation of 2% per year since 2005; but, with only its current policies, that will drop to 0.5% per year to 2020.

With currently implemented policies, the share of coal in China's electricity sector is projected to remain above 50% in 2030 and at roughly 35% in the USA, while scenarios compatible with holding warming below 2°C require a fast and complete phase-out of coal.

Figure 1 shows that also in terms of overall emission intensity of the electricity sector, both countries are not yet on a 2˚C pathway.

The development and policy approaches of both countries are remarkably similar:

- Both regulate the emissions intensity of the electricity production: China through regional targets and closing inefficient plants; the US through proposed national regulations limiting the emissions intensity of new power plants and obliging states to decrease power sector emissions.
- Both implement renewable energy targets, China on a national level and the US on a state level.
- Both implement emissions trading systems covering the electricity sector on a regional level, with China planning to roll it out on a national level in the coming years.

Industry

Industrial structures in China and the USA are quite different: Chinese industry is expanding rapidly, while US industry is stagnating or declining and it has therefore a larger share of older and inefficient plants.

For iron & steel production, China's emissions intensity has decreased since the 1990s but potential savings per tonne of steel to reach best available technology are still significantly higher than in the US. In the cement sector, it is the other way around: China is slightly more efficient than the US. (Figure 2).

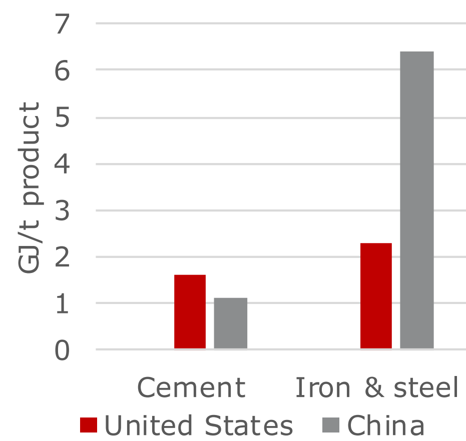

Figure 2. Current specific energy *saving* potential in iron & steel and cement production (not energy use per product) (Source: (IEA 2012))

Policy approaches are also quite different: China applies binding energy targets to the 10,000 top-emitting companies and regulates the closure of inefficient plants. Conversely, the US builds on voluntary programs with the industry and standards for industrial motors. The regional emissions trading systems in both countries also apply to emissions from industry.

In essence, China has generally more efficient plants in the cement sector but still has increasing absolute emissions due to rapid expansion. The intensity of the iron and steel sector is lower in the US. With binding targets, China generally has a more rigid policy framework.

Buildings

Energy consumption and related emissions from buildings are quite different in China and the US. In the US, existing buildings make up the major part of energy consumption, while China's share is much smaller as some of the floor space is still not heated or cooled. Consequently the energy use per m2 (intensity) is lower in China by a factor of 4 than in the US (Figure 3).

In addition, each US inhabitant occupied, on average, almost 80 m² in 2010 (shrinkthatfootprint.com 2014) (activity), while in China it was only between 30 and 40 m² (National Bureau of Statistics of China 2013).

In China, large amounts of new buildings are added annually (Feng et al. 2014), which presents a large opportunity to make them energy efficient from the outset.

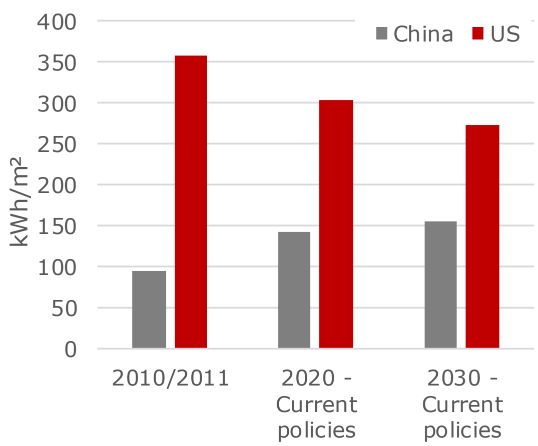

Figure 3. Energy use per m² (incl. heating/cooling + appliances, residential only) (Source: Own calculations based on AOE 2014 for US, and on Chinese Statistical Yearbook 2013 for China historic, and WEO and own assumptions for 2020/2030)

Both the US and China have minimum energy performance standards for new and refurbished buildings. China has defined standards for urban areas and all climate zones, setting limits on heat losses and the structural design of buildings (Wuppertal Institut 2014). The US regularly updates standards for commercial and residential buildings ("Ashrae codes"), which the states then implement. However, it's difficult to compare the two codes directly, due to differences in the design.[4]

Transport

Personal transport is quite different in China and the USA. While car ownership has grown rapidly in China, there are still 10 times more passenger vehicles per person (a proxy for activity) in the US than in China (World Bank 2014). US cars are usually larger and therefore less fuel efficient (intensity), although the difference is declining (Figure 4).

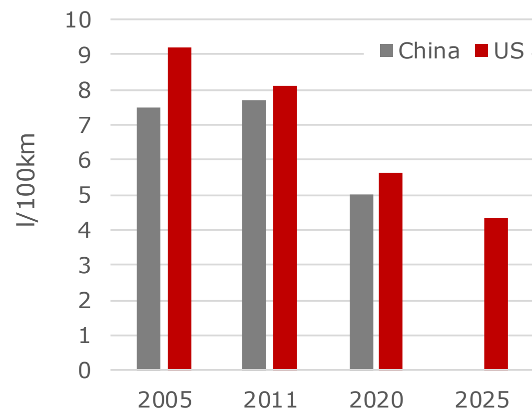

Figure 4. Fuel efficiency of new cars (source: history GFEI Annual Report 2014 (GFEI 2013), future: currently implemented fuel efficiency standards)[5]

Policy approaches for both countries are similar: both countries have emission standards for new cars that are significantly strengthened over time. China has a slightly stronger standard for cars for 2020 but has not yet set one for 2030 (ICCT 2014). The US has implemented standards up to the year 2025 (US EPA 2014b). Both have emissions standards for trucks and both support biofuels for transport.

In summary, China has lower emissions intensity and lower transport activity.

[4] The Ashrae 2013 standards in the USA are expected to lead to an average of 171kWh/(m²*a) (=54.1kBtu/(m²*a) (US Department of Energy 2014) while a exemplary reference building in China would use 122kWh/(m²*a) of primary energy (internal building simulation).

[5] For China we assume that the standard for 2020 currently under revision will pass.

Summary

While sectoral trends in China and USA are quite different, the policy approaches are remarkably similar in many cases (Table 1).

Table 1. Summary of sectoral developments and policies in China and the USA (green shading indicates the less emission intensive value of both)

Sector	Figures with recent developments	China	US	Comparison
Electricity generation	Activity: electricity generation per capita in 2011 (kWh/cap)	3500	13000	- Significantly higher generation per capita in the US - Similar development on GHG intensity of electricity reducing coal, China starting from a higher level - Similar policy approaches with more stringent trend in China
	Intensity: emissions per kWh electricity in 2011 (gCO2/kwh)	764	503	
	Intensity: emissions per kWh electricity in 2030 current policies (gCO2/kwh)	596	461	
	Main policies	- Regional targets - Closing inefficient power plants - Renewable capacity targets - Pilot emission trading systems and national roll out	- Clean power plan regulating emissions per kWh - State level renewable targets - State level ETS	
Industry	Intensity: Energy saving potential for iron & steel production in 2010 (GJ/t of product)	6.4	2.3	- China less emission intense in cement, USA less in iron & steel production - Generally more rigid policy framework in China - Still growing emissions in China due to expansion
	Intensity: Energy saving potential for cement production in 2010 (GJ/t of product)	1.1	1.6	
	Main policies	- Targets for the top 10 000 energy consuming companies - Closing inefficient plants - Pilot emissions trading systems and national roll out	- Voluntary programmes - Efficiency standards for industrial motors - State level ETS	
Buildings	Activity: Floor space per inhabitant in 2010	30-40	80	- Floor space per inhabitant in the US double that of China - US energy use per floor space 4 times higher than China - Similar policies with building codes and standards but both can be improved
	Intensity: Energy use for heating, cooling and appliances 2010/2011 [kWh/m²]	94	357	
	Main policies	- Building standards in residential and commercial sector - Some mandatory labelling	- Building standards in residential and commercial sector - Mandatory labelling for a broad range of appliances	
Transport	Activity: Car ownership (passenger cars per 1000 persons 2010	44	423	- China has lower emissions intensity and lower transport activity - Similar policy approaches with standards; Chinese standard for cars slightly more ambitious for 2020, US standards extend until 2025
	Intensity: Fuel economy of new cars in 2010 (l/100km)	7.7	8.1	
	Intensity: Share of biofuels 2010	0.6%	4.1%	
	Main policies	- Car standard - Truck standard - Biofuel support - Tax incentives for energy efficient cars	- Light duty vehicle standard - Truck standard - Tax incentives and quota for biofuels	

Possible emissions pathways of increased action

China and the USA are currently discussing their "intended nationally determined contributions" (INDC's) for a 2015 international climate agreement. In determining them, they will be closely watching the other party's proposal. To support such a comparison, we provide two hypothetical scenarios where we assume that (for the selected policy areas) both countries apply the same ambition level. Then we compare the resulting numbers with least cost scenarios compatible with holding global warming below 2°C.

We consider the following scenarios:

- "**Best of both**": for the selected policy areas, both countries apply the more ambitious level of the two.
- "**Best practice globally**": both countries apply global best practice - the most ambitious level that can be found in anywhere in the world.
- "**2°C compatible global least cost**": for reference, we also show scenarios used in the IPCC report that describe how emissions reductions can be distributed globally in the most cost-efficient way, with mitigation starting immediately, while guaranteeing global levels consistent with holding temperature increase below 2°C.[6]

For the "global best practice" case, we made the following assumptions:

- Electricity: increase in share of renewable generation of 1.3 percent per year (the average trend since 2005 in Germany or UK)
- Industry: additional annual emission reduction by 1%point[7].
- Buildings: all new buildings comply with low energy standard of 40 kWh primary energy per m² as of today and move

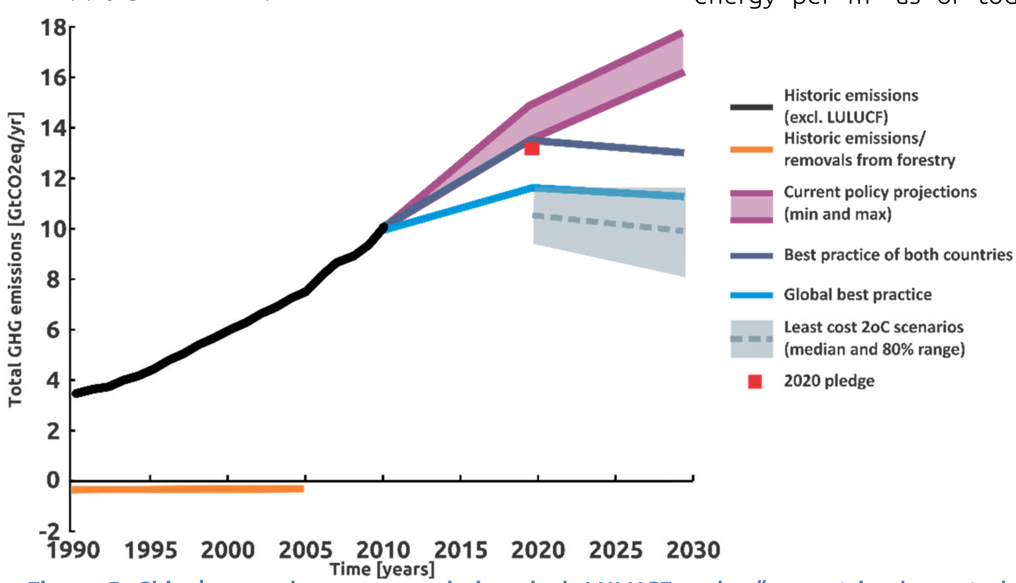

Figure 5. China's greenhouse gas emissions incl. LULUCF under "current implemented policy", the explorative scenarios "best of both" and "best practice globally" and "2°C compatible global least cost". Least cost scenarios do not reflect fair shares or reductions.

[6] The scenarios do not reflect who should pay for the mitigation in the region where the reductions are achieved. "Immediate mitigation" means starting year 2010. We do not extend the analysis to a comparison with 1.5°C because of limited data availability.

[7] Each 0.5% for renewable energy and for energy efficiency. See methodology document of Climate Action Tracker 2.0 (Climate Action Tracker 2011)

towards zero energy in 2020 (policy in the EU).

- Transport: fuel efficiency standard is that of new cars of the EU; 6% of new vehicles are electric in 2020, 12% in 2030 (currently 12% in Norway (Shahan 2014)). We did not consider biofuels because their uncertain net effect on emissions.
- All other emissions were not considered in detail, but for completeness we assumed that also in these areas reductions of the same level are achieved (same percentage below the current policy scenario).

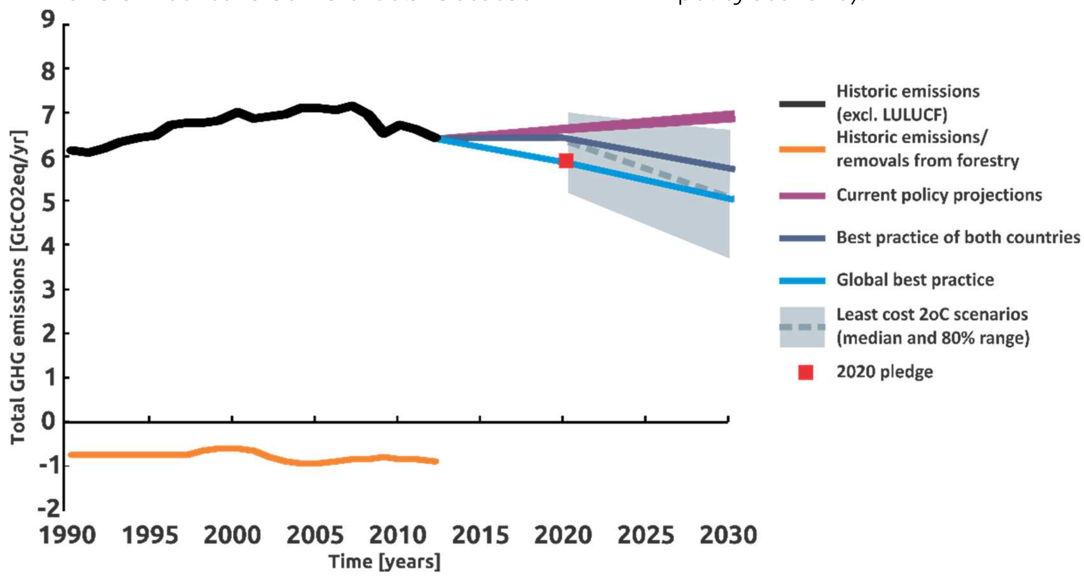

Figure 6. US Greenhouse gas emissions excl. LULUCF under "current implemented policy," the explorative scenarios "best of both" and "best practice globally" and "2°C compatible global least cost". The least cost scenarios do not necessarily reflect fair shares of reductions.

Findings

In each of these policy areas, if China and the USA were to move to the more ambitious policy level of the two, they could achieve additional reductions of 170/3200Mt in China and 220/1100Mt in the USA by 2020/2030. In relative terms these are reductions of 1.2% in 2020 and 20% in 2030 below current policy projections for China and 3.2% and 16% for the US.

As the largest emitters of greenhouse gases, both could lead by significantly improving their action to global best practice to be compatible with 2°C. For each policy area, if China and the USA were to apply global best practice, US emissions would be 18% below 2005 in 2020 and 32% in 2030. China's emissions would peak below 12 GtCO2e around 2020. We find that if China and the US applied global best practice, this would put them both on track to stay within a cost-efficient pathway to hold warming below 2°C ("best practice globally" is in the range of the 2°C compatible scenarios from the IPCC). Together the countries would reduce emissions in 2020 by 2.8 GtCO2e/a below current policy projections and thus close 23% of the 12 GtCO2e/a emissions gap[8]. In 2030, the collective reductions would be at 6.7 GtCO2e/a or 10% below the Climate Action Tracker global current policy projections.

[8] This is the difference between the median estimate of emissions by 2020 in likely 2°C pathways from IPCC (Climate Action Tracker 2014) on the one hand, and the global emissions level by that time in the CAT emission pathway based on current policy projections on the other.

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Background on the Climate Action Tracker

The "Climate Action Tracker", www.climateactiontracker.org, is a science-based assessment by Ecofys, Climate Analytics and the Potsdam Institute for Climate Impact Research (PIK) that provides regularly updated information on countries' reduction proposals.

The Climate Action Tracker[9] reflects the latest status of the progress being made at international climate negotiations. The team that performed the analyses followed peer-reviewed scientific methods (see publications in Nature and other journals)[10] and significantly contributed to the UNEP Emissions Gap Report[11].

The Climate Action Tracker enables the public to track the emission commitments and actions of countries. The website provides an up-to-date assessment of individual country pledges about greenhouse gas emission reductions. It also plots the consequences for the global climate of commitments and actions made ahead of and during the Copenhagen Climate Summit.

The Climate Action Tracker shows that much greater transparency is needed when it comes to targets and actions proposed by countries. In the case of developed countries, accounting for forests and land-use change significantly degrades the overall stringency of the targets. For developing countries, climate plans often lack calculations of the resulting impact on emissions.

Contacts

Dr. Niklas Höhne (n.hoehne@ecofys.com) - Director of Energy and Climate Policy at Ecofys and lead author at the IPCC developed, together with Dr. Michel den Elzen from MNP, the table in the IPCC report that is the basis for the reduction range of -25% to -40% below 1990 levels by 2020 that is currently being discussed for Annex I countries.

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9 www.climateactiontracker.org

10 e.g. http://www.nature.com/nature/journal/v464/n7292/full/4641126a.html and http://iopscience.iop.org/1748-9326/5/3/034013/fulltext

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