THINK TANK & RESEARCH

TECHNICAL NOTE

Background and Methodology

Climate Change Performance Index

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Summary

Emitting about 75% of global greenhouse gas (GHG) emissions and 82% of global energy-related CO_2 emissions (2014), the G20 as the 20 biggest economies have a particularly high responsibility in leading the world towards success in limiting global warming to well below 2°C, if not 1.5°C, as agreed to in the Paris Agreement in 2015. With its new methodology, the Climate Change Performance Index (CCPI) is now suited to measure the progress of countries towards contributing to the climate goals agreed to in Paris. It is applied for the first time for the G20 countries in July 2017. If the data availability is guaranteed for all 58 CCPI countries, the methodology will be adopted for the following CCPI editions.

The Climate Change Performance Index is an instrument designed to enhance transparency in international climate politics. Its aim is to put political and social pressure on those countries which have, up until now, failed to take ambitious action on climate protection. It also aims to highlight those countries with best practice climate policies.

Content

Foreword

Corresponding to the record breaking global emissions of the last years, the carbon dioxide (CO_2) concentration in our atmosphere already exceeds the historic value of 400ppm. If this trend is not inverted, our chances to stay well below the 2°C guardrail and thus avoid climate change with all its expected impacts are virtually zero. With business as usual (BAU) scenarios, at the moment we are heading towards an average global warming of 4 to 6°C and still towards an up to 3°C, if countries fulfil their publicly announced mitigation targets.

The subsequent worldwide dramatic consequences are impressively documented in the World Bank report "Turn down the Heat". The World Energy Outlook from the International Energy Agency (IEA) states clearly that, if we want to protect our atmosphere properly, two-thirds of the available fossil fuel resources must remain in the ground.

At the same time the future of our energy supply system is at a crossroads. For one thing, we may well be seeing the start of a new fossil age. The shale gas revolution in the United States, the tar sands in Canada and a lot of other unconventional new sources of fossil fuels are being exploited right now. This new supply is driving down the price of conventional fossil fuels. For another, we witness massive investment in renewable energy all over the world. Renewable energy technologies are constantly improving and the costs involved are sinking at an impressive pace. Especially wind and solar energy provide already a sustainable and affordable - oftentimes already cheaper - energy alternative. The competition of the two supply systems – new fossil fuels vs. renewable energies – has not been decided yet. But this competition is one key issue and will be decisive for the success or failure of decarbonisation process.

The other key issue is energy efficiency. We must produce our electricity and goods much more efficiently, yet simultaneously avoid rebound effects that are typically associated with gains in efficiency.

The two most promising strategies for a low-carbon future, that are large-scale deployment of renewable energies and efficiency improvements leading to a globally stable or even decreasing energy use, play a prominent role in the methodology of the Climate Change Performance Index (CCPI). The CCPI was developed to accompany countries along this low-carbon pathway as well as to point out the weaknesses and strengths in the development of their national and international climate policies.

After the twenty-first session of the Conference of the Parties (COP21) in Paris 2015, the next years will decide on the path towards a sustainable future. Alongside the G20 Summit 2017 in Hamburg, Germanwatch, the NewClimate Institute and the Climate Action Network will present a Climate Change Performance Index 2017 G20 Edition to the global public. Acknowledging the special responsibility of the 20 largest economies to promote effective climate protection, the CCPI aims at inducing enhanced action on climate change both, domestically and in international diplomacy. The CCPI compares countries by their development and current status in the three categories "GHG Emissions", "Renewable Energy" and "Energy Use", the 2°C-compatibility of their current status and future targets in each of these categories and their ambition and progress in the field of climate policy.

As has been the case with the previous editions, the CCPI 2017 G20 Edition would not have been possible without the help of about 280 climate experts from all over the world, who evaluated their countries' climate policy. We would like to express our deep gratitude and thanks to all of them.

By simplifying complex data the Index not only addresses experts, but everyone. We would like to emphasize that so far not one country in the world has done enough to protect the climate. We hope that the index provides an incentive to significantly change that and step up efforts.

The following publication explains the background and the methodology of the Climate Change Performance Index. The results of the CCPI can be accessed online at www.germanwatch.org/en/ccpi.

Christoph Bals (Germanwatch), Elif Gündüzyeli (CAN-E) and Jan Burck (Germanwatch) at the press conference for the CCPI 2017 in Marrakech

1 Who does how much to protect the climate?

Getting a clear understanding of national and international climate policy is difficult, as the numerous countries which need to be taken stock of, each have various initial positions and interests. To untangle the knot of differentiated responsibilities, as well as kept and broken promises, and to encourage steps towards an effective international climate policy, Germanwatch developed the Climate Change Performance Index (CCPI). The index usually compares those 58 countries that together are responsible for more than 90 percent of annual worldwide carbon dioxide emissions and for the CCPI 2017 G20 edition, the G20, accounting for about 75% of global greenhouse gas- and about 82% of energy-related CO_2 emissions.

The climate change performance is evaluated according to uniform criteria and the results are ranked. With reaching the Paris Agreement in 2015, every country has put forward own mitigation targets and the global community emphasised the need to limit global temperature rise well below 2°C or even 1.5°C. The CCPI evaluates how far countries have come in achieving this goal. It helps to access and judge the countries' climate policy, their recent development, current levels and well below 2°C compatibility of GHG emissions, renewable energies, energy use (as an indication of their performance in increasing energy efficiency) and their targets for 2030.

The component indicators provide all actors with an instrument to probe in more detail the areas that need to see movement. The objective is to raise the pressure on decision makers, both at the political and civil society level, and to move them to consequently protect the climate. Thus, the index is to be both a warning, as well as an encouragement, to everybody involved. With this in mind, the NewClimate Institute, the Climate Action Network and Germanwatch present the CCPI every year at the UN Climate Change Conference and now also in the context of the G20 Summit 2017, thus creating as much attention as possible in the observed countries and pushing forward the discussion on climate change. The astounding press echo to the CCPI shows its relevance: Both, at the national and international level, numerous media report about the outcomes and on how well their country performed in the latest edition of the index. Awareness was also raised in politics. Many delegates at the climate conferences as well as national government institutions inform themselves on ways of increasing their countries' rank. Naturally, the index is also available online for general public interest.[1]

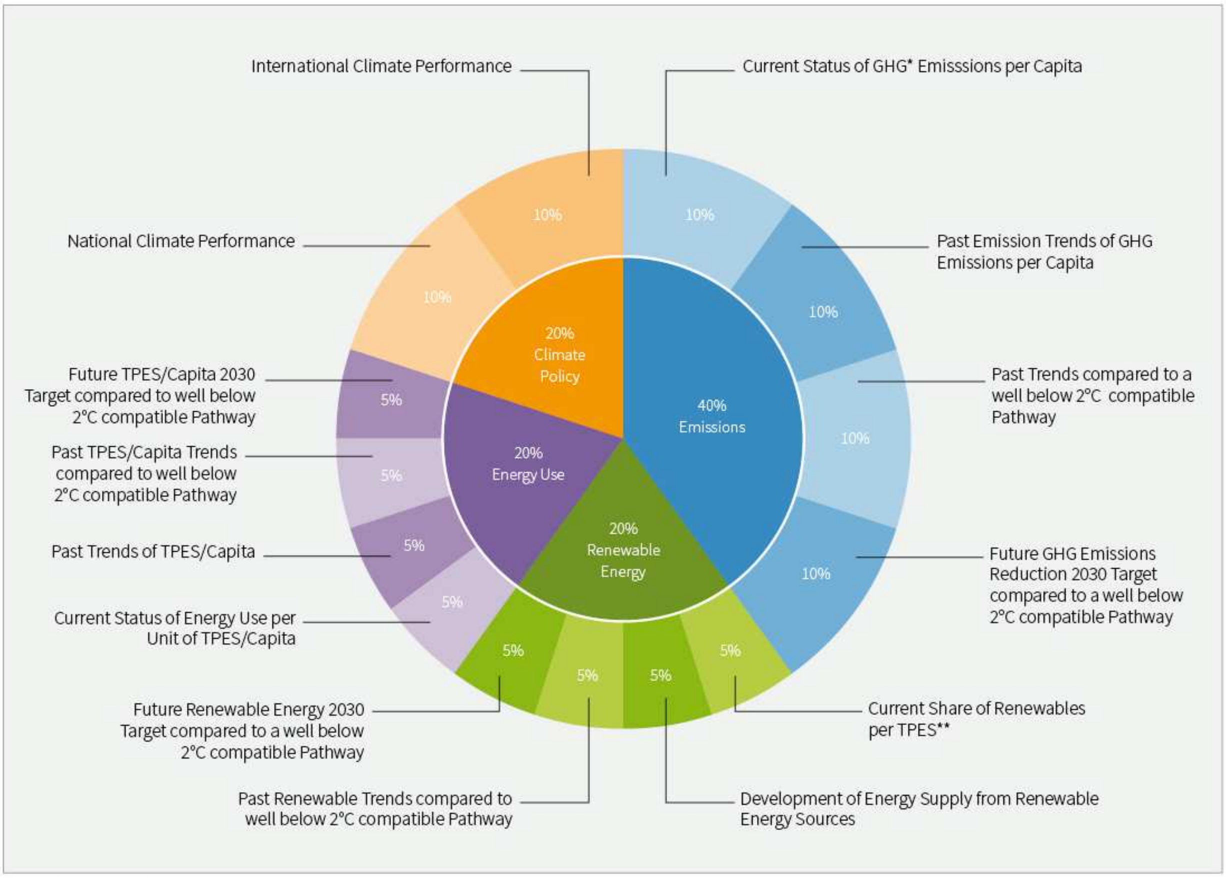
[1] Burck et al. (2017).

2 Methodology

The climate change performance is measured via fourteen indicators, classified into three categories: "GHG Emissions" (40%), "Renewable Energy" (20%), and "Energy Use"(20%). A country's performance in each of these categories is defined by its performance regarding four different equally weighted indicators, reflecting four different dimensions of the category: "recent developments", "current levels", "2°C compatibility of the current level" and the "2°C compatibility of its 2030 target". These twelve indicators are complemented by two indicators, measuring the country's performance regarding its national climate policy framework and implementation as well as regarding international climate diplomacy in the category "Climate Policy" (20%).

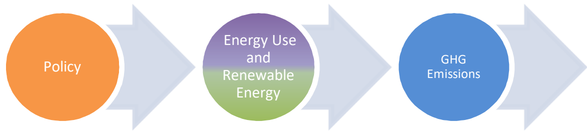
Figure 1 gives an overview of the composition and weighting of indicators defining a country's overall score in the CCPI. For details on the constitution of a country's scoring, please see chapter 3. "Calculation and Results".

Figure 1: **Components of the CCPI**



*Greenhouse Gas Emissions
**Total Primary Energy Supply

The index rewards policies which aim for climate protection, both at the national level and in the context of international climate diplomacy. Whether or not countries are striving towards a better performance can be deduced from their scores in the "Climate Policy" indicators. If these policies are effectively implemented can be read - with a time lag of a few years - in the country's improving scores in the categories "Renewable Energy" and "Energy Use" and lastly in positive developments in the category "GHG Emissions". Following this logic, the index takes into account the solutions, an effective climate policy, an expansion of renewable energy and improvements in energy efficiency and thus control over domestic energy use with 20% each. This weighting scheme leaves the CCPI responsive enough to adequately capture recent changes in climate policy and newly achieved improvements on the way to reduce GHG emissions. As GHG emissions reductions are what needs to be achieved for preventing dangerous climate change, this category weights highest in the index (40%). Measuring both, emissions trends and levels, the CCPI provides a comprehensive picture of a country's performance, neither too generously rewarding only countries, which are reducing emissions from a very high level, nor countries, which still have low levels but a vast development. This combination of looking at emissions from different perspectives and since 2017 also taking into account a country's performance in relation to its specific well below 2°C pathway ensures a balanced evaluation of a country's performance.



Data sources and adaptions

For the first time, the CCPI assesses all GHG emissions arising across all sectors, using the PRIMAP[2] data base. For all energy-related data in the categories "Renewable Energy" and "Energy Use", the index continues to use data from the International Energy Agency (IEA)[3], generally following the definitions given by the IEA. However, the CCPI assessment excludes non-energy use from all data related to total primary energy supply (TPES), as well as traditional biomass from all numbers provided by the IEA for both, TPES numbers and the assessment of renewable energy[4].

All evaluation of the countries' mitigation targets is based on their Nationally Determined Contributions (NDCs), communicated to the UNFCCC.[5] Since clear guidelines and frameworks for the framing of NDCs is not existent, the countries targets partly had to be inter-/extrapolated to 2030 in order to assure comparability (for details, please see chapters (2.1.4 for GHG reduction targets, 2.2.4 for RE targets and 2.3.4 for energy use targets). Evaluations of countries' performance in climate policy is based on an annually updated survey among national climate and energy experts from the country's civil societies (for details, please see chapter 2.4).

[2] PRIMAP (annual updated).
[3] IEA (annual updated-a).
[4] Since the IEA does not explicitly identify traditional biomass as such, it is assumed that the residential use of biomass (explicitly listed in the IEA statistics) strongly coincides with traditional use biomass, especially in developing countries. In industrialised countries this quantity is negligible in most cases.
[5] UNFCCC (2017).

Box 1: What's new? - Comparability of different editions of the CCPI

An index that compares the climate change performance of different countries over several years encourages comparing one country's ranking position to the past years. We need to point out that, due to three factors, a comparison between two years is possible only up to a limited extent.

The first reason is limited comparability of the underlying data. The calculation of the CCPI is partly based on the annual publication "CO_2 Emissions from Fuel Combustion" by the International Energy Agency (IEA). The data gives an overview of the last year's CO_2 emissions and adds the most recent data, which we used for the new edition of the CCPI. However, in many cases the IEA has revised historic data retroactively in later editions, if it needed to complete former results, e.g. due to new measuring sources. So it might not be possible to reproduce the exact results of one year with updated data from the same year but taken from a later edition of "CO_2 Emissions from Fuel Combustion".

The second factor that leads to limited comparability is that our expert pool is continuously being extended and altered. We strive to increase the number of experts so that new evaluations of the countries' policies depict a more differentiated result. At the same time, some experts change their positions or are not available any more for other reasons. When the people acting as the judges of a country's policy change, then the judgement also changes.

Thirdly, in 2017, the underlying methodology of the CCPI has been revised and adapted to the new climate policy landscape of the Paris Agreement. Even though the new methodology is based on similar ranking categories and data sources, some indicators as well as its weighting scheme have been adapted. With its new composition, the CCPI was extended to measuring a country's performance also in absolute terms, assessing its progress towards the globally acknowledged goal of limiting temperature rise well below 2°C. The index now also evaluates the country's 2030 targets and the former scope of looking at energy-related CO_2 emissions has been extended to all GHG emissions.

The CCPI 2017 G20 Edition is the first index publication based on the new methodology. Hence, comparing previous with current editions of the CCPI might lead to misinterpretation.

2.1 GHG emissions (40% of overall score)

The greenhouse gas (GHG) emissions of each country are what ultimately influence the climate. Therefore, they may be perceived as the most significant measure in the success of climate policies. That is why the emissions category contributes 40% to the overall score of a country.

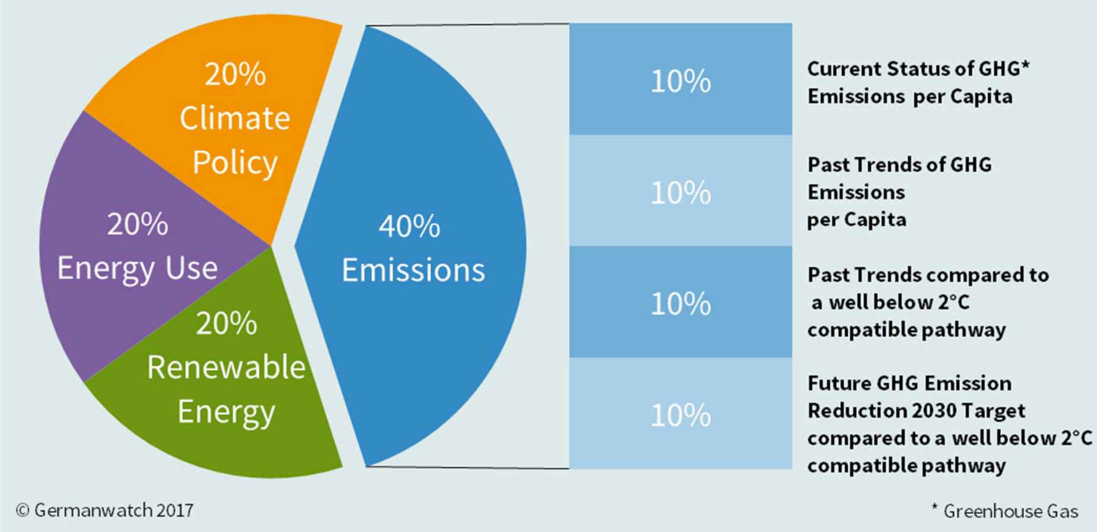
However, the diversity of countries evaluated in the CCPI is enormous. It therefore is indispensable that more than just one perspective be taken on the emissions level and how the GHG emissions of a given country have developed in the recent past.

The GHG emissions category therefore is composed of four indicators. "Recent Developments" of per capita GHG emissions and the "Current Level" of per capita emissions are complemented by two indicators, comparing the countries' current level, and 2030 emissions reduction targets to its country-specific well-below-2°C pathway. All of these indicators are weighted equally with 10% each.

For the first time, the CCPI covers all GHG emissions. This includes energy-related CO_2 emissions, CO_2 emissions from land use, land use change and forestry (LULUCF), methane (CH_4), nitrous oxide (N_2O), and the so-called F-gases hydrofluorocarbons (H-FKW), perfluorocarbons (FKW) and sulphur hexafluoride (SF_6) for which we use data from PRIMAP provided by the Potsdam Institute for Climate Impact Research. [6]

With using overall GHG-related instead of only energy-related CO_2 emissions as in previous editions of the CCPI, the index now reflects a more comprehensive picture of the actual mitigation performance of a country, taking into account that emissions from other sectors play a crucial role in some of the evaluated countries.

Figure 2: Weighting of Emissions Indicators



[6] Potsdam Institute for Climate Impact Research (2017).

Box 2: Emissions accounting and trade

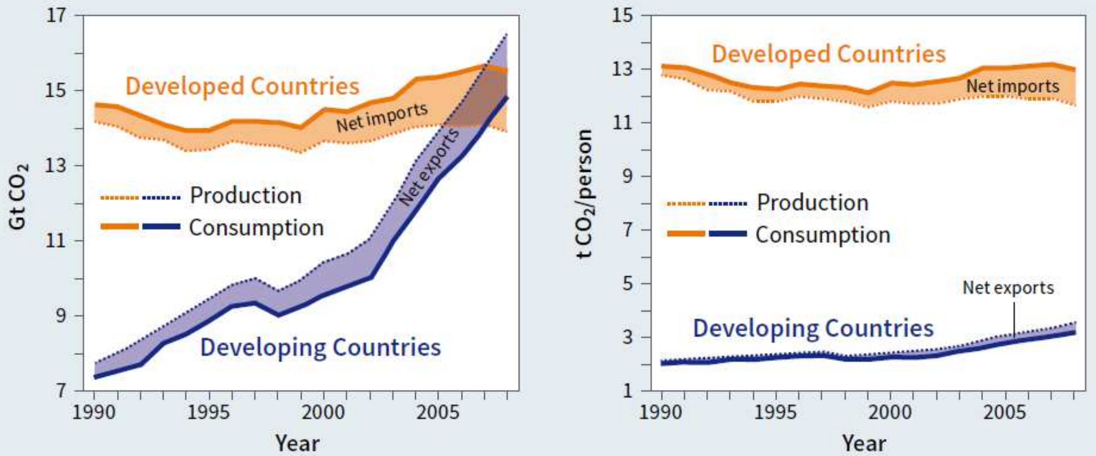
The currently prevailing way of accounting national emissions encompasses all emissions emerging from domestic production using a territorial system boundary while excluding international trade. In this sense, the nation producing the emissions is also the one held accountable no matter if those emissions are closely connected to an outflow of the produced goods to other countries. Considering that national governments can only exert political influence on domestic production but have no power over production-related emissions abroad, this conception seems prima facie plausible.

In the course of globalisation, international trade has caused an increasing spatial separation between production and consumption of goods. Thus, on the one hand China, Thailand and South Africa, who belong to the group of high-producers and greenhouse gas exporters, currently report emission levels that are considered too high. On the other hand, France, Switzerland and the USA are large importers of CO_2 intensive goods but the emissions imported are not charged to their account.

With increasing international trade influencing national economies as well as related emissions, an alternative emission accounting approach has emerged from scientific research. In contrast to the production-based approach, it is focused on emissions caused by national consumption. As a basis for calculating nation-level emissions this account uses the total of national consumption being the sum of all goods produced, less the ones exported, plus the ones imported by a country. Measuring emissions based on what is consumed would lead to an increase of the absolute amount of CO_2 for several of the industrialised countries, induced by their emission intensive trade record. In contrast, countries like China and other emerging economies have proactively attracted production industries and continue to do so. In general, those countries also profit from their exports of emission intensive goods and should therefore not be entirely relieved of their responsibility.

The evaluation of emission data from the production and consumption of goods and services as presented in the graph in figure 3 by Caldeira and Davis (2011: 8533) shows significant differences between consumption-based and production-based data, while their development is clearly related. Generally, the amount of emissions embodied in global trade is constantly growing, increasing the importance of understanding and acknowledging consumption-based emission data. At the same time, the graph implies a high level of aggregation, wiping away diversity within the aggregate groups of developed and developing countries. Acknowledging this diversity, however, would require far more detailed analyses.

Figure 3: Historic CO_2 Emissions from Production and Consumption of Goods and Services[10]



Historic CO_2 emissions from 1990 to 2010 of developed (Annex B) and developing (non-Annex B) countries with emissions allocated to production/territorial (as in the Kyoto Protocol) and the consumption of goods and services (production plus imports minus exports). The shaded areas are the trade balance (difference) between Annex B/non-Annex B production and consumption. Bunker fuels are not included in this figure.

2.1.1 Recent developments of GHG emissions per capita

The indicator describing the recent development of GHG emissions accounts for 10% of a country's overall score in the CCPI. To reflect the development in this category, the CCPI evaluates the trend over a five-year period of greenhouse gases per capita.

The indicator measuring recent development in emissions is comparatively responsive to effective climate policy, and is therefore an important indicator of a country's performance

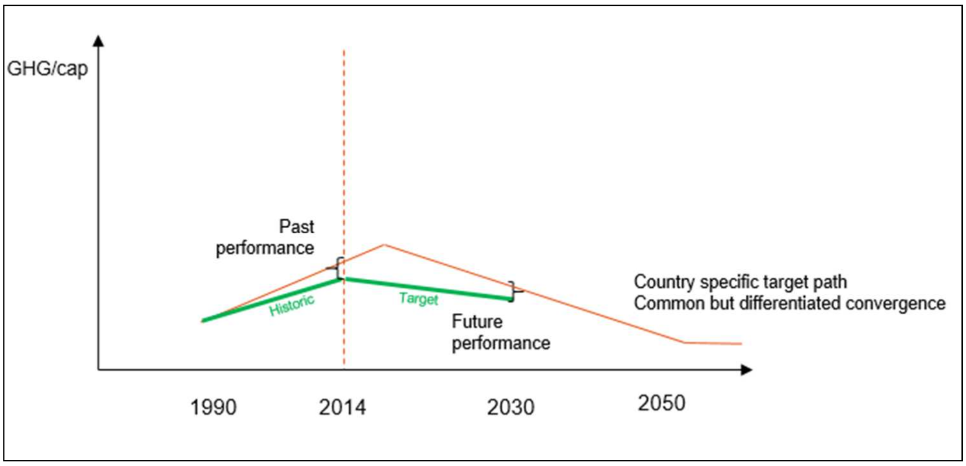
2.1.2 Current level of GHG emissions per capita

The level of current per capita GHG emissions only changes very slowly. Thus, it is less an indicator of the performance of climate protection than an indicator of the respective starting point of the countries being investigated. From an equity perspective, it is not fair to use the same yardstick of climate protection performance on countries in transition as on developed countries. The level of current emissions therefore is a means of taking into account each country's development situation and thus addressing the equity issue.

2.1.3 Well-below-2°C compatibility of current level of GHG emissions

The benchmark in the index category "GHG Emissions" is based on a global scenario of GHG neutrality in the second half of the century, which is in close alignment with the long-term goals of the Paris Agreement. To stay within these limits, GHG emissions need to be drastically reduced, a peak needs to be reached by 2020 and CO_2 emissions need to decline to net zero by around 2050. [7]

Figure 4: GHG emissions pathway



[7] Rogelj, J., et al. (2015).

The calculation of individual country pathways is based on the common but differentiated convergence approach (CDC).[8] It is based on the principle of “common but differentiated responsibilities” laid forth in the Framework Convention on Climate Change; “common” because all countries need to reduce their per capita emissions to the same level (here net zero) within the same time-period (here 60 years), “differentiated” because developed countries start on this path as of 1990, developing countries only once they reach the global average per capita emissions. Hence, some developing countries can temporarily increase their emissions without letting the overall limit of well below 2 °C out of sight.

For this indicator we measure the distance of the country's current (2014) level of per capita emissions to this pathway.

2.1.4 2030 target compared to a well below 2°C compatible Benchmark

The CCPI also evaluates a country's future 2030 mitigation target, i.e. its emissions reduction plans for 2030. We also measure the distance between this target and the country's pathway determined using the common but differentiated convergence approach.

The GHG emission targets of the countries were taken from the Climate Action Tracker.[9]

2.2 Renewable Energy (20% of overall score)

Swift action is required as 2016 was the first year with a constant CO_2 concentration in the atmosphere above 400ppm[10]. Most of the researchers anticipate that a permanent transgression of this threshold will lead to a temperature rise above 2°C.[11] Therefore, a constant expansion of renewable energies and a decline in fossil fuel combustion are essential.

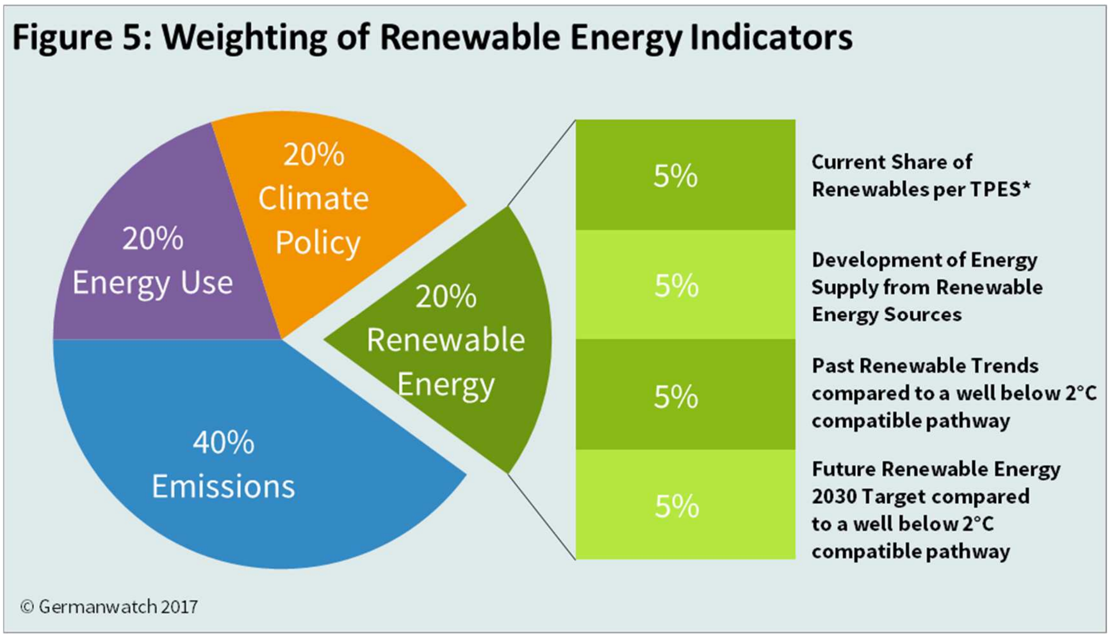
Substituting fossil fuels with renewable energies is one of the most prominent strategies towards a transformed economic system that is compatible with limiting global warming well below 2°C and equally important to an increase in energy efficiency, leading to a reduction in global energy use. For example, in the year 2015, renewable energies in Germany accounted for approximately 14.9% of total final energy consumption. Calculations show that deployment of renewable energies resulted in a net avoidance of 156 Mt. CO_2 in 2015.[12] This shows that a targeted increase in the share of renewable energies can make a vital contribution to climate change protection efforts. The “renewable energies” category assesses whether a country is making use of this potential for emissions reduction. This category, therefore, contributes with 20% to the overall rating of a country, within which each of the four indicators accounts for 5%.

In the absence of data assessing traditional biomass only, all renewable energy data is calculated without residential biomass for heat production, in order to prevent disadvantages for countries increasing their efforts to replace the unsustainable use of traditional biomass in their energy mix.

The recent developments and the 2°C compatibility of the current level exclude hydropower, while values for the current level and the 2°C compatibility of the 2030 target include hydropower (see Box 3).

Furthermore, all values for total primary energy supply (TPES) integrated in the CCPI exclude non-energy use, such as oil usage for other reasons than combustion, in order not to distort the picture and avoid disadvantages for countries with e.g. a larger chemical industry.

8 Höhne, N. et al-(2006).
9 Climate Action Tracker (2017).
10 Betts, R.A. et al. (2016).
11 OECD (2012).
12 BMWi (2015).



2.2.1 Recent developments of Renewable Energy per unit of total energy supply (TPES)

The first dimension of a country's performance in the renewable energy category shows the recent development of energy supply from renewable sources over a five-year period. Like the other dimensions in this category, this dynamic indicator accounts for 5% of the overall CCPI score. To acknowledge the previously described risks surrounding an expansion of hydropower and to adequately reward countries that concentrate on more sustainable solutions, it excludes this technology from the underlying data and therefore focuses on "new" renewable energy sources, such as solar, wind and geothermal, only.

2.2.2 Current level of Energy Supply from Renewable Energy sources

To recognize countries such as Brazil, that have already managed to gain a major share of their total energy supply from renewable sources and therefore have less potential to further extend their share of renewable energies, 5% of the overall ranking is attributed to the share of renewable energies in the total primary energy supply.[13]

[13] See Box 3: Hydropower and Human rights violation, p.14.

Box 3: Hydropower and human rights violation

One of the largest contributors to renewable energy supply is the generation of hydropower. However, many large hydropower projects are considered to be not sustainable. Large hydropower projects often have profound negative impacts on local communities, wildlife and vegetation in the river basins and sometimes even produce additional greenhouse gas emissions where water catchments are particularly shallow.

This causes a double challenge to the CCPI. Firstly, countries that already meet a large share of their energy demand with supply from renewable energies – often old and potentially non-sustainable hydropower – can hardly raise their production in relative terms as easily as a country that starts with near zero renewable energy supply. On the contrary, if a country already covers nearly 100% of its demand via renewable energy supply and at the same time increases efficiency, renewable energy supply might even fall. In such an extreme case a country would score a very low CCPI score while demonstrating exemplary climate change performance.

Secondly, the CCPI would reward to some degree the development of unsustainable dam projects when an increase in renewable energy supply is solely driven by such projects. Such an approach is not regarded as adequate climate protection by the authors of the CCPI.

Unfortunately, data availability on the structure or even sustainability of hydropower generation and a distinction between large non-sustainable projects and sustainable small scale hydropower generation is insufficient. In its attempt to balance the extent of rewarding countries for expanding large-scale hydropower, the CCPI excludes all hydropower from two of four indicators measuring in the renewable energy category. As a result, the recent developments in renewable energy as well as the indicator that measures the current level of renewables to a country's well-below-2°C pathway exclude hydropower, while the total values of the current level and the indicator evaluating the 2030 RE target include hydropower.

If data availability on large-scale and non-sustainable hydropower changes in the future, we will include these data and therefore exclude non-sustainable hydropower only from all four indicators.

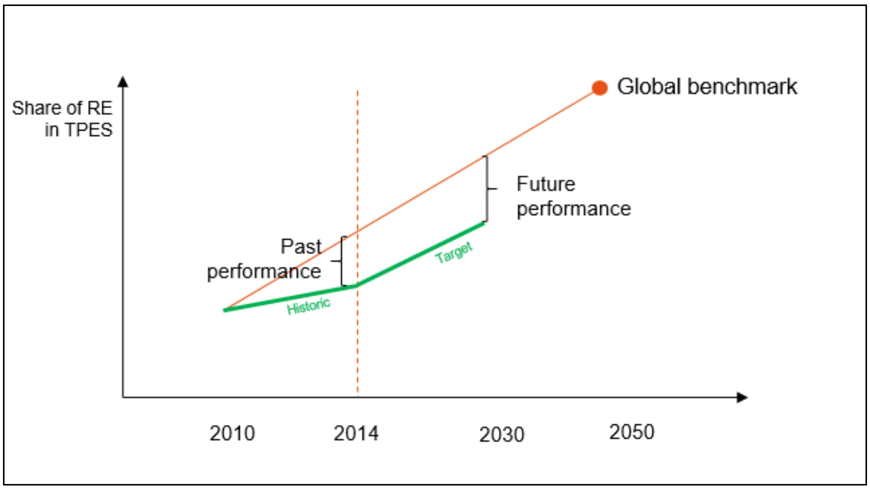
Non-sustainable approaches and human rights violations related to the expansion of renewable energy are increasingly also affecting other RE technologies. The drain of land resources for energy generation from biomass and the resulting conflict with land resources for food production is only one example of the complexity surrounding the necessary expansion of RE. Both fields of conflict are also increasingly being seen in reactions to the expansion of onshore wind power generation. The authors of the CCPI are well aware of the increasing importance of these developments and will be continuously examining possibilities to acknowledge them in future editions of the ranking.

2.2.3 Well below 2°C compatibility of current level

The benchmark within the index category "Renewable Energy" is 100% renewable energy by 2050. The Paris Agreement requires net zero greenhouse gas emissions by the second half of the century, while energy-related emissions need to reach zero already by the middle of the century. Renewable energy will play a significant role in the transition. Accordingly, the CCPI continues to emphasise the necessity of making progress in renewable energy, even if other low or zero carbon options could be available (nuclear or carbon capture and storage).

Although the target is very ambitious, studies emphasise the possibility of reaching almost 100% RE even with current technologies by mid-century.[14] Many NGOs therefore support a 100% renewable target to set the right incentives for countries in transforming their energy systems, also taking into account the necessity to establish and follow a holistic approach to sustainable development and inter-generational justice.

Figure 6: Renewable Energy pathway



2.2.4 2030 target compared to a well below 2°C compatible Benchmark

The CCPI also evaluates the distance between a country's renewable energy targets for 2030 and the country's desired linear pathway from 2010 to 100% renewable energy in 2050.

Comparing renewable energy targets is a substantial challenge, because countries put forward their RE targets in many ways, as there is an absence of uniform rules for such target setting. Some countries only have targets for subnational states, others have national targets. Some define their targets in terms of installed capacity rather than share of renewables in the TPES.

In order to convert these different types of indication into a future share of renewable energy in the TPES, we had to perform several assumptions.

[14] WWF et al. (2011).

- When available, we referred to numbers projected by the World Energy Outlook (WEO) 2016 current policy scenarios[15], since this outlook "translates" policies into national renewable energy deployment, taking into account federal policies as well as sectoral targets.
- Whenever a target is formulated for a year other than 2030, a 2030 value is calculated by linear interpolation of the target share.
- All numbers for the current share of renewables in a countries energy supply are taken from the IEA energy balances.[16]

In the table below the approach chosen for each individual country is explained including all accompanying assumptions.

Country	Method
Argentina	The Argentinian target is defined as a share of 20% renewable energy in the total final consumption of electricity in 2025, where hydropower is not considered as renewable. Assuming the share of hydropower to remain constant at 21.8% this yields a target of 41.8% of electricity in the final consumption to originate from sources that this index refers to as renewable. To convert this target into a share of renewable energy in the TPES the following assumption have been made: a), b), c) and d) Under these assumptions the target share of renewable energy in the total final consumption of electricity together with present shares determines all other future shares in the TPES and therefore a corresponding share of renewable in TPES can be calculated. Source of the target: http://servicios.infoleg.gob.ar/infolegInternet/anexos/250000-254999/253626/norma.htm [accessed: 26.06.2017]
Australia	The Australian renewable energy target given as a share of 23.5% of renewable energy in electricity generation in 2020 was converted into a share of renewable energy in the TPES under the following assumptions: a), b), c), d) and e). Under these assumptions the target share of renewable energy in the total final consumption of electricity together with present shares determines all other future shares in the TPES and therefore a corresponding share of renewable in TPES can be calculated. Source of the target: https://www.environment.gov.au/climate-change/renewable-energy-target-scheme [accessed: 26.06.2017]
Brazil	The Brazilian renewable energy target for 2030 is formulated as a "share of renewable in the energy mix". For a lack of information on the precise definition of "the energy mix" we extracted the share of renewable energy in 2030 from WEO projections. Sources of the target: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Brazil%20First/BRAZIL%20iNDC%20english%20FINAL.pdf [accessed: 26.06.2017]
Canada	Canada has no national target for the use of renewable energy. However, there are plenty policies that promote renewable energy and some subnational targets. We decided to rely our evaluation on a projection for 2030 provided by the Canadian National Energy Board available on their website (see below). The projections are based on the policies implemented until mid-2016 and are discussed in the Canada's Energy Future2016 Update report (National Energy Board, 2016). Still, it is unclear whether the underlying definitions are in accordance to our definitions. Source of the target: https://apps.neb-one.gc.ca/ftrppndc4/dflt.aspx?GoCTemplateCulture=en-CA [accessed on 26.6.2017]
China	Due to a lack of information on the underlying definitions for the Chinese target, we extracted the future share of renewable energy from WEO projections for 2030. Sources of the target: http://www4.unfccc.int/ndcregistry/PublishedDocuments/China%20First/China's%20First%20NDC%20Submission.pdf [accessed: 26.06.2017]
EU28	The renewable energy target of the EU for 2030 is formulated in a share in the total final consumption. Hence, we decided to rely on the WEO projection for the share of renewables in TPES instead of converting the target ourselves. Sources of the target: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy [accessed: 26.06.2017]
France	In order to convert the French target defined as a share of 32% renewable energy in the gross final consumption in 2030 the following assumption was made: b) The target shares for renewable and fossil energy in the TPES then follow by dividing the shares in the GFC by the average efficiencies for either renewable or fossil energy and normalizing the result. Source of the target: https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031044385&categorieLien=id [accessed: 26.06.2017]
Germany	In order to convert the German target given as a share of 60% renewable energy in the gross final consumption in 2050 the following assumption was made: b)

[15] IEA (annually update-b).

[16] IEA (annual update-c).

	The target shares for renewable and fossil energy in the TPES then follow by dividing the shares in the GFC by the average efficiencies for either renewable or fossil energy and normalizing the result. Source of the target: http://www.bmwi.de/Redaktion/DE/Downloads/E/energiekonzept-2010.pdf?__blob=publicationFile&v=3 [accessed: 26.06.2017]
India	We used the Indian draft energy plan as a basis which states that by 2027 54.2% of the electricity generation capacity will be renewable. Supplementing the capacity targets of the plan with load factors assumed in the WEO2016 allowed to calculate the future generated electricity by source. A linear interpolation of the capacity additions yields a target share of 36.8% of the electricity originating from renewable sources in 2030. This share was than translated into a share of the TPES under the following assumptions: a), b), c) and d) Under these assumptions the target share of renewable energy in the total final consumption of electricity together with present shares determines all other future shares in the TPES and therefore a corresponding share of renewable in TPES can be calculated. Sources of the target: http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf [accessed: 26.06.2017]
Indonesia	Indonesia has formulated its target as a share of 23% new and renewable in the TPES in 2025. We could not find information on how much energy will be produced from "new" but not renewable sources. Therefore, we took the 23% in the TPES as the renewable energy target, knowing that this overestimates the Indonesian target. Source of the target: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Indonesia First/First NDC Indonesia_submitted to UNFCCC Set_November 2016.pdf [accessed: 26.06.2017]
Italy	In order to convert the Italian target given as a share of 60% renewable energy in the gross final consumption in 2050 the following assumption was made: b) The target shares for renewable and fossil energy in the TPES then follow by dividing the shares in the GFC by the average efficiencies for either renewable or fossil energy and normalizing the result. Source of the target: http://www.sviluppoeconomico.gov.it/images/stories/documenti/SEN_EN_marzo2013.pdf [accessed: 26.06.2017]
Japan	The future share of renewable energy in Japan's TPES was extracted from WEO projections.
Mexico	Mexico aims to achieve a share 35% of "clean energy" in the electricity generation by 2024. It is likely that fossil based cogeneration and nuclear electricity generation, which are both considered as clean by the Mexican government, will make a contribution of approximately 10% in the electricity generatio. Hence, we subtract these 10% from the original target. The resulting target of 25% of renewable energy in the electricity generation was converted into a corresponding target in TPES under the following assumptions: a), b), c), d) and e). Under these assumptions the target share of renewable energy in the total final consumption of electricity together with present shares determines all other future shares in the TPES and therefore a corresponding share of renewable in TPES can be calculated. Source of the target: http://www.diputados.gob.mx/LeyesBiblio/pdf/LTE.pdf https://www.iea.org/media/workshops/2015/15thghgtradingworkshop/SpecialClimateChangeProgram20142018Englishversion.pdf (p.50)
Russian Federation	The future share of renewable energy in Russia's TPES was extracted from WEO projections.
Saudi Arabia	The original target of 9.5GW renewable electric capacity in 2023 corresponds to a share of 5% renewable energy in the electricity generation. This was converted into TPES under the following assumptions: a), b), c), d) and e) Under these assumptions the target share of renewable energy in the total final consumption of electricity together with present shares determines all other future shares in the TPES and therefore a corresponding share of renewable in TPES can be calculated. Source of the target: https://www.apricum-group.com/saudi-arabia-announces-9-5-gw-renewable-energy-target-new-king-salman-renewable-energy-initiative/ [accessed: 26.06.2017]
South Africa	The future share of renewable energy in the TPES of South Africa was extracted from WEO projections.
South Korea	South Korea formulated its target for 2035 in TPES, no conversion was required. However, it is not certain that definition underlying the South Korean target formulation are in accordance with our definitions. Source of the target: http://large.stanford.edu/courses/2016/ph240/hyman2/docs/korea_energy.pdf [accessed: 26.06.2017]
Turkey	In order to convert the Turkish target given as a share of 20.5% renewable energy in the gross final consumption in 2023 the following assumption was made: b) The target shares for renewable and fossil energy in the TPES then follow by dividing the shares in the GFC by the average efficiencies for either renewable or fossil energy and normalizing the result. Source of the target: www.ebrd.com/documents/comms-and-bis/turkey-national-renewable-energy-action-plan.pdf [accessed: 26.06.2017]
United Kingdom	In order to convert the British target defined as a share of 15% renewable energy in the gross final consumption in 2020 the following assumption was made: b)

	The target shares for renewable and fossil energy in the TPES then follow by dividing the shares in the GFC by the average efficiencies for either renewable or fossil energy and normalizing the result. Source of the target: http://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans [accessed: 26.06.2017]
USA	The future share of renewable energy in the US American TPES was extracted from WEO projections.

Legend for general assumptions used for many countries:

a) the share of electric energy remains constant in the total final consumption

b) the average efficiencies of transforming primary energy into secondary energy (before losses and energy industry own use) remain constant for energy from renewable and from fossil sources with respect to today.

c) the "energy industry own use" is distributed between the electric and non-electric energy sector according to the share they hold in the TPES - in both sectors renewable energy generation is assumed not to consume any energy for energy generation.

d) within the non-electric sector, the share of renewable energy remains constant in TPES and TFC respectively.

e) the share of renewable energy the in final consumption of electricity is the same as the share of renewable energy in electricity generation, i.e. losses affect equally electricity from renewable and fossil sources.

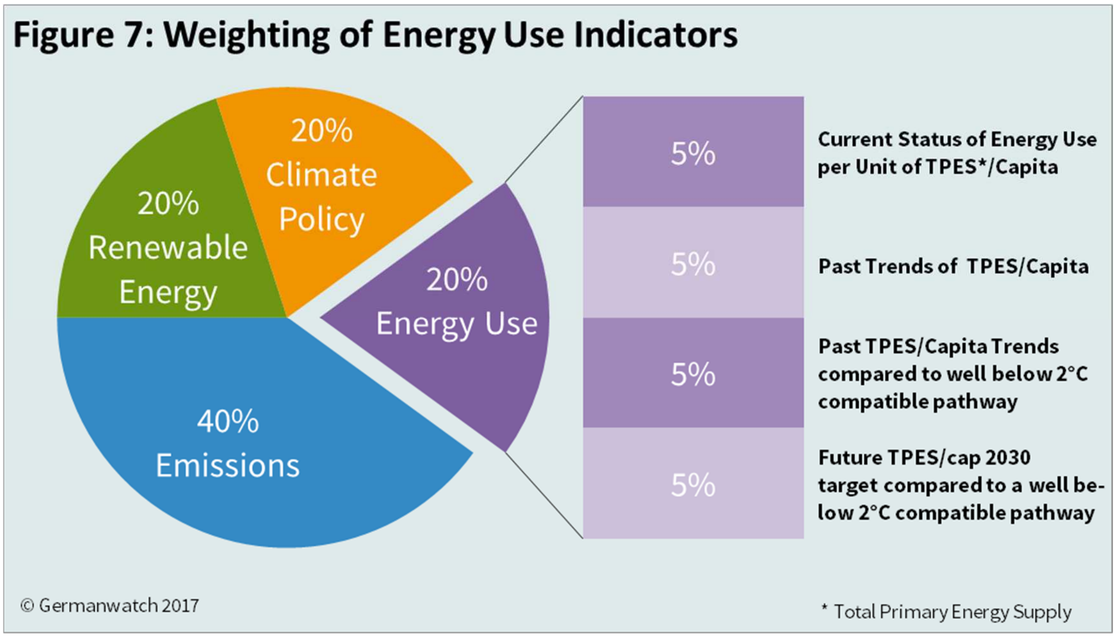
2.3 **Energy Use** (20% of Overall Rating)

Besides an expansion of renewable energies, a vast increase in energy efficiency is crucial to achieving global decarbonisation and overall GHG neutrality by mid-century. The more efficient that energy can be used, the faster and easier countries can reach net-zero emissions. Therefore one major step in combatting the global climate crisis is to reduce the energy needed to provide for some products and services.

Increases in energy efficiency are complex to measure and would require a sector-by-sector approach, for which there are no comparable data sources across all countries available at the present time. The CCPI therefore assesses the per-capita energy use of a country and measures progress in this category.[17] As in the categories "GHG Emissions" and "Renewable Energy", the CCPI aims to provide a comprehensive picture and balanced evaluation of each country, acknowledging the different development stages of countries and thus basing their performance evaluation in per-capita energy use on four different dimensions: recent developments, current levels and the 2°C compatibility of both the current level and the 2030 target.

As in the renewable energy category, TPES data excludes values for non-energy use and traditional biomass (see chapter 2.2).

[17] Rebound effects can diminish positive effects of increased efficiency or even reverse them. Still, we cannot forgo these efficiency improvements, but rather must complement them with adequate measures that limit rebound effects.



2.3.1 Recent developments of Energy Use per Unit of Total Primary Energy Supply per Capita (TPES/capita)

In accordance with the other two categories, the indicator measuring recent developments in per-capita energy use describes improvements in the period of the last five years for which there is data available that allows for comparison across all evaluated countries. The indicator "recent developments in per-capita energy use" accounts for 5% of the overall CCPI ranking.

2.3.2 Current level of Energy Use per unit of Total Energy Supply per Capita (TPES/capita)

To recognize some countries increasing their per-capita energy use but doing so from a still very low level, this indicator gives the current TPES/capita values, which also account for 5% in the overall index ranking.

2.3.3 Past Trends compared to well below 2°C compatible benchmark

For 2°C and 1.5°C scenarios, a decrease in emissions by reducing the (growth in) energy use is as crucial as deploying renewable (or other low-carbon) technologies. The IPCC carried out a scenario comparison using a large number of integrated assessment models.[18] From the available scenarios, we observe that global energy use in 2050 has to be roughly the same level or a bit higher than it is today, with a margin of uncertainty. At the same time population will grow slightly between today and 2050. We therefore pragmatically chose the benchmark to be "same energy use per capita in 2050 as the current global average",

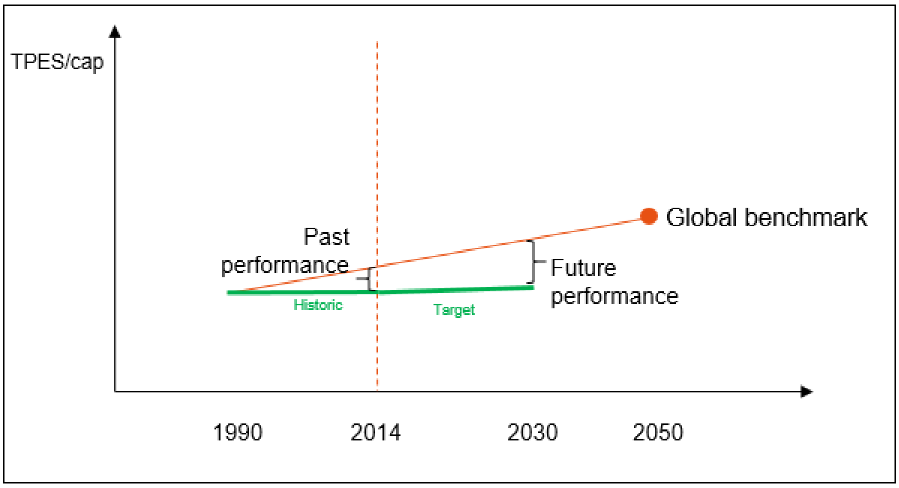
[18] Clarke, L. et al. (2014).

which is 80 gigajoule per capita in Total Primary Energy Supply.

Current energy use per capita is very diverse. At the present time, India is only a third of the global average, while USA is more than three times higher than the global average. Consequently, the chosen benchmark would allow India to increase its energy use per capita threefold by 2050, while absolute energy demand can grow even further due to growing population. The USA would need to cut per-capita energy use to a third by 2030.

We calculate a linear pathway from 1990 to the described benchmark in 2050 and measure the distance of the country's current level to this pathway.

Figure 8: Energy Use pathway



2.3.4 Future Energy Use Target compared to well below 2°C compatible Benchmark

The CCPI also evaluates the distance between the country's future energy targets for 2030 along the country's pathway to the 2050 benchmark.

Energy efficiency and energy use targets are not formulated in standardized units and therefore lack comparability. Some countries indicate these targets as efficiency gains compared to a certain baseline scenario, whereas others announce reduction targets for the energy intensity of their domestic economy.

We gathered information and combined various data sources to transform all targets expressed in different units into a future per-capita energy use. We therefore rely on population projections by the United Nations[19] and, where necessary, on OECD projections for the gross domestic product (GDP).[20]

Where no explicit economy-wide target was available, we based our analysis on projections that incorporate current and new sectoral or federal policies such as the IEA World Energy Outlook 2016[21]. Whenever a target is indicated for a year other than 2030, we interpolate or extrapolate the result linearly to obtain a value for 2030. The list below specifies the approach we chose for each individual country. All historical data on TPES are taken from the IEA energy balances.[22]

[19] UN (2017).

[20] OECD (2017).

[21] IEA (annually updated-b).

[22] IEA (annually updated-c).

Country	Target
Argentina	No target or scenario was available
Australia	Australia sets out a target of a 40% increase in energy productivity from 2015 to 2030. Combined with population and GDP forecasts and the 2015 energy productivity this yields a future energy use per capita. Source of the target: http://www.coagenergycouncil.gov.au/publications/national-energy-productivity-plan-2015-2030
Brazil	For Brazil, no explicit economy wide target was available. Therefore, WEO projections for the total energy demand were combined with population forecasts to calculate the future energy use per capita.
Canada	Canada has no national target regarding the energy use per capita. However, there are several policies that promote energy efficiency and some subnational targets. We decided to rely our evaluation on a projection provided by the Canadian National Energy Board which indicates a future energy demand. The projection from the National Energy Board is based on the policies implemented until mid-2016. As historic figures provided by the National Energy Board significantly deviate from IEA figures, we calculated a relative change in the energy use from 2014 to 2030 in the framework of the NEB data and then applied the relative change to the 2014 TPES from IEA data to derive a future energy use according to IEA definitions. Finally, dividing this future energy use by the forecasted population, yielded the future energy use per capita. Source: https://apps.neb-one.gc.ca/ftrppndc4/dflt.aspx?GoCTemplateCulture=en-CA [accessed on 26.6.2017]
China	China indicates a target of a 15% reduction in energy consumption per unit GDP from 2015 to 2020 in its twelfth 5 years plan. However, since Chinas energy use is presumed to evolve highly non-linear, we decided to rely our assessment on the WEO projections for 2030 rather than linearly extrapolating Chinas 2020 target. Sources of the target: http://en.ndrc.gov.cn/newsrelease/201612/P020161207645765233498.pdf [accessed: 27.06.2017] IEA, 2016
EU28	The EU formulates its energy efficiency target as at least 27% energy savings in 2030 with respect to a business as usual scenario. Since no further specification is made on the BAU, we use the usual PRIMES 2007 baseline as the reference scenario. Dividing the corresponding TPES by the forecasted population yields the target energy consumption per capita. Source of the target: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy [accessed: 27.06.2017]
France	The French energy efficiency target is given as a reduction of the total final consumption by 50% in 2050 relative to the base year 2012. We assumed, that the efficiencies of transformation processes of primary energy into secondary energy for end use purpose from renewable and fossil energy sources do not change. However, we incorporated an improvement in the overall transformation efficiency caused by an increasing share of renewable energy in the TPES. Knowing the target TFC the corresponding target TPES was derived by dividing the target TFC by the average overall efficiency. The TPES per capita followed by dividing the result by the forecasted population. Source of the target: https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031044385&categorieLien=id [accessed: 27.06.2017]
Germany	The German energy efficiency target is given as a reduction of the total final consumption by 50% from 2008 to 2050. We assumed, that the efficiencies of transformation processes of primary energy into secondary energy for end use purpose from renewable and fossil energy sources do not change. However, we incorporated an improvement in the overall transformation efficiency caused by an increasing share of renewable energy in the TPES. Knowing the target TFC the corresponding target TPES was derived by dividing the target TFC by the average overall efficiency. The TPES per capita followed by dividing the result by the forecasted population. Source of the target: http://www.bmwi.de/Redaktion/DE/Downloads/M-O/nationaler-energieeffizienz-aktionsplan-2014.pdf?__blob=publicationFile&v=1 [accessed: 27.06.2017]
India	The Indian Twelfth Five Year Plan indicated a targeted TPES for 2021. Together with the population forecast this determines a future energy use per capita that we linearly extrapolated to 2030. Source of the target: http://planningcommission.gov.in/plans/planrel/12thplan/pdf/12fyp_vol2.pdf [accessed: 27.06.2017]
Indonesia	In the regulation of the government of the Republic of Indonesia number 79 year 2014, a targeted energy use per capita of 1.4 toe/capita is indicated for the year 2025. Source of the target: www.apbi-icma.org/wp-content/uploads/2014/12/PP-79-2014.pdf
Italy	Italy formulates its energy efficiency target as a reduction of the TPES by 17-26% by 2050 compared to 2010 TPES. For the index, we used the mean value of 23% reduction and supplemented the corresponding future TPES with population forecasts. Source of the target: http://www.sviluppoeconomico.gov.it/images/stories/documenti/SEN_EN_marzo2013.pdf [accessed: 27.06.2017]
Japan	Even though Japan provides information on targeted energy use, we decided to rely our assessment on the WEO projection, since data provided by the Japanese government on the current energy use significantly deviate from IEA statistics suggesting different underlying methodology of measurement. Sources of the target: http://www.meti.go.jp/english/press/2015/pdf/0716_01a.pdf [accessed: 27.06.2017] was not used, as differences in the base year and in the energy statistics could not be resolved
Mexico	The Mexican target of keeping energy intensity constant from 2012 to 2018 was converted into an energy use per capita by combining it with GDP and population forecasts. We point out that the short period of time defining the slope of the linear extrapolation causes a high level of uncertainty regarding the 2030 target in the case of Mexico. Source of the target: http://www.gob.mx/cms/uploads/attachment/file/224/PRONASEpendt.pdf [accessed: 27.06.2017] (p.39)
Russian Federation	The Russian target to reduce energy intensity by 40% from 2007 to 2020 was converted into an energy use per capita by combining it with GDP forecasts and population forecasts. As the implementation status of this target is unclear, the TPES per capita value from 2020 was also used for 2030. The combination of an unrealistic target set out by the government and

	conservative economic growth projections provided by the OECD leads to a low future energy use per capita and therefore a high score in the index rating. Sources of the target: http://aperc.ieej.or.jp/file/2012/12/28/Russia_2011.pdf [accessed: 27.06.2017] http://www.energosovet.ru/dok/ensovmed.htm [accessed: 27.06.2017, in Russian]
Saudi Arabia	No energy efficiency target was found. Energy projections were taken from the CAT assessment based on a source which is presently not available anymore. Source: http://www.kaust.edu.sa/assets/downloads/kicp-annual-strategic-study-appraisal-and-evaluation-of-energy-utilization-and-efficiency-in-the-ksa%202014-volume1.pdf [not available anymore]
South Africa	For South Africa, no explicit economy wide target was available. Therefore, WEO projections for the total energy demand were combined with population forecasts to calculate the future energy use per capita.
South Korea	The South Korean energy efficiency target is given as a reduction of final energy consumption by 13% with respect to a scenario value by 2035. We calculated the target value from the scenario value and combined it with population forecasts in order to calculate the target energy use per capita. The historic energy data provided in the source document significantly deviate from IEA data. We therefore derived a relative change of the TPES per capita in the framework of the source data and applied the change to the corresponding IEA numbers. Source of the target: http://large.stanford.edu/courses/2016/ph240/hyman2/docs/korea_energy.pdf [accessed: 27.06.2017]
Turkey	The Turkish target given as an energy intensity reduction of 20% from 2008 to 2023 was converted into an energy use per capita by combining it with GDP forecasts and population forecasts. The value for 2023 was extrpolated to 2030. Source of the target: www.ebrd.com/documents/comms-and-bis/turkey-national-renewable-energy-action-plan.pdf [accessed: 26.06.2017]
United Kingdom	The British target of a TPES of 177.6 Mtoe was combined with population forecasts to calculate a future energy use per capita. The 2020 value was extrapolated to 2030. Source of the target: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive [accessed: 27.06.2017]
USA	We assumed no energy efficiency target and used the WEOs current policy projection for the 2030 value. The US Department of Energy, under the Obama Administration, created a partnership to double energy productivity by 2030 (http://www.energy2030.org/wp-content/uploads/Executive-Summary.pdf). The Trump Administration issued a memorandum "Regulatory Freeze Pending Review", which affects the department of energy's energy efficiency rules (https://www.whitehouse.gov/the-press-office/2017/01/20/memorandum-heads-executive-departments-and-agencies). We interpret this Memorandum to mean that the earlier target is no longer in place.

2.4 Climate Policy (20% of Overall Rating)

The climate policy category in the CCPI considers the fact that measures taken by governments to reduce GHG often take several years to show their effect on the emissions, energy use and renewable energy categories. On top of this, the most current GHG emissions data enumerated in sectors of origin, provided by PRIMAP and the IEA, is about two years old. However, the assessment of climate policy includes very recent developments. The effect that current governments benefit or suffer from the consequences of the preceding administration's climate actions is thereby reduced.

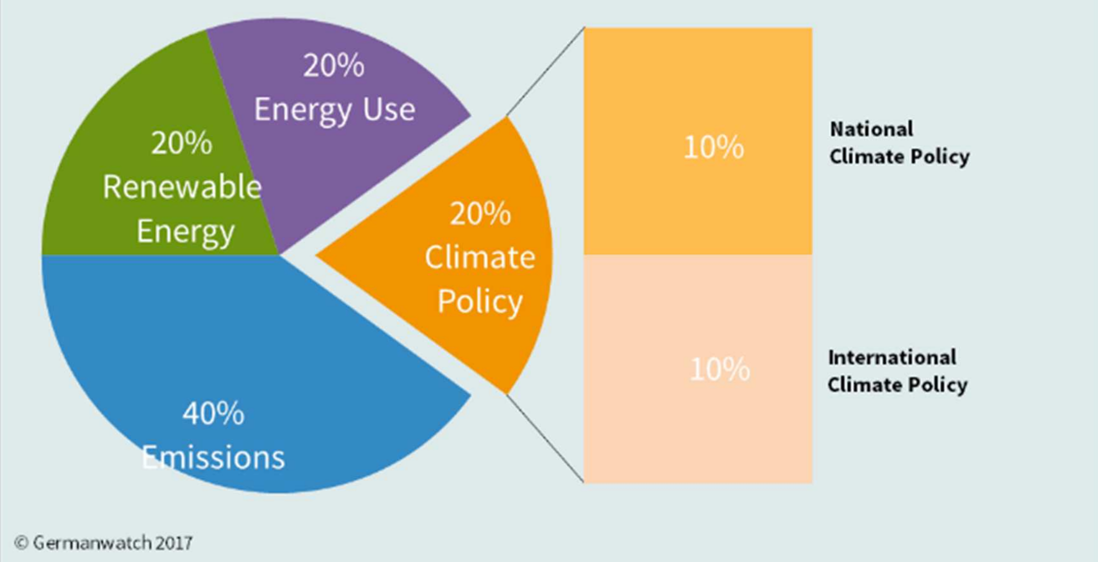
The data for the indicator "climate policy" is assessed annually in a comprehensive research study. Its basis is the performance rating by climate change experts from non-governmental organisations within the countries that are evaluated. In a questionnaire, they give a judgement and "rating" on the most important measures of their governments. The questionnaire covers the promotion of renewable energies, the increase in energy efficiency and other measures to reduce GHG emissions in the electricity and heat production sector, the manufacturing and construction industries, and transport and residential sectors. Beyond that, current climate policy is evaluated with regard to a reduction in deforestation and forest degradation brought about by supporting and protecting forest ecosystem biodiversity, and national peat land protection.

In line with the Paris Agreement, experts also evaluate the ambition level and well-below-2°C compatibility of their country's Nationally Determined Contributions (NDCs) as well as their progress towards reaching these goals. The performance at UNFCCC conferences and other international conferences and multilateral agreements is also evaluated. Thus, both the national and international efforts and impulses of climate policies are scored. To compensate the absence of independent experts in some countries (due to the lack of functioning civil society structures), the national policy of such countries is flatly rated as scoring average points. The goal is to close these gaps in the future and steadily expand the network of experts. About 280 national climate experts contributed to the evaluation of the 58 countries of the CCPI 2017 and CCPI 2017 G20 Edition.

They each evaluated their own country's national and international policy. The latter is also rated by climate policy experts that closely observe the participation of the respective countries at climate conferences.

Climate policy has an overall weight of 20%, with national and international policy making up 10% each. Despite the apparently low influence of climate policy, this category has quite a considerable influence on short-term changes in the overall ranking. Unlike the rather "sluggish" categories of "GHG Emissions", "Renewable Energies" and "Energy Use", a positive change in climate policy can lead a country to jump multiple positions. On the other hand, the "sluggish" categories can only be changed through successful climate change protection – the policy therefore plays a decisive role for future scores within the CCPI.

Figure 9: Weighting of Climate Policy Indicators



3 Calculation and Results

The current evaluation method sets zero as the bottom cut off, and 100 points are the maximum that can be achieved. A country that was best in one indicator receives full points (in that indicator). The best possible overall score is therefore 100 points. Important for interpretation is the following: 100 points are possible in principle, but for each partial indicator, and for the overall score, this still only means the best relative performance, which is not necessarily the optimal climate protection effort.

The CCPI's final ranking is calculated from the weighted average of the achieved scores in the separate indicators with the following formula:

$$I = \sum_{i=1}^{n} w_i X_i$$

I: Climate Change Performance Index,
X_i: normalised Indicator,
w_i: weighting of X_i,

$$\sum_{i=1}^{n} w_i = 1 \; and \; 0 \leq w_i \leq 1$$

i: 1,…., n: number of partial indicators (currently 14)

$$\text{Score} = 100 \left(\frac{actual\ value - minimum\ value}{maximum\ value - minimum\ value} \right)$$

The differences between countries' efforts to protect the climate are only to be seen clearly in the achieved score, not in the ranking itself. When taking a closer look at the top position of the CCPI 2017 G20 Edition, one can see that the highest-ranking country Italy was not at the top in all indicators, let alone have they achieved 100 points. This example shows that failures and weak points of a country can only be recognised within the separate categories and indicators.

The current version of the Climate Change Performance Index including model calculations and the press review can be downloaded from:

www.germanwatch.org/en/ccpi

Development and Prospects

The CCPI was first introduced to a professional audience at the COP 11 – Montreal Climate Conference in 2005. The growing media/press response in the countries surveyed confirms the ever-increasing relevance of the Index, and encourages us in our work.

CAN International supports the index through its international network of experts working on the issue of climate protection since the beginning.

Following a methodological evaluation of the 7th edition of the CCPI we began to include the carbon emissions data from deforestation. However, due to the lack of comparable data for various other sectors, like agriculture, peatland or forest degradation, the corresponding emissions could not be taken into account until this year.

With a second methodological revision this year, we are now able to assess all GHG emissions arising across all sectors. The Index for the first time also includes assessments of the countries' current performance and own future targets in relation to their well below 2°C pathway.

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Germanwatch

Following the motto "Observing, Analysing, Acting", Germanwatch has been actively promoting global equity and the preservation of livelihoods since 1991. In doing so, we focus on the politics and economics of the North and their worldwide consequences. The situation of marginalised people in the South is the starting point of our work. Together with our members and supporters as well as with other actors in civil society, we intend to represent a strong lobby for sustainable development. We attempt to approach our goals by advocating for the prevention of dangerous climate change, for food security, and compliance of companies with human rights.

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