

# Decoupling in the IPCC AR6 WGIII

**Author:** Timothée Parrique

**Affiliation:** None at the time of writing

**Corresponding author:** [contact@timotheeparrique.com](mailto:contact@timotheeparrique.com)

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**Abstract:** This article critically examines how the concept of decoupling is treated in the IPCC Sixth Assessment Report (AR6) Working Group III report on climate-change mitigation. Through a close reading of Chapter 2 and related sections of the report, I evaluate the empirical evidence cited in support of the claim that economic growth can be decoupled from greenhouse-gas emissions and other environmental pressures. The analysis reviews the studies referenced by the IPCC, assesses whether they actually demonstrate absolute decoupling, and compares the conclusions of the underlying literature with the way findings are summarized in the report's Technical Summary and Summary for Policymakers. The paper argues that much of the cited evidence either concerns relative rather than absolute decoupling, reports only temporary or limited cases of decoupling, or concludes that observed rates of decoupling are insufficient to meet climate targets. While acknowledging instances in which emissions have stabilized or declined alongside economic growth, the article contends that these examples do not provide robust support for the feasibility of green growth as a comprehensive mitigation strategy. It concludes that the more cautious findings contained in the scientific literature and in parts of the full IPCC report are presented more optimistically in policy-oriented summaries, creating a tension between scientific evidence and policy communication.

## Introduction

It's the Galileo affair of the 21<sup>st</sup> century: Has economic growth in developed countries decoupled from environmental pressures? For the last decade, the prevailing (yet unproven) answer was: yes, it has – high-income nations have greened their growth which means that they can now increase their GDP while reducing their emissions. This illusion of a scientific consensus has served as the backbone of most environmental policies in the world.

But what if we're wrong about decoupling? I've been defending this claim since [Decoupling debunked](#) and I never felt as right as now after reading the IPCC "[Mitigation of Climate Change](#)" report. What I intend to show in this paper is that the reassuring claim that decoupling is feasible, as one may read in the [Summary for Policymaker](#) and hear in the media, is scientifically ungrounded, and this based on the very analysis provided by the IPCC report.

## Decoupling in the full report

The term “decoupling” is found in 83 pages of the 2,913-page full report (41 pages being in the bibliography).<sup>1</sup> Most of the discussion happens in [Chapter 2: Emission trends and drivers](#), sub-section 2.3.3 *Decoupling of emissions from economic growth* (pp. 37-39). This sub-section is made of only five paragraphs and so I will here dissect them one by one.

“There has been a long-standing discussion on whether environmental impacts such as carbon emissions and use of natural resources can be decoupled from economic growth. It is controversial whether absolute decoupling can be achieved at a global scale ([Ward et al., 2016](#); [Hickel and Kallis, 2020](#)). However, a number of studies found that it is feasible to achieve decoupling at the national level and have explored the reasons for such decoupling ([Ward et al., 2016](#); [Zhao et al., 2016](#); [Schandl et al., 2016](#); [Deutch, 2017](#); [Roinioti and Koroneos, 2017](#); [Li et al., 2019](#); [Vadén et al., 2020](#); [Habimana Simbi et al., 2021](#); [Shan et al., 2021](#)).”

What I find most surprising about this opening paragraph is that it starts with the critics of green growth. This is new. For as long as I can remember, discussions on decoupling always started from the assumption that green growth was possible, and that it was just a matter of finding the most effective way to achieve it. But now it seems the burden of proof has changed camp. Decoupling is unfeasible, unless proven so – this in itself is already progress.

The two studies selected to represent critics of green growth are unambiguous on the matter. [Ward et al. \(2016\)](#) conclude that “growth in GDP ultimately cannot be decoupled from growth in material and energy use” and that “it is therefore misleading to develop growth-oriented policy around the expectation that decoupling is possible.” Along the same line, [Hickel and Kallis \(2020\)](#) conclude that “there is no empirical evidence that absolute decoupling from resource use can be achieved on a global scale.” They also affirm that “absolute decoupling from carbon emissions is highly unlikely to be achieved at a rate rapid enough to prevent global warming over 1.5°C or 2°C,” which lead them to write that “green growth is likely to be a misguided objective.”

Concerning the structure of the paragraph, the text is almost identical to [Hubacek et al. \(2021, pp. 1-2\)](#), which is understandable since Klaus Hubacek is lead author of Chapter 2 (together with three of his co-authors on that particular paper, one of them also lead author and the two others contributing authors). The only difference between the two documents is the choice of references. Here is the passage in the original article: “Although it is controversial whether absolute decoupling can be achieved at a global scale ([Hickel and Kallis 2021](#); [Ward et al. 2016](#); [Schandl et al. 2016](#); [Haberl et al. 2020](#); [Parrique et al. 2019](#)), a number of studies found some evidence for decoupling at the national level.” I cannot explain why the authors of Chapter 2 decided to only include the first two references. The omission of [Haberl et al. \(2020\)](#) is particularly odd since it’s the largest literature review of the empirical literature on decoupling, and also because it is referenced several times elsewhere in the report (Ch.1 p.41, p.44; Ch. 2 p.47; Ch.3 p.26; and Ch.4 p.68). For example, one can read in Chapter 4 (p.68) that “while some literature indicates that absolute decoupling of economic growth and GHG emissions has occurred in some countries ([Le Quéré et al. 2019](#)), a larger systematic review found limited evidence of this ([Haberl et al. 2020](#))” (Ch.4 p.68). (I will comment on [Le Quéré et al. 2019](#) later on.)

Let’s now look at the actual scientific proof behind the initial claim. The second sentence of the paragraph references nine studies who supposedly show that *it is feasible to achieve decoupling at the national level*. My contention is that they don’t. Out of the nine studies, two of them argue the exact opposite ([Ward et al. 2016](#); [Vadén et al. 2020](#)), three only find local proof of – mostly relative – decoupling ([Roinioti and Koroneos 2017](#); [Habimana Simbi et al. 2021](#); [Shan et al. 2021](#)), two are not even about decoupling ([Zhao et al. 2016](#); [Li et al. 2019](#)), and one is not a research article but only a

short commentary whose message is rather ambiguous on the matter ([Deutch 2017](#)). This leaves us with only one study that actually fits the claim it is referenced for ([Schandl et al. 2016](#)).

Let's review all of them, starting with the two who actually argue against the feasibility of green growth. The conclusion from [Ward et al. \(2016\)](#) is unequivocal: "Our model demonstrates that growth in GDP ultimately cannot plausibly be decoupled from growth in material and energy use, demonstrating categorically that GDP growth cannot be sustained indefinitely." This leads them to conclude that "it is ultimately necessary for nations and the world to transition to a steady or declining GDP scenario" (basically a degrowth claim). Same situation for [Vadén et al. \(2020\)](#). After reviewing 179 articles on decoupling, they conclude that even though some papers present evidence of absolute impact decoupling (mainly between CO<sub>2</sub> and GDP), there is "no evidence of economy-wide, national/international absolute resource decoupling" and "no evidence of the kind of decoupling needed for ecological sustainability." Hence their conclusion: "in the absence of robust evidence, the goal of decoupling rests partly on faith."

The findings of three cited decoupling studies do not correspond to the claim that *it is feasible to achieve decoupling at the national level*. [Roinioti and Koroneos \(2017\)](#) look at Greece from 2003 and 2013 and only find an absolute decoupling for three years (2005, 2007, and 2008). [Habimana Simbi et al. \(2021\)](#) study 20 African countries between 1984 and 2014. They find that CO<sub>2</sub> emissions increased by 2.11% over the period, and that "the industrial structure and emission efficiency contributed to the reduction of CO<sub>2</sub> emissions but were inadequate to offset the positive contribution of population and economic growth." Finally, [Shan et al. \(2021\)](#) study the link between economic growth and CO<sub>2</sub> emissions in 294 Chinese cities for the years 2005, 2010, and 2015, finding "varying degrees of decoupling": 11% achieved absolute decoupling and 65% relative decoupling. In the end, the authors write that "although there was slow emission growth or even an emission decline in decoupled cities, they kept adding CO<sub>2</sub> to the atmospheric and increasing CO<sub>2</sub> concentration."

There are two articles that are not even on the topic of decoupling. [Zhao et al. \(2016\)](#) study the environmental impacts of a fleet of 30 commercial delivery trucks in the United States (the article does not use the word "decoupling" or "green growth"). Same for [Li et al. \(2019\)](#) who look at the impacts of demographic structure on CO<sub>2</sub> emissions in China with no mention of decoupling whatsoever. And there is [Deutch \(2017\)](#), not a scientific study but a 2-page commentary reflecting on decoupling in the United States and China, which actually warns against investing too much hope in decoupling: "the decline [in energy and carbon intensity] is insufficient to avoid significant average global temperature increase in the second half of this century. It is misleading to suggest that, while this trend may create jobs and benefit to the United States, it will successfully avoid the risks of climate change."

So far, we have ruled out eight studies out of nine, which leaves us with [Schandl et al. \(2016\)](#). The first important thing to understand about this study is that it is a prospective modelling exercise. What it models is a hypothetical scenario that assumes the introduction of a global carbon price. Modelling hypothetical scenarios is uncertain enough, but one where one assumes the world would suddenly introduce a global carbon price significantly more so.

But let's nonetheless look at the results. "Our research shows that while relative decoupling can be achieved in some scenarios, none would lead to an absolute reduction in energy or material footprint, while carbon footprint could be reduced in absolute terms." Concerning carbon, the most ambitious scenario (one with a global carbon price starting at \$50 per tonne and rising to \$236 in 2050) only manages to stabilise global carbon emissions at their 2015 levels (so it's a case of absolute decoupling where GDP increases while emissions remain stable).

My contention is that this opening paragraph is deceiving because it offers no evidence that *it is feasible to achieve decoupling at the national level*. But let's see how the rest of the section unfolds.

“Table 2.3 shows the extent of decoupling of CBEs [Consumption-based emissions] and GDP [Gross Domestic Product] of countries based on CBEs from the Global Carbon Budget ([Friedlingstein et al., 2020](#)) and GDP data from the World Bank. Table 2.4 also presents countries’ degree of decoupling of PBEs [Production-based emissions] and GDP. These data allow a comparison of decoupling between GDP and both PBEs and CBEs. Absolute decoupling refers to a decline of emissions in absolute terms or as being stable while GDP grows (i.e., a decoupling index greater than 1); relative decoupling refers to growth of emissions being lower than growth of GDP (a decoupling index between 0 and 1); and no decoupling, which refers to a situation where emissions grow to the same extent or faster than GDP (a decoupling index of less than 0) ([Wu et al., 2018](#)).”

The table comes from Hubacek et al. (2021) “[Evidence of decoupling consumption-based CO<sub>2</sub> emissions from economic growth](#).” Before coming to that, however, let’s note an important sentence in the paragraph: *absolute decoupling refers to a decline of emissions in absolute terms or as being stable while GDP grows*. This is something most people do not realise about green growth: you can have so-called absolute decoupling without actually reducing emissions – we’ve seen this above in the case of these few [Chinese cities](#) who absolutely decoupled without actually reducing their emissions, or globally in the study by [Schandl et al. \(2016\)](#). Needless to say, in terms of mitigation, and especially for countries who already overshoot their carbon budgets, a stabilisation of emissions is no victory.

[Hubacek et al. \(2021\)](#) look at 116 countries from 1990 to 2018, applying a structural decomposition analysis to understand the drivers behind changes in emissions. The table shown in the IPCC report displays the grouping of these countries based on their degree of decoupling during the 2015-2018 period.

“During the most recent three-year period from 2015 to 2018, 23 countries (or 20% of the 116 sample countries) have achieved absolute decoupling of CBEs [Consumption-based emissions] and GDP, while 32 countries (or 28%) achieved absolute decoupling of PBEs [Production-based emissions] and GDP. 14 of them (e.g., the UK, Japan, and the Netherlands) also decoupled PBEs and GDP. Countries with absolute decoupling of CBEs tend to achieve decoupling at relatively high levels of economic development and high per capita emissions. Most of EU and North American countries are in this group. Decoupling was not only achieved by outsourcing carbon intensive production, but also improvements in production efficiency and energy mix, leading to a decline of emissions. Structural Decomposition Analysis shows that the main driver for decoupling has been a reduction in carbon intensity (that is change in energy mix and energy efficiency) from both domestic production and imports ([Hubacek et al., 2021](#)). Similarly, [Wood et al., \(2019c\)](#) found that EU countries have reduced their overall consumption-based GHG emissions by 8% between 1995 and 2015, mainly due to the use of more efficient technology. The literature also shows that changes in the structure of economy with a shift to tertiary sectors of production may contribute to such decoupling ([Xu and Ang, 2013](#); [Kanitkar et al., 2015](#); [Su and Ang, 2016](#)).”

“67 (or 58%) countries, including China and India, have relatively decoupled GDP and CBEs between 2015 and 2018, reflecting a slower growth in emissions than GDP. It is worth noting that the USA shows relative decoupling of emissions (both CBEs and PBEs) and GDP over the most recent period, although it strongly decoupled economic growth from emissions between 2005 and 2015. Thus decoupling can be temporary and countries’ emissions may again increase after a period of decoupling.”

(Little aside: focus on the last sentence: *decoupling can be temporary and countries' emissions may again increase after a period of decoupling*. In [Decoupling Debunked](#), we called it the *recoupling hypothesis*: a country like the United States, for example, may experience an absolute decoupling during an energy transition from coal to gas, but once that transition is complete, GDP will *recouple* with greenhouse gas emissions because burning additional gas will generate additional emissions.)

“Another 19 (or 16%) countries, such as South Africa and Nepal, have experienced no decoupling between GDP and CBEs from 2015 to 2018, meaning the growth of their GDP is closely tied with the consumption of emission-intensive goods. As a result, a further increase of GDP in these countries will likely lead to higher emissions, if they follow the historical trend without substantive improvement in efficiency of production and energy use.”

I will proceed in two steps. First, I will comment on the results of the [Hubacek et al. \(2021\)](#) study, and then I will address the second part of the first paragraph which references four other studies supposedly bringing additional proof. In [Hubacek et al. \(2021\)](#), 23 countries<sup>2</sup> achieve absolute decoupling of emissions and GDP. But what does that mean in actual emission reduction? Answer: not much. “In developed countries, CBE peaked at 15 GtCO<sub>2</sub> in 2007 with a subsequent 16% decline until 2016 and a slight rebound of 1.6% until 2018” (ibid. p.4). We have here again a case of emissions semi-stabilising at a too-high level, which brings the authors to write that these countries “cannot serve as role models for the rest of the world” given that their decoupling “was only achieved at very high levels of per capita emissions.”

In the discussion section of the paper, the authors conclude that “absolute decoupling is insufficient to avoid consuming the remaining CO<sub>2</sub> emission budget under the global warming limit of 1.5°C or even 2°C and avoid potential climate breakdown ([Hickel and Kallis, 2020](#)). Overwhelming efforts are needed to reduce global emissions in line with Paris Agreement targets, and the evidence seems to be mounting that even widespread and rapid absolute decoupling alone might not suffice to achieve these goals without some form of economic degrowth ([Hickel et al., 2021](#); [Keyßer and Lenzen 2021](#); [Stoknes and Rockström, 2018](#))” (ibid. p.7).

They go even further in the last paragraph of the conclusion: “Even though some countries have achieved absolute decoupling, they are still adding emissions to the atmosphere thus showing the limits of ‘green growth’ and the growth paradigm. Even if all countries decouple in absolute terms, this might still not be sufficient to avert dangerous climate change. Therefore, decoupling can only serve as one of the indicators and steps toward fully decarbonizing the economy and society” (ibid. p.9).

Let us now look at the four other studies mentioned at the end of the first paragraph. [Wood et al. \(2020\)](#) is a fairly niche study, which estimates emission transfers between OECD and non-OECD countries. Concerning OECD countries, consumption-based emissions are slightly higher in 2015 than they were in 1995 (another case of decoupling without emissions cut). [Xu and Ang \(2013\)](#) is also quite specific. It surveys 80 papers on structural decomposition analysis of energy-related CO<sub>2</sub> emissions from 1991 to 2012, but do so before the invention of consumption-based emissions indicators, which limits the usefulness of its results. [Kanitkar et al. \(2015\)](#) is a prospective case-study evaluating two different climate targets for India, and [Su and Ang \(2016\)](#) conducts a Structural Decomposition Analysis (SDA) to rank 30 geographical regions in China based on their emission performance. Let’s remember the claim these studies are referenced to: *changes in the structure of economy with a shift to tertiary sectors of production may contribute to such decoupling*. I find it odd that none of these studies actually look at the developed country who absolutely decoupled their consumption-based emissions.

Let’s continue and analyse the final paragraph of the *Decoupling of emissions from economic growth* section.

“It is important to note that a country’s degree of decoupling changes over time. For example, 32 countries achieved absolute decoupling from 2010 to 2015 but only 10 of them remained decoupled over the next three years. More importantly, although absolute decoupling has reduced annual emissions, the remaining emissions are still contributing to an increase in atmospheric carbon concentration. Absolute decoupling is not sufficient to avoid consuming the remaining CO<sub>2</sub> emission budget under the global warming limit of 1.5°C or 2°C and to avoid climate breakdown ([Stoknes and Rockström, 2018](#); [Hickel and Kallis, 2020](#)). Even if all countries decouple in absolute terms this might still not be sufficient and thus can only serve as one of the indicators and steps toward fully decarbonizing the economy and society.”

Before commenting on that paragraph, allow me a little aside on [Stoknes and Rockström \(2018\)](#), which argues that Sweden, Finland and Denmark have achieved what the authors call “genuine green growth” (a requirement of a yearly 5% improvement in carbon productivity). A recent study by [Tilsted et al. \(2021\)](#) revisited their results showing that Denmark had only achieved the 5% threshold a couple of years between 2000 et 2017, and that all the other Nordic countries remained far under the 5% threshold when their imported emissions were accounted for. Today, and given the results of the AR6, we know that 5% yearly reduction in emissions are not enough, and so we realise that the Nordic countries are far from having achieved a green growth compatible with the 1.5°C climate threshold.

Back to the paragraph. It basically says that absolute decoupling in itself is not an effective mitigation strategy if it doesn’t actually decrease emissions. This is a point I have made a few times here already, and this is probably the most precious message of this whole discussion. Economic growth makes it more difficult to reduce emissions compared to a [degrowth scenario](#) where the volume of production and consumption gets smaller. This is not rocket science: the goods and services the easiest to green are the ones you don’t have to produce, and so the more of them we can downshift with demand-side measures, the easiest it will be to cut emissions.

This marks the end of the section on decoupling but there are two other places in [Chapter 2: Emission trends and drivers](#) that we need to look at, starting with the paragraph dedicated to decoupling in the Executive Summary of the chapter:

**“A growing number of countries have achieved GHG emission reductions longer than 10 years – a few at rates that are broadly consistent with climate change mitigation scenarios that limit warming to well below 2°C (*high confidence*).** There are about 24 countries that have reduced CO<sub>2</sub> and GHG emissions for longer than 10 years. Reduction rates in a few countries have reached 4% in some years, in line with rates observed in pathways that *likely* limit warming to 2°C. However, the total reduction in annual GHG emissions of these countries is small (about 3.2 GtCO<sub>2</sub>eqyr<sup>-1</sup>) compared to global emissions growth observed over the last decades. Complementary evidence suggests that countries have decoupled territorial CO<sub>2</sub> emissions from Gross Domestic Product (GDP), but fewer have decoupled consumption-based emissions from GDP. This decoupling has mostly occurred in countries with high per capita GDP and high per capita CO<sub>2</sub> emissions” (Ch.2 p.5)

In light of the available scientific evidence, this opening sentence is ungrounded and misleading. So far in Chapter 2, there has been no evidence showing that emissions could actually be significantly decreased. All the rates we’ve seen in the handful of cases where emissions actually decrease (instead of just stabilising) have been far far (far) away from the *rates that are broadly consistent with climate change mitigation scenarios that limit warming to well below 2°C*. The reference to a 4% yearly decrease is confusing because such cases have been so rare. It would be like pointing to the top speed of Usain Bolt implying that we could all potentially run that fast, all the time. Plus, we’ve seen that this

decoupling was often temporary, and so picking the fastest decoupling years of the fastest decoupling countries is not representative of more general, long-term trends. The rest of the paragraph is more cautious, warning that these cases of decoupling have occurred at levels of GDP and CO<sub>2</sub> emissions so high that they “cannot serve as role models for the rest of the world,” to use the concluding words of [Hubacek et al. \(2021\)](#).

The second passage worth mentioning is a FAQ at the end of Chapter 2: *Are there countries that have reduced emissions and grown economically at the same time?*

“About 24 countries that have reduced territorial CO<sub>2</sub> and GHG emissions for more than 10 years. Uncertainties in emission levels and changes over time prevents a precise assessment in some country cases. In the short observation period of 2010–2015, 43 out of 166 countries have achieved absolute decoupling of consumption-based CO<sub>2</sub> emissions from economic growth, which means that these countries experienced GDP growth while their emissions have stabilised or declined. A group of developed countries, such as some EU countries and the United States, and some developing countries, such as Cuba, have successfully achieved an absolute decoupling of consumption-based CO<sub>2</sub> emissions and GDP growth. Decoupling has been achieved at various levels of per capita income and per capita emissions. Overall, the absolute reduction in annual emissions achieved by some countries has been outweighed by growth in emissions elsewhere in the world” (Ch.2 p.83).

Even after spending that much time studying the report, I could not identify the study with 43 countries having decoupled their consumption-based CO<sub>2</sub> emissions – [Hubacek et al. \(2021\)](#) only look at 116 with 23/24 nations in the absolute decoupling group. In any case, the sentence is overly optimistic in light of the reviewed scientific evidence. Notice also how the sentence “*decoupling has been achieved at various levels of per capita income and per capita emissions*” is quite more hopeful than the one in the paragraph above (Executive Summary of Chapter 2): “*This decoupling has mostly occurred in countries with high per capita GDP and high per capita CO<sub>2</sub> emissions.*” Notice as well how the sentence “*a group of developed countries, such as some EU countries and the United States, and some developing countries, such as Cuba, have successfully achieved an absolute decoupling of consumption-based CO<sub>2</sub> emissions and GDP growth*” could be potentially misinterpreted as a form of green growth compatible with limiting global warming to well-below 2°C (which it is not since the EU and the United States are still largely overshooting their national carbon budgets).

That’s it for Chapter 2. Some may say that decoupling is discussed elsewhere in the report, and indeed there are few passages we can analyse, starting with this one in [Chapter 5: Demand, services and social aspects of mitigation](#).

“Worldwide trends reveal that at best only relative decoupling (resource use grows at a slower pace than GDP) was the norm during the twentieth century ([Jackson 2009](#); [Krausmann et al. 2009](#); [Ward et al. 2016](#); [Jackson 2017](#)), while absolute decoupling (when material use declines as GDP grows) is rare, observed only during recessions or periods of low or no economic growth ([Heun and Brockway 2019](#); [Hickel and Kallis 2019](#); [Vadén et al. 2020](#); [Wiedenhofer et al. 2020](#)). Recent trends in OECD countries demonstrate the potential for absolute decoupling of economic growth not only from territorial but also from consumption-based emissions ([Le Quéré et al. 2019](#)), albeit at scales insufficient for mitigation pathways ([Vadén et al. 2020](#)) (Chapter 2)” (Ch.5 p.15).

Most of the paragraph is sceptical of decoupling supporting the argument I have developed so far, so let’s focus on the more hopeful bit. The last sentence refers to “[Drivers of declining CO<sub>2</sub> emissions in](#)

[18 developed economies](#)” by Le Quéré et al. (2019). The study analyses 18 developed economies (Sweden, Romania, France, Ireland, Spain, UK, Bulgaria, The Netherlands, Italy, United States, Germany, Denmark, Portugal, Austria, Hungary, Belgium, Finland, and Croatia) between 2005 and 2015, finding that emissions decreased by a median -2.4% per year during that decade.

What’s great about this study is that it shows how overly hopeful the Executive Summary of the Chapter 2 is about these *rates that are broadly consistent with climate change mitigation scenarios that limit warming to well below 2°C*. Take UK, for example, often-cited as one of the most successful decoupling countries. In the Le Quéré study, its consumption-based emissions decreased by -2.1% per year between 2005 and 2015 with positive GDP rates of around 1.1%. This is not much; the country has pledged to reduce emissions by twice that (5.1% per year). And to comply with the Paris Agreement, UK would need to achieve a steady [13% cut in emissions](#) every year.

Second remark: part of that decoupling is explained by a slowing down of rates of GDP growth (so closer to degrowth than to green growth). Le Quéré et al. acknowledge that the studied period is nothing extraordinary: “These reductions in the energy intensity of GDP in 2005-2015 do no stand out compared to similar reductions observed since the 1970s, indicating that decreases in energy use in the peak-and-decline group could be explained at least in part by the lower growth in GDP.” Using simulations, the authors estimate that “if GDP returns to strong growth in the peak-and-decline group, reductions in energy use may weaken or be reversed unless strong climate and energy policies are implemented.” The authors themselves err on the side of caution: “as significant as they have been, the emissions reductions observed [...] fall a long way short of the deep and rapid global decarbonization of the energy system implied by the Paris Agreement temperature goals, especially given the increases in global CO<sub>2</sub> emissions in 2017 and 2018, and the slowdown of decarbonization in Europe since 2014.”

So, the results for greenhouse gases are rather disappointing, but perhaps there are more comforting evidence concerning the decoupling of other environmental pressures. Except that no, there is not. In fact, the situation for material footprint (the only other environmental pressure mentioned by the IPCC in the context of decoupling) is even worse. The situation is well summarised in the Executive Summary of [Chap 11: Industry](#) and then further in the chapter.

“Global material intensity (in-use stock of manufactured capital, in tonnes per unit of GDP is increasing (*high confidence*). In-use stock of manufactured capital per capita has been growing faster than GDP per capita since 2000. Total global in-use stock of manufactured capital grew by 3.4% yr<sup>-1</sup> in 2000–2019. At the same time, per capita material stocks in several developed countries have stopped growing, showing a decoupling from GDP per capita” (Ch.11 p.4).

“Since 1970 material stock growth driven by industrialization and urbanization slightly exceeded that of GDP and there was no decoupling, so in Kaya-like identities material stock may effectively replace GDP” (p.12). There is a footnote attached to the word decoupling that says: “This conclusion is also valid separately for developed countries, rest of the world, and for China, when adjusted GDP for this country is used ([Krausmann et al. 2020](#))” (ibid.). The paragraph continues: “While the composition of basic materials within the stock of manufactured capital was evolving significantly, overall stock use associated with a unit of GDP has been evolving over the last half-century in a quite narrow range of 7.7–8.6 t per 1000 USD (2017 PPP) showing neither signs of decoupling from GDP, nor saturation as of yet” (Ch.11 p.13).

So, we’ve done it. We have reviewed the totality of the IPCC report on the question of decoupling. After reviewing all the scientific evidence available, I remain highly sceptical of that claim we encountered in the first paragraph that *it is feasible to achieve decoupling*, unless we debase decoupling

to a minuscule decrease or stabilisation of emissions, which would be a sham, especially in the context of a mitigation report. Now that this is done, let's look at how these results have been synthesised in the Technical Summary (TS) and in the Summary for Policymakers (SPM).

## Decoupling in the Technical Summary (TS) and in the SPM

The term “decoupling” is mentioned three times in the [Technical Summary](#), two of which are worth commenting on.<sup>3</sup> The first mention happens in *Emission trends and drivers*.

**“A growing number of countries have achieved GHG emission reductions over periods longer than 10 years - a few at rates that are broadly consistent with the global rates described in climate change mitigation scenarios that likely to limit warming to 2°C (*high confidence*). At least 24 countries have reduced CO<sub>2</sub> and GHG emissions for longer than 10 years. Reduction rates in a few countries have reached 4% in some years, in line with global rates observed in pathways that *likely* limit warming to 2°C. However, the total reduction in annual GHG emissions of these countries is small (about 3.2 GtCO<sub>2</sub>-eq yr<sup>-1</sup>) compared to global emissions growth observed over the last decades. Complementary evidence suggests that countries have decoupled territorial CO<sub>2</sub> emissions from GDP, but fewer have decoupled consumption-based emissions from GDP. Decoupling has mostly occurred in countries with high per capita GDP and high per capita CO<sub>2</sub> emissions”** (TS p.16, bold in original).

This is almost the same paragraph than in the Executive Summary of [Chap 2: Emissions trends and drivers](#), with one interesting difference. Instead of “there are about 24 countries” in the full report, the TS states “at least 24 countries” (implying there could be more). This suggests that, with better data or looser assumptions, we might discover that more countries have actually greened their growth. In research reality, however, it is the opposite situation that usually happens. As we get better and better data (for example about imported emissions), we update past decoupling achievements *downwards*. For example, a large portion of countries who were considered absolutely decoupled in term of territorial emissions ceased to be so when their decoupling was measured based on consumption-based emissions.

One second mention worth commenting on is found in *Industry*:

**“Global material intensity – the in-use stock of manufactured capital in tonnes per unit of GDP – is increasing (*high confidence*). In-use stock of manufactured capital per capita has been growing faster than GDP per capita since 2000. Total global in-use stock of manufactured capital grew by 3.4% yr<sup>-1</sup> in 2000-2019. At the same time, per capita material stocks in several developed countries have stopped growing, showing a decoupling from GDP per capita”** (TS p.77).

This is a surprising summary for those who remember the footnote in Ch.11 p.13 that “This conclusion is also valid separately for developed countries, rest of the world, and for China, when adjusted GDP for this country is used ([Krausmann et al. 2020](#)). Interestingly, the two co-authors of F. Krausmann are the lead authors of the largest literature review of the decoupling literature ([Wiedenhofer 2020](#); [Haberl et al. 2020](#)). Their conclusions about the available science on material decoupling contradicts this statement from the SPM: “absolute reductions of material flows are generally only found in periods of very low economic growth or even recession” (p.6).

It gets worse. It even says that “in contrast to those measures of decoupling based on territorial indicators, consumption-based perspectives unveil a reversal of trends with efficiencies deteriorating

instead of improving and no evidence even for relative decoupling” (p.29), adding that “currently, decoupling appears to depend on prior use and accumulation of materials and on extractive expansion and rising material flows elsewhere. As long as this is the case, decoupling cannot be achieved in the long-term or universally” (ibid.). It is therefore no surprise that the authors conclude their literature review by appealing to “sufficiency and other transformative strategies” (in the paper, they directly associate sufficiency with degrowth).

The term “decoupling” is not mentioned in the [SPM](#), but there are three passages worth commenting.

**B.3** “Regional contributions to global GHG emissions continue to differ widely. Variations in regional, and national per capita emissions partly reflect different development stages, but they also vary widely at similar income levels. The 10% of households with the highest per capita emissions contribute a disproportionately large share of global household GHG emissions. At least 18 countries have sustained GHG emission reductions for longer than 10 years. (high confidence)” (SPM p.8)

**B3.5** “At least 18 countries have sustained production-based GHG and consumption-based CO<sub>2</sub> emission reductions for longer than 10 years. Reductions were linked to energy supply decarbonisation, energy efficiency gains, and energy demand reduction, which resulted from both policies and changes in economic structure. Some countries have reduced production-based GHG emissions by a third or more since peaking, and some have achieved several years of consecutive reduction rates of around 4 %/yr, comparable to global reductions in scenarios limiting warming to 2°C (>67%) or lower. These reductions have only partly offset global emissions growth. (high confidence)” (SPM P.10)

**B5.1** “At least 18 countries that had Kyoto targets for the first commitment period have had sustained absolute emission reductions for at least a decade from 2005, of which two were countries with economies in transition (very high confidence)” (SPM p.14)

I find it strange that the 18 countries of [Le Quéré et al. \(2019\)](#) make it to the SPM, given that they have played such a minor role in the decoupling section of the report. Overall, [Le Quéré et al. \(2019\)](#) is cited 6 times in the report, so as often as [Hickel and Kallis \(2020\)](#). (This is not an issue of scientific standing: the Hickel and Kallis paper has been cited 727 times according to Google Scholars, whereas Le Quéré et al. only 194 times.) I also find it surprising that [Haberl et al. \(2020\)](#) (cited 5 times in the report) is not given a more prominent role given that it is the largest, most respected literature review on the topic (it has the same number of citation on Google Scholars than Le Quéré et al. 2019). I’m also surprised not to see [Hubacek et al. \(2021\)](#) here since it is the central study used in Chapter 2.

In the end, what I find most startling is the hopeful tone. Whereas the full report is actually quite sceptical of decoupling and green growth, the SPM is smoothed out to be more green growth-friendly than science suggests.

## Conclusion

The IPCC has spoken, but it has done so in two voices. The voice of careful, rigorous science has spoken against the feasibility of green growth as a mitigation strategy. Decoupling is described as “insufficient” ([Hubacek et al. 2021](#)), “not sufficient” ([IPCC AR6 WGIII, Ch.2 p.39](#)), with rates that “fall a long way short” ([Le Quéré et al. 2019](#)), which makes green growth a “misleading” ([Ward et al. 2016](#)), “misguided” ([Hickel and Kallis 2020](#)) strategy which “rests partly on faith” ([Vadén et al. 2020](#)).

But there is also another dangerous voice. It is the once of cherry-picked statements that give the illusion that developed nations have gotten green and that further economic growth is compatible with climate targets. This voice is made of vague claims and fuzzy definitions which can neither be proven true nor false. It is a pat on the back for regions, countries, and industries who use these arguments to turn a blind eye to the necessary degrowth of their economic activities.

So, “the jury has reached a verdict,” said [UN Secretary-General António Guterres](#) during the release of the report. For me, the AR6 is the last nail on the coffin of the green growth hypothesis, which I consider to be a broken promise, one of the “empty pledges that put us firmly on track towards an unliveable world,” as Guterres says.

What if we could time travel to Galileo’s trial today? I think the situation concerning decoupling is dramatically similar. Give a few years (hopefully less) for the smoke to disappear, and we’ll soon realise that, just like the Sun doesn’t revolve around the Earth, the continued pursuit of economic growth in rich nations is not compatible with a stable climate.

## Notes

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<sup>1</sup> There are many mentions where the term is only used without further engagement. For example, here: “The economic centrality of fossil fuels raises obvious questions regarding the possibility of decarbonisation. Economically, this is well understood as a problem of decoupling” (Ch.1 p.28), or here: “This suggests initial evidence that policy has driven some decoupling (e.g. Figure 1.1d) and started to ‘bend the curve’ of global emissions, but more specific attribution to observed trends is not as yet possible” (Ch.1 p.31). A small comment in passing concerning relative decoupling in China and India (Ch.2 p.44). Another concerning eco-industrial parks in China (Ch.17 p.41). A couple of loose mentions in Chapter 8, talking about “economic decoupling” in general.

<sup>2</sup> In the [Supplementary Material](#) of [Hubacek et al. \(2021\)](#), there are actually 24 countries in the absolute decoupling group: Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, El Salvador, Estonia, Finland, France, Germany, Hungary, Ireland, Jamaica, Japan, Latvia, the Netherlands, New Zealand, Romania, Slovenia, Spain, Sweden, the United Kingdom, and the USA.

<sup>3</sup> There is a second, less remarkable mention in *Urban and other settlements*: “**Given the dual challenges of rising urban GHG emissions and future projections of more frequent extreme climate events, there is an urgent need to integrate urban mitigation and adaptation strategies for cities to address climate change (very high confidence).** Mitigation strategies can enhance resilience against climate change impacts while contributing to social equity, public health, and human well-being. Urban mitigation actions that facilitate economic decoupling can have positive impacts on employment and local economic competitiveness” (TS p.65, bold in original).

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