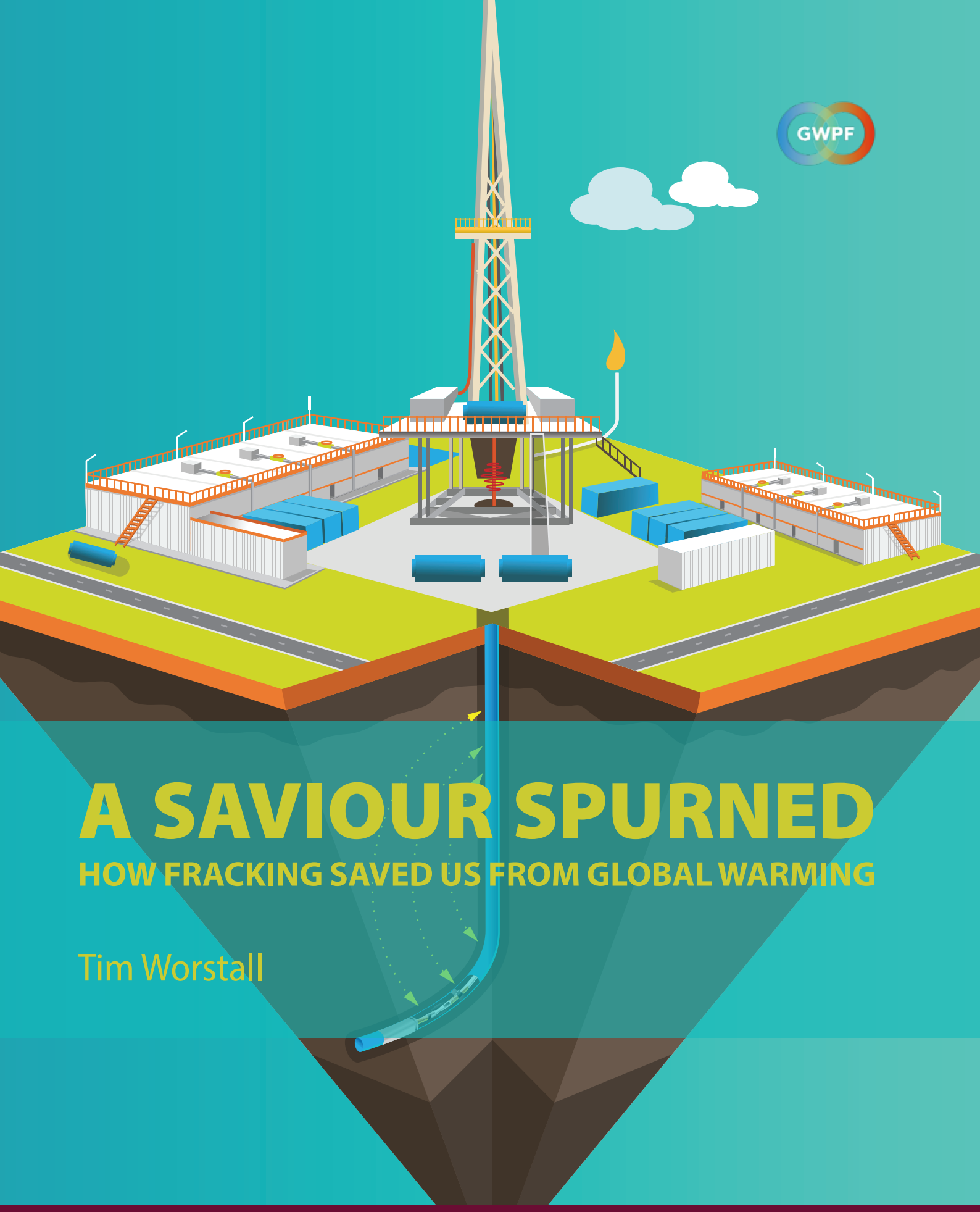

A SAVIOUR SPURNED

HOW FRACKING SAVED US FROM GLOBAL WARMING

Tim Worstall

The Global Warming Policy Foundation
Briefing 53

A Saviour Spurned: How fracking saved us from global warming

Tim Worstall

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About the author

Tim Worstall is a businessman, and writer and blogger. He has written for many publications, including *The Times* and *The Daily Telegraph*. He is a fellow of the Adam Smith Institute.

1. Introduction

The good news is that the worst predictions of climate change aren't going to come true. The bad news is that they never were going to and we've been misled all these years.

The headline prediction was that carbon dioxide emissions were on track for something called Representative Concentration Pathway (RCP) 8.5. This trajectory is what drives the near-hysterical predictions of sea-level rise, warming itself, droughts, crop failures and the rest. But we're not on that path; we're currently on something closer to RCP4.5. This is where climate change itself is a minor – if chronic – problem, largely solved by standard market processes with, if we should so wish, the addition of a little bit of tinkering. The overturning of consumer capitalism, of civilisation itself, is therefore not warranted.

The reason for this improvement in the outlook is the advent of fracking. This one, and one alone, event is what means those excessive warnings are, well, excessive. For it never has been necessary to replace fossil fuels with renewables in order to dodge those wilder claims of doom. All that was ever required was that we shouldn't move back to a largely coal-energised civilisation. Once that is achieved – which is what fracking has done – those claims of imminent doom are entirely vanquished.

A strong claim, but one that is true. For in the original discussions of what might happen, there was a 'what if?' That being 'what if we run out of conventional gas and so turn back to coal?' Another way of saying the same thing being 'what if we don't use the unconventional gas we know is out there and so turn back to coal?' But we haven't run out of gas because we *have* exploited those unconventional sources – that is what fracking is – and so are not turning back to coal. This one event, this one single change in those original assumptions, is all that is or ever has been needed to avoid those claimed horrors of excessive climate change. In other words, everything we need to do to avoid significant climate change has already been done. Climate never was likely to be the problem currently claimed and the probability of it being so now is zero.

Just for the avoidance of doubt, the importance of unconventional gas in avoiding climate disaster is inherent – actually detailed – in the standard climate science itself. The building blocks of the models developed by the Intergovernmental Panel on Climate Change (IPCC) – the assumptions that led to the Paris Agreement – tell us, specifically, that this is true. This is not some claim from out of left field; it is simply what the IPCC's own documents tell us.

As to why this is not more generally agreed and accepted, we'll leave that to others to discuss. This paper argues only within the IPCC's own agreed science.

2. The importance of CO_2 concentrations

It is necessary to work through a number of steps in order to calculate the effects of climate change. A higher atmospheric concentration of carbon dioxide has what effects, for example? Basic physics can tell us the first level, or first iteration, effect of a change in atmospheric composition. There is then the task of working out what feedbacks there are; whether they are positive or negative and so on. Less snow means less heat reflected from the Earth's surface; greater or lesser cloud cover could accelerate or decelerate temperature changes, dependent upon which type of clouds they are. Then there's the effect upon what we're actually interested in: our ability to live in the resultant environment. Fewer or smaller glaciers will be a problem for those whose water supply depends upon them, thermal expansion of the oceans and meltwater from glaciers and icesheets poses problems for beachfront property.

All of those subsequent steps are interesting and important. But they do all, clearly, depend upon what the atmospheric concentration of carbon dioxide is going to be. This is the point we address in this paper. We are not interested in – because they are irrelevant to the point being made – all of the subsequent models, structures, arguments and predictions. The reason for this should be obvious enough. Whatever those climate models say about the effects of concentrations, the output is going to be different given different inputs. That is the base contention after all – more carbon dioxide (or equivalents) in the air causes problems. These problems being connected to how much that 'more' is. After all, if this contention were not the basis of the entire subject then there couldn't be a problem with increasing concentrations. So, at the root of the subject is some idea of how much we think concentrations are going to rise. We cannot gain any useful information about our likely futures without substantial investment in deciding the possible range.

The estimates of what emissions are going to be are therefore of paramount importance. Nothing will make sense – the dangers of change, the actions needed to adapt to it or avoid it, the scale of it – if that input number, future emissions, is wrong. Of course, there are a number of possible futures, and so we have a number of different estimates of future emissions. But we must, however, limit ourselves to considering the ones that are realistically possible, for only those are of use to us in any decision-making process. Or, in fact, in any estimation process of the likely effects.

3. The scenarios

The current set of predictions about how future emissions are going to turn out are the Representative Concentration Pathways (RCPs). These are in the process of being replaced by the Shared Socio-economic Pathways, but the RCPs are what we're working with right now. The previous set came from the Special Report on

Emissions Scenarios (SRES).

The two RCPs that concern us here are RCP8.5 and RCP4.5. These broadly correspond to SRES A1FI and SRES A1T (with FI standing for 'Fossil Intensive' and T for 'Technology'). The full details of their correspondence and its importance are set out in the appendix to this report.

As a pencil sketch, RCP8.5 (and A1FI) is a world in which emissions continue to climb strongly. Unlike all other scenarios, methane emissions also increase substantially. This then leads the atmospheric CO_2 (correctly, CO_2-e) concentration to soar. Given this input, the climate models detailing the subsequent effects upon the world suggest substantial problems. Note that these problems depend upon not just the effects of high CO_2 concentrations, but also on whether high concentrations are actually going to occur. If emissions aren't going to be that high, it might still be interesting to explore the effects of high CO_2 levels, but it would not be relevant to policymaking.

The full discussion of what RCP8.5 is, together with details about the two SRES scenarios, can be found in the appendix. However, its exact nature is less important than our knowing why it matters and that it isn't going to happen.

4. Why RCP8.5 matters

Something that was always unlikely to happen – extremely so – and now isn't happening at all should not be important. Yet RCP8.5 is important simply because it's the baseline from which too many people are measuring those future effects of climate change. That is, it's not particularly the model and prediction itself which is problematic – why not investigate truly extreme outcomes after all? – but its portrayal as a *likely* outcome. As Roger Pielke Jr has pointed out:

> The decision by the IPCC to center its Fifth Assessment Report on its most extreme scenario has been incredibly consequential. Thousands of academic studies of the future impacts of climate change followed the lead of the IPCC, and have emphasized the most extreme scenario as 'business as usual' which is often interpreted and promoted as where the world is heading. For instance, so far in 2019 two new academic studies have been published every day that present this most extreme scenario as 'business as usual' and predict extreme future impacts. Journalists promote these sensationalist findings, which are amplified by activists and politicians and as a consequence climate change becomes viewed as being more and more apocalyptic.[1]

Or there is this, from *Nature* in January of this year:

> Another [RCP] paints a dystopian future that is fossil-fuel intensive and excludes any climate mitigation policies, leading to nearly 5°C of warming by the end of the century. That one is named RCP8.5.
>
> RCP8.5 was intended to explore an unlikely high-risk future. But

> it has been widely used by some experts, policymakers and the media as something else entirely: as a likely 'business as usual' outcome. A sizeable portion of the literature on climate impacts refers to RCP8.5 as business as usual, implying that it is probable in the absence of stringent climate mitigation.[2]

In other words, RCP8.5 has been used to tell us what a carbon-using future is likely to be. Unfortunately, it was never likely, and we now know for sure that it's not what that future is going to be. Which does cause a certain problem if we're trying to use science to look into possibilities for our collective future.

5. Why RCP8.5 isn't going to happen

RCP8.5 was never a likely outcome. It assumes that we run out of conventional supplies of gas. Further, that we never work out ways of accessing the known unconventional reserves and resources of fossil fuels. However, do note that detail in there: the model for RCP8.5 does agree that the unconventional hydrocarbon resources are out there. It's just that we don't develop the technology to extract them and therefore don't use them.

It is also assumed we also don't develop cheap renewables or invest heavily in nuclear. Instead we turn back to coal as our major energy source. Actually, RCP8.5 assumes that we'll not only turn back to coal, we'll party with it like it's 1899. As David Rutledge, a professor of engineering at Caltech, has said:

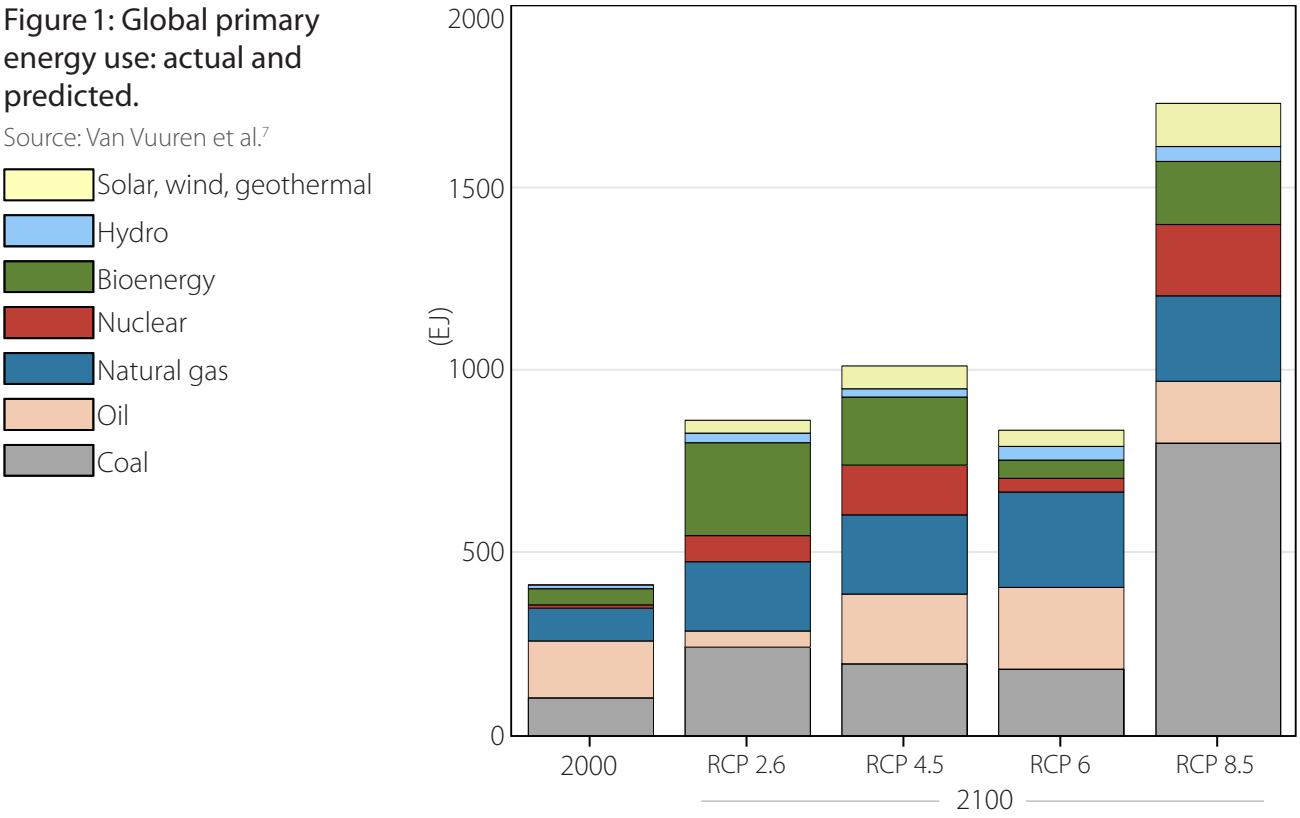
> In the IPCC's business-as-usual scenario, Representative Concentration Pathway (RCP) 8.5, coal accounts for half of future carbon-dioxide emissions through 2100, and two-thirds of the emissions through 2500. The IPCC's coal burn is enormous, twice the world reserves by 2100, and seven times reserves by 2500. Burning more than the reserves we've got is achieved by doing the work to translate mineral resources into reserves – resources are many times greater than currently proven reserves. Coal so dominates that it is not an exaggeration to say that the IPCC and climate-change research programs depend on this massive coal burn for their existence. Without the threat of coal, the IPCC could close up shop and the research program funding would drop to a small fraction of what is spent on research in weather forecasting.[3]

Figure 1 shows how extreme RCP8.5 is. Such a huge increase in coal use never was a realistic assumption; technology tends not to regress, after all. The reasons we gave up using coal in that sort of volume would still be there. Thus it's reasonable to assume that we wouldn't go back to using it. In fact, RCP8.5 – actually its earlier equivalent, SRES A1FI – has long been critiqued in the academic literature as a highly unlikely if not impossible future. Even twenty years ago, Bjørn Lomborg was suggesting that:

> ...under any reasonable scenario of technological change and without policy intervention, carbon emissions will not reach the levels of A1FI and they will decline toward the end of the century, as we move towards ever cheaper renewable energy sources.[4]

Figure 1: Global primary energy use: actual and predicted.

Source: Van Vuuren et al.[7]



However, note that it is not necessary for it to be renewables that become cheaper. Anything other than coal would do the trick of knocking the world off this high-carbon path. So, if it's natural gas that is cheapest, that still achieves the key goal of not being on an A1FI path, albeit the aim needs to be to eventually move to fuels with even lower carbon intensity: nuclear, hydrogen and renewables.

And we already have confirmation that the doubters were correct: the extreme 'business as usual' scenario of the IPCC's Fifth Assessment Report is already obsolete. We *did* develop that technology to enable us to exploit unconventional hydrocarbons – fracking – and it is being used at large scale. Thus we are going to use less coal purely on the basis that humans use more of the less expensive things, and less of the more, as relative prices change. We can see this happening around us. We are phasing out coal-fired plants in the rich world.

This is why American emissions have been falling in recent years. It's not regulation, it's not the installation of renewables, nor an expansion of the nuclear fleet. It hasn't even been a result of government action. It was simple – OK, it wasn't easy, so perhaps 'simply' – technological advance. Extracting unconventional gas turned out, once fracking had been developed, to be cheap. No one builds new coal-fired plants in the US these days, or at least there are many fewer of them than the extreme models predict. Coal-fired power stations tend to be closed before the end of their useful lives under the cost pressures from gas turbine power plants fed by unconventional gas.

The UK's 'dash for gas' has had the same effect: emissions are down as a result of using cheaper gas-fired plants rather than coal. Sadly, fracking is not yet supported, given the regulatory constraints put upon the practice, but perhaps people will come to realise that small and unnoticeable earth tremors would be a reasonable cost to bear to avoid the worst of climate change.

The one place that *has* obviously followed that pathway to the full-blown horrors of RCP8.5 is Germany. The removal of nuclear from their energy mix has led to much greater use of coal and a rise in emissions, even as a trillion euros was spent upon the *Energiewende*. The issue here is that people have been using the extreme scenario as a guide to follow, rather than a problem to be avoided. This is not a mere rhetorical swipe; the very warning is that retreating from lower-emission energy generation to coal will cause a problem. Germany *has* retreated from lower-emission energy generation to coal.

Fortunately, most of the world has not followed suit, and the empirical data on CO_2 concentrations shows the effect. Figure 2a shows what was predicted back in 2012; Figure 2b shows what has actually happened up to 2019.

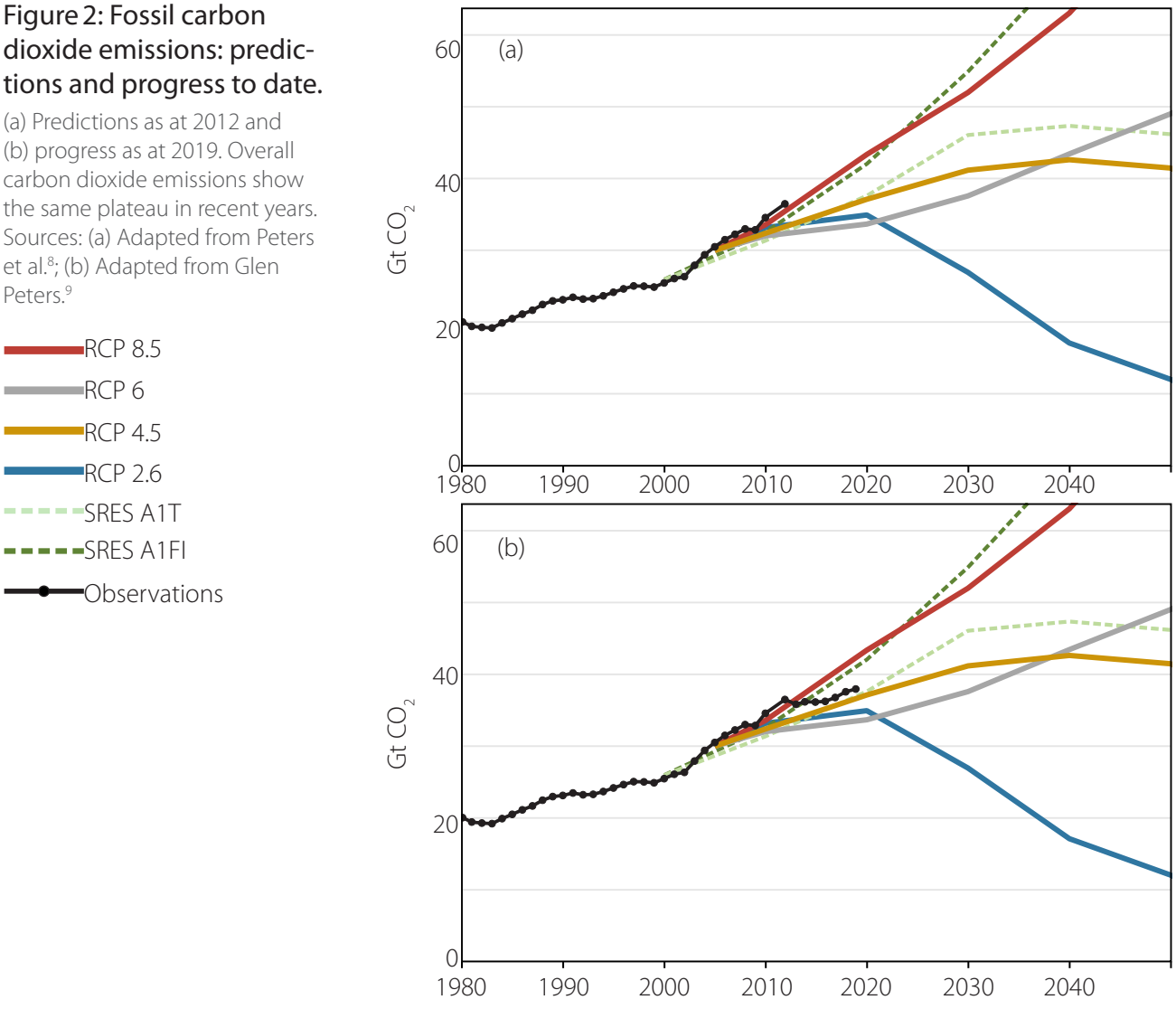


Figure 2: Fossil carbon dioxide emissions: predictions and progress to date.

(a) Predictions as at 2012 and (b) progress as at 2019. Overall carbon dioxide emissions show the same plateau in recent years. Sources: (a) Adapted from Peters et al.[8]; (b) Adapted from Glen Peters.[9]

We simply are not on the path to the very high emissions of RCP8.5; we're on something between RCP4.5 and RCP6. These are pathways in which technological progress largely takes care of matters; the world ceases to use fossil fuels because other energy generation forms become cheaper and more efficient. Annual emissions don't keep on rising, nor do atmospheric concentrations. Climate change in this model is a chronic – i.e. long lasting – but not serious problem. It means, in the usual estimations, a degree or two of further warming by 2100, as opposed to RCP8.5's 3.7°C (see Figure 3).

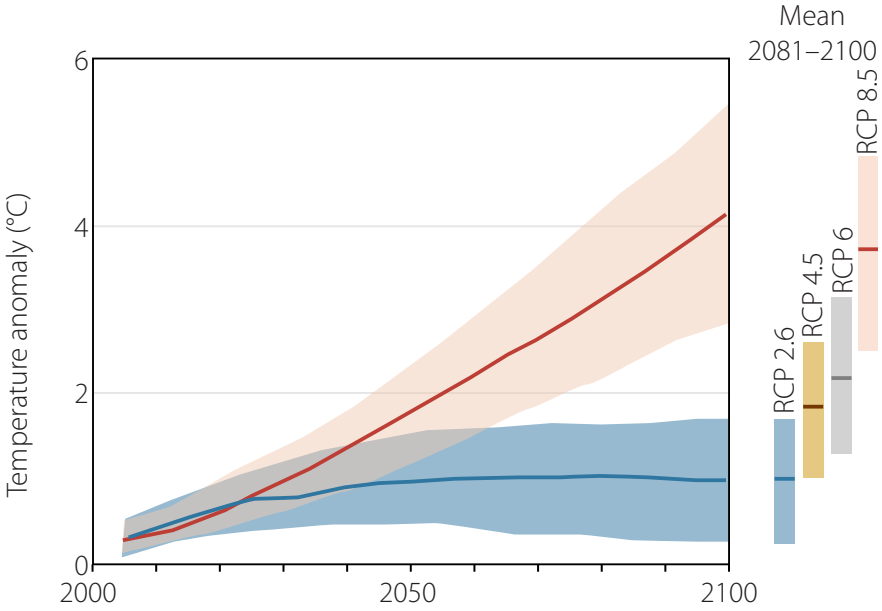


Figure 3: Global temperature change under the RCPs.

Anomalies against 1986–2005 mean. Source: IPCC AR5 Technical Summary.[10]

Moreover, the problem is largely solved by simply doing a little bit more each year of what we do naturally: investigate and invent new technologies to produce goods and services more cheaply. It doesn't require the overthrowing of capitalism or industrial civilisation, nor even the end of consumerism; just more focus on increasing the pace of reduction of the economy's carbon intensity, so that the actual emissions pathway tracks RCP4.5 rather than RCP6 (despite some other key factors, in particular population growth, likely being closer to RCP6).

In summary then, because of fracking natural gas, RCP8.5 isn't happening. The actual emissions path is something very much more like RCP4.5 or RCP6, and with technological development should increasingly follow RCP4.5 in future decades.

6. The consensus on RCP8.5 is growing

Ever since the SRES was published in the 1990s it has been, to those who appreciate the drivers of economic development, an absurdity to argue that the world would retreat to a coal-fired energy system. Thus A1FI never was believed. A1T was always vastly more likely, reflecting how productivity of resource use improves step by step over time. However, those who appreciate the small print of development models are a rare breed, and their voices never gained much of a hearing in the climate change community.

However, there is now a growing realisation within that community that the assumption that RCP8.5 is a likely scenario is incorrect. For example, from *Nature* on 29 January 2020:

> Happily – and that's a word we climatologists rarely get to use – the world imagined in RCP8.5 is one that, in our view, becomes increasingly implausible with every passing year. Emission pathways to get to RCP8.5 generally require an unprecedented five-fold increase in coal use by the end of the century, an amount larger than some estimates of recoverable coal reserves. It is thought that global coal use peaked in 2013, and although increases are still possible, many energy forecasts expect it to flatline over the next few decades. Furthermore, the falling cost of clean energy sources is a trend that is unlikely to reverse, even in the absence of new climate policies.[2]

That screeching sound you hear is U-turns being performed as the world takes on board that this extreme and entirely-outside-the-envelope prediction of carbon dioxide concentrations is just that: extreme and outside any reasonable prediction envelope. Or, as we might put it, something that isn't going to happen.

The place where we differ from this growing consensus is in our analysis of why RCP8.5 (or SRES A1FI) is not going to happen, namely because of the invention and deployment of fracking and the subsequent dash for gas. This has been obvious for at least a decade, as we explain in detail in the appendix.

7. The current situation

The great majority of the problems of climate change have been wildly overstated in recent years. This is because various researchers and prognosticators have based their predictions upon RCP8.5. We now know that RCP8.5's assumption that shales would not be exploited has turned out to be wrong. It is also possible to see from current atmospheric concentrations that the world simply is not on the RCP8.5 pathway.

The meaning of this is that we need to junk many of the predictions of imminent doom. We must rebase forecasts on the information that we have, not what might have been if matters had been different. Being on that RCP4.5 pathway means that climate change is a chronic problem that needs management. To use a medical analogy, it's not crash surgery required, rather more some bed rest and gentle analgesics. The RCP4.5/SRES A1T future is amenable to emissions reductions being achieved through the normal spontaneous (or perhaps encouraged and, where helpful, supported) development of new technologies, so by 2100 we will have a world largely weaned off fossil fuels, with emissions low enough not to be cumulatively troubling. In other words, we're able to deal with the problem calmly and efficiently rather than in a mass panic and wastefully.

The grosser claims of imminent doom are incorrect. This is good news, obviously. Now all that is necessary is to change policy to reflect it.

8. Afterword

It is, perhaps, worth noting that the concern over carbon cycle feedbacks[5] is irrelevant to this analysis. If net feedbacks are positive then that is of course an input into our concerns over climate change. Similarly, if net feedbacks are negative that is also something we must account for in our projections. But whatever feedbacks are, net negative or net positive, they will still be something that stems from the gross emissions and their effects. Ruling out the highest set of emissions in the current scenario literature also, obviously enough, rules out the carbon cycle feedbacks that stem from that high level of emissions and their effects.

Another way to make the same point is that feedback effects will be, by their nature, additional to the initial effects of emissions. Any discussion of those feedback effects must therefore start from possible sets of initial effects. This is not something that is changed by showing that the more extreme estimations of initial effects will not happen. Feedbacks plus RCP8.5 will be more than feedbacks plus RCP 6.0 or RCP 4.5 plus feedbacks. Nothing in the nature of whatever those feedbacks might be changes that obvious point.

Appendix

We want to show the details of how SRES A1FI and therefore RCP8.5 get to those excessive estimations of emissions and of CO_2 concentrations in the atmosphere. Following the details of what was assumed does indeed lead to the simple conclusion that the deployment of fracking alone makes the prediction invalid. It was not necessary to have a renewables-only future, nor a deindustrialised one. All that has ever been necessary is a non-coal fuelled one, something already achieved.

RCP8.5 is what is generally used in those climate change papers telling us how bad it's all going to get. It's not really valid to say that we can move from RCP8.5 to RCP4.5; the two models make different assumptions about economic growth, population and so on. Thus a change in energy generation technology isn't in fact a move from one to the other; not entirely. However, within the earlier SRES models we can move from one A1 model to another, for they are making the *same* assumptions about growth, population and so on; the only change is the energy generation technology. Thus changing energy generation does, by definition, move from one scenario to the other. This makes less difference than it might seem. The emissions outcome from A1FI is very nearly the same as RCP8.5, that of A1T is very similar to RCP4.5 (see Figure 2). The change in energy generation technology can therefore be said to be moving from the one emissions total to the other. So in essence, RCP8.5 can be seen as largely a re-cooking of A1FI.

This is helpful, because it is within the SRES documentation that the condition about exploitation of unconventional fossil fuels is made clear.

First, the general background to the SRESs. We note that there is no attempt to ascribe a probability to any of the scenarios. Indeed, when the SRES report was published we were positively abjured from doing so. No scenario is any more, or less, likely than any other. Further, all the SRESs are 'business as usual' (BAU) outcomes, in the sense that they are ways in which the world could spontaneously develop. If, for example, solar power becomes cheaper, say because of technological advances, then that's part of a BAU assumption – probably A1T. The eventuality that solar power becomes cheaper because we actively intervene to make it so because of climate change is not contained in any of the scenarios. Such interventions – carbon taxes, the banning of fossil fuels, an insistence that everyone uses electric cars or any other policy change – are not considered at all in the SRES. So to reiterate, not only are all of these outcomes, by definition, equally likely, they all, again by definition, assume no policy interventions.

The A1 world is one where the 21st century is largely like the 20th: mostly capitalist and market-oriented with, at minimum, a static – if not increasing – level of globalisation. This leads to significant economic growth: GDP in 2100 is forecast to be some 11 times that in 1990. It also leads to the associated significant reduction in fertility levels. Global population peaks as the demographic shift kicks in and then gently declines. Annual GDP growth is about what it was in the 20th century, and resource use per unit of GDP declines, as it did in the 20th century. This is generally the best economic forecast we usually have: tomorrow will be much like today, next year much like this. Processes that have been ongoing for some time will continue.

Most of the significant analysis of possible futures takes place in that A1 family of scenarios. So, simply on the basis above, the most useful economic analysis is that things will proceed much as they have. Thus analysing different technologies within that rich and globalised world seems the most productive use of effort. The two pathways to which we should pay particular attention are A1FI (for fossil intensive) and A1T (for technology).

A1FI depends upon one single and critical assumption: that the world has a coal-fired future. More specifically, it is assumed that we run short of oil and natural gas, the prices of which rise above that of coal (Figure 4a). Therefore the world turns to coal to keep civilisation going. A1FI is a world in which we use very much more coal than we do now. In fact, not only does society not become more energy efficient over time, we gain an ever-increasing portion of our energy from coal. It is this which gives us the ballooning emissions and thus, given the way we use the emissions outputs as inputs into the computer models, predictions of excessive warming.

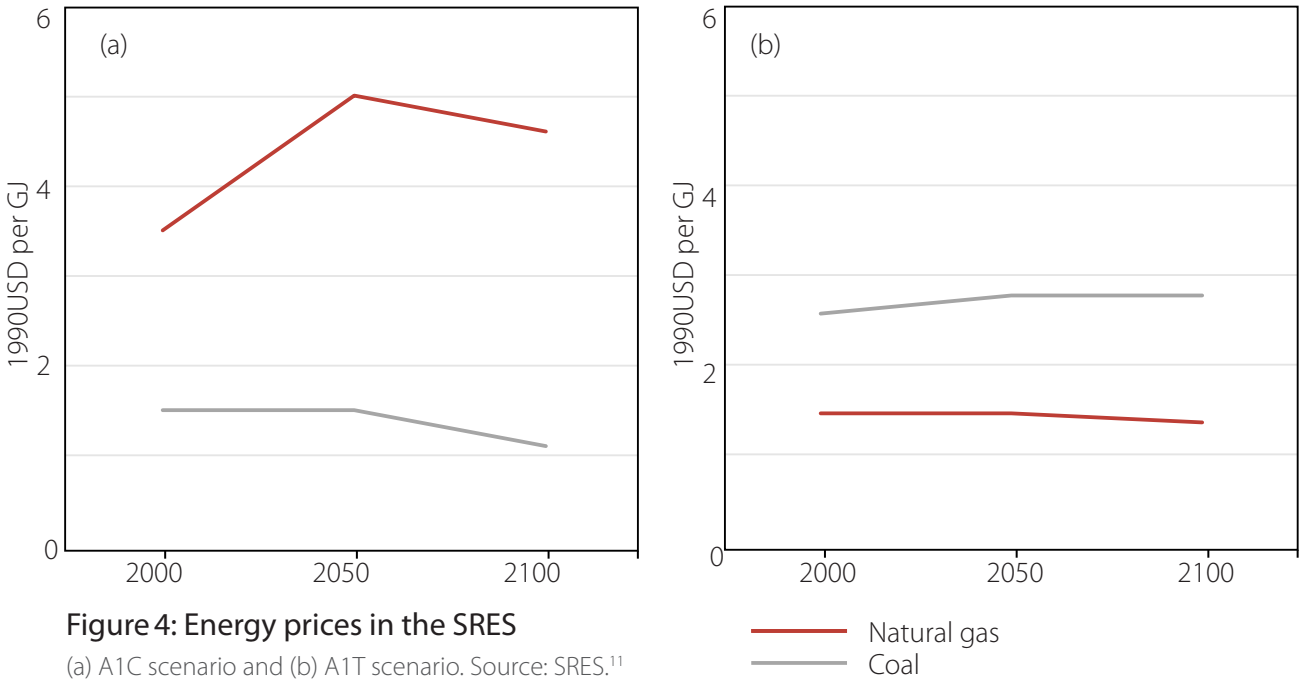


Figure 4: Energy prices in the SRES

(a) A1C scenario and (b) A1T scenario. Source: SRES.[11]

This is made quite clear in those original specifications of the A1C models, on which A1FI is based:

> The coal-intensive scenario group A1C is restricted mainly to conventional oil and gas, which results in the lowest cumulative oil and gas use (15 to 19 ZJ) of all scenarios...As such, the scenario illustrates the long-term GHG emission implications of quickly 'running out of conventional oil and gas' combined with rapid technological progress in developing coal resources and clean coal winning and conversion technologies. As a result, cumulative coal use is very high – between 48 and 62 ZJ (median, 60 ZJ) between 1990 and 2100.[6]

The assumption that oil and gas supplies become depleted also depends, again in detail, upon the idea that *unconventional* deposits are not exploited, perhaps because the technology is not developed to do so, perhaps (relatedly) because they are not economic, or perhaps because some nations decide to ban their extraction – as, say, the UK appears to be doing and certain European countries have done. The price assumptions behind the A1C models specifically cover both conventional and unconventional sources.

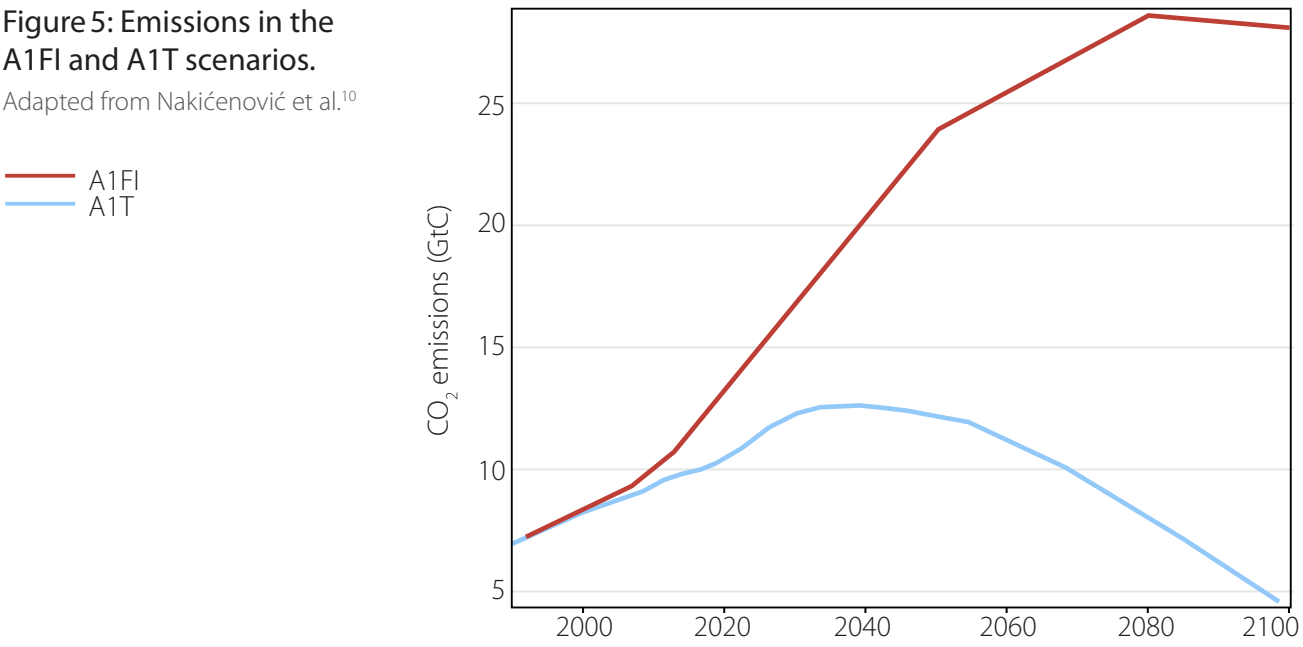
A1T, roughly enough, runs again with the idea that current experience is a useful guide to the future. The important point is that non-coal energy sources continue to gain in price competitiveness against coal at about the same rate that they did in the 20th century. In the A1T scenario assumptions, natural gas prices remain below those of coal (Figure 4b).

It's difficult to see why this wouldn't happen, so it's a reasonable assumption; perhaps not one that we'd choose to follow to the exclusion of all other possibilities, but definitely one we'd like to explore.

The contrasting end points of the two scenarios are shown in Figure 5. A1FI is clearly a disaster, with ever-increasing emissions and thus those excessive CO_2 concentrations. A1T is largely self-solving: over time, technologies and the economy itself become more efficient, more productive in resource use, as market economies generally tend to do. Energy sources other than coal are developed at what seem like reasonable rates (the assumptions are rather slower than have actually been achieved since the 1990s when these models were created). There's not really much of a problem at all.

Figure 5: Emissions in the A1FI and A1T scenarios.

Adapted from Nakićenović et al.[10]



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The Global Warming Policy Foundation is an all-party and non-party think tank and a registered educational charity which, while openminded on the contested science of global warming, is deeply concerned about the costs and other implications of many of the policies currently being advocated.

Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

The key to the success of the GWPF is the trust and credibility that we have earned in the eyes of a growing number of policy makers, journalists and the interested public. The GWPF is funded overwhelmingly by voluntary donations from a number of private individuals and charitable trusts. In order to make clear its complete independence, it does not accept gifts from either energy companies or anyone with a significant interest in an energy company.

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