How much climate warming can we expect from today’s infrastructure?

In October 2018, the International Governmental Panel on Climate Change (IPCC) released a [report](https://www.ipcc.ch/sr15/) on the impacts of allowing global temperatures to exceed 1.5°C above pre-industrial (roughly, 1850) levels. As the negative impacts of climate change increase rapidly with continued warming, there has been a renewed urgency to limit global temperature change to under 1.5°C.

This work started out investigating the level of “committed warming” - the amount of climate change that could be expected due to past emissions. The good news is that if we stopped emitting tomorrow, global temperatures would likely stabilise or cool slightly in the long term. Future climate change therefore depends on future emissions, and addresses a [misconception](http://www.realclimate.org/index.php/archives/2010/03/climate-change-commitments/) that we are too late to prevent the world warming further from past activities.

We know that stopping emissions tomorrow is politically and socially impossible. We therefore asked: what is the committed warming from all of the things in the world that currently contribute to human emissions if they are gradually phased out? We call the climate change resulting from these future emissions projections the “infrastructure commitment”.

The infrastructure commitment works on the basis that every asset has a useable lifespan. We allow every power and industrial plant, car, airplane, ship, and yes, cow, currently in existence to continue to be used for the rest of its lifetime, after which it is removed from the system or replaced with something zero-emissions. For power plants the usable lifespan is about 40 years; for cars, ships and planes, somewhat less, and gruesomely, most meat cattle only [hang around for 3 years](http://www.fao.org/3/T0279E/T0279E05.htm) before they end up on our plates. We use information about the probable age distribution of these current assets to project emissions into the future. For example, the number of aircraft being produced has grown year-on-year, so there are many more younger aircraft in existence, which will be around longer than older planes that we expect will be retired soon.

If this was to happen in practice, it means replacing coal and gas power plants with wind turbines, solar panels and nuclear. Cars and trains would need to become electric and powered by our new, low-carbon renewable electricity grid. Shipping emissions would somehow also need to be brought to zero ([for which there is ambition](https://www.businessgreen.com/bg/news/3067654/maersk-promises-net-zero-emissions-by-2050)), as well as aircraft emissions (which will be harder). Zero-carbon replacements for concrete and steel would need to be developed too. In farming, meat and dairy production would end when the last dairy cow flew off to bovine heaven, and globally we switched to a plant-based diet with declining reliance on fertiliser use over time. These pathways are exceptionally ambitious and probably unrealistic, but were chosen to answer the question of how much our current “stuff” will contribute to future climate change.

We ran these emissions pathways through a simple climate model, which replicates the behaviour of how emissions affect temperatures in more complex models. Because the actual climate response to emissions is uncertain, we run the climate model in 1000 different configurations, each of which represents a possible representation of the actual climate using information from the IPCC and other studies. To keep our results realistic, we keep 310 runs where the historical temperatures predicted by the model match those from observations, and use these runs to make projections. Most - 64% of the runs - show an infrastructure commitment of less than 0.4°C. We assess the global human temperature change since pre-industrial time to be 1.1°C, so that global temperature change is less than 1.5°C in the majority of cases. The infrastructure commitment ranges from about 0.1°C to 0.8°C over the full set of runs, showing the range of uncertainty in climate projections. Most of this uncertainty in warming relates to how much air [pollution cooling offsets present-day greenhouse warming](https://e360.yale.edu/features/air-pollutions-upside-a-brake-on-global-warming?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+YaleEnvironment360+%28Yale+Environment+360%29), which is not known precisely and the focus of much ongoing research.

We therefore showed that the committed warming from our present-day infrastructure is not likely in itself to take us over the 1.5°C Paris Agreement limit. However, delaying action (say to 2030) makes this limit much harder to achieve. It is useful knowledge to be equipped with in the transition to a net-zero society, and importantly shows that we should not give hope of avoiding the worst effects of climate change if we start rapid emissions reductions now.