

# Seven steps to save the planet: How to take on climate change and win

It's the biggest challenge humanity has ever faced, but we can keep global warming to within the "safe" boundary of 1.5°C. Here's how we do it



Woods Wheatcroft/Aurora Photos

By **Graham Lawton**

“We have to do everything, and we have to do it immediately.” As a summary

of the challenge facing humanity, those words are about as pithy as it gets. They come from [Piers Forster](#), a professor of climate physics at the University of Leeds, UK, and a lead author on the [latest report from the Intergovernmental Panel on Climate Change](#) (IPCC). In case you missed it, [it said we're done for](#). Almost.

To give ourselves a better-than-evens chance of avoiding 1.5°C of global warming – the agreed threshold of irreversible, dangerous and possibly game-over climate change – we must hit peak greenhouse gas emissions as soon as possible, and then taper them down to net zero by 2050, give or take five years.

That's doable – just. “It is not impossible,” says [Heleen de Coninck](#), another IPCC lead author at Radboud University in the Netherlands. “We don't need any fancy new technologies.”

But it will require “unprecedented rates of transformation”, according to the IPCC report. We must break our addiction to [fossil](#) fuels, [meat](#), flying, reckless consumption in general, and above all confront the [head-in-the-sand denial](#) that has prevented us from making changes we knew we had to make yonks ago, but somehow kept telling ourselves weren't necessary just yet.

So how can we do it? Think of it as a video game with seven levels of increasing difficulty – seven levels we must now play simultaneously.

There are many pathways in this giant, multidimensional, multiplayer game, although none is certain to lead to the outcome we want. We explore them here. But before we do, we need to go over some ground rules.

## How to play Hitting 1.5°C

Our overall aim is clear: limiting global warming to the magic number of

1.5°C above pre-industrial levels. To get there, however, we need to keep another magic number in mind: how many more tonnes of carbon dioxide can we afford to dump into the atmosphere before we bankrupt the climate. Depending on what “carbon budget” we choose, we can increase our chances of winning the game at the expense of making the gameplay harder.

We might choose 770 gigatonnes. That is the level of future emissions we think gives us a 50 per cent chance of limiting warming to 1.5°C. To tilt the odds to the tune of two-thirds in our favour, however, we must go a lot lower, down to 570 gigatonnes. More-pessimistic assessments of how much warming has already happened put these numbers considerably lower.

To put the figures in perspective, annual global carbon emissions are currently around 40 gigatonnes. So it will be game over in less than 20 years if we don't start to play now. “Doing nothing isn't an option,” says Forster.

One catch is that unknowns such as [exactly how sensitive the climate is to carbon dioxide](#) and other greenhouse gases, especially methane, mean our carbon budget could change even as we play. To make things even hairier, about half of the budget is already spoken for, in the shape of existing or planned electricity generating plants that – unless they are retired early – will carry on burning fossil fuels for many years to come.

To give ourselves that better-than-evens chance, we must spend our carbon budget wisely throughout the game. Where we need to spend more in one level, we must cut down in another, with the aim of peaking and then tapering down to the promised land of net zero emissions by 2050.

That goal is non-negotiable. If we keep on emitting, the climate keeps on warming, and we lose the game. As the IPCC report says: “Any scenario that fails to reduce CO<sub>2</sub> emissions to net zero would not limit global warming”.

So, let's play.

## Level 1: Kill fossil fuels

Geothermal power, as here in Iceland, provides low-carbon energy

Carlos Spottorno/Panos

A journey of a thousand miles begins with a single step. As we start playing level 1 of the game, we get an immediate boost: we have already taken that first step. In the past few years, the transition to renewable energy has begun in earnest, driven by rapid progress in ramping up wind and solar electricity generation. In 2016, a quarter of the world's electricity needs, making up more than 10 per cent of our total energy consumption, were covered by modern renewable sources, meaning anything but the traditional burning of biomass such as wood and dung.

Most pathways to limit warming to 1.5°C require at least 50 per cent (and preferably much more) of the world's energy needs to come from renewables by 2050. That means the almost complete decarbonisation of electricity generation.

The winning scenarios rely heavily on wind and solar, but also hydropower, [geothermal energy](#) and [biofuels](#). Most pathways also require us to use nuclear energy more. In some scenarios, fossil fuels can remain in the mix, but must be defanged by using [carbon capture and storage \(CCS\)](#) – a technology to neutralise carbon emissions that we are busy developing in level 4. Coal, which produces more carbon per unit of energy than any other fossil fuel, must cover at most 13 per cent of our overall energy needs, and preferably zero.

The transition still isn't happening fast enough, but nobody doubts that it is

[eminently doable](#), given the right nudges from policy-makers and financiers. These include ending both direct and hidden subsidies for fossil fuels, and imposing a form of carbon pricing to reflect the environmental damage that fossil fuels cause. Whether we will get those things to help us complete this level is another question entirely.

## Level 2: Travel light

Already things are a little hairier in level 2. Decarbonising electricity isn't enough to reach net zero: at the same time, we must ensure that other kinds of energy-consuming activities, currently powered by dirty fuels, convert to clean electricity or otherwise clean up their act.

This pitches us straight into a big one: how we move ourselves around. More than 90 per cent of [transport is powered by oil](#), in the form of petrol, diesel and aviation fuel, and just 3 per cent of transport-related energy comes from renewables. Transport accounts for something like a quarter of the world's energy-related CO<sub>2</sub> emissions, and its contribution is growing by about 2.5 per cent a year. As the IPCC says, this presents “major challenges for deep decarbonisation”.

### **“We'll need personal sacrifices to meet our transport goals”**

Recognising the scale of the challenge, most 1.5-degree pathways call for only a 30 per cent reduction in transport-related emissions by 2030. But even reaching this goal means mastering multiple weapons simultaneously.

Besides switching to electric vehicles (powered, of course, by renewables), we need to improve fuel efficiency and switch from oil to the biofuels we have made land available to produce in level 5, including in [aviation](#). Together, these can deliver 80 per cent of the required cuts.

The rest will have to be done through personal sacrifice: choosing buses and trains over cars and planes, car-sharing and even avoiding travel altogether – unless you go on foot or by bike.

## Level 3: Rebuild everything

Buildings account for almost a quarter of carbon emissions

plainpicture/goZooma/Jörg Dickmann Photography

If level 2 sounds like a slog, level 3 is even harder. At the last count in 2014, homes, offices, shops and other buildings were responsible for 23 per cent of the world's energy-related emissions. Most of that is indirect consumption, via electricity used for lighting, heating, cooling, elevators, office equipment and other energy-sapping services such as kettles and servers. So clever gameplay in level 1, resulting in the massive expansion of zero-carbon electricity, will give us a head start to this level.

But a third of building-related carbon emissions come directly from burning fossil fuels, [mostly gas for heating and cooking](#). And because we're already lagging in tackling level 2, we must give it our all in this level, reducing emissions by 80 to 90 per cent by 2050.

Simply waiting for zero-carbon electricity to arrive is not an option. Our strategy for this level must include switching to energy-efficient lighting to reduce electricity consumption, installing state-of-the-art insulation and double-glazed windows and putting in new heating and cooking systems that don't burn fossil fuels.

To put that challenge in perspective, the London offices of *New Scientist* occupy one floor of a six-storey building. The heating system is gas-powered, the lighting is mostly fluorescent and air conditioning is required in the

summer to maintain a comfortable temperature. Most of the staff go home to draughty old housing stock with gas-fired boilers and stoves.

Now scale these problems up to the whole of London, the whole of the UK, the whole world. According to the IPCC report, 5 per cent of buildings in rich-world OECD countries alone will need to be “energy refurbished” every year from now on.

**“New buildings will have to emit no CO<sub>2</sub> at all – preferably by 2020”**

Even that does not get you through the level, however. New buildings will have to be constructed without emitting any carbon dioxide at all, preferably by 2020. That means shifting away from carbon-intensive concrete and steel towards carbon-neutral wood-based materials – or fundamentally recasting the way we make those materials. Which brings us neatly to the next of our parallel levels.

## **Level 4: A new industrial revolution**

Now we are deep into the game, and the difficulty ratchets up another notch. Industry is staggeringly hungry for fossil fuels – more so than buildings or transport – and its emissions are growing. Producing metals, pulp and paper, chemicals, concrete and minerals uses copious amounts of coal and other fossil fuels for heat and steam. To complete this level, these and other emissions will have to be slashed, by around 80 per cent.

Our first move must be to phase out coal. The next is to vastly increase energy efficiency, and electrify wherever possible. At this point, however, our gameplay is not good enough, because we start butting up against the limits of the weapons in our existing arsenal. The IPCC report admits that it will take massive investment in R&D to roll out new, carbon-free industrial

processes for making things such as cement, iron and steel. And that is simply to hit what is called the “overshoot target”, of going over 1.5°C for a few decades before clawing our way back (see [graphic](#), below).

The jam-tomorrow technological fix doesn't end there. For fossil fuels that we cannot wean ourselves off, the answer is carbon capture and storage. These technologies, as yet unproven on a large scale, aim to capture CO<sub>2</sub> emissions and sequester them somewhere, most probably underground, so they never reach the atmosphere.

So are we doomed to fail at this level? Forster, at the University of Leeds, says not. “We do have the technologies, but we have to make them cheaper, more affordable, and make them work at a much bigger scale.” That means not just CCS, but greener processes for making aluminium, steel, cement and the rest. Again, ideas exist – to make it through this level, we need to make them reality, and fast.

## Level 5: Reap what we sow

Intense greenhouse agriculture will allow land to be reforested

Luca Locatelli/National Geographic Image collection

Level 5 is in some ways the longest and trickiest of all – a journey through [forests](#), [farms](#) and [food](#).

At present, land use accounts for about a quarter of carbon emissions. Getting that to net zero is a game of complex trade-offs. Land can be used as a carbon sink, but we also need it to grow food, which inevitably emits CO<sub>2</sub>. While balancing these competing needs isn't easy, it gives us multiple buttons to press. “There's a whole portfolio of actions, and if you push hard on one you can push less hard on the others,” says [Drew Shindell](#) at Duke University in

North Carolina, another IPCC lead author.

To cut a very long story short, the best way forward is to intensify agriculture while reducing our consumption of foods whose production results in lots of greenhouse gas emissions, predominantly those that come from cattle. That allows us to swap pasture for forest, while finding room to grow biofuels for aviation and other forms of transport. Pasture, especially with cows on it, is a gigantic source of both CO<sub>2</sub> and methane. Forests, on the other hand, pull CO<sub>2</sub> out of the air, so reducing deforestation is also a must.

Do all that successfully by mid-century and we're close to winning the game. Close – but no banana.

## **Level 6: Suck, not blow**

Our goal of net-zero emissions doesn't mean emitting nothing at all. Some emissions are from sources that we do not know how to eliminate, such as nitrous oxide from agricultural fertilisers, and others are too hard to get rid of entirely. To limit global warming to 1.5°C, these remaining emissions must be balanced out by removing carbon dioxide already in the atmosphere.

This is the theme of level 6: carbon dioxide removal (CDR) technologies. They are a secret portal that allows a successful exit from the game, delivering us to net zero as well as potentially clawing back any emissions overshoot. As the IPCC says: “All analysed 1.5°C-consistent pathways use CDR to some extent.”

### **“The goal of net-zero emissions doesn't mean emitting nothing”**

The technology might conjure up ideas of some miraculous machine that sucks CO<sub>2</sub> out of the air, but such a technology does not exist – and may never. So we have to do it using what we already know.

Planting forests is the simplest way, so our success on this level is tied up with our progress on level 5. Another approach is BECCS, or bioenergy with carbon capture and storage: you grow biofuels, burn them and then sequester the CO<sub>2</sub> using the CCS technologies being simultaneously developed in level 4.

Neither is a shoo-in, says the IPCC: “CDR deployed at scale is unproven and reliance on such technology is a major risk in the race to limit warming to 1.5°C”.

But it’s not the biggest. That comes in level 7.

## Level 7: Change ourselves

Dinendra Haria/SOPA Images/ZUMA Wire/Alamy Live News

Level 7 is by far the most difficult and tortuous stage of our game – because it requires game-players to confront their own weaknesses. “We have to address demand,” says Forster.

This could be the real sticking point. When we talk about power generation, transport, industry, buildings and agriculture, we are talking about our own actions. If on any given day you use an electrical appliance, spend time inside a building, use hot water, travel anywhere in a vehicle or buy or eat anything, you are contributing to the problem. Changing that means making sacrifices, starting today: driving less, flying less, consuming less meat, having fewer children (see “What you can do”).

Things are starting to change, says Forster, although not fast enough. Sales of electric cars are increasing. More people are cutting down on meat. Even the US, [the climate rogue nation](#), is waking up, says Shindell. “I feel there is an increasing awareness among the general population. I live in North Carolina,

where we've had two huge hurricanes. People are flabbergasted when they see the Trump administration respond but refuse to acknowledge the role of climate change at the same time.”

And that, as the IPCC pointed out, is what is still lacking: political will. “We're talking about the biggest transformation ever, and we're expecting policy-makers to drive it,” says [Michael Grubb](#) at the Institute of Sustainable Resources at University College London. “Is that conceivable in a democracy?”

Caroline Lucas, the UK's only Green Party MP, thinks it is – but only through people power demanding the sort of changes that will see us through levels 1 to 6. “It's clear we're going to need a mass movement,” she says. “As people come to see that green alternatives improve our quality of life, as well as the state of our environment, I believe we can persuade politicians to take action.”

One way or another, big change is coming. It is up to us to decide in what direction. “We've never seen this kind of transformation in terms of change at the global scale,” says [James Ford](#), another climate scientist and IPCC author at the University of Leeds. “It will be very difficult,” says de Coninck.

Forster goes further than that. “Of course it's impossible,” he says. “But we have to try.” Even if we go over 1.5°C, every bit of extra warming we shave off makes the world more liveable. And if we overshoot a little, we may be able to claw our way back. “We have an opportunity,” says Forster. “Not only to solve climate change, but also to really make the world far better.” Game on.

## What you can do

Keeping global warming below 1.5°C will require behavioural changes – but that doesn't mean you have to don a hair shirt. The cumulative effect of small,

low-effort actions can be great, and the more each of us contributes, the less impossible it will be to meet the target. Here's a selection of the most doable and effective interventions, as [selected by scientists on the Intergovernmental Panel on Climate Change](#).

## **Veg out**

Switching to a plant-based diet can [reduce the carbon footprint of your food](#) by more than 90 per cent. If nothing else, avoid beef: its carbon footprint is three times that of pork and six times that of chicken. The second-worst offenders are tropical fruits imported by air, and cheese. It is estimated that a shift to a plant-based diet across the globe would [cut carbon emissions by up to 70 per cent](#).

## **Drive off**

Car journeys, especially short ones in cities, account for a disproportionate share of emissions. That doesn't mean you have to stop driving entirely: a 2017 study in the Netherlands found that members of a car-sharing scheme [drove 15 to 20 per cent fewer kilometres](#) than before they joined, and so emitted between 13 and 18 per cent less CO<sub>2</sub>.

Leg power can replace many car journeys, too. In London in 2009, for example, journeys to places within walking distance (defined to be up to 2 kilometres) accounted for 11 per cent of the distance travelled in cars, while trips within cycling distance (up to 8 kilometres) [accounted for 55 per cent](#).

Be warned, though: all of the small gains achieved by not driving can be wiped out by taking a single holiday flight. A return economy flight from London to Majorca in Spain – about 2 hours' flying time – emits the equivalent of 490 kilograms of CO<sub>2</sub>, about the same as you would save in a year by going vegetarian or driving 2500 kilometres less.

## Run a tight ship

According to [a US study from 2009](#), just choosing an energy-efficient model when it comes to replacing a home appliance could reduce your carbon emissions by 1.9 per cent on average. Other simple changes such as lowering the temperature of your hot water and washing machine, using a lower-flow showerhead, not leaving appliances on standby and drying washing on an outdoor line rather than with a tumble dryer can cut a further 2.2 per cent – not huge, but everything counts.

Smart thermostats would make a bigger contribution. A modelling study in Germany in 2017 found that these can [reduce a household's emissions by up to 26 per cent](#), with a bonus reduction in energy bills.

And if you are rattling round a big house, consider downsizing. A smaller home can cut your emissions by 27 per cent, [according to a UK study in 2016](#).

## Be a desk warrior

Offices are a major source of unnecessary emissions. So turn off lights when everyone has left for the day, switch off your workstation when you go home and don't leave phone chargers plugged in when they aren't in use. A UK study from 2017 found that these simple actions [can cut office emissions by up to 28 per cent](#).

Even better, don't go into the office if you can get away with it. A US review from 2012 found that homeworkers [travel up to 77 per cent fewer kilometres](#) in a vehicle by avoiding a commute.

## Hitting 1.5°C

This is the first of a series of four features over the coming two months

looking at the 1.5°C climate target. Next week: why no one's climate numbers agree

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