

Electricity: Build More Solar Plants

The Basic Idea

Solar farms and rooftop systems use photovoltaic panels to turn sunlight into electricity. Once built, they produce power without burning fuel, and so avoid CO₂ that would otherwise come from coal- and gas-fired power stations.

Complications

The climate benefit depends on what mix of power stations they replace, and on being able to deliver electricity when and where it's needed. Solar power only generates during daylight hours and so needs to be supported by stronger grids, flexible supply and demand, or energy storage.

The Scale

Achieving one wedge requires an additional capacity equal to about 133% of all solar power produced worldwide in 2024. This will require a total land area equal to about 10% of the area of Colorado.

Number of Wedges

More wedges just means more area—so you can get up to 4 wedges by adding more solar panels.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: Build More Nuclear Reactors

The Basic Idea

Nuclear power stations generate electricity by splitting uranium atoms to produce steam, which spins a turbine to generate electricity. Because no fossil fuel is burned in the reactor, nuclear power has very low direct CO₂ emissions, and so avoid CO₂ that would otherwise come from coal- and gas-fired power stations.

Complications

The climate benefit depends on what mix of power stations they replace. Like any major industrial facility, nuclear power requires strict oversight, robust safety systems, and long-term management of radioactive waste to minimise the risk of accidents, environmental harm, and the diversion of fuel or spent fuel to make weapons.

The Scale

Achieving one wedge requires doubling the world's current nuclear generation capacity.

Number of Wedges

More wedges means more plants. Doubling the total number = 1 wedge. Let's take as an upper limit increasing the total number of plants by a factor of 5, for 4 wedges.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: Build More Wind Turbines

The Basic Idea

Wind farms turn atmospheric motion into electricity using large-bladed wind turbines. Once built, they produce power without burning fuel, and so avoid CO₂ that would otherwise come from coal- and gas-fired power stations.

Complications

The climate benefit depends on what mix of power stations they replace, and on being able to deliver electricity when and where it's needed. Wind power only generates when it is windy and so needs to be supported by stronger grids, flexible supply and demand, or energy storage.

The Scale

Achieving one wedge requires an additional capacity equal to about 110% of all wind power produced worldwide in 2024. This will require a total land area equal to about 50% of the area of Colorado.

Number of Wedges

More wedges means more area. You can get up to 4 wedges by adding more wind turbines.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: Switch from Coal Plants to Gas Plants

The Basic Idea

Replacing coal-fired power stations with gas-fired power station cuts emissions because burning gas emits roughly half the amount of CO₂ for each unit of electricity generated.

Complications

Gas is still a fossil fuel, so this strategy does not eliminate emissions. It can also increase emissions of methane (a powerful greenhouse gas) from extracting and transporting gas, so the overall climate benefit depends on controlling leaks across the supply chain.

The Scale

Achieving one wedge requires replacing around 40% of the world's coal-fired plants with gas-fired plants. This would increase global gas-fired electricity generation by 60%, relative to 2024. In fuel terms, the additional gas required is roughly one-seventh of global gas consumption in 2024. This means more drilling, and more fracking.

Number of Wedges

Replacing 40% of plants gets one wedge, so you can only get a total of 2 wedges this way.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: Retrofit Coal Plants with CCS

The Basic Idea

Adding carbon capture and storage (CCS) to coal power plants means fitting extra equipment that separates CO₂ from the exhaust, then compressing it and transporting it to be injected deep underground for long-term storage. This can allow a plant to keep generating electricity while releasing much less CO₂ to the air. This extends the lifetime of existing power plants and grid connections, while providing controllable electricity that can be dispatched when needed.

Complications

CCS does not capture emissions from fuel production and transportation or all emissions from the plant. It uses energy to run the capture system, so the plant needs to burn more fuel. And you need somewhere to stash the CO₂....

The Scale

Achieving one wedge requires retrofitting CCS at roughly 13 large power stations per year until 2050. By 2050, these power plants would produce around one-quarter of all coal-fired electricity generated worldwide in 2024. Today there are only a few CCS power plants operating, so this scale-up is hundreds of times larger.

Number of Wedges

This is a very technically challenging option already, so only 1 wedge is possible.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: BECCS with Waste

The Basic Idea

Bioenergy with carbon capture and storage (BECCS) produces electricity by burning plant material, separating CO₂ from the exhaust, then compressing it and transporting it to be injected deep underground for long-term storage. Plants absorb CO₂ while growing, so storing that CO₂ can reduce the amount of CO₂ in the atmosphere when the fuel is waste material like leftover straw rather than crops grown on new land.

Complications

This would require large-scale changes to farming practices worldwide, and would entail a lot of logistical and transportation complications for the fuel and the CO₂.

The Scale

Achieving one wedge requires producing just over two times the electricity generated from bioenergy worldwide in 2024. There are only a few BECCS plants operating today, so this scale-up is hundreds of times larger. It also requires about 75% of globally available straw residue.

Number of Wedges

This is a very challenging option, so only 1 wedge is possible.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: Retrofit Gas Plants with CCS

The Basic Idea

Adding carbon capture and storage (CCS) to gas power plants means fitting extra equipment that separates CO₂ from the exhaust, then compressing it and transporting it to be injected deep underground for long-term storage. This can allow a plant to keep generating electricity while releasing much less CO₂ to the air. This extends the lifetime of existing power plants and grid connections, while providing controllable electricity that can be dispatched when needed.

Complications

CCS does not capture emissions from fuel production and transportation or all emissions from the plant. It uses energy to run the capture system, so the plant needs to burn more fuel. And you need somewhere to stash the CO₂....

The Scale

Achieving one wedge requires retrofitting CCS at roughly 33 large power stations per year until 2050. By 2050, these power plants would produce almost all the gas-fired electricity generated worldwide in 2024. Today there are only a few CCS power plants operating, so this scale-up is hundreds of times larger.

Number of Wedges

This is a very technically challenging option already, so only 1 wedge is possible.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Electricity: BECCS with Crops

The Basic Idea

Bioenergy with carbon capture and storage (BECCS) produces electricity by burning plant material, separating CO₂ from the exhaust, then compressing it and transporting it to be injected deep underground for long-term storage. As plants absorb CO₂ while growing, storing that CO₂ can reduce the amount of CO₂ in the atmosphere overall, but only if the full supply chain is well managed.

Complications

With purpose-grown energy crops, climate benefits are strongest when crops are grown on appropriate land (i.e., avoiding clearance of natural ecosystems) and managed with low-carbon farming practices.

The Scale

Achieving one wedge requires producing almost three times the electricity generated from bioenergy worldwide in 2024. Today there are only a few BECCS power plants operating, so this scale-up is hundreds of times larger.

Number of Wedges

You can get up to 2 wedges with the noted details.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Industry: Clean Hydrogen

The Basic Idea

Hydrogen is a flammable gas, and can replace fossil fuels in many applications.

Complications

At present, hydrogen is produced from fossil fuels, but clean hydrogen can be produced using renewable energy. Producing hydrogen this way will require new sources of renewable electricity as well, and the resulting clean hydrogen will be much more expensive than that produced from fossil fuels. Hydrogen produced from fossil fuels can be clean if CCS is used.

The Scale

Achieving 1 wedge would require producing 1.5 times as much clean hydrogen as the world produces conventional hydrogen, and 150 times as much clean hydrogen as is produced at present.

Number of Wedges

Clean hydrogen can deliver up to 4 wedges if it is deployed widely.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Industry: Decarbonize Steel Production

The Basic Idea

Steel is typically made in blast furnaces that use coal to strip oxygen from iron ore, which releases large amounts of CO₂. Steelmaking can be decarbonised using CCS or a combination of hydrogen and electricity.

Complications

CCS involves fitting extra equipment to capture CO₂, then compressing it and transporting it to be injected deep underground for long-term storage. The hydrogen-electric alternative uses clean hydrogen to directly reduce iron ore and electricity in arc furnaces to melt and refine it. The resulting steel will be more expensive than conventional steel.

The Scale

Achieving one wedge requires converting six large-integrated steel mills each year. If using the hydrogen-electric process, a wedge requires one-sixth of global electricity generation in 2024, or 1.5 wedges of wind, solar or nuclear power.

Number of Wedges

Decarbonizing all steel production will give 2 wedges.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Industry: Direct Air Capture

The Basic Idea

Direct air capture uses large fans and chemical filters to pull carbon dioxide out of the air, then concentrates it for storage deep underground. This is useful for offsetting emissions that are very hard to eliminate, such as aviation.

Complications

Direct air capture must be powered by renewable energy, and vast amounts of land area and capture chemicals will be required.

The Scale

Achieving one wedge requires building 56,000 plants that each capture 36,000 tons of carbon dioxide each year. Powering these plants would require more electricity than is used by all US households.

Number of Wedges

If you build enough plants, you can get up to 2 wedges.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Industry: Decarbonize Cement Production

The Basic Idea

Cement is made by heating limestone in kilns, releasing a great deal of carbon dioxide in the process. Cement plants can be fitted with CCS systems to capture and store this carbon dioxide.

Complications

Adding CCS to a cement plant adds cost and complexity to the operation.

The Scale

Achieving one wedge requires converting 30 large cement plants every year.

Number of Wedges

Decarbonizing all cement production can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Industry: Reduce Oil and Gas Methane Emissions

The Basic Idea

Oil and gas production releases methane, which is a powerful greenhouse gas (30-80 times the warming impact of CO₂). Methane can leak, be vented, or be incompletely flared at oil and gas wells, processing plants, pipelines, and other parts of the supply chain.

Complications

This is a straightforward one! Many fixes are practical: regular leak detection and repair, replacing high-leak valves and pneumatic devices, capturing gas that would be vented, and improving flaring performance. Because the leaked gas is also a valuable fuel, a substantial share of methane can be avoided at low or no net cost. If oil and gas production slow, so will methane emissions.

The Scale

Achieving one wedge requires cutting 1 billion tonnes of methane, almost half of all emissions, cumulatively to 2050. That's equivalent to reducing baseline methane emissions by around 3% each year out to 2050.

Number of Wedges

Reducing methane emissions can deliver up to 2 wedges.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Land and Food: Reduce Tropical Forest Loss

The Basic Idea

Tropical forests store huge amounts of carbon in trees and soils. When forests are cleared or degraded, that carbon is released quickly if trees are burned, and more slowly as vegetation and disturbed soils decay. Reducing deforestation and forest degradation therefore avoids emissions that would have happened otherwise, and it keeps forests standing so they can continue absorbing some CO₂ as they grow.

Complications

Tropical forests mostly exist in countries with poor environmental records and where enforcement of regulations can be limited.

The Scale

To achieve 1 wedge, yearly tropical forest loss must decrease by 40%. Brazil achieved nearly that reduction in 2023, but this is likely to be reversed.

Number of Wedges

If all tropical forest loss is halted, it will provide 2 wedges.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Industry: Reduce Refrigerant Emissions

The Basic Idea

Hydrofluorocarbon (HFC) refrigerants are used in fridges, air conditioners and heat pumps. They contribute strongly to global warming, as common HFCs have a climate impact 1,000 to 15,000 times stronger than CO₂. These impacts can be reduced by switching to alternative refrigerants, improving equipment to prevent leaks, and recovering and destroying gases at end of life

Complications

As the world warms, air conditioning use is expanding. But there is some good news: HFCs are being phased out already. Achieving 1 wedge would require a more rapid phase out.

The Scale

Achieving 1 wedge would require reducing the currently permitted emissions of HFCs by $\frac{2}{3}$.

Number of Wedges

Reducing refrigerant emissions can deliver 1 wedge.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Land and Food: Rewet Drained Peatlands

The Basic Idea

Peatlands are waterlogged wetlands that build up decaying plant material (peat) over centuries, and store vast amounts of carbon. Peatlands cover only ~3–4% of Earth's land but contain about twice the carbon found in the world's forests. When peatlands are drained the water table is lowered and oxygen can reach the peat, so it decomposes and releases the stored carbon to the atmosphere. Rewetting reverses this drainage, which slows decomposition and can also reduce the risk of severe peat fires.

Complications

Peatlands are concentrated a few places, requiring an outsized effort from a few countries that don't always have excellent environmental records.

The Scale

Achieving one wedge requires both stopping the roughly half a million hectares of new drainage that occurs in the tropics each year, and rewetting an area of tropical peatland roughly the size of Cambodia.

Number of Wedges

Rewetting peatlands and preventing further loss can deliver 1 wedge.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Land and Food: Reforest the Tropics

The Basic Idea

Forests cover around 50% of global land area in the tropical biome. Reforesting the tropics means bringing forests back to places that have been cleared or degraded. As new forests grow, they remove CO₂ from the air and store it in trunks, roots, leaf litter and soils – a form of “carbon dioxide removal”.

Complications

Tropical forests mostly exist in countries with poor environmental records and where enforcement of regulations can be limited.

The Scale

Achieving 1 wedge would require reforesting an area the size of Columbia, an area just shy of 3% of the earth’s forest cover.

Number of Wedges

Tropical reforestation can deliver up to 2 wedges.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Add Trees to Tropical Pasture

The Basic Idea

Silvopasture involves grazing livestock among trees and shrubs, rather than on open grassland. The trees store carbon in wood and help build soil carbon through roots and leaf litter, so the land can remove CO₂ from the air over time. Trees can also improve pasture conditions (shade, shelter, sometimes fodder), which can raise productivity per hectare and reduce pressure to clear additional land elsewhere.

Complications

This would require a change in agricultural practice in tropical countries where environmental concerns are often given low priority.

The Scale

Achieving one wedge requires adding trees across a grazing area roughly the size of Peru. This implies expanding tree-on-farm systems by roughly 13% from today’s footprint.

Number of Wedges

Tropical silvopasture can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Reforesting the Temperate Zone

The Basic Idea

Forests cover 37% of global land area in the temperate biome. Reforesting the temperate zone means bringing forests back to places that have been cleared or degraded. As new forests grow, they remove CO₂ from the air and store it in trunks, roots, leaf litter and soils – a form of “carbon dioxide removal”.

Complications

Most of the land to be reforested is in a few countries, requiring an outsized effort from these places.

The Scale

Achieving one wedge requires creating new forest that spans roughly the land area of Mongolia, or just over 3.5% of today’s total global forest area.

Number of Wedges

Temperate reforestation can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Add Trees to Temperate Pasture

The Basic Idea

Silvopasture involves grazing livestock among trees and shrubs, rather than on open grassland. The trees store carbon in wood and help build soil carbon through roots and leaf litter, so the land can remove CO₂ from the air over time. Trees can also improve pasture conditions (shade, shelter, sometimes fodder), which can raise productivity per hectare and reduce pressure to clear additional land elsewhere.

Complications

This would require a change in agricultural practices in the relatively few countries with appropriate grazing areas.

The Scale

Achieving one wedge requires adding trees across a grazing area roughly the size of Iran. This implies expanding tree-on-farm systems by roughly 18% from today’s footprint.

Number of Wedges

Temperate silvopasture can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Add Trees to Tropical Cropland

The Basic Idea

Adding trees to tropical cropland is a form of agroforestry, where farmers grow crops alongside trees or shrubs (for example, shelterbelts, hedgerows, or “alley cropping”). The trees store carbon in wood and help build soil carbon through roots and leaf litter, so the land can remove CO₂ from the air over time. Tree cover can also protect soils (for example by reducing erosion) and create microclimates that help crops cope with heat and drought.

Complications

This would require a change in agricultural practice in tropical countries where environmental concerns are often given low priority.

The Scale

Achieving one wedge requires adding trees to croplands roughly the size of Thailand and Tanzania combined. This implies expanding tree-on-farm systems by roughly 15% from today’s footprint.

Number of Wedges

Tropical intercropping can deliver 1 wedge in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Waste Less Food

The Basic Idea

Around one third of all food produced globally does not get eaten. Losses happen “upstream” when crops spoil during harvesting, storage and transport, especially where cooling, roads and storage are limited, while waste happens “downstream” in shops, restaurants and homes when food is thrown out. Cutting food loss and waste reduces the need to produce extra food in the first place and avoids all associated emissions.

Complications

Making a change at scale would require significant changes in food production, storage, transport, and sales.

The Scale

Achieving one wedge requires avoiding just over half of the 2.5 billion tons of food that is lost or wasted globally today. For perspective, this is roughly 8 times the amount of food consumed in the US in 2024.

Number of Wedges

Reducing food loss and waste can deliver up to 2 wedges in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Add Trees to Temperate Cropland

The Basic Idea

Adding trees to temperate cropland is a form of agroforestry, where farmers grow crops alongside trees or shrubs (for example, shelterbelts, hedgerows, or “alley cropping”). The trees store carbon in wood and help build soil carbon through roots and leaf litter, so the land can remove CO₂ from the air over time. Tree cover can also protect soils (for example by reducing erosion) and create microclimates that help crops cope with heat and drought.

Complications

A change at scale would require a few countries with large areas of cropland to make significant changes to agricultural practices.

The Scale

Achieving one wedge requires adding trees to croplands roughly the size of Mexico and Mongolia combined. This implies expanding tree-on-farm systems by roughly 34% from today’s footprint.

Number of Wedges

Temperate intercropping can deliver 1 wedge in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Eat Less Meat

The Basic Idea

Eating meat causes more emissions than other diets because livestock production (especially for cattle and sheep) releases large amounts of greenhouse gases and uses a lot of energy and land to grow feed. Eating less meat cuts emissions mainly by reducing demand for these animals, and thus the amount of energy and land devoted to rearing them. People in many parts of the world eat more meat than is healthy, so shifting diets can have a meaningful climate impact while improving public health.

Complications

This would require significant shifts in how much of the world eats.

The Scale

Achieving one wedge requires half the people on Earth to reduce their meat consumption by about half a beef patty per day.

Number of Wedges

Reducing meat consumption can deliver 3 wedges in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Land and Food: Soil Carbon Management

The Basic Idea

Earth's soils store roughly two trillion tonnes of organic carbon. Changing how cropland is farmed can allow more carbon to stay in the soil instead of returning to the air as CO₂. Often referred to as "conservation agriculture", practices include reducing or avoiding ploughing, keeping the soil covered (for example with crop residues or cover crops), and using more diverse rotations.

Complications

This will require significant changes in much of the world's cropland is managed.

The Scale

Achieving 1 wedge requires applying these practices to about 15% of the world's cropland, about 4 times the amount current under conservation agriculture.

Number of Wedges

Soil carbon management can deliver 1 wedge in total.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Buildings: Install More Heat Pumps

The Basic Idea

Heat pumps move heat from outside air, the ground or water into buildings (like a fridge or air conditioner working in reverse). Because they move heat rather than create it by burning fuel, modern heat pumps can deliver 5 units of heat for each unit of electricity. When that electricity is low-carbon, heat pumps can cut emissions from space and water heating sharply compared with gas, oil or coal boilers.

Complications

This will require significant numbers of people and businesses to upgrade their heating systems, and will require increased sources of low-carbon electricity.

The Scale

Achieving one wedge requires heat pumps to provide about four times their current global contribution: in 2023 they met just over 10% of buildings' heating needs.

Number of Wedges

Heat pumps can deliver up to 2 wedges in total.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Land and Food: Apply Enhanced Weathering

The Basic Idea

Spreading finely crushed silicate rocks (such as basalt) over farmland speeds up natural chemical reactions that remove CO₂ from the air. As the rock dust dissolves in rainwater and soils, it forms carbonates that wash into rivers and eventually the ocean, where the carbon can be stored in long-lived, stable forms. Many farmers already spread crushed limestone on fields to reduce soil acidity, so the machinery and know-how for large-scale spreading is already familiar.

Complications

This would require a massive effort: The energy consumed for rock crushing alone would consume up to 3% of current electricity supply in each country participating.

The Scale

Achieving one wedge requires treating a total cropland across an area of roughly the size of India, if applied to regions with the greatest potential. The twelve countries with the greatest potential, including China and the US, would need to apply weathering materials across 35-55% of their croplands.

Number of Wedges

Enhanced weathering can deliver 1 wedge in total.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Buildings: Better Insulation

The Basic Idea

Improving the "fabric" of buildings with more insulation, draftproofing, and better windows allows less heat to escape in winter, and less unwanted heat to enter in summer. Because heating and cooling are a major source of emissions in many countries, reducing demand lowers the amount of fuel burned in boilers and electricity required for air conditioning, making it easier to decarbonise buildings overall.

Complications

Achieving improvements at global scale implies sustained, high retrofit rates in addition to new buildings being designed to tight insulation standards.

The Scale

Achieving one wedge requires roughly halving average heat transfer of buildings worldwide. This is similar to insulating an unfilled cavity wall with cavity fill and a thermal plasterboard.

Number of Wedges

Insulating buildings can deliver 1 wedge in total.

Based on "Climate Wedges" by Nathan Johnson and Iain Staffell

Buildings: Deploy Clean Cookstoves

The Basic Idea

Around 2.3 billion people (600 million households) use “unimproved” open fires or basic stoves. Clean cookstoves cut emissions by burning fuel more completely and using less of it to cook the same meal. That reduces CO₂ from harvesting and burning wood/charcoal, and also cuts climate-warming pollutants from incomplete combustion, such as methane and black carbon.

Complications

The countries where people cook over open fires and basic stoves are lower income countries with limited resources. If wealthier countries chip in, the cost to supply clean cookstoves is relatively modest, but reaching the people who need them will be a challenge.

The Scale

Achieving one wedge requires all of the world’s “unimproved” stoves to be replaced with clean stoves.

Number of Wedges

More wedges just means more area—so you can get up to 4 wedges by adding more solar panels.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Deploy More Electric Vehicles

The Basic Idea

Electric vehicles (EVs) cut emissions by replacing gasoline and diesel cars with vehicles powered by electricity. Electric motors are much more efficient than combustion engines, so EVs use less energy per mile, and they have no exhaust-pipe CO₂. The remaining climate impact depends on how the electricity is generated: the cleaner the grid, the bigger the emissions saving.

Complications

Achieving this change will require worldwide changes in vehicles, the addition of charging infrastructure, and the development of renewable sources of electricity.

The Scale

Achieving one wedge requires the global stock of electric vehicles to increase 17-fold from 2024 levels to around 1 billion in 2050.

Number of Wedges

If all vehicles worldwide are swapped with electric vehicles, this would provide 4 wedges.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Decarbonize Surface Freight

The Basic Idea

Freight transport over land and sea can be decarbonised by shifting to lower-carbon modes (from trucks to railways), improving the powertrains of trucks and ships to zero-emission options such as batteries and hydrogen, and using more efficient vehicles and logistics.

Complications

This is a worldwide effort that will require significant changes to transport. But the changes do provide cost savings, so some of these changes are happening already.

The Scale

Achieving one wedge requires reducing emissions from transport by 36% by 2050.

Number of Wedges

Decarbonising surface freight can deliver up to 2 wedges in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Improve Efficiency of Cars

The Basic Idea

Improving vehicle efficiency reduces emissions by using less gasoline or diesel to travel the same distance. This can come from better engines and gearboxes, hybrid systems, lighter materials, improved aerodynamics, and low-rolling-resistance tyres. Because burning fuel creates CO₂ directly, every litre saved avoids emissions at the tailpipe.

Complications

Achieving the necessary level of efficiency improvement will require people to compromise on the size and power of vehicles.

The Scale

Achieving one wedge requires doubling the fuel economy of current vehicles, getting the average car on the roads up to current “best-in-class” hybrid performance, similar to that of a Toyota Prius.

Number of Wedges

Improving vehicle efficiency can deliver 1 wedge in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Reduce Air Travel

The Basic Idea

Airplanes contribute to global warming through both burning jet fuel (which has greater impacts at higher altitudes) and other effects such as persistent contrails and changes in atmospheric chemistry from nitrogen oxide emissions. Reducing the number of flights reduces these emissions, for example by avoiding the need to travel (e.g. with online meetings), or shifting to lower-carbon modes (e.g. high-speed rail).

Complications

The necessary reduction to provide 1 wedge would imply a significant reduction in air miles traveled—and the trend is moving in the other direction.

The Scale

Achieving one wedge requires reducing global aviation by 70%.

Number of Wedges

Reducing air travel can deliver 1 wedge in total.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Use More Public Transportation

The Basic Idea

Using more public transport cuts emissions by shifting trips from private vehicles to buses, trams, metros and trains that carry many people at once.

Complications

Increasing public transport by the necessary amount would require significant changes in how people get around worldwide.

The Scale

Achieving one wedge requires increasing global public transport usage by around 80%.

Number of Wedges

Increasing the rate of public transportation can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell

Transport: Bike or Walk More

The Basic Idea

Using active travel cuts emissions by shifting trips from private vehicles to walking and cycling. That means less fuel burned per mile traveled, and can also reduce congestion and local air pollution.

Complications

This would require a significant increase in miles walked or biked, which would require changes in the design of towns and cities worldwide.

The Scale

Achieving one wedge requires that active travel rises from about 3 km per person per day today to 6.6 km per person per day by 2050.

Number of Wedges

Active travel can deliver 1 wedge.

Based on “Climate Wedges” by Nathan Johnson and Iain Staffell