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# Cumulative emission budgets and their implications: the case for SAFE carbon

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The risk of dangerous long-term climate change due to anthropogenic carbon dioxide emissions is predominantly determined by cumulative emissions over all time, not the rate of emission in any given year or commitment period. This has profound implications for climate mitigation policy: emission targets for specific years such as 2020 or 2050 provide no guarantee of meeting any overall cumulative emission budget. By focusing attention on short-term measures to reduce the flow of emissions, they may even exacerbate the overall long-term stock. Here we consider how climate policies might be designed explicitly to limit cumulative emissions to, for example, one trillion tonnes of carbon, a figure that has been estimated to give a most likely warming of two degrees above pre-industrial, with a likely range of 1.6-2.6 degrees. Three approaches are considered: tradable emission permits with the possibility of indefinite emission banking, carbon taxes explicitly linked to cumulative emissions and mandatory carbon sequestration. Framing mitigation policy around cumulative targets alleviates the apparent tension between climate protection and short-term consumption that bedevils any attempt to forge global agreement. We argue that the simplest and hence potentially the most effective approach might be a mandatory requirement on the fossil fuel industry to ensure that a steadily increasing fraction of fossil carbon extracted from the ground is artificially removed from the active carbon cycle through some form of sequestration. We define Sequestered Adequate Fraction of Extracted (SAFE) carbon as a source in which this sequestered fraction is anchored to cumulative emissions, increasing smoothly to reach 100% before we release the trillionth tonne. While adopting the use of SAFE carbon would increase the cost of fossil energy much as a system of emission permits or carbon taxes would, it could do so with much less explicit government intervention. We contrast this proposal with, for example, the WBGU budget approach which also recognises the importance of cumulative emissions, noting their different implications for global equity and development considerations. The implications of cumulative emissions for the issue of historical responsibility for adaptation costs will also be discussed.