HARVARD PROJECT ON CLIMATE AGREEMENTS

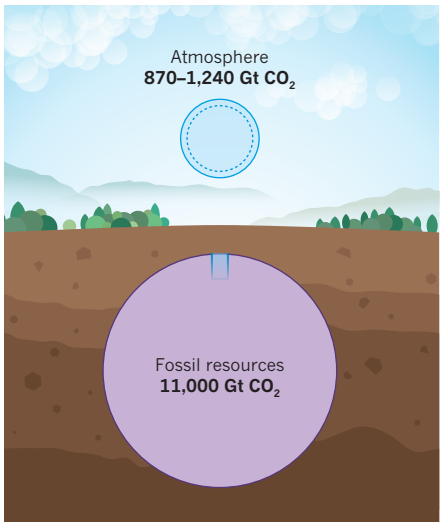

Figure 1 | Fossil-fuel resources exceed atmospheric disposal space for carbon emissions. McGlade and Ekins[2] report that the carbon contained in fossil-fuel reserves (equivalent to 11,000 gigatonnes of carbon dioxide) is much more than the amount that can be emitted as CO_2 to the atmosphere (870–1,240 Gt) if global warming is to be limited to 2 °C above the average global temperature of pre-industrial times. (Figure adapted from ref. 14.)

use currently under way in many places[7].

Gas-fired power plants emit less CO_2 per unit of energy produced than coal-fired plants, and so 'unconventional' sources of natural gas, such as shale gas, have been touted as a bridge to the projected global transition to carbon-free, renewable energy technologies (although this bridging role has recently been challenged[8]). Encouraged by the recent shale-gas production boom in the United States, several world regions, including China, India, Africa and the Middle East, are seeking to unlock their large endowments or increase existing production. However, McGlade and Ekins' analysis shows that Africa and the Middle East would have to leave their entire unconventional gas resources underground, and that about 10% of the combined endowment of China and India (which includes substantial amounts of coal-bed methane) could be produced.

McGlade and Ekins' figures, computed for the period 2010–50, show that the amounts of unburnable fossil fuels are modestly sensitive to the availability of carbon capture and sequestration technology. When this technology is not available, even less coal, oil and gas can be extracted, and natural gas must be used in preference to coal because of the gas's lower ratio of emissions to energy produced. The future use of CO_2-removal technologies might allow further extraction of all fossil fuels after 2050, but there are many uncertainties associated with predicting the availability of these young technologies.

The authors' insights echo calls[9] in the past few years for society to divest itself of fossil fuels. Such calls have been made by organizations in an attempt to influence institutional investors, such as pension funds, to shift their portfolios towards clean-energy investments. These organizations also draw attention to a potential bursting of the 'carbon bubble' that would result from the adoption of ambitious climate policies, leading to severe devaluations of fossil-fuel reserves, which are currently worth about US$27 trillion[9]. Fossil-fuel companies must therefore ask themselves whether they should continue to invest in exploration for, and processing of, oil, gas and coal, or risk losing billions of dollars of stranded assets. Given the political influence of the fossil-fuel industry, policy-makers must design solutions that ensure stakeholders' acceptance.

Importantly, McGlade and Ekins' results clearly highlight the distributional challenge of climate policy: imposing a limit on the use of fossil fuels transfers economic benefits (known as rents) from resource owners to those who obtain the right to use the remaining burnable reserves. Hence, successful climate policy will crucially hinge on the question of whether this 'climate rent' can be shared in an equitable way that also ensures resource owners are compensated for their losses[4]. This could be achieved by an appropriate allocation of emissions permits in an international carbon market, or by payments through the Green Climate Fund (which was set up by the United Nations to assist developing countries in adopting practices that counter climate change). Other proposals include alleviating national debt in exchange for emissions reductions[10], or using some part of the climate rent to finance access to basic infrastructure services, such as water, sanitation and electricity[11].

But given the crucial role of energy in economic development, how can countries be convinced to forgo the use of fossil fuels if this is perceived to imperil primary policy objectives such as poverty reduction? During the US–Africa Leaders' Summit last August, for example, Tanzania's energy minister, Sospeter Muhongo, said[12]: "We in Africa, we should not be in the discussion of whether we should use coal or not. In my country of Tanzania, we are going to use our natural resources because we have reserves which go beyond 5 billion tons." Only a global climate agreement that compensates losers and is perceived as equitable by all participants can impose strict limits on the use of fossil fuels in the long term. By identifying potential winners and losers of climate-change mitigation, analyses such as the one by McGlade and Ekins provide valuable support for the design of such an agreement, and inform short-term measures that can pave the way to an accord[13]. ■

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50 Years Ago

The Schizophrenia Research Fund has been established to support research into problems connected with mental illness in general and schizophrenia in particular … Initial impetus has been given to the fund by a gift of £50,000 from the Rothschild family, and the establishment of a Schizophrenia Research Fellowship, to which Dr. D. Straughan has been appointed … Dr. Straughan's contract is for seven years. His work … has been concerned with pharmacological aspects of mammalian brain physiology, and he will concentrate on the biochemical basis of schizophrenia. It is hoped that this initial effort will attract interest in, and support for, work in the immense field of research bearing on the problems of mental health.

From *Nature* 9 January1965

100 Years Ago

There is a widespread but erroneous belief in official circles, and among wealthy philanthropists, to the effect that you can hire a scientific discoverer and then say to him, "Discover me this" or "Discover me that" (naming to him a possible and greatly desired piece of new knowledge), and that he will thereupon proceed right away to make the discovery which you want … But valuable and important scientific discovery cannot be produced directly in response to orders given and money expended. You cannot manufacture scientific discovery like soap. The great difficulty, in the first place, is to catch that rare and evasive creature — a scientific discoverer — and when you have found him you have to humour him and let him do as he fancies. Then he will discover things, but probably not the things which either you or he wanted or expected.

From *Nature* 7 January 1915