

<b>Institution:</b> University College London		
<b>Unit of Assessment:</b> 13 – Architecture, Built Environment and Planning		
<b>Title of case study:</b> Keeping fossils fuels in the ground: helping investors, companies, and governments understand how much fossil fuel is made unburnable by the target of limiting global warming to 2°C		
<b>Period when the underpinning research was undertaken:</b> 2013-2015		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Paul Ekins	Professor of Resources and Environment Policy	2009-Present
Christophe McGlade	Research Associate	2013-2015
Neil Strachan	Professor in Energy Economics and Modelling	2009-Present
<b>Period when the claimed impact occurred:</b> 2015-2020		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>Research at the Bartlett has shown that a third of oil reserves, half of gas reserves and over 80% of current coal reserves need to remain unused from 2010 to 2050 in order to keep global warming to 2°C – and this has changed how investors view climate risk. Directly contributing to an important revision of the value of assets related to oil, gas, and coal reserves, this research was foregrounded in The Guardian’s ‘Keep it in the Ground’ campaign, underpinning decisions on divestment, climate change policy, and litigation, all lending strength and authority to the fight to mitigate and limit global warming.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>The Paris Agreement proposed to keep the increase in global average temperature to well below 2°C above pre-industrial levels. To have a 50% chance of achieving the target this century, cumulative carbon emissions between 2010 and 2050 need to be limited to around 1,100 gigatonnes of carbon dioxide (Gt CO<sub>2</sub>). Researchers from the UCL Institute for Sustainable Resources, based in the Bartlett, identified how much of the global oil, gas, and coal reserves must remain in the ground and ‘unburned’ to limit carbon emissions and keep global warming below 2°C, and identified the regional distribution of these reserves.</p>		
<b>Modelling complex energy systems to 2050</b>		
<p>Research as part of the UK Energy Research Centre (UKERC), supported by the UK Research Councils under Natural Environment Research Council award NE/G007748/1 (2009-2014), and conducted by McGlade and Ekins, explored the implications of the cumulative emissions limit for fossil fuel production using the TIMES Integrated Assessment Model (TIAM-UCL). TIAM-UCL models energy systems by minimising energy system costs over the duration of a scenario (in this case, the carbon budget for CO<sub>2</sub> emissions to 2050) and optimising how energy service demands are met for 16 regions using available primary energy sources and technologies, and calculating the impact of selected primary energy sources on emissions and temperature rise.</p>		
<p>The model was developed through subsequent UKERC research phases, led by Ekins and Strachan, with McGlade central in developing its representation of fossil fuels. The TIAM-UCL model examined the world’s fossil fuel resources, and optimised the use of these and other energy resources so the carbon budget (the amount of greenhouse gas emissions that can enter the atmosphere) did not exceed an average 2°C global temperature increase. Because energy systems are so complex, the TIAM-UCL model required myriad input assumptions, which were tested across many variables (including population and energy service demands, fossil fuel production costs and availability, alternative energy sources, low carbon technology,</p>		

and climate policy). The model identified what portion of global fossil energy reserves – oil, coal and natural gas – should remain unburned, and in which regions they are located. It identified which reserves should remain untouched to restrict the average global temperature increase to 2°C [a].

### Identifying ‘unburnable’ carbon reserves by geography

The research suggests that, globally, a third of oil reserves, half of gas reserves, and over 80% of current coal reserves should remain unused from 2010 to 2050, to meet the target of 2°C [b]. This carbon budget would be vastly exceeded by the emissions contained in the world’s fossil fuel reserves, owned by state and publicly-traded fossil fuel companies. If global climate commitments are to be met, such reserves must be deemed ‘unburnable’. This would then make them – as well as the infrastructure needed to extract, refine and transport them – into low or no value, ‘stranded assets’.

The research also shows that extraction from the Arctic and unconventional oil production (such as oil sands, directional drilling, and fracking) are incompatible with cost-effective efforts to limit average global warming. Implementation of the 2°C policy commitment would render unnecessary much further expenditure on fossil fuel exploration, because new discoveries could not lead to increased production within the carbon budget, and so policymakers’ instincts to exploit territorial fossil fuels will be increasingly seen as inconsistent with global warming policy.

### 3. References to the research (indicative maximum of six references)

- a) McGlade, C. and Ekins, P., (2014). *Unburn-able oil: an examination of oil resource utilisation in a decarbonised energy system*, *Energy Policy*, Vol.64, pp.102-112  
<https://doi.org/10.1016/j.enpol.2013.09.042>
- b) McGlade, C. and Ekins, P., (2015). *The geographical distribution of fossil fuels unused when limiting global warming to 2°C*, *Nature*, pp.187-190  
<https://doi.org/10.1038/nature14016>

### 4. Details of the impact (indicative maximum 750 words)

Ekins and McGlade’s paper [b] was published in *Nature* in January 2015, and immediately received significant public attention. *Carbon Brief* data reported it as the climate science paper most featured in the media and on social media in 2015, and the third highest of all time [1]. The research was foregrounded in the Guardian’s ‘Keep it in the Ground’ campaign, and influenced the financial sector where it informed a major shift in the understanding of the financial risks of climate change. Impacts can also be seen in law-making, policy and litigation.

#### 4.1 The ‘Keep it in the Ground’ campaign

In 2015, the editor-in-chief of The Guardian launched the ‘Keep it in the Ground’ divestment campaign, encouraging the Wellcome Trust and the Bill and Melinda Gates Foundation to divest from fossil fuel companies in which the foundation has a minimum of USD1,400,000,000 invested. The Head of Environment at The Guardian directly cited [b] in his launching article for the campaign, indicating that this “new analysis calls into question the gigantic sums of private and government investment being ploughed into exploration for new fossil fuel reserves” [2].

Since the launch of the campaign, the Guardian has tracked that institutions worth USD2,600,000,000,000 have now pulled investments out of fossil fuels, while the Guardian Media Group has divested its GBP800,000,000 fund from fossil fuels [3]. The campaign’s petition for the Wellcome Trust and the Bill and Melinda Gates Foundation to divest gained over 140,000 signatures and support from a range of public figures [4]. While the Wellcome

Trust did not divest, in 2016 the Gates Foundation divested from Exxon Mobil (worth USD824,000,000) and BP (worth USD187,000,000) [5].

The campaign continues to have traction in public debate. Citing the same findings provided in [b], the former UN Secretary General, Ban Ki-Moon, writing in The Guardian in 2019 stated that the “UK must stop investing in fossil fuels in developing countries [...] Research indicates that a third of oil reserves, half of gas reserves and over 80% of current coal reserves need to remain in the ground in order to meet the target of 2C of global warming” [6].

#### 4.2 Changing how investors and companies understand and report climate risk

This research was the first scientific study to highlight the consequences of a 2°C climate target for fossil fuel reserves, and it formed a foundational part of the body of research that has changed the way investors understand climate risk. The Managing Director of the Centre of Sustainable Finance at HSBC described how the rigour of the UCL research made it particularly influential with stakeholders in finance: “The work has primarily contributed to our risk assessment of fossil fuel assets, by providing us with a geographical distinction to understand climate risks by country more effectively. It has also helped with knowledge capacity building on climate issues across client facing teams” [7]. The Managing Investment Director of the Board Governance and Sustainability department at the California Public Employees' Retirement System, with responsibility for strategic initiatives across their USD440,000,000,000 portfolio indicates a shift in their investment approach, citing the importance of [b]: “The work of UCL, in mapping the extent of challenge and opportunity faced by investors, has been vitally important to us framing our approach. The work makes a compelling argument that disclosure may be necessary but it is not sufficient to drive the energy transition, which needs both [...] incentives and measures to overcome the drag of legacy on the financial markets' capital allocation and stewardship decisions” [8].

The financial implications arising from the research were cited in advice for investors. In January 2016, it was highlighted in the United Nations Principles for Responsible Investment's (UNPRI) quarterly advice to investors following the Paris Agreement. UNPRI's Director of Policy and Research, said at the time: “As a consequence of fulfilling the Paris Agreement, 80% of proven coal reserves may go unused, along with half of proven gas reserves and one third of proven oil reserves. This analysis is provided in the first report in this month's *R/ Quarterly* by McGlade and Ekins [...] As our academic and investment practitioner readers will be well aware - numbers do not lie. Following resolution of the Paris Agreement, it is time for investors to redo their sums” [9]. The *IPCC Special Report on 1.5C* (2018) further used the research to outline another financial challenge: the impending depreciation of infrastructure, assets, and exports related to extraction that would result from the need to leave so much of the world's energy reserves in the ground [10].

Heeding such warnings, investors have used the research to rethink investment strategies, reflecting the financial consequences of leaving energy reserves untapped. A 2015 Citigroup report cited [b], advising that any investment in coal should be “stress-tested” against low-carbon scenarios, in which demand for coal was dramatically reduced or subject to a high carbon-tax [11]. The increasing pressure for companies to reveal their own financial risks related to decarbonisation can also be found in policy changes, such as the establishment of the Task Force on Climate-related Financial Disclosures (TCFD). The TCFD controlled by the Financial Stability Board and chaired by Michael Bloomberg, has since developed guidelines for companies to report climate risks to investors, which has lent major credibility to the climate risk problem. Special Advisor to the TCFD attested to the change in mindset that took place upon reflecting on [b], stating that “the invest[ment] community now understands that we're on a path towards 3 or 4 degrees of global warming and that's really problematic for us, from both an investment perspective and indeed in terms of planetary health in its broadest sense. That's been translated into direct engagement by various groups and shareholders, with the management teams of oil and gas companies putting them under pressure to change what they're doing. That was not true 5 to 10 years ago” [12].

### 4.3 Impact on law and policy making

The research has been referenced in legislation constraining the extraction of fossil fuels, and in one example provided crucial evidence in support of banning Unconventional Coal Gasification (UCG) in Scotland.

In 2016, the Scottish Government commissioned the Independent Review on Underground Coal Gasification, which found that the technology might jeopardise the country's climate targets. The review cited the research, alongside the Intergovernmental Panel on Climate Change (IPCC) and high-profile US climate scientist James Hansen, as the three key sources for understanding the global case for constraining emissions. It used [b] as a key source to demonstrate the need to avoid additional carbon emissions [13]. The Scottish Government subsequently banned underground coal gasification.

### 4.4 Impact on litigation in fossil fuel developments

The research provided important evidence that prevented the construction of a coal mine in Australia, stopping carbon emissions estimated at more than 38,000,000 tonnes.

In December 2017, Gloucester Resources Limited sued the Minister of Planning, appealing the denial of the company's application to construct an open cut coal mine in New South Wales. The Land & Environment Court of New South Wales upheld the government's denial of the application and found that the project was not in the public interest, in part because of the climate change impacts of the mine's direct and indirect greenhouse gas emissions.

An expert witness and Emeritus Professor at the Australian National University, stated: "The McGlade and Ekins paper in *Nature* 2015 was a central part of the scientific case that I put forward to the Court that the proposed Rocky Hill Coal Mine near Gloucester NSW Australia should not be allowed to proceed. The Court denied the licence for the mine to proceed, and the McGlade and Ekins analysis was cited in the Court's decision as an important factor" [14].

Summing up, Chief Judge Brian Preston noted the witness' arguments regarding the carbon budget: "Approval of the Project will not assist in achieving the rapid and deep reductions in GHG emissions that are needed now in order to balance emissions by sources with removals by sinks of GHGs in the second half of this century and achieve the generally agreed goal of limiting the increase in global average temperature to well below 2°C above pre-industrial levels" [15].

In conclusion, this research has shaped how investors, companies, and governments understand the financial impacts of climate change, and as a result contributed to a global revaluation of assets, divestment, climate change policy and litigation.

## 5. Sources to corroborate the impact (indicative maximum of 10 references)

1. *The climate change papers most feature in the media*, Carbon Brief (29 July 2015) <https://bit.ly/3rTpcdj>
2. *Leave fossil fuels buried to prevent climate change, study urges*, The Guardian (7 Jan 2015) <https://bit.ly/30TyHNJ>
3. *Guardian Media Group to divest its £800m fund from fossil fuels*, The Guardian (1 Apr 2015) <https://bit.ly/30TrPQv>
4. *Institutions worth \$2.6 trillion have now pulled investments out of fossil fuels*, The Guardian (22 Sept 2015) <https://bit.ly/3qXKCVi>
5. *The Gates Foundation divested from fossil fuels - and you should too*, Global Citizen (26 May 2016) <https://bit.ly/3r2B4lx>

6. Ban Ki-moon, *UK must stop investing in fossil fuels in developing countries*, The Guardian (24 Feb 2019) <https://bit.ly/2QgK0m2>
7. Testimonial: Managing Director, Centre of Sustainable Finance at HSBC
8. Testimonial: The Managing Investment Director, Board Governance and Sustainability at CalPERS
9. Nathan Fabian, UNPRI's Director of Policy and Research <https://bit.ly/3eM1EU2>
10. *IPCC special report on 1.5C*, Chapter 4: Strengthening and Implementing the Global Response (2018) <https://bit.ly/3ty5DHT>
11. *Energy Darwinism II*, Citi Group (August 2015) <http://citi.us/3cFawlm>
12. Testimonial: Chair of the Trustee board of the HSBC Bank (UK) Pension Fund and Special Advisor to the Task Force on Climate-related Financial Disclosures
13. Independent Review of Underground Coal Gasification – Report <https://bit.ly/2Q92hg0> pp. 84-88
14. Testimonial: Emeritus Professor, The Fenner School of Environment and Society, The Australian National University
15. *Gloucester Resources Limited v Minister for Planning [2019] NSWLEC 7* <https://bit.ly/2NtPW5f>