

Institution: University of Bath		
Unit of Assessment: C16 Economics and Econometrics		
Title of case study: Informing international and organisational policy and decision-making around climate change		
Period when the underpinning research was undertaken: 2001-2011		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Anil Markandya	Professor of Economics, Honorary Professor	April 1996 – August 2011 2011 - present
Period when the claimed impact occurred: 2014-2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact <p>Research by Professor Anil Markandya at the University of Bath into the effects of climate change has informed policies across the world, which so far have collectively led to a 0.7°C reduction in global warming estimates for the year 2100. Markandya's research underpinned a 2014 report for the Intergovernmental Panel on Climate Change, which was approved by over 100 national governments, among them the UK, and influenced their climate targets. The report was also a key scientific input into the Paris Climate Agreement, which was signed in 2016 and aims to limit the rise in global average temperature to 1.5°C above pre-industrial levels.</p>		
2. Underpinning research <p>Anil Markandya produced a series of articles at the University of Bath that examined the harmful effects of climate change in a number of contexts and identified policy mechanisms – often market-based – that might alleviate this damage.</p> <p>In a 2009 paper, Markandya critically reviewed the methodologies used in the literature on the effects of climate change on the health costs arising from diseases such as malaria and diarrhoea in developing countries (Ref 1). This concluded that the costs per life saved in the case of diarrhoea are considerably lower than those in the case of malaria and that even though the costs required to improve water and sanitation are very high, these result in costs per case avoided that are quite low.</p> <p>Markandya wrote two articles in the <i>Lancet</i> in 2009. In the first, he modelled the effect of policies that aim to reduce total carbon dioxide emissions (Ref 2). This found that changes in modes of production of electricity would reduce concentrations of fine particulate matter with aerodynamic diameter 2.5 micrometres or less, with the greatest effect in India and the smallest in the EU. The health benefits greatly offset the costs of greenhouse-gas mitigation, especially in India. In the second article, Markandya provided advice for policy makers, noting that mitigation strategies can have large benefits for both health <i>and</i> climate protection, meaning that policy choices exist that can be both cost effective and socially attractive (Ref 3).</p> <p>A 2011 paper by Markandya quantified the cost of an increased prevalence of cholera in Tanzania due to climate change, combining historical data on temperature and rainfall with</p>		

the burden of the disease (**Ref 4**). This found that a 1°C temperature increase raises the risk of cholera by 15% to 29%, suggesting that climate change might raise the risk of the disease in other countries in the future, as average temperatures rise.

Markandya was Principal Investigator on the EU-funded projects GreenSense (2001-2003), CASES (2006-2008) and HEATCO (2004-2006), which concluded that the transition towards a low-carbon global economy should be faster and that the energy sector had a prime role to play. The projects also highlighted new policies and approaches that were needed to generate a truly 'green' economy, given increasingly urgent environmental concerns. In a 2012 book, which summarised the lessons learnt from the three projects, Markandya recommended taxing polluters, establishing property rights, changing accounting systems and working with China on sustainable development and the integration of climate and economic policy (**Ref 5**).

In a 2012 paper written at Bath, Markandya examined the market for biological materials, such as the use of plant extracts in medicines (**Ref 6**). He noted that the real value of such resources is obscured by the fact that they are largely open access. He modelled various policies that would privatise the resource by allowing companies to make exclusive deals with the supplier of the resource. Since the destruction of biodiverse habitats is a major consequence of climate change, in doing so, Markandya identified a potential policy instrument to mitigate such change.

3. References to the research

1. **Markandya, A** & Chiabai, A 2009, 'Valuing Climate Change Impacts on Human Health: Empirical Evidence from the Literature', *International Journal of Environmental Research and Public Health*, vol. 6, no. 2, pp. 759-786. <https://doi.org/10.3390/ijerph6020759>
2. **Markandya, A**, Armstrong, BG, Hales, S, Chiabai, A, Criqui, P, Mima, S, Tonne, C & Wilkinson, P 2009, 'Public health benefits of strategies to reduce greenhouse-gas emissions: low-carbon electricity generation', *The Lancet*, vol. 374, no. 9706, pp. 2006-2015. [https://doi.org/10.1016/S0140-6736\(09\)61715-3](https://doi.org/10.1016/S0140-6736(09)61715-3)
3. Haines, A, McMichael, AJ, Smith, KR, Roberts, I, Woodcock, J, **Markandya, A**, Armstrong, BG, Campbell-Lendrum, D, Dangour, AD, Davies, M, Bruce, N, Tonne, C, Barrett, M & Wilkinson, P 2009, 'Public health benefits of strategies to reduce greenhouse-gas emissions: overview and implications for policy makers', *The Lancet*, vol. 374, no. 9707, pp. 2104-2114. [https://doi.org/10.1016/S0140-6736\(09\)61759-1](https://doi.org/10.1016/S0140-6736(09)61759-1)
4. Trærup, SLM, Ortiz, RA & **Markandya, A** 2011, 'The costs of climate change: A study of cholera in Tanzania', *International Journal of Environmental Research and Public Health*, vol. 8, no. 12, pp. 4386-4405. <https://doi.org/10.3390/ijerph8124386>
5. Barbier, E & Markandya, A 2013, *A New Blueprint for a Green Economy*. Routledge. <https://doi.org/10.4324/9780203097298>
6. **Markandya, A** & Nunes, P 2012, 'Is the value of bioprospecting contracts too low?', *International Journal of Ecological Economics and Statistics*, vol. 26, no. 3, pp. 85-102. <http://www.ceser.in/ceserp/index.php/ijeas/article/view/1983>

4. Details of the impact

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body responsible for assessing the science related to climate change and its impacts, potential future risks and possible response options. Through Markandya's long-standing involvement with the IPCC, his research has influenced many of the body's recommendations, in turn

leading to the signing of the Paris Agreement by 196 countries in 2016, which aims to limit the increase in global average temperature to 1.5°C above pre-industrial levels, and to changes in many countries' emission targets between 2016 and 2020.

Shaping international environmental strategy through the IPCC Fifth Assessment Report

Markandya was an author of the Third (2001) and Fourth (2007) IPCC Assessment Reports and shared in the Nobel Peace Prize that was awarded to the IPCC in 2007. Following these successes, Markandya was selected to be an author of the Fifth IPCC Assessment Report (AR5) in 2014. Markandya was a lead author of Chapter 17 ("Economics of Adaptation"). However, the entire report was heavily influenced by Markandya's research, with all six papers listed in Section 3 cited in Chapters 10, 11, 12 and 17 (**Source i**).

The report specifically draws on Markandya's research into the role of market-based instruments and expresses a "*general preference in terms of overall efficiency for taxes over subsidies*" (**Ref 5**; **Source i**, p. 965) and recommends the development of markets for genetic resources (**Ref 6**; **Source i**, p. 966). These insights go on to be reflected in the recommendations within the report that "*Not all adaptation actions are investment-based. Policy actions are also important tools for adaptation*", including the possible role of economic instruments such as taxation (**Source i**, p. 948).

Over 100 governments attended a meeting in Copenhagen in 2014 to discuss and adopt the Synthesis Report, which summarises for policy makers the key points of AR5 (**Source ii**). The UK's Department of Energy and Climate Change website highlights in its response to the 2014 report that "*Its assessment of the state of the climate is the most comprehensive ever written and it provides a strengthened body of evidence of man-made climate change*". The website goes on to state that the Synthesis Report "*provides a strengthened case for international leaders to act now to reduce domestic carbon emissions and to secure an ambitious legally binding global agreement in 2015*" (**Source iii**).

Influencing the Paris Agreement

A year after the Copenhagen meeting, AR5 was a key input into the Paris Agreement, which was an international agreement addressing greenhouse gas emissions mitigation, adaptation and finance. It was signed in 2016, following negotiations by representatives of 196 states at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015. 189 of these members were still party to the agreement as of December 2020. Under the UNFCCC's Article 21.2, its secretariat is required to "*cooperate closely with the Intergovernmental Panel on Climate Change to ensure that the Panel can respond to the need for objective scientific and technical advice*" (**Source iv**).

The Paris deal sets a goal of limiting the increase in global average temperature to 'well below' 2°C above pre-industrial levels and, if possible, to limit the increase to 1.5°C. It requires all signatories to set reduction targets for greenhouse gas emissions. It also commits signatories to balance greenhouse gas emissions and 'sinks' (which remove gases) by the second half of the 21st century, referred to as 'net zero'.

As part of its commitments under the Paris Agreement, the UK (along with the rest of the EU) committed to reduce greenhouse gas emissions by 40% below their 1990 levels. This was raised to 57% in June 2016 and 68% in December 2020. In addition, the UK announced a legally-binding commitment to reduce greenhouse gas emissions to net zero by 2050 in June 2019 (**Source v**).

Climate Action Tracker, a non-profit science consortium, provides warming estimates due to real-world emissions for the year 2100, based on all adopted national policies. In December

2020, they reported that these had fallen by 0.7°C over the previous five years, from 3.6°C to 2.9°C, which they attributed to the Paris Agreement (**Source vi**).

5. Sources to corroborate the impact

(i) IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*

[Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

https://archive.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-PartA_FINAL.pdf

- Markandya's research is cited on pages 688, 689, 716, 737, 738, 740, 779, 918, 954, 957, 965, 966.

(ii) IISD (2014) "Summary of the Fortieth Session of the Intergovernmental Panel on Climate Change" *Earth Negotiations Bulletin* 12 (607).

<https://enb.iisd.org/vol12/enb12607e.html>

(iii) Department of Energy and Climate Change (2014) "Key Points and Questions: IPCC AR5 Synthesis Report". 3 November 2014.

<https://www.gov.uk/government/publications/ipcc-5th-assessment-report-synthesis-report/key-points-and-questions-ipcc-ar5-synthesis-report>

(iv) Cooperation with the IPCC, UN website accessed December 2020.

<https://unfccc.int/topics/science/workstreams/cooperation-with-the-ipcc>

(v) Department for Business, Energy & Industrial Strategy (2019). "UK becomes first major economy to pass net zero emissions law".

<https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law>

(vi) Climate Action Tracker (2020) "Paris Agreement turning point".

https://climateactiontracker.org/documents/829/CAT_2020-12-01_Briefing_GlobalUpdate_Paris5Years_Dec2020.pdf