A Report on Responsible Energy Investing

Fossil Free Yale

Presented to the Yale Advisory Committee on Investor Responsibility (ACIR)

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I. Summary

The overwhelming scientific consensus has concluded that the extraction and burning of fossil fuels cause climate change. Consequences include crop failures, sea levels rising, ocean acidification, and extreme weather. By some estimates, climate change currently causes 300,000 human deaths per year, and is blamed for widespread economic damage.[1] The 2010 World Bank World Development Report[2] and United Nations Environmental Programme Report[3] declare that inaction by 2020 would make stabilization of global temperatures nearly impossible. To keep global temperatures within the internationally agreed upon limit, fossil fuel companies must keep 4/5 of their current carbon reserves in the ground.[4] Unfortunately, the next major international mitigation treaty is not scheduled to occur until 2020.[5] Fossil fuel extraction practices such as mountaintop removal, hydraulic fracturing, oil sands recovery, and oil shale mining contribute to local harms in addition to climate change. Under well established Yale tradition, Yale cannot ignore this global crisis in the manner it invests its endowment.

Yale has a history of socially responsible investing.[6] Members of the Yale community published *The Ethical Investor* handbook in 1972, which pioneered responsible institutional investing at Yale and across the nation. Those guidelines use the Kew Gardens Principles to determine what "moral obligation" is required for the University to divest. Yale applied these guidelines and divested from 17 companies operating in apartheid South Africa between 1978 and 1994. According to these principles, Yale should divest from the fossil fuel industry if the following

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[1] Global Humanitarian Forum. "Human Impact Report: Climate Change — The Anatomy of a Silent Crisis." Geneva, 2009. p. 1

[2] The World Bank, *World Bank Development Report 2010: Development and Climate Change* (Washington, D.C.: The International Bank for Reconstruction and Development, 2010.

[3] Michel den Elzen et al., *The Emissions Gap Report.* United Nations Environment Programme, 2010.

[4] The Carbon Tracker Initiative, "Unburnable Carbon." August 2012. http://www.carbontracker.org/wp-content/uploads/downloads/2012/08/Unburnable-Carbon-Full.pdf

[5] Harvey, Fiona, and John Vidal. "Global Climate Change Treaty in Sight after Durban Breakthrough." www.guardian.co.uk. N.p., 11 Dec. 2011.

[6] Yale Advisory Committee On Investor Responsibility, "Committee History And Mission." http://acir.yale.edu/policies_and_past_actions.html (accessed 7 Mar. 2013).

conditions are met: need, proximity, capability, and last resort.

First, there must be "need." The Yale investments office will take action to reduce only a grave social injury. The increasing magnitude and breadth of climate change's threats to human life qualify it as a grave social injury.

The second principle states that Yale must be in close "proximity" to climate change. This means awareness of the harms global warming creates, not necessarily geographical closeness. Ground breaking research performed at Yale has furthered the world's knowledge of climate change. Members of the Yale administration, including our president, have made compelling statements about the University's role in resisting the adverse effects of global warming. On campus, Yale has taken great steps to demonstrate its knowledge of the importance of emissions reductions through its sustainability strategic plan, LEED certified buildings, biodiesel shuttles, cogeneration power plant, and renewable energy projects. The Yale community has demonstrated its awareness of the crisis throughout the Yale campus. Yale's investments beyond its campus should reflect the same values.

The "capability" condition of the Kew Gardens Principles refers to Yale's capacity to address the social injury through endowment policies. Yale has no moral obligation to divest if doing so would sacrifice the vitality of its endowment, and less of a reason to if divesting will not reduce the social injury. Financial analysis actually suggests divestment from fossil fuels has a negligible impact on investor risk.[7] Fossil fuel investments may also be becoming increasingly risky themselves.[8] The growing push on over 300 campuses and other public groups across the country to divest from fossil fuels reinforces Yale's ethical obligation, as the increased scale of action created by the national movement means Yale's action would go farther to reduce the social harms associated with climate change than isolated action. A message from Yale would amplify the growing movement's impact on the industry's social license, which would engender

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[7] Patrick Geddes, "Do the Investment Math: Building a Carbon-Free Portfolio," *Aperio Group, LLC*, http://www.aperiogroup.com/system/files/documents/building_a_carbon_free_portfolio.pdf
[8] Leslie Lowe, Tom Sanzillo. *Financial Risks Of Investments In Coal.* As You Sow, 2011.

more actions to address the social injury they cause. Because Yale's endowment amounts to approximately one twentieth of all U.S. university endowment money, it cannot deny that its action, or inaction, poses a question of moral leadership.[9][10] Shortly after the publication of the Ethical Investor, Yale participated in a similar nationwide divestment movement that helped motivate the Comprehensive Anti-Apartheid Act of 1986.[11]

The final condition of "last resort" does not need to be met to necessitate a moral obligation to act, though it strengthens the case for divestment. Nevertheless, the lack of concerted global or national action on climate change firmly makes institutional investor efforts a last resort. Additionally, divestment must be the last resort of Yale, meaning before considering divestment, the university must exhaust all other options, including communication and engagement with company management to attempt to exert influence over the direction of fossil fuel companies. Past examples show that shareholder action aimed at increased environmental responsibility has limited effectiveness. That said, direct communication by Yale as a shareholder would be more effective than shareholder resolutions. To pass a shareholder resolution, Yale would have to go through certain resolution preconditions and gain majority support of shareholders who do not necessarily abide by the same moral investments code.[12] Yale could avoid these hurdles by directly communicating with the management of a company.

Fossil Free Yale recommends that the Yale investments office consider divestment from the most complete list available to the public of companies furthering climate change, the 200 companies with the greatest carbon reserves as provided by the Carbon Tracker Initiative. We outline a process that would allow Yale to identify and target the worst subset of those companies, and we suggest that Yale implement an engagement and divestment procedure to

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[9] Yale University Investments Office "The Yale Investments Office" http://investments.yale.edu. (accessed 11 Mar. 2013).

[10] United States Accountability Office, *College And University Endowments Have Shown Long-Term Growth, While Size, Restrictions, And Distributions Vary, 2010* (Washington, DC: GAO-10-393).

[11] Cecelie Counts, "Just One Weapon in Battle Against Apartheid," *The New York Times,* January 27, 2013.

[12] Australian Securities & Investments Commission, "Company Resolutions" http://www.asic.gov.au/asic/asic.nsf/byheadline/Company+resolutions?opendocument (accessed 13 March 2013).

allow for reinvestment in companies that substantially improve their environmental practices and continued investment in companies that already have satisfactory practices.

II. Climate Change

Climate change refers to the significant and long-lasting global and regional alterations in weather patterns. Climate change encompasses more than the well-known phenomenon of "global warming" and refers to alterations in oceanic circulation, precipitation systems, wind patterns, etc. There are four key features of climate change that compel the ACIR, in accordance with the policies of *The Ethical Investor*, to recommend immediate action with respect to the Yale University endowment:

1. Climate change is ongoing.
2. Human activity is driving and will continue to drive climate change.
3. The single most important human source of climate change is the extraction, use, and combustion of fossil fuels.
4. Human and environmental costs of climate change constitute "grave social injury," as defined in *The Ethical Investor*.

Since March 1985, the monthly average of global temperatures has exceeded the expected global average. This global temperature increase is depicted by an image published by the National Oceanic and Atmospheric Administration (NOAA). The map (Fig.1) indicates land and ocean temperature percentiles from January through December of 2012, denoted by the varying shades of color. The map places temperature anomaly data (using a 30-year average) in a historical perspective by comparing these values to the historical temperature record at that particular location and in this way is able to designate the 2012 temperature as "record warmest," "much warmer than average," etc.

NOAA measurements reveal Jan-Dec 2012 to have produced the highest average temperatures

on record in many parts of the world, including in the American Midwest, much of which suffered severe droughts during that period. 2012 marked the 36th consecutive year (since 1976) with above-average global temperatures.[13]

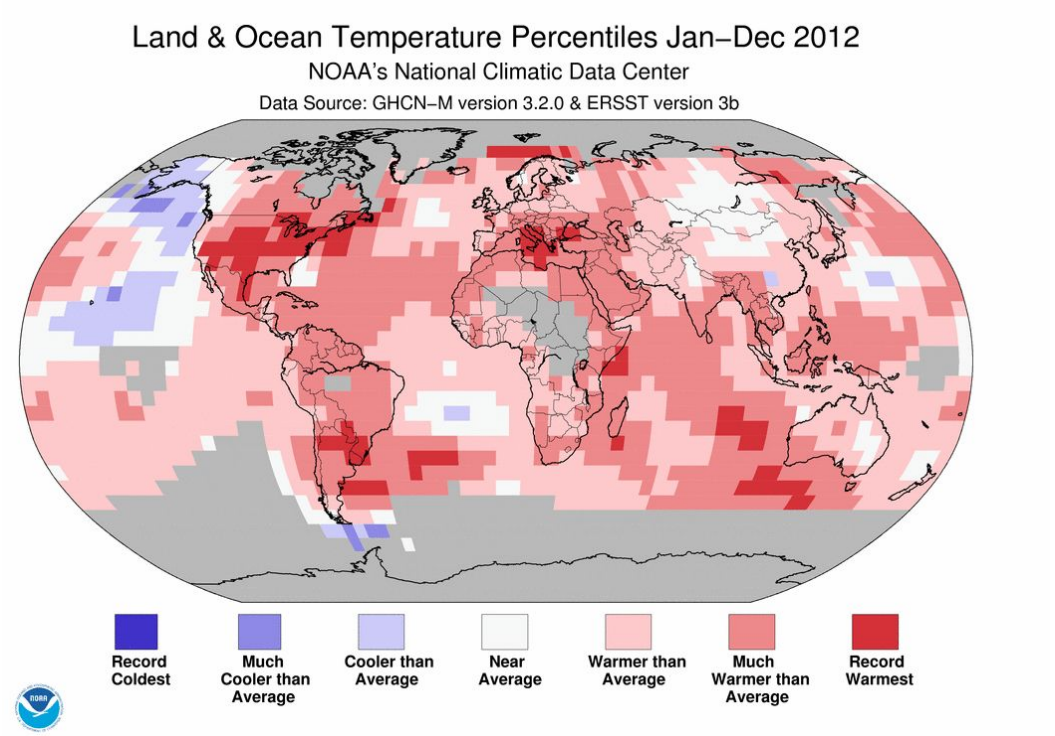

Figure 1: NOAA measurements reveal the short-term manifestation of long-term warming trends[14]

For decades, scientific consensus has been that human activity is driving and will continue to drive climate change. In 2001, the Intergovernmental Panel on Climate Change (IPCC) published its Third Assessment Report and stated that "Human activities have increased the atmospheric concentrations of greenhouse gases and aerosols since the pre-industrial era."[15] The IPCC, established by the World Meteorological Organizations and the UN Environmental Programme, is the leading international body on the scientific, technical, and socio-economic assessment of climate change. A 2010 meta-analysis of climate research, published in the Proceedings of the National Academy of Sciences, indicates that "(i) 97–98% of the climate researchers most

[13] NOAA National Climatic Data Center, "State of the Climate: Global Analysis for Annual 2012," December 2012. http://www.ncdc.noaa.gov/sotc/global/

[14] Ibid.

[15] Intergovernmental Panel on Climate Change, "Climate Change 2001: Working Group 1: The Scientific Basis, Summary for Policymakers," 2001. http://www.ipcc.ch/ipccreports/tar/vol4/008.htm

actively publishing in the field agree with the occurrence of anthropogenic climate change as outlined by the Intergovernmental Panel on Climate Change, and (ii) the relative climate expertise and scientific prominence of the researchers unconvinced of climate change are substantially below that of the convinced researchers."[16]

After that brief introduction of anthropogenic climate change, this analysis will now turn to point (3): that the single most important human source of climate change is the extraction, use, and combustion of fossil fuels.

III. The Extraction and Burning of Fossil Fuels Lead to Climate Change

Greenhouse gases such as carbon dioxide, methane and nitrous oxide, are released into the atmosphere when fossil fuels are burned. Greenhouse gases are molecules able to absorb and emit radiation in the thermal infrared range. Short wave, high-energy radiation from the Sun passes through the atmosphere, and is reflected as long wave radiation once it hits the Earth. Greenhouse gases absorb and trap this long wave radiation, heating the Earth. This process is important in sustaining life on Earth, but excess greenhouse gases lead to excess heat.

The graph below (Fig. 2) illustrates the link between atmospheric CO_2 levels and temperature.[17] The blue line indicates the atmospheric carbon dioxide concentration over time; the red line tracks temperature. This graph shows that present-day values of the blue CO2 line exceed all other points in human history. Because the greenhouse gas carbon dioxide traps heat, global

[16] William R. L. Anderegg, et al., "Expert Credibility in Climate Change," *Proceedings of the National Academy of Sciences of the United States of America*, 2010 ; published ahead of print June 21, 2010, doi:10.1073/pnas.1003187107

[17] Southwest Climate Change Network, "CO_2 Concentrations and Temperature Have Tracked Closely Over the Last 300,000 Years | Southwest Climate Change Network." http://www.southwestclimatechange.org/figures/icecore_records

temperatures are will soon follow the dramatic increase in carbon dioxide concentrations.

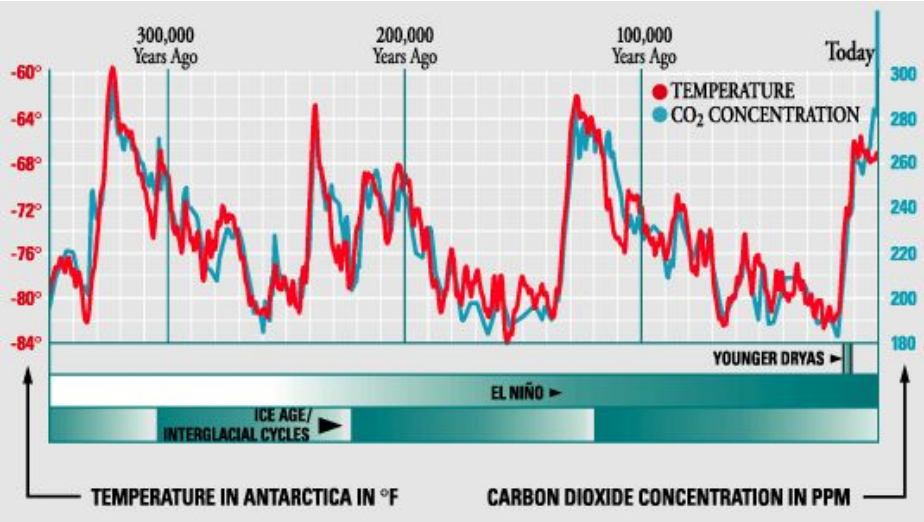

Figure 2: Carbon Dioxide Concentration impacts global temperature fluctuations[18]

Fossil fuel use is responsible for the massive increase in carbon dioxide concentration. According to the most recent IPCC report, carbon dioxide (CO_2) from fossil fuels comprises 56.6% of global greenhouse gas emissions in equivalent tons of CO_2, while total methane (CH_4) accounts for 14.3% and total nitrous oxide (N_2O) for 7.9%.[19] According to the Environmental Protection Agency (EPA), fossil fuels are partially responsible for methane and nitrous oxide emissions. The combustion of fossil fuels for transportation and stationary processes produces about 14% of all nitrous oxide emissions in the US.[20] Likewise, the extraction and production of natural gas, petroleum, and coal accounts for about 48% of all U.S. methane emissions.[21]

A. The Two Degree Threshold, and How Fossil Fuels Will Get Us There

The National Aeronautics and Space Administration (NASA) concluded that if global temperatures rise by a minimum of two degrees Celsius, "there will be dire consequences for life

[18] Western Michigan University, "Climate Change." http://www.wmich.edu/corekids/Climate-Change.htm
[19] Intergovernmental Panel on Climate Change [IPCC], "Climate Change 2007: Mitigation of Climate Change," 2007. http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter1.pdf
[20] Environmental Protection Agency [EPA], "Nitrous Oxide Emissions." <http://www.epa.gov/climatechange/ghgemissions/gases/n2o.html>
[21] EPA, "Methane Emissions." <http://www.epa.gov/climatechange/ghgemissions/gases/ch4.html>

on Earth."[22] This pronouncement was echoed in the *Stern Review: The Economics of Climate Change*, a report commissioned by the British government in 2006, which said a rise of two degrees Celsius will lead to increased flood risk and displacement, reduced water availability, declining crop yields and insufficient food supply, malnutrition, heat stress, increased spread of vector-borne diseases, and 15-40% species extinction.[23] According to the National Climatic Data Center, global temperatures have already risen 0.74°C since the late 19th century.[24]

At the United Nations Framework Convention on Climate Change session in 2009, members of the international community signed the Copenhagen Accord, an agreement recognizing "The scientific view that the increase in global temperature should be below 2 degrees Celsius." The Accord suggests that action be taken to remain under that threshold.[25]

A December 2012 study, "The Challenge to Keep Global Warming below 2°C," reports new measurements of CO_2 emissions and suggests it is increasingly unlikely that global temperature increases will remain below 2°C.[26] However, if the global community wishes to reduce future extreme weather events, crop shortages, and other effects of climate change, urgent action is necessary to stay away from a 2°C rise. The Carbon Tracker Initiative, a British NGO that researches the distribution of carbon in the world economy, estimates that in order to stay below this temperature limit, mankind can release no more than 565 gigatons of carbon by 2050.[27] Fossil fuel companies now have 2,795 gigatons declared in their reserves, which is

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[22] James E. Hansen and Makiko Sato, "Paleoclimate Implications for Human-made Climate Change" NASA Goddard Institute for Space Studies and Columbia University Earth Institute, New York, 2011).

[23] Nicholas Stern. "The Economics of Climate Change." Second IG Panel Lecture. New Delhi. 26 October 2007. London School of Economics.

[24] NOAA National Climatic Data Center, "Global Warming: Frequently Asked Questions." http://www.ncdc.noaa.gov/cmb-faq/globalwarming.html.

[25] United Nations Framework Convention on Climate Change, "Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009." <http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf>.

[26] Glen P. Peters et al., "The Challenge to Keep Global Warming Below 2 Degrees C," *Nature Climate Change* 3, no. 1 (December 2, 2012).

[27] M. Meinhausen et al., "Greenhouse-Gas Emission Targets for Limiting Global Warming to 2 Degrees C," *Nature* 458, no. 7242 (April 30, 2009), 1158-1162.

approximately *five times* what we can burn and stay under that 2°C limit.

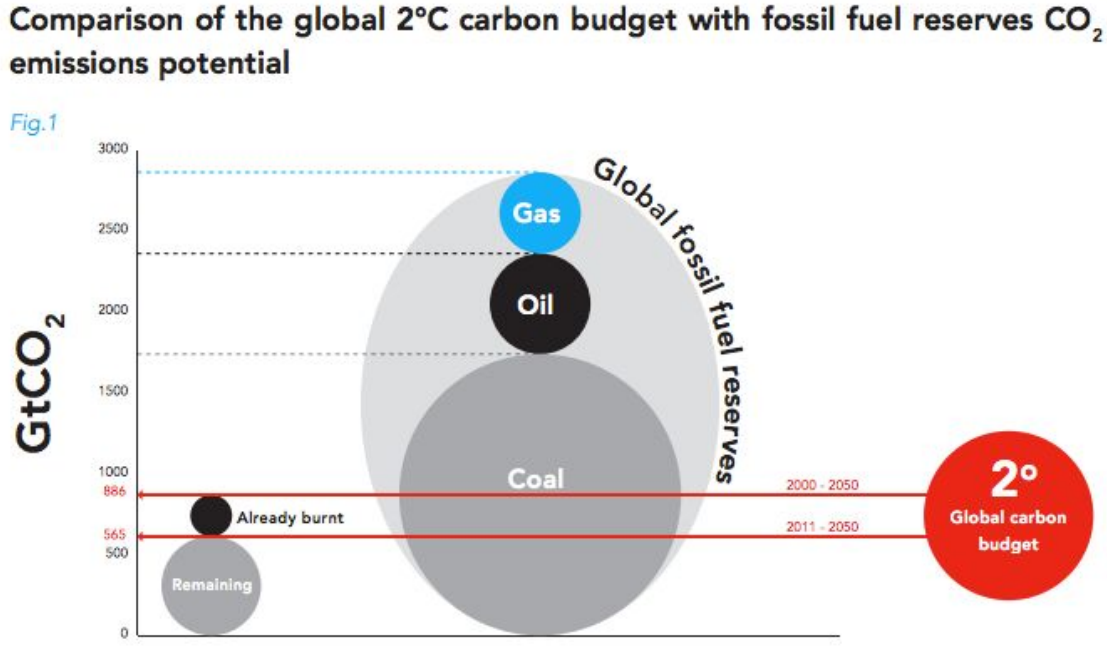

Figure 3: Global fossil fuel reserves in comparison to the 2˚ global carbon budget

The above graphic (Fig. 3) from the Carbon Tracker Initiative, shows how far reserves held by the fossil fuel industry exceed the carbon budget. The far left black "already burnt" circle demonstrates how by 2011 we had already used one third of our fifty year (2000-2050) carbon budget (pictured in red) in the first decade of this time period.[28] The gray "remaining" circle directly below the "already burnt" circle depicts the remaining carbon we can burn to remain below two degrees Celsius of warming. The central circles for coal, oil, and gas depict stated global fossil fuel reserves, and how far they exceed the 2° carbon budget.

B. The Urgency

Failure to reach emission reduction targets within our limited window of opportunity will compound the climate problem. The International Energy Agency's 2012 World Energy Outlook Report declares that "If action to reduce CO_2 emissions is not taken before 2017, all the

[28] The Carbon Tracker Initiative, "Unburnable Carbon." August 2012. http://www.carbontracker.org/wp-content/uploads/downloads/2012/08/Unburnable-Carbon-Full.pdf

allowable CO_2 emissions would be locked-in by energy infrastructure existing at that time."[29] The 2010 World Bank Development Report and the 2010 United Nations Environmental Programme Report on the emissions gap confirm the immediate need for action, setting a similar action deadline of 2020[30][31].

Despite the imminence of climate change, carbon dioxide emission rates have continued to increase globally. As long as the fossil fuel industry continues to make enormous profits from burning fossil fuels, they will continue to burn fossil fuels. If the extraction of fossil fuels from reserves is not reduced or halted soon, expect 2°C of global warming and the social harms associated with such warming within fifty years.

On May 10, 2013, scientists recorded that the atmosphere hit 400 parts per million of carbon dioxide.[32] The atmosphere has not seen carbon dioxide levels at 400 ppm for since three million years ago, at a time before humans evolved.[33] In a New York Times article reporting the new level, Yale geochemist and director of the Yale Climate and Energy Institute. Michael Pagani, was quoted as saying "I feel like the time to do something was yesterday."[34]

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[29] International Energy Agency, "World Energy Outlook 2012: Executive Summary," 3. http://www.iea.org/publications/freepublications/publication/English.pdf

[30] The World Bank, *World Bank Development Report 2010: Development and Climate Change* (Washington, D.C.: The International Bank for Reconstruction and Development, 2010.

[31] Michel den Elzen et al., *The Emissions Gap Report.* United Nations Environment Programme, 2010.

[32] Justin Gillis, "Heat-Trapping Gas Passes Milestone, Raising Fears," *New York Times*, sec. Environment, May 10, 2013, 2013.

[33] Ibid.

[34] Ibid.

IV. The Social Harms Caused by Fossil Fuel Consumption Create the Need for Action

This section will discuss in further detail some of the destructive effects of anthropogenic climate change on human health, the global economy, and the environment.

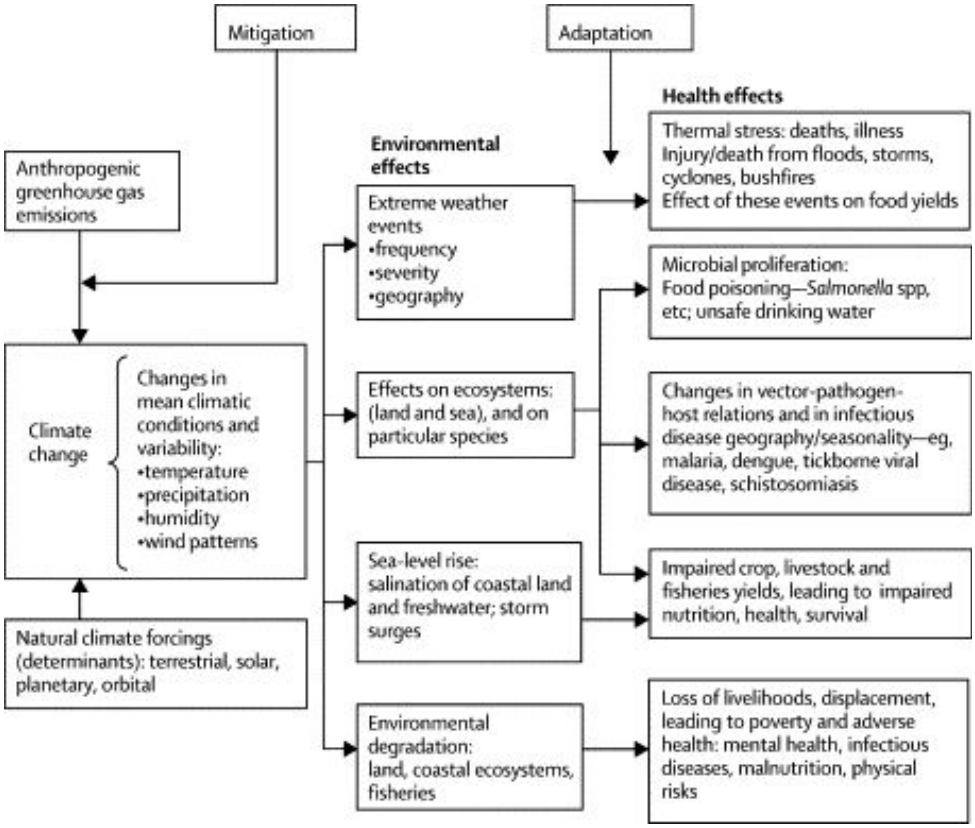

Figure 4: A flow chart covering some of the main human health impacts of climate change. From *The Lancet.*[35] Original caption reads: "Schematic summary of main pathways by which climate change affects population health. Mitigation refers to true primary prevention (reducing greenhouse gas emissions). Adaptation (a form of late primary prevention) entails interventions to lessen adverse health effects."

[35] Anthony J. McMichael, Rosalie E. Woodruff and Simon Hales, "Climate Change and Human Health: Present and Future Risks," The Lancet 368, no. 9538 (2-8 September 2006), 842.

A. Human Health

Climate change will have a negative impact on human health worldwide, particularly in impoverished communities and tropical climates. Projected climate change conditions will adversely affect human health through more extreme weather and natural disasters, environmental and ecological disruption affecting disease vectors, waterborne pathogens, air and water quality, and food availability and quality.[36] Climate change is projected to cause more frequent heat waves and more extreme precipitation events and tropical storms.[37] It is expected to increase the prevalence of high concentration ground-level ozone, which can cause respiratory symptoms such as asthma[38] and cardiovascular problems. Raised temperatures and extreme precipitation may also increase exposure to molds, common allergens, aerosolized marine toxins, and other particulate matter, which could again lead to more widespread diseases. [39]

Rising global temperatures and ecological changes are likely to expand the range of vector-borne diseases.[40] For example, rising temperatures increase habitable area for mosquitoes that carry infectious diseases such as malaria and dengue fever,[41] and shorten pathogen incubation periods. In 2009, UK-funded research demonstrated a seven-fold increase in prevalence of malaria on the slopes of Mount Kenya caused by climate shifts as compared to 10 years earlier.[42] Malaria already kills approximately 1 million people per year.[43] It afflicts as many as 1 billion people in

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[36] World Health Organization (WHO), "Climate Change and Human Health - Risks and Responses (Summary)." http://www.who.int/globalchange/environment/en/ccSCREEN.pdf

[37] *U.S. Climate Extremes Index* (National Oceanic and Atmospheric Administration: National Climate Data Center.

[38] U.S. Environmental Protection Agency (EPA), "Human Health Impacts & Adaptation." http://www.epa.gov/climatechange/impacts-adaptation/health.html

[39] NIEHS, "A Human Health Perspective On Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change." http://www.niehs.nih.gov/health/assets/docs_f_o/human_health_perspectives_on_climate_change.pdf

[40] *Climate Change, Natural Disasters, and Human Displacement: A UNHCR Perspective,* The UN Refugee Agency,[2008]). http://www.unhcr.org/4901e81a4.html

[41] "Climate change increasing malaria risk, research reveals." *The Guardian* 31 December 2009. http://www.guardian.co.uk/environment/2009/dec/31/climate-change-malaria-kenya

[42] Ibid.

[43] Christopher L.J. Murray, et al., "Global Malaria Mortality between 1980 and 2010: a Systematic Analysis." *The Lancet* - 4 February 2012 (Vol. 379, Issue 9814, Pages 413-431).

109 countries throughout Africa, Asia, and Latin America.[44]

A 2009 report from the Global Humanitarian Forum states that "every year climate change leaves over 300,000 people dead, 325 million people seriously affected, [with] annual economic losses of US$125 billion. Four billion people are vulnerable, and 500 million people are at extreme risk." [45] The most vulnerable people tend to be part of impoverished and coastal communities in the developing world, where the effects of climate change are very difficult to mitigate.

B. Negative Effects on Agriculture – Drought, Water Shortages, and Extinction

Climate change poses considerable risk to the growing conditions of many common crops due to altered precipitation and temperature patterns.[46] The International Food Policy Research Institute issued a report in 2009 on how "agriculture and human well-being will be negatively affected by climate change."[47] Climate change will cause declining yields for the most important crops in developing countries, especially in South Asia where irrigated yields will also decline sharply.[48] Prices of the most important agricultural crops -- rice, wheat, maize, and soybeans will then rise, and calorie availability in developing countries will go under 2000 levels by 2050, increasing child malnutrition by 20% compared to a scenario with no climate change.[49] This increase will negate improvement in child malnourishment levels from increased humanitarian effort.[50]

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[44] Fernando, S. D., R. Wickremasinghe, and A. R. Wickremasinghe. "UN Chronicle - Climate Change and Malaria - A Complex Relationship." *UN News Center*. UN, 2010. Web. 30 Jan. 2013.
[45] Global Humanitarian Forum. "Human Impact Report: Climate Change — The Anatomy of a Silent Crisis." Geneva, 2009.
[46] EPA, "Agriculture and Food Supply Impacts & Adaptation." http://www.epa.gov/climatechange/impacts-adaptation/agriculture.html
[47] International Food Policy Research Institute, "Climate Change: Impact on Agriculture and Costs of Adaptation." http://www.ifpri.org/sites/default/files/publications/pr21.pdf
[48] Ibid.
[49] Ibid.
[50] Ibid., vii.

Though crop yields in a few select areas may increase in the short-term with the rise in global temperature, the cumulative effects of climate change will be decidedly negative.[51]

Climate change will "yield increases in frequency and intensity of drought occurring under warming temperatures."[52] Increasing drought due to climate change has already induced some regional vegetation die-off and will lead to even more severe die-off effects. This would pose considerable damages to the agricultural industry. Drought in the United States is already damaging crop yields, and climate change will likely exacerbate such events. For example, last year the United States suffered "the most severe and extensive drought in at least 25 years, [which] seriously affected U.S. agriculture" according to the United States Department of Agriculture.[53]

C. Glacier Melt and Sea Level Rise

Glaciers are retreating at alarming rates due to rising temperatures. Though a small minority of glaciers have grown, most have melted at substantial speeds, and data from NASA demonstrate an accelerating rate of ice mass loss in Antarctica, the largest single ice mass on Earth.[54]

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[51] Ibid.
[52] David D. Breshears et al., "Regional Vegetation Die-Off in response to Global-Change-Type drought" *PNAS* 102 (2005): 15144-15148. doi:10.1073/pnas.0505734102
[53] *U.S. Drought 2012: Farm and Food Impacts,* USDA Economic Research Service,[2013]).
[54] Erik Conway, "Is Antarctica Melting?" http://www.nasa.gov/topics/earth/features/20100108_Is_Antarctica_Melting.html

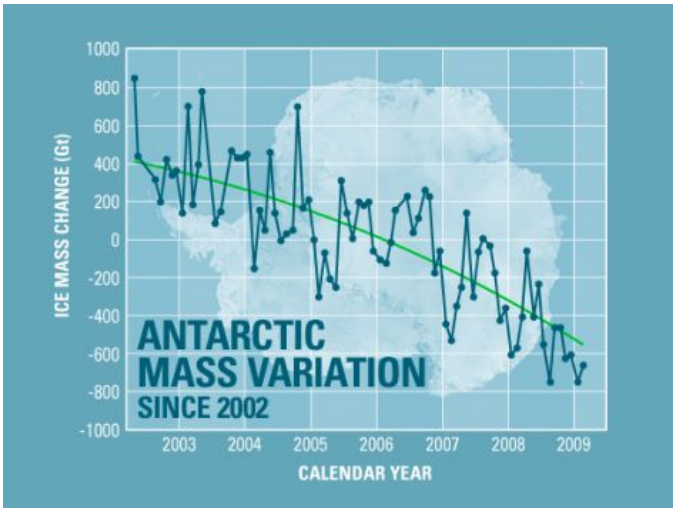

Figure 5: Antarctic Ice Mass Change from 2002-2009

This melting of glaciers and ice produces sea level rise. Average global temperatures are projected to rise between 1.4˚C and 5.8˚C over the next century, and computer simulations project that a 4˚C rise could cause almost all of the world's glaciers to melt. A complete melting of the Greenland ice sheet could be triggered by 2-3˚C rise in global temperatures, and could result in an estimated 6.5 meter sea level rise.[55] The short term trends in glacial melting raise concern. Modest global sea level rise directly impacts low-lying coastal areas and small island populations due to flooding, resulting in economic damage to and displacement of those populations. For example, roughly half of the nation of Bangladesh will become flooded with a sea level rise of just one meter,[56] impacting close to 100 million people.[57]

D. Oceans and Ocean Acidification

With a growing amount of carbon dioxide released from anthropogenic sources, more carbon dioxide is being absorbed by the world's oceans.[58] Approximately one third of atmospheric carbon dioxide is absorbed by the oceans, where it forms carbonic acid and alters the ocean's

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[55] R. Z. Poore, R. S. Williams Jr. and Christopher Tracey, "Sea Level and Climate: U.S. Geological Survey Fact Sheet 002-00," http://pubs.usgs.gov/fs/fs2-00/

[56] Oliver-Smith, *Sea Level Rise and the Vulnerability of Coastal Peoples: Responding to the Local Challenges of Global Climate Change in the 21st Century*

[57] Ibid.

[58] N. Bednaršek, et al., Extensive dissolution of live pteropods in the Southern Ocean. *Nature Geoscience*, 2012. http://www.nature.com/ngeo/journal/v5/n12/full/ngeo1635.html

natural pH. According to a recent study, without drastic emissions cuts, the world's oceans could become 150% more acidic by the end of this century, a rate that "has not been experienced for around 65 million years, since the dinosaurs became extinct."[59] Already, oceans are 30% more acidic than they were before the Industrial Revolution.[60] Increased levels of carbon dioxide have a direct effect on decreasing the pH of the ocean. [61]

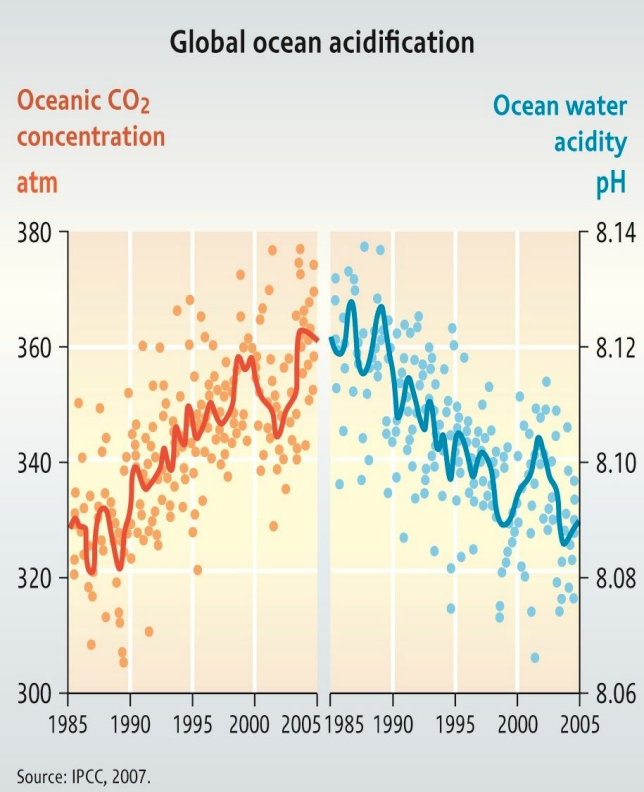

Figure 6: Ocean Carbon Dioxide Concentration and pH from 1985-2005 IPCC

Oceanic carbon dioxide absorption drastically harms marine ecosystems. Organisms have a specific range of acidity within which they can survive (pH range), and ocean acidification means that the waters become too acidic to be habitable for marine life. These types of chemical changes jeopardize marine ecosystems, threatening global fisheries and other marine resources.[62]

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[59] Lauren Morello, "Ocean Acidification Threatens Global Fisheries," *The Scientific American,* Dec 6, 2012, .
[60] Ibid.
[61] Intergovernmental Panel on Climate Change (IPCC), 2007: Climate Change 2007: The Physical Science Basis, Solomon, S., et al. eds., Cambridge University Press.
[62] Lauren Morello and *Climatewire*, "Ocean Acidification Threatens Global Fisheries." *The Scientific American*, Dec 6, 2012

For example, increased acidity makes it more difficult for shell-building organisms, such as pteropods and diatoms, to transform calcium carbonate into shells. At projected CO2 levels, the acidity of the ocean will cause shells to dissolve (see image below). The loss of these pteropods and diatoms hurts the upper level marine organisms that feed on them, causing fish populations to decline.[63] Increasing acidity also has the potential to kill fish eggs and many species of marine larvae.[64]

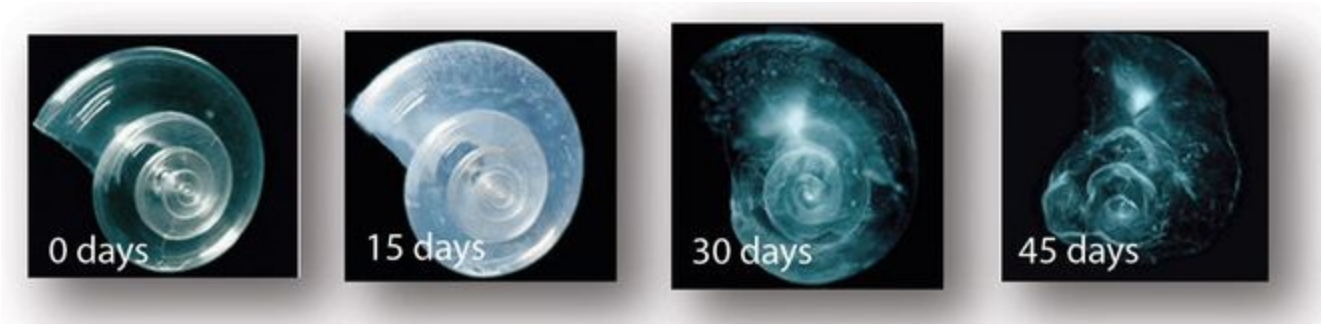

Figure 7: a pteropod shell dissolves at projected seawater CO2 levels[65]

Ocean acidification and a warming climate both contribute to harmful algal blooms (HABs).[66] Algae are single-celled organisms that are food for many species, but some types of algae are harmful. Harmful Algal Blooms refer to clusters of one of many species of algae that harm their ecosystems and humans. HABs can clog fish gills and smother coral, others make fishing crops and drinking water fetid and unpalatable. Other algae produce toxins that kill fish, mammals, and birds, and cause human illness.[67]

Climate change contributes to harmful algal blooms through a variety of ways. Warmer

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[63] Jennifer S. Holland, "Acid Threat," *National Geographic,* 2007, .
[64] H. Baumann, et al., "Reduced Early-life Growth and Survival in a Fish in Direct Response to Increased Carbon Dioxide." *Nature Climate Change*, December 11, 2011, 38-41. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1291.html
[65] Jennifer S. Holland, "Acid Threat," *National Geographic,* 2007, .
[66] Stephanie K. Moore, Vera L. Trainer and Nathan J. Mantua, "Impacts of Climate Variability and Future Climate Change on Harmful Algal Blooms and Human Health," *Environmental Health* (7 November 2008, .
[67] "Harmful Algal Blooms: Simple Plants with Toxic Implications."National Oceanic and Atmospheric Administration, http://oceanservice.noaa.gov/hazards/hab/

temperatures expand the habitats of warm water-loving harmful algae,[68] and increase the amount of time each year the species exists in an area.[69] Though much of the science regarding the formation of toxic algal blooms is new, current research suggests that the increased carbon dioxide levels in water from ocean acidification markedly increases the toxin production within harmful strains of algae.[70] Though economic projections of the impact of increased algal blooms are in their infancy, it is clear that increased disruption of ecosystems will be a travesty for fishing industries and food supplies.

Warming climate also trends towards increased 'fish kills' by more hypoxia (no oxygen) zones. Most water has in it some dissolved oxygen - this is what allows fish to 'breathe' through gills. Hypoxic zones are areas of water without sufficient oxygen. Animals passing through hypoxic zones suffocate, resulting in 'fish kill' events like the one depicted below, where whole schools of fish die and float to the surface of the water belly-up.

Higher global temperatures mean that surface water temperatures will rise, decreasing the water's efficiency at absorbing oxygen.[71] That surface water can serve as a cap, preventing oxygen from reaching the lower depths.[72] When this deeper water 'upwells,' or rises to the surface, surface water species become unable to breathe. If this projected trend comes to pass, hypoxic zones will become more frequent.[73]

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[68] Ibid.
[69] Ibid.
[70] Valerie Brown, "Could Climate Change Boost Toxic Algal Booms in the Oceans?" *Scientific American,* December 21, 2012.
[71] Valerie Brown, "Could Climate Change Boost Toxic Algal Booms in the Oceans?" *Scientific American,* December 21, 2012.
[72] Ibid.
[73]"Hypoxia Tends to Increase as Climate Warms, Study Finds." *Science Daily* (Dec 22, 2009)

Figure 8: A fish kill from a hypoxic "no oxygen" zone. Climate change and ocean acidification will increase hypoxic zones.[74]

Coral reef ecosystems are also being destroyed by increasing acidification. Coral reefs support at least 25% of all marine life on Earth,[75] and are areas of immense biodiversity and bioactivity. They are extremely sensitive to temperature and carbon dioxide levels, and require stable conditions to survive. As carbon dioxide and temperature levels increase, corals' calcium carbonate structures erode until a threshold is reached where corals cannot survive at all.[76] Just like with the shellfish, the calcium carbonate skeletons of coral dissolve in acidic water.

The world has already lost 19% of original coral reefs, while in 10-20 years 15% more are predicted to be destroyed, and in 20-40 years that number will increase to include an additional 20%.[77] Fish that rely upon coral reefs are a food source for half a billion people around the

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[74] Christine Dell'Amore, "Massive Fish Kill in Gulf Caused by "Dead Zone," Oil?" *National Geographic,* 2010, .
[75] "Coral Reefs."World Wildlife Fund, http://wwf.panda.org/about_our_earth/blue_planet/coasts/coral_reefs/2013).
[76] "What is Ocean Acidification?"National Oceanic and Atmospheric Administration Pacific Marine Environmental Laboratory, http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F, 2013).
[77] O. Hoegh-Guldberg, et al. "Coral Reefs Under Rapid Climate Change and Ocean Acidification," *Science*, 318, no. 5857 (2007): 1737-1742, http://www.sciencemag.org/content/318/5857/1737.full.

world, and in developing countries more than 25% of people subsist upon fish that cannot live without reefs.[78] Carnegie Institution oceanographer Ken Caldiera predicts that, if current trends continue, "reefs will one day survive only in walled-off, acid-controlled refugees."[79] The rapid decline of coral reefs will put additional pressure on our global fisheries and we must act quickly to maintain their fragile ecosystems.

E. Disastrous Weather Events

Increasing global temperature, rising sea levels, and altered climate patterns are predicted to cause more severe and unpredictable weather events. Extreme heat events are now more than four times as common as they were in 2000.[80] High temperatures and changing climate conditions have been related to surges in wildfires, increased flooding and drought, and more intense hurricanes and typhoons.[81]

Even though hurricanes and other tropical cyclones arise from complex factors, current trends and model forecasts unanimously indicate that global warming will increase the incidence and intensity of such storms.[82] The graph below demonstrates the increasing incidence of hurricanes from 1980 to 2005. Despite some variation in numbers from year to year, the trend is surely increasing.

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[78] Jennifer S. Holland, "Acid Threat," *National Geographic,* 2007,
[79] Ibid.
[80] Environmental Defense Fund, "Climate Change Impacts." <http://www.edf.org/climate/climate-change-impacts>
[81] Environmental Defense Fund, "Climate Change Impacts." <http://www.edf.org/climate/climate-change-impacts>
[82] Thomas R. Knutson et al., "Tropical Cyclones and Climate Change," *Nature Geoscience* 3 (21 February, 2010), 157-163.

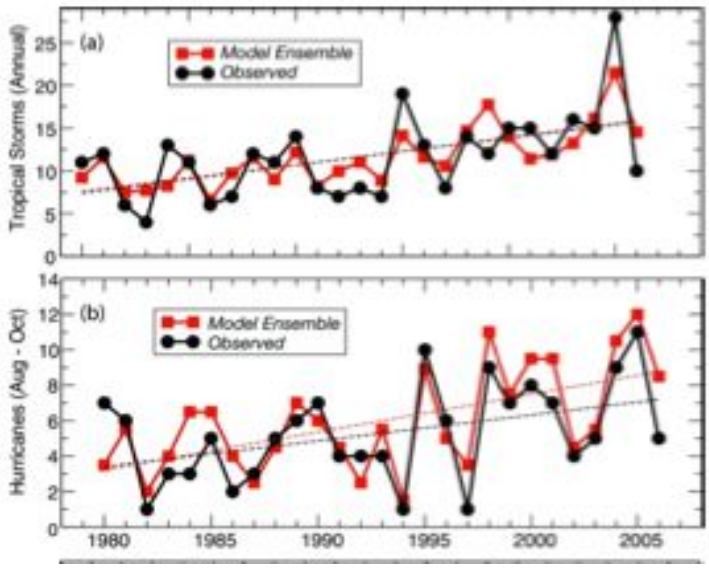


Figure 9: Simulated vs. observed Atlantic tropical cyclone interannual variability (approximately 1980-2006) using several methods: a) tropical storm counts using a statistical/dynamical downscaling method11; b) hurricane counts (Aug.-Oct.) using a regional climate model downscaling method12; c) tropical storm counts using a ~100 km grid global model31; and d) hurricane counts using a 50 km grid global model29. Methods: (a) uses NCEP reanalyses and observed SSTs as input; (b) uses observed SSTs and interior spectral nudging to NCEP reanalyses; and (c, d) use only observed SSTs. Future projections of tropical storm frequency using methods (a, b, d) included in Table S1.[83]

F. Summary of Climate Change Impacts

The *Stern Review* estimates that in business-as-usual scenarios, the overall costs of climate change will result in a 5% loss in global GDP per annum.[84] If a wider range of risks and impacts is taken into account, the damage could extend to over 20% of GDP.[85] The following figure summarizes the many harms of global warming; it is described fully in the box below.

Figure 2 Stabilisation levels and probability ranges for temperature increases
The figure below illustrates the types of impacts that could be experienced as the world comes into equilibrium with more greenhouse gases. The top panel shows the range of temperatures projected at stabilisation levels between 400ppm and 750ppm CO_2e at equilibrium. The solid horizontal lines indicate the 5 - 95% range based on climate sensitivity estimates from the IPCC 2001[2] and a recent Hadley Centre ensemble study[3]. The vertical line indicates the mean of the 50th percentile point. The dashed lines show the 5 - 95% range based on eleven recent studies[4]. The bottom panel illustrates the range of impacts expected at different levels of warming. The relationship between global average temperature changes and regional climate changes is very uncertain, especially with regard to changes in precipitation (see Box 4.2). This figure shows potential changes based on current scientific literature.

[83] Ibid.
[84] Nicholas Stern. "The Economics of Climate Change." Second IG Panel Lecture. New Delhi. 26 October 2007. London School of Economics.
[85] Ibid.

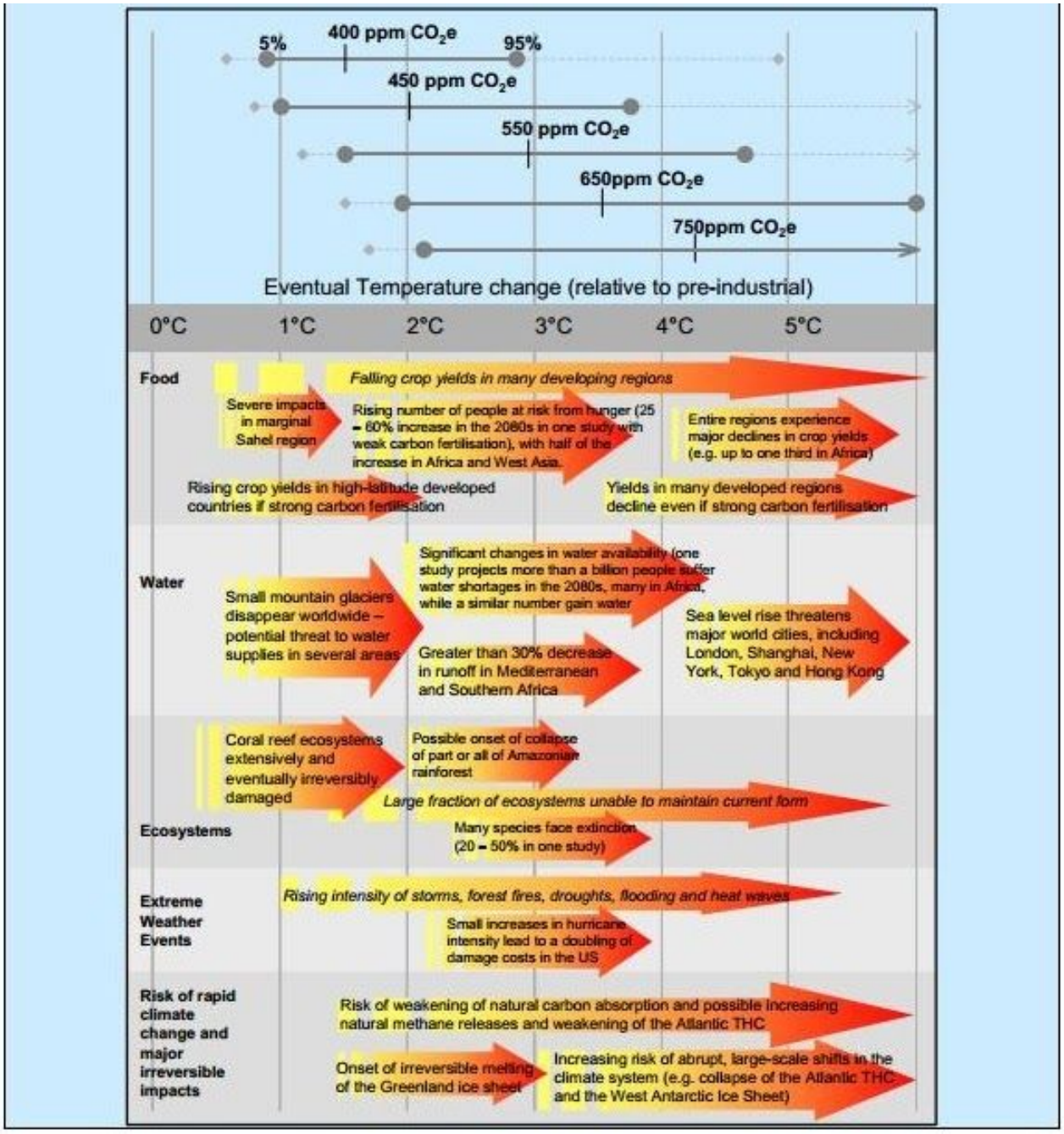


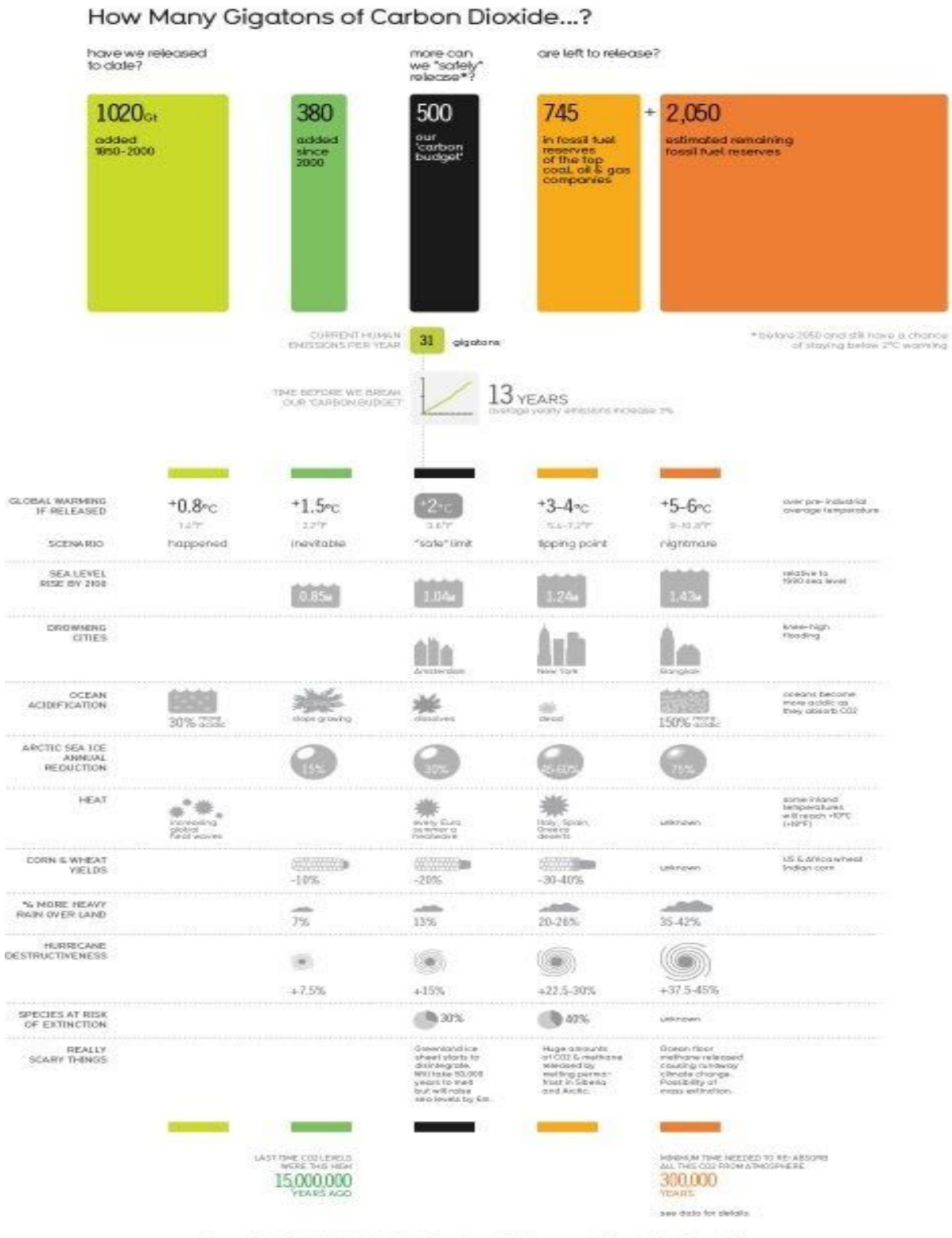
Figure 10: Effects of Global Temperature Change[86]

Below is another infographic displaying data from the Carbon Tracker initiative, the International Energy Agency, the Intergovernmental Panel on Climate Change, NASA, NOAA, the National Research Council, the Potsdam Institute for Climate Impact Research, the World

[86] Ibid.

Bank, and the European Commission Joint Research Center.[87]

[87] David McCandless et al., *How Many Gigatons of Carbon Dioxide...?* Information is Beautiful, [2013]).


How Many Gigatons of Carbon Dioxide...?
have we released to date?
more can we "safely" release*?
are left to release?
1020Gt
added 1850-2000
380
added since 2000
500
our 'carbon budget'
745
in fossil fuel reserves of the top coal, oil & gas companies
+
2,050
estimated remaining fossil fuel reserves
CURRENT HUMAN EMISSIONS PER YEAR
31
gigatons
* before 2050 and still have a chance of staying below 2°C warming
TIME BEFORE WE BREAK OUR 'CARBON BUDGET'
13 YEARS
average yearly emissions increase 3%
GLOBAL WARMING IF RELEASED
+0.8°C
1.4°F
+1.5°C
2.7°F
+2°C
3.6°F
+3-4°C
5.4-7.2°F
+5-6°C
9-10.8°F
over pre-industrial average temperature
SCENARIO
happened
inevitable
"safe" limit
tipping point
nightmare
SEA LEVEL RISE BY 2100
0.85m
1.04m
1.24m
1.43m
relative to 1990 sea level
DROWNING CITIES
Amsterdam
New York
Bangkok
knee-high flooding
OCEAN ACIDIFICATION
30% more acidic
stops growing
dissolves
dead
150% more acidic
oceans become more acidic as they absorb CO2
ARCTIC SEA ICE ANNUAL REDUCTION
15%
30%
45-60%
75%
HEAT
increasing global heat waves
every Euro summer a heatwave
Italy, Spain, Greece deserts
unknown
some inland temperatures will reach +10°C (+18°F)
CORN & WHEAT YIELDS
-10%
-20%
-30-40%
unknown
US & Africa wheat Indian corn
% MORE HEAVY RAIN OVER LAND
7%
13%
20-26%
35-42%
HURRICANE DESTRUCTIVENESS
+7.5%
+15%
+22.5-30%
+37.5-45%
SPECIES AT RISK OF EXTINCTION
30%
40%
unknown
REALLY SCARY THINGS
Greenland ice sheet starts to disintegrate. Will take 10,000 years to melt but will raise sea levels by 6m.
Huge amounts of CO2 & methane released by melting permafrost in Siberia and Arctic.
Ocean floor methane released causing runaway climate change. Possibility of mass extinction.
LAST TIME CO2 LEVELS WERE THIS HIGH
15,000,000
YEARS AGO
MINIMUM TIME NEEDED TO RE-ABSORB ALL THIS CO2 FROM ATMOSPHERE
300,000
YEARS
see data for details
Sources: Carbon Tracker Initiative, International Energy Agency (IEA), Intergovernmental Panel on Climate Change 2007, NASA, National Oceanic and Atmospheric Administration (NOAA), National Research Council, Potsdam Institute for Climate Impact Research, World Bank, European Commission Joint Research Centre, our own calcs
Studies & Books: Diffenbaugh et al 2007, Lynas 'Six Degrees' 2007, Maslowski et al 2012, Robinson et al 2012, Stern Review, Tyndall et al 2007, Vermeer and Rahmstorf 2009
All data and workings: bit.ly/CO2gigatons
Concept & Design: David McCandless // v1.1// Dec 2012
Research: Miriam Quick, Ella Hollowood
Additional design: Kathryn Ariel Kay, Paulo Estriga
InformationIsBeautiful.net

To avoid environmental destruction and human suffering, it is critical that climate change be curtailed. We now turn our attention to specific processes of the fossil fuel industry.

V. Specifics of the Fossil Fuel Industry

No two fossil fuel companies are the same; similarly, not all fossil fuels are equally harmful. For example, while coal is a less-used fossil fuel, it releases more carbon dioxide per unit of energy than many other fuels, and has additional deleterious localized environmental impacts such as ash deposits and airborne mercury poisoning.[88] Moreover, the methods of extraction vary amongst fossil fuels, some more injurious than others. This section is intended to be a brief overview of the environmental impact of varying methods in the industry. It is not intended to be fully comprehensive.

a. Industry Trends: Unconventional Futures

All energy analysts today who study the fossil fuel industry agree on one certainty: the current trajectory of the energy industry is towards 'unconventional' fuels.

Although the U.S. Department of Energy has yet to strictly define the term 'unconventional fuel,'[89] the term typically refers to oil or gas extracted from geologic formations which differ from conventional oil and gas wells.[90] Conventional oil and gas are extracted from underground reservoirs which hold trapped mineral deposits. Within these deposits, the less dense natural gas

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[88] Anthony Carpi, "Mercury from Combustion Sources: A Review of the Chemical Species Emitted and their Transport in the Atmosphere," *Water, Air, and Soil Pollution* 98, no. 3-4 (1997), 241-254.
[89] Deborah Gordon, *The Carnegie Papers: Understanding Unconventional Oil*. The Carnegie Endowment for International Peace, May 2012. http://www.carnegieendowment.org/files/unconventional_oil.pdf
[90] Gene Whitney, et al., *U.S. Fossil Fuel Resources: Terminology, Reporting, and Summary*. Congressional Research Service, November 30, 2012. p.6
http://epw.senate.gov/public/index.cfm?FuseAction=Files.view&FileStore_id=04212e22-c1b3-41f2-b0ba-0da5eaead952

and oil separate from water and other surrounding liquids. Unconventionals, however, cannot be recovered simply through drilling and pumping. Rather, they are extracted from lower-density formations that absorb oil and gas, such as tar sands and shale rock. To extract the oil and gas, one has to heat and pulverize these low-density formations through a variety of intensive processes. The resulting product is often of lower quality.[91] Oil shale and oil sands are two of the most important unconventional reserves.

Oil shale is rock that traps oil or natural gas. To remove the trapped fossil fuels, the shale is heated and fractured. Oil sands, or "tar sands," are oil deposits within a sandstone formation. Oil recovery from oil sands requires energy-intensive methods such as stream flooding, extreme heating, and excavation.[92] The technical difficulty of extracting unconventional reserves has historically prevented the fossil fuel industry from fully exploiting them. Within the last ten years, however, fossil fuel companies have been able to tap unconventional reserves on an increasingly large scale; most growth in the fossil fuel industry is now projected to come from these reserves. [93] [94] [95] [96] [97] [98]

Unconventionals are projected to become economically viable because of increasing demand, new extraction technology, and declining production of conventionals. Figure 11, from the W*orld Energy Report*, illustrates that conventional oil production peaked in 2005 and will likely

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[91] Ibid., 10.
[92] Ibid., 6.
[93] Robert Priddle, et al. *World Energy Outlook 2010*. International Energy Administration, 2010. http://www.iea.org/publications/freepublications/publication/weo2010-1.pdf
[94] Michael Toman, et al. *Unconventional Fossil-Based Fuels: Economic and Environmental Trade-Offs*. RAND: Environment, Energy, and Economic Development, 2008. http://bipartisanpolicy.org/sites/default/files/RAND_TR580.pdf
[95] G.M. Evans and S.H. Mohr, "Long Term Prediction of Unconventional Oil Production." *Energy Policy*, Vol. 38, 1, January 2010, 265-276. http://dx.doi.org/10.1016/j.enpol.2009.09.015
[96] Task Force on Strategic Unconventional Fuels, *Development of America's Strategic Unconventional Fuel Resources*. September 2006. http://fossil.energy.gov/programs/reserves/npr/publications/sec369h_report_epact.pdf
[97] Anu K. Mittal. "Unconventional Oil and Gas Production: Opportunities and Challenges of Oil Shale Development." *GAO Reports* 1, May 10, 2012.
[98] 2011. "Oil Outlook: Enter Unconventional Liquids?." *Bernstein Black Book - North American E&Ps: Manifest Destiny & The Unconventional Resource* 95-102. *Business Source Complete*, EBSCO*host* (accessed 28 Feb. 2013).

decline further.

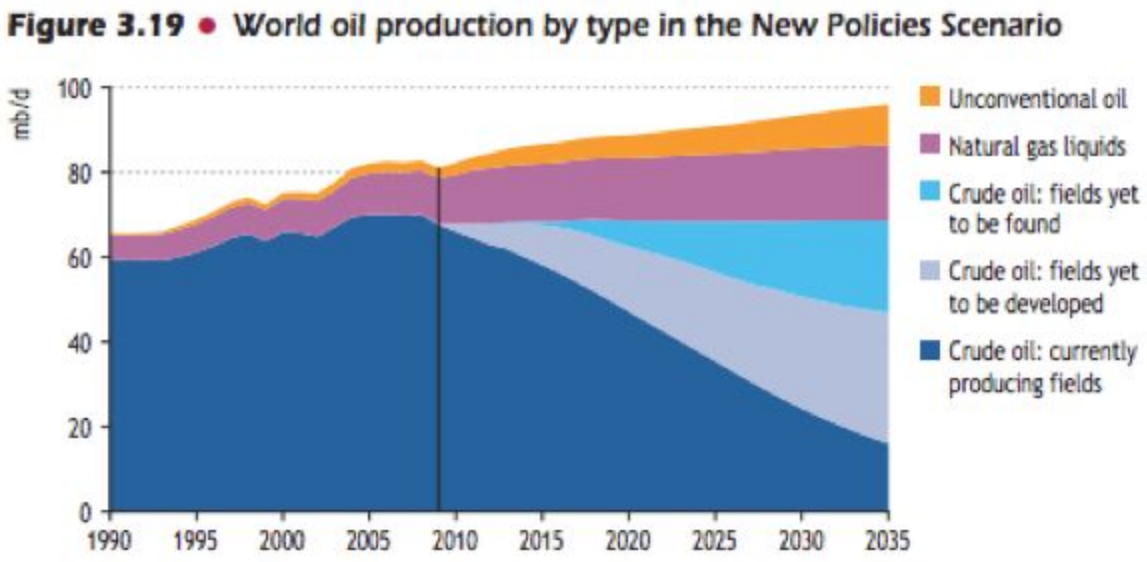

Figure 11: Graph showing types of current and future oil produced under a feasible policy scenario[99]

Yale Professor Michael Oristaglio was formerly employed in the fuel industry. The following slide is taken from a course he taught on the fossil fuel transition. It compares reserves of conventional oil with unconventionals.

[99] Priddle, et al.

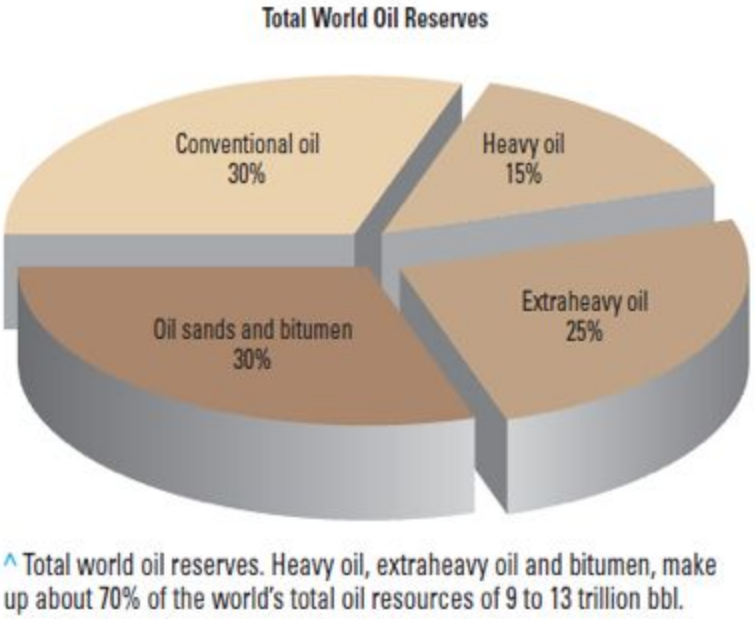

Figure 12: Graph shows percentages of world oil reserves by type[100]

Unconventional fuel production is even more carbon-intensive than traditional methods of extraction, and the carbon content of heavy oil far exceeds that of conventional fuel. Moreover, the new sources of oil will, by increasing supply of fossil fuels, reduce pressure on the energy market to innovate in low-carbon technologies. Therefore, unconventionals forestall development of environmentally friendly fuel sources.

This *Science* magazine graphic below demonstrates the drastic disparity in carbon emissions among current energy sources. This chart does not include additional greenhouse gas emissions from methane and other pollutants. The low impacts of renewables relative to conventional fossil fuel extraction methods highlight the importance of a shift from fossil fuel technologies to other energy technologies to effectively reduce emissions while still meeting the world's energy needs. This chart does not show the unconventional fossil fuel sources, which have carbon emissions that weigh in at multiple times higher than the highest carbon dioxide contributors on this chart,

[100] Lecture slide from Michael Oristaglio, "Geology and Geophysics 274a: Fossil Fuels and Energy Transitions" (Lecture 30). Yale University.

coal and oil.

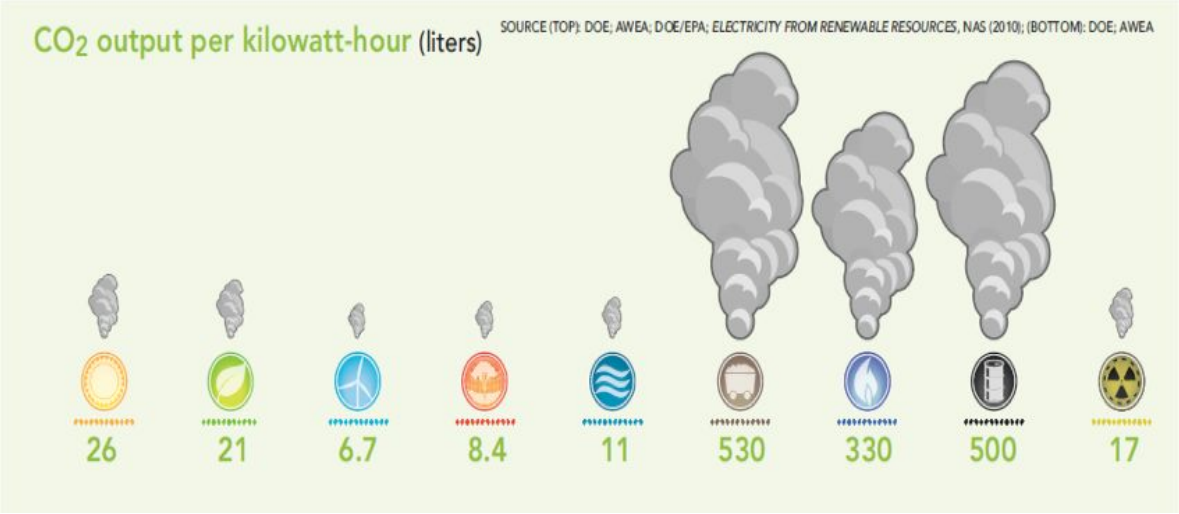

Figure 13: Chart shows carbon intensity of different energy types[101]

b. Mountaintop Removal

Mountaintop removal mining (MTR) is a procedure common in the Appalachian region of the United States which has profound negative impacts on local ecology and human health. It entails the deforestation and removal by explosives of up to 400 vertical feet of soil from the summit of a mountain to allow surface access to entire seams of coal. After the coal is extracted, displaced soil is either returned to the ridge to in an attempt to mimic the mountain's original contours, or dumped as waste in an adjacent valley (this is known as a "valley fill"). MTR sites can cover up to 10 square miles and require valley fills that are up to 1,000 feet wide and one mile long.[102] The total area despoiled by MTR so far is well over 2,000 mi.^{2}.[103]

Southern Appalachian forests have globally significant biodiversity,[104] and the adverse effects of

[101] Adrian Cho, "Energy's Tricky Tradeoffs." *Science* Vol. 329, 5993, 13 August 2010. http://www.sciencemag.org/content/329/5993/786.full.pdf
[102] Natural Resources Defense Council, "Moving Mountains for Dirty Coal." http://www.nrdc.org/energy/coal/mtr/about.asp
[103] Mountaintop Mining/Valley Fills in Appalachia: Final Programmatic Environmental Impact Statement, Environmental Protection Agency,[2005]).
[104] Emily S. Bernhardt and Margaret A. Palmer, "The environmental costs of mountaintop mining valley fill

MTR on regional biodiversity are well-documented.[105] MTR requires the destruction of forests and streams in the mining and valley fill sites. The procedure also releases toxins from the mining activity, including mercury, lead, arsenic, and selenium, into local ecosystems. These contaminants, in aggregate, cause "substantial reduction in water quality and biological integrity in streams and rivers below mine sites"[106] Though federal regulations require that coal companies revegetate MTR sites, attempts to reclaim previous biodiversity have been consistently unsuccessful.[107]

Figure 14: MTR in Mud River, WV has devastated local ecosystems[108]

Mercury, lead, arsenic, and selenium are all also toxic to humans. When these chemicals are released through MTR, they can enter wells and render tap water unsafe.[109] Children born near MTR sites are 42% more likely to have birth defects and are 50% more likely to die of cancer

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operations for aquatic ecosystems of the Central Appalachians," *Annals of the New York Academy of Sciences* 1223 (2011), 39. http://palmerlab.umd.edu/Bernhard_and_Palmer_2011.pdf

[105] Ibid.

[106] Ibid., 52.

[107] Ibid., 53.

[108] Zaid Jilani, "Paul On Mountaintop Removal: 'I Don't Think Anyone's Going To Be Missing A Hill Or Two Here And There.'" June 13, 2010. http://thinkprogress.org/politics/2010/06/13/102235/rand-paul-mountaintop/?mobile=nc

[109] Antrim Caskey, "What Happens When You Blow Up a Mountain?" *Slate*, Nov. 30, 2012. http://www.slate.com/articles/health_and_science/coal/2012/11/mountaintop_removal_photos_antrim_caskey_award_winning_photographer_of_appalachian.html

than children born elsewhere.[110] The explosives used to destroy mountain summits are made from a mix of diesel fuel and ammonia nitrate. This compound can rain down on communities in the form of toxic dust, and has been linked to increase incidence of liver and kidney disease, and pulmonary heart disease.[111]

c. Hydraulic Fracturing, or 'Fracking'

Hydraulic fracturing is a method of extracting natural gas from shale located deep underground. It entails drilling vertically into the desired layer of shale, then horizontally, with multiple fingers branching outwards, to fissure, or fracture, the surrounding rock and release the methane gas. Some new studies find that like MTR, fracking often allows toxic chemicals—both those used in the drilling process and those released by it—to seep into nearby drinking water supplies.[112] Pollution caused by fracking has been linked to health problems in communities near gas fields, including respiratory infections, headaches, neurological impairment, nausea and skin rashes, and more rarely, more serious effects, including miscarriages, tumors, benzene poisoning, and cancer.[113]

Advocates of hydraulic fracturing claim that natural gas produces a lower carbon footprint relative to other fossil fuels.[114] This claim, however, is currently coming into extreme scrutiny, with some members of the scientific community now finding that overall greenhouse gas emissions from hydraulic fracturing of natural gas are many times higher than emissions from coal. Though natural gas extracted through conventional methods may produce fewer carbon

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[110] Ahern M, Hendryx M. (In Press) "Cancer mortality rates in Appalachian mountaintop mining areas."
[111] Antrim Caskey, "What Happens When You Blow Up a Mountain?" *Slate*, Nov. 30, 2012. http://www.slate.com/articles/health_and_science/coal/2012/11/mountaintop_removal_photos_antrim_caskey_award_winning_photographer_of_appalachian.html
[112] Abrahm Lustgarten, "New Study: Fluids from Marcellus Shale Likely Seeping into PA Drinking Water." *ProPublica*, July 9, 2012. http://www.propublica.org/article/new-study-fluids-from-marcellus-shale-likely-seeping-into-pa-drinking-water
[113] Abrahm Lustgarten and Nicholas Kusnetz, "Science Lags as Health Problems Emerge Near Gas Fields." *ProPublica*, September 16, 2011. http://www.propublica.org/article/science-lags-as-health-problems-emerge-near-gas-fields
[114] Aubrey McClendon, "Natural Gas: Fueling America's Future." Chesapeake Energy. http://www.chk.com/naturalgas/pages/fueling-americas-future.aspx

dioxide emissions than oil or coal combustion, leaked natural gas may be provide other pollutants that are much more potent greenhouse gases than carbon dioxide. Hydrofracking wellheads leak methane to some degree. The methane (CH_4) released in extracting natural gas has a far greater greenhouse potential than the CO_2 emitted by the combustion of coal or oil: according to the IPCC, CH_4 has 72 times the warming potential of CO_2 over a 20-year span.[115] Given that global warming potential ratio, small leakage rates of methane through hydrofracking can result in comparatively more emissions than coal or oil combustion.

According to recent studies of the current rates of methane leakage in hydrofracking fields, Yale Professor of Atmospheric Chemistry Nadine Unger underscores that "natural gas is not any better for the climate than coal; it is better for air quality, but not for global warming."[116] A 2012 Cornell study found that the GHG footprint of shale gas is no smaller than that of oil or gas at the century time scale; at the particularly critical decadal time scales, it is much greater.[117] The authors of that paper noted that when considering shale gas, "the decadal scale is critical, given the urgent need to avoid climate-system tipping points," concluding that, "the large GHG footprint of shale gas undercuts the logic of its use as a bridging fuel over coming decades, if the goal is to reduce global warming."[118]

Figure 15: Drinking water can become flammable due to the toxins released by fracking[119]

[115] IPCC, "Climate Change 2007: Working Group I: The Physical Science Basis: Direct Global Warming Potentials." http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
[116] Nadine Unger, "Yale University Forum Debates Natural Gas Boom's Impact on Climate Change" (New Haven, CT, Between the Lines, March 27, 2013).
[117] Robert W. Howarth, et al., "Venting and leaking of methane from shale gas development: response to Cathles et al. http://www.eeb.cornell.edu/howarth/Howarthetal2012_Final.pdf
[118] Ibid.
[119] Fox, J. "Gasland." (2010)

The precise scale of the impact of fracking on climate change is still a matter of scientific debate, and one that is rapidly advancing. These new findings bear consideration and encourage caution against embracing shale gas as a sustainable alternative solution. Regardless of the impact of shale gas, many of the largest companies on the Carbon Tracker 200 list are not engaged in the shale gas business.

d. Oil Sands (Tar Sands)

Oil sands are a mixture of sand, clay, water, and bitumen, a dense and extremely viscous form of petroleum. The process for extracting petroleum from oil sands is more carbon-intensive than simple oil drilling: to produce useable oil, one must steam-heat the sands to produce a petroleum slurry, and further dilute that product.[120] The result is that "well-to-wheel" greenhouse gas emissions of oil sands are 14-40% higher, and "well-to-refinery" emissions up to three times higher than those from conventional oil production and use.[121] Oil sands are most commonly found in Alberta, Canada, under boreal forests, almost 1,000,000 acres of which will have to be destroyed (in total) to meet Canada's oil production targets, eradicating many species that the depend on the forests.[122] [123] The forests themselves—when left intact—have a climate change mitigating function as carbon reservoirs.[124]

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[120] New York Times Editorial Board, "Tar Sands and the Carbon Numbers." *New York Times*, August 21, 2011. http://www.nytimes.com/2011/08/22/opinion/tar-sands-and-the-carbon-numbers.html?_r=0

[121] The Co-operative Financial Services and World Wildlife Fund United Kingdom, "Carbon Capture and Storage in the Alberta Oil Sands—A Dangerous Myth," October 26, 2009, 1. http://assets.wwf.org.uk/downloads/carbon_capture_report.pdf

[122] The New York Times Editorial Board.

[123] Alberta Government, "Alberta's Oil Sands: Reclamation." http://www.oilsands.alberta.ca/reclamation.html

[124] Natural Resources Defense Council, "Fuel Facts: Say No to Tar Sands Pipeline: Proposed Keystone XL Project Would Deliver Dirty Fuel at a High Cost. http://www.nrdc.org/land/files/TarSandsPipeline4pgr.pdf

Figure 16: An oil sands site in Alberta, Canada. Oil sands sites release toxins that can seep into drinking water.[125]

Like MTR and fracking, the extraction of oil sands threatens human health near industrial sites, by releasing toxic pollutants into drinking water supplies. One study found that the Athabasca River, in Alberta, had been severely tainted with 13 elements considered priority pollutants (PPE) under the U.S. Clean Water Act.[126] This pollution has a particularly severe effect on the aboriginal peoples of Canada living near oil sands, who have suffered from rare cancers since the start of extraction activities.[127]

A Co-operative Financial Services/World Wildlife Fund joint report found that Carbon Capture and Storage methods (CCS), though touted as a means of reducing the climate impact of oil sands, will be ineffectual in that context, and "will not enable oil sands products to meet emerging international low carbon fuel standards or enable Canada to meet its international

[125] Lenz, Garth. "Tar Pit Alberta Tar Sands," Cornell iGEM, 2010 http://2012.igem.org/wiki/images/3/30/Oil_Sands_Photo_3.jpeg

[126] David W. Schindler et. al, "Oil Sands Development Contributes Elements Toxic at Low Concentrations to the Athabasca River and its Tributaries," Proceedings of the National Academy of Sciences vol. 107, no. 37, (August 30, 2010), 16178-16183, http://www.pnas.org/content/107/37/16178.full.pdf.

[127] World Wildlife Fund, "Oil Sands." http://www.wwf.org.uk/what_we_do/changing_the_way_we_live/oilsands.cfm

climate change commitments."[128]

Figure 17: Oil sands operations require the destruction of hundreds of thousands of acres of pristine boreal forests.[129]

d. Oil Shale

Oil shale refers to any sedimentary rock that can form synthetic petroleum through exposure to extreme heat, in a process called "retorting." Extraction of petroleum is more difficult from oil shale than from conventional sources, because the shale itself must be mined as solid rock before retorsion, which allows the oil to be separated and collected.[130]

As a 2005 study by the RAND Corporation estimates, a 1200-megawatt power plant is required

[128] The Co-operative Financial Services and the World Wildlife Fund United Kingdom, "Unconventional Oil: Scraping the Bottom of the Barrel?" 1. assets.panda.org/downloads/unconventional_**oil**_final_**low**res.pdf
[129] *Destruction of Boreal Forest Near Athabasca Oil Sands, Canada - September 8th, 2010* (Earth Snapshot: Earth Snapshot, 2010).
[130] Sierra Club, "Dirty Fuels: Oil Shale." http://www.sierraclub.org/dirtyfuels/oil-shale/

to unlock just 100,000 barrels of shale oil a day (less than 1 percent of our total oil demand).[131] Such a power plant could serve half a million people by itself, and would burn 5 million tons of coal each year, releasing 10 million tons of carbon dioxide equivalents."[132] Extracting one million barrels of shale oil per day would require the support of 20 typical coal-fired plants.[133] Coal-fired power plants are well known to cause health problems such as heart attacks and asthma in the surrounding area."[134]

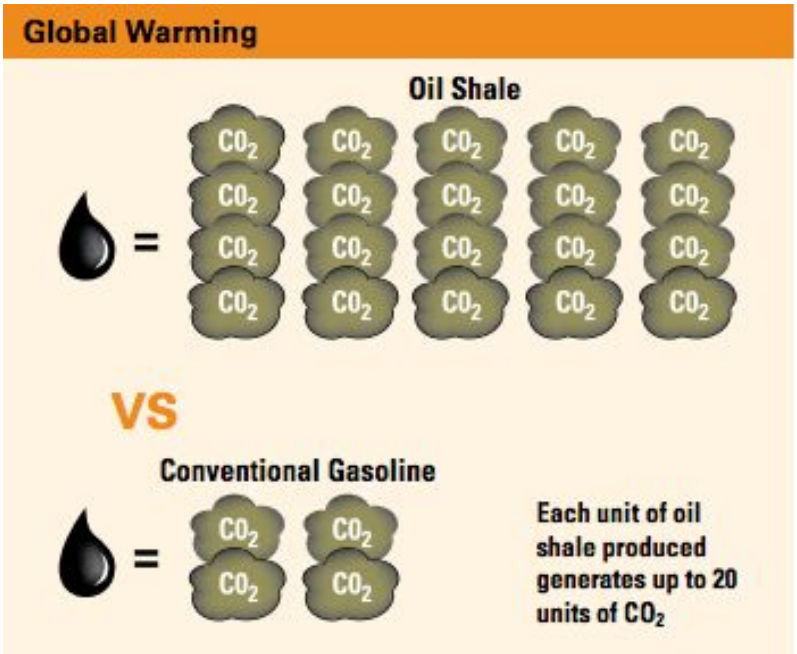

Figure 18: The Natural Resources Defense Council estimates that the production and consumption of fuel from oil shale as *five times* the climate impact of that of already-unsustainable conventional petroleum.[135]

Additionally, The Bureau of Land Management predicts that a viable oil shale industry would use upwards of 200 million gallons of water daily.[136] Oil shale extraction activities would

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[131] Michael Toman, et al. *Unconventional Fossil-Based Fuels: Economic and Environmental Trade-Offs*. RAND: Environment, Energy, and Economic Development, 2008. http://bipartisanpolicy.org/sites/default/files/RAND_TR580.pdf

[132] Parag Chokshi and Elizabeth Heyd (Natural Resources Defense Council), "Controversial Oil Substitutes Sharply Increase Emissions, Devour Landscapes," June 11, 2007. http://www.nrdc.org/media/2007/070611.asp

[133] Ibid.

[134] Natural Resources Defense Council, "Oil Shale by the Numbers; Dirty Fuels Won't Solve America's Energy Crisis." http://www.nrdc.org/energy/numbers.pdf

[135] Ibid.

[136] Bureau of Land Management, "Draft Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah, and Wyoming and Programmatic Environmental Impact

therefore threaten communities in arid Colorado, Wyoming, and Utah—the states that house the Green River Formation, which contains most available oil shale. As with other unconventional fossil fuels, oil shale threatens wildlife and local communities by producing mining runoff. Similar problems may result from the toxic waste produced by retorting.[137]

Because of its astronomical climate impact, Jim Hansen, head of the NASA Goddard Institute for Space Studies and Adjunct Professor of Earth and Environmental Sciences at Columbia University's Earth Institute, has said of oil shale, "squeezing oil from shale mountains is not an option that would allow our planet and its inhabitants to survive."[138]

V. Yale University

a. Socially Responsible Investing at Yale

Yale University has a history of socially responsible investing. In 1972, three members of the Yale community wrote *The Ethical Investor: Universities and Corporate Responsibility*, a book which centers around the social consequences of the endowment returns of universities and provides moral guidelines for these investments.[139] Yale University subsequently adopted these principles to become "the first major university to resolve this issue by abandoning the role of passive institutional investor."[140] From 1978 to 1994, the rules set by *The Ethical Investor* led Yale University to divest from 17 companies operating in Apartheid South Africa and in the 1990s, the Yale Corporation instructed the Advisory Committee on Investor Responsibility to vote in favor of certain restrictions on the tobacco industry.[141] In 2006, Yale University divested

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Statement," Vol. 2, Chapter 4.5, December 21, 2007.

[137]"Dirty Fuels: Oil Shale." Sierra Club, http://www.sierraclub.org/dirtyfuels/oil-shale/ (accessed 7 Mar. 2013).

[138]"Oil Sands."World Wildlife Fund, http://www.wwf.org.uk/what_we_do/changing_the_way_we_live/oilsands.cfm

[139] Yale Advisory Committee On Investor Responsibility, "Committee History And Mission." http://acir.yale.edu/policies_and_past_actions.html (accessed March 7, 2013).

[140] Ibid.

[141] Yale Advisory Committee On Investor Responsibility, "Policies And Past Actions." http://acir.yale.edu/policies_and_past_actions.html (accessed March 7, 2013).

from seven companies operating in Sudan and supporting the country as the government perpetrated a genocide in the Darfur region.[142]

While *The Ethical Investor* lays out a set of guidelines and scenarios for making decisions regarding responsible investment, it also explicates that every company in the endowment need not match Yale's ideals as a university. Furthermore, *The Ethical Investor* stresses that companies should not be punished simply for being in Yale's portfolio. The principle behind *The Ethical Investor* contains a "moral minimum" obligation. It is impossible for a university to act on every social wrong but it should work to "avoid and correct self-caused social injury." [143]

b. Environmental Responsibility at Yale

Yale University champions environmental responsibility. The university's 2010-2013 "Sustainability Strategic Plan" states its vision as a sustainability leader.[144] The institution takes pride in its LEED certified buildings, its Office of Sustainability, and its commitment to reduce its greenhouse gas emissions by 43% below 2005 levels by 2020.[145] As President Richard Levin writes in the Strategic Plan:

> "We hope to instill in our students, staff, and faculty a full understanding of what it means to be a part of a sustainable tomorrow. I look forward to having the entire Yale community join me as we work to create such a sustainable environment."[146]

The President continued in the 2012 Yale Baccalaureate Address:

> "How do we prevent the continued consumption of fossil fuels from warming our planet to the point that ecosystems are destroyed, food supplies are threatened, and rising sea

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[142] Ibid.
[143] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 21
[144] Yale University Sustainability Task Force, "Sustainability Strategic Plan 2010-2013." September 2010. http://sustainability.yale.edu/sustainability-strategic-plan-0. 2012
[145] Ibid., 1.
[146] Ibid.

levels force hundreds of millions to relocate?"[147]

This is a difficult but critical question, one this report explores and attempts to answer. To prevent the consumption of fossil fuels, we must create the same economic incentives which motivate the profits of the fossil fuel industry, in order to encourage the consumption of renewable resources instead of harmful fuels. The University's investments in the fossil fuel industry which directly support fossil fuel consumption directly contradict Yale's commitment to a sustainable future.

VI. The Kew Gardens Principle

The guidelines of the *Ethical Investor* focus on the Kew Gardens Principles. Now a base of common institutional investor practices, *The Ethical Investor* uses the Kew Gardens Principles to determine when shareholder action is required by the university.

We will apply the Kew Gardens Principle as detailed in *The Ethical Investor* to the fossil fuel industry. This Principle includes four key criteria: need, proximity, capability, and last resort. **Need** in this context means a need for action; there must be some harm which calls for redress, and "increased need increases responsibility."[148] The level of grave social harm caused by climate change, detailed in sections II. through V., supplies a need for urgent action. To establish **proximity**, we determine whether this problem is close to the University. Proximity is not limited to the geographic definition - the injury is considered near to the University if the students and faculty are aware of and affected by it. Given the prominence of Yale's institutional

[147] Levin, Richard. Yale Baccalaureate Address. May 19-20, 2012. "Taking Responsibility." Text found on Huffington Post College Blog.
[148] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 23

commitment to a sustainable campus and the production of world-class research, Yale is most certainly aware of the issue. **Capability** is the ability of the institution to act: if it is demonstrated that the institution can act to solve the problem without inducing significant self-harm, it should do so unless there are other ways to remedy the social injury. When other methods have been exhausted, are unavailable, or are insufficient, divestment becomes necessary. *The Ethical Investor* makes an important comment about the principle of **last resort**; divestment is not only the last resort of the university, but the university's action should also be the last resort in solving the problem. Here, *The Ethical Investor* explains why Yale is the last resort: "the guilt of all becomes the guilt of no one. This result is unacceptable. We may not be able to avoid the world's guilt, but we can seek to reduce the level of injury."[149] This quote is all too appropriate for our current predicament. Because we all contribute to global warming in some way, Yale, just like all other members of the world, is responsible for reducing the effects of climate change since action to regulate the negative externalities produced by the fossil fuel industry is thus far inadequate.

If fossil fuel driven climate change is causing grave social injury (need), Yale is aware of it (proximity), is capable of acting on it through its endowment (capability), and other actions that might be taken have failed or are not available (last resort), then Yale has an ethical obligation to divest.

A. Need

We have demonstrated need for intervention in the Section III (the Extraction and Burning of Fossil Fuels Leads to Climate Change) and Section IV (the Social Harms Caused by Fossil Fuels Create the Need for Action) of this report. In simplified form: the fossil fuel industry emits greenhouse gases, these gases cause global temperature increases which will have adverse ramifications on agriculture, sea levels, weather patterns, human health, and ocean life, thereby causing grave social injury.

[149] Ibid., 26.

B. Proximity

The Ethical Investor states that "When we become aware of a wrongdoing or a social injury we take on obligations that we did not have while ignorant."[150] The faculty, staff, students, alumni, and other members of the Yale community are aware of and concerned about climate change. President Levin affirmed this in a 2007 interview when he stated that:

> Universities are a natural place to demonstrate that global warming can be resisted and its adverse long-term consequences avoided. It is, after all, our scientists who have identified the causes and effects of climate change and who are researching ways to address it. And it is our students who, in the coming decades, will have the responsibility for ensuring that the opportunities for the health and prosperity of future generations will be no less abundant than they have been for the generations that preceded them.[151]

Hurricanes Irene and Sandy are emblematic of the increased likelihood of extreme weather events--some of which will be close geographically and economically to the operations of the University--caused by a rise in global temperature. The *The Ethical Investor* continues that "We expect a man to be more alert to the plight of his next-door neighbor than to the needs of a child in East Pakistan."[152] Climate change is a worldwide problem as well as an increasingly salient local problem. Yale is not only ignoring the needs of its neighbors but is neglecting its own needs if it does not reconsider its investments in fossil fuels. In the context of proximity, Yale must recognize the immediate need to cease supporting the fossil fuel companies that cause climate change.

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[150] Ibid., 23.

[151] Richard Levin, interview by Jeff McIntyre, "The TH Interview: Richard C. Levin, President of Yale University," Record, 03 01, 2007. http://www.treehugger.com/culture/the-th-interview-richard-c-levin-president-of-yale-university.html.

[152] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 24

C. Capability

The Ethical Investor states in regards to capability that "if the university is able, by non self-sacrificial means, to mitigate injury caused by a company of which it is an owner, it would not seem unreasonable to ask it to do so."[153]

While it is likely that a portion of Yale's endowment is invested in fossil fuels, it may not be likely that these investments are so crucial to Yale's operations that reconsidering them would materially affect Yale's future.

Any fiduciary has two main factors to consider in investments: risk and return. The Aperio Group, LLC, an index-based investment firm, conducted a study in January 2013 using the Russell 3000 index (the index of the 3000 largest businesses in the United States, representing 98% of the whole US market).[154] In the Russell 3000, 9.90% of companies are in the energy sector,[155] which is roughly consistent with world indices as well: the energy sector comprises 9.73% of the MSCI World Index[156] and 11.0% of the S&P Global 1200 Index.[157] In 2012, Yale's Endowment portfolio included a reported 5.8% of assets in "Domestic Equity," and 7.8% of assets in "Foreign Equity," which combine to a total of 13.6% of the Yale Endowment.[158] If one reasons that roughly one tenth of Yale's equity investments are with the energy sector writ large (10% of 13.6% would make 1.36%), Yale's stake in fossil fuel company equity as a percentage of total investments would be far less than the 9.90% figure used by The Aperio Group to calculate risk of divestment. Though we cannot crunch specific numbers without access to more specific data for Yale's endowment, the Aperio report's analysis strongly suggests that investors

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[153] Ibid., 24.
[154] "Vanguard Russelll 3000 ETF."The Vanguard Group, Inc., https://personal.vanguard.com/us/funds/snapshot?FundId=3354&FundIntExt=INT
[155] Ibid.
[156] MSCI, "MSCI World Index Fact Sheet," http://www.msci.com/resources/factsheets/index_fact_sheet/msci-world-index.pdf
[157] S&P Dow Jones Indices, "S&P Global 1200 Equity Indices," http://us.spindices.com/documents/factsheets/fs-sp-global-1200-ltr.pdf
[158] Yale University Investments Office, 2012 The Yale Endowment http://investments.yale.edu/images/documents/Yale_Endowment_12.pdf (accessed March 7, 2013)

would be financially capable of divesting from a significant portion of fossil fuel equity, and may overstate risk when considered in light of Yale's total endowment portfolio.

i. Risk

The first question in evaluating investment policy is risk. Compared with analysis of future returns, risk is much more readily calculable.

Analysis of the risk of removing fossil fuel stocks from a portfolio reveals that the risk "can be so minor as to be virtually irrelevant."[159] One way that Aperio looks at this is by using a multi-factor computer model to estimate tracking error of screened portfolios versus the Russell 3000 (they used the Aegis model from the company Barra).[160] For a portfolio screened for the "Filthy Fifteen," a list of fifteen companies with reprehensible environmental impacts, the Aperio Group concludes (Table 1):

	Standard Deviation	Variance = (Std. Dev.)^2	Theoretical Return Penalty
Market Risk (Russell 3000)	17.9500%	3.2220%	
Tracking Error vs. R3000	0.1400%	0.0002%	
Screened Portfolio	17.9505%	3.2222%	
Incremental Risk	0.0005%		0.0002%

Source: Barra Aegis and Aperio Group

Table 1

As shown (Table 1), tracking error from screening those "Filthy Fifteen" companies is 0.14%. Aperio Group demonstrates that "adding 0.14% of tracking error increases absolute portfolio risk by only 0.0005%, or about a half of one one-thousandth of a percent. In other words, the portfolio does become riskier, but by such a trivial amount that the impact is statistically irrelevant. In other words, excluding the Filthy Fifteen has no real impact on risk."[161]

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[159] Patrick Geddes, "Do the Investment Math: Building a Carbon-Free Portfolio," *Aperio Group, LLC*, http://www.aperiogroup.com/system/files/documents/building_a_carbon_free_portfolio.pdf
[160] Ibid.
[161] Ibid.

For a more comprehensive screen than just excluding the "Filthy Fifteen," the Aperio report also analyzed the risk from divestiture from the full Oil, Gas & Consumable Fuels industry (as per the Global Industry Classification Standards). They found that such an approach added 0.5978% tracking error (Table 2), which "increases absolute portfolio risk by 0.0101%" [162] which adds a theoretical return penalty of less than half of a basis point.[163] Responsible energy investment would not be guaranteed to have either a positive or negative return on investment.

Table 2: Impact of Tracking Error for Industry Exclusion

	Standard Deviation	Variance = (Std. Dev.)^2	Theoretical Return Penalty
Market Risk (Russell 3000)	17.6657%	3.1208%	
Tracking Error vs. R3000	0.5978%	0.0036%	
Screened Portfolio	17.6758%	3.1243%	
Incremental Risk	0.0101%		0.0034%

Source: Barra Aegis and Aperio Group. Numbers may not sum exactly due to rounding.

[162] Ibid.
[163] Ibid.

How Does TE Change with Different Screening?

Less Impact on Both Risk & Advocacy ⟷ More Impact on Both Risk & Advocacy

	No Env. Values in Portfolio	No Screening; Engagement & Proxies Only	Mild Negative Screens	Full Carbon Divestment	Full Carbon Divestment plus Positive Screens	Full Carbon Divestment; Include Energy Private Equity
Negative Screens	None	None	Limited, e.g. "Filthy Fifteen"	Exclude Main Carbon Industries	Exclude Main Carbon Industries	Exclude Main Carbon Industries
Positive Screens (Renewable Energy or Other Investments in Sustainable Industries)	None; renewable industries held at same weightings as public equity benchmarks	None; renewable industries held at same weightings as public equity benchmarks	None; renewable industries held at same weightings as public equity benchmarks	None; renewable industries held at same weightings as public equity benchmarks	Over-weight positive companies, but only public equities	Reinvest funds from divestment into both public and private equity
Focused Proxy Voting	None	Yes, if desired	Yes, if desired	Yes, if desired	Yes, if desired	Yes, if desired
Shareholder Engagement	None	Yes, if desired	Yes, if desired	Yes, if desired	Yes, if desired	Yes, if desired
Environmental Advocacy	None	Any positive impact from proxy voting or engagement	Any positive impact from proxy voting or engagement	Any positive impact from proxy voting or engagement	Proxy or engagement plus steering more public capital to impact firms	Proxy or engagement plus steering more public and private capital to impact firms
Impact on Portfolio Risk and Return	None	None	Extremely low tracking error, e.g. **0.14%**	Moderate tracking error, e.g. **0.60%**	Slightly higher tracking error, e.g. **0.91%**	Potentially more significant impact on risk from over-weighting

Aperio v. [Latin] to make clear, to reveal the truth 23

Figure 19: Shows the impact of certain company divestments on tracking error. The Fossil Free Yale Proposal, which suggests divestiture from a portion of the worst performing companies among the 200 largest carbon reserve holders, would present low risk to the Endowment portfolio - less than 0.6%

As we call upon the university to reevaluate investments in significant portion of fossil fuel corporations, we must be skeptical of any claims that fossil fuel divestment would destabilize a critical asset class of the endowment. In addition to mitigating the grave social injury caused by the fossil fuel industry, fossil fuel divestment is highly unlikely to acutely impact the financial stability of the endowment.

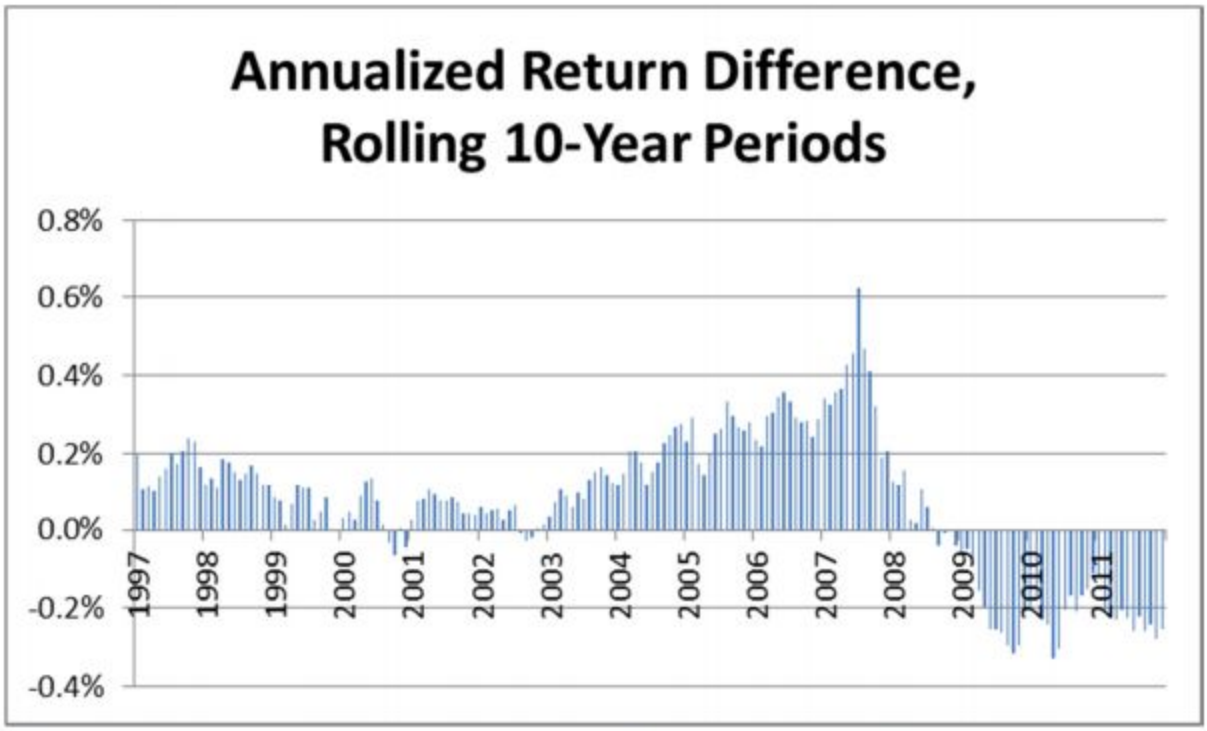
ii. Returns

The second most material issue in analyzing fiduciary performance is returns.

In response to the nationwide divestment movement, the American Petroleum Institute (API) in December 2012 released a report that sought to demonstrate the strength of oil and gas assets in providing returns for educational portfolios.[164] To the contrary, the Aperio report suggests that the API numbers may not be as potent as they suggest.

While investment professionals regard that past results are certainly no guarantee of future returns, the Aperio paper computed the returns for two indices - Russell 3000 with carbon investments and the Russell 3000 without carbon investments - in 10-year rolling periods from 1988 until 2012.

[164] Robert J. Shapiro and Nam D. Pham, *The Financial Returns from Oil and Natural Gas Company Stocks Held by American College and University Endowments,* Sonecon,[2012]).



Return numbers show annualized return difference between Full Carbon Divestment portfolio and Russell 3000 for periods from Jan 1988 to Dec 2012.

Average Annualized 10-year Return Difference	+0.08%
Percentage of Periods Higher than R3000	73%
Percentage of Periods Lower than R3000	27%
Tracking error, current forecast	0.60%
Tracking error, historical simulation	0.78%

Figure 20: The differences in theoretical returns between the Russell 3000 index and a carbon free portfolio[165]

The above graph illustrates that in the period discussed in the API report, the last ten years, the carbon inclusive index slightly outperformed the carbon free index, but that the carbon free index outperformed the full Russell 3000 on average over the longer time periods from 1988 to 2012 by 0.8%. Of note are the magnitudes of the numbers. Even in the years where the carbon inclusive index outperformed the carbon free index, the margin was around .3% difference per the graph, which is hardly material.

Aperio is not the only entity that links carbon divestment with low risk and neutral or

[165] Patrick Geddes, "Do the Investment Math: Building a Carbon-Free Portfolio," *Aperio Group, LLC*, http://www.aperiogroup.com/system/files/documents/building_a_carbon_free_portfolio.pdf

near-neutral return impacts. Acclaimed hedge fund investor, Tom Steyer ES '79, has argued to the trustees of Middlebury College that a carbon-free investment strategy will outperform the market.[166] As previously mentioned, the San Francisco Board of Supervisors was confident enough in the stability of a carbon-free investment tt unanimously vote to divest the $16 billion San Francisco Employee Retirement System from the full 200 companies listed by the Carbon Tracker Initiative report, representing the sale of $583 million in funds.[167]

Results similar to Aperio's have also been replicated using the S&P 500 index. Advisor Partners, a San Francisco-based socially responsible investment advisory, released a report in June that modeled comparisons of back-tested partially and fully divested S&P 500 portfolios. Even in a full divestment scenario, where the stocks of all major fossil fuel companies (comprising a full 15% of the index) were removed, standard deviation increased by only .22% and tracking error versus the S&P was +/-1.57%, a moderate increase in projected risk given the relatively large decrease in holdings. A twenty-two year return simulation from 1990-2012 showed similar return projections over the full-period between the S&P 500 and the fully divested portfolio, although there were stretches of both out-performance and underperformance in back-tested rolling three year returns.[168]

Furthermore, investments in the fossil fuel industry may be overvalued as they stand. The 2011 white paper, *Financial Risks of Coal Investments,* released by As You Sow, details the (1) unprecedented level of regulatory uncertainty, (2) commodity risk due to low natural gas and power prices and volatile and rising coal prices, and (3) increasing construction costs associated with the coal industry.[169] The *Economist* magazine recently ran a feature on the 'Unburnable Carbon' report raised by the Carbon Tracker Initiative, which suggests that current carbon-based fuel companies are experiencing a bubble that will become uneconomic as governments take

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[166] "Statement of Tom Steyer to the Middlebury College Board of Trustees." January 22,2013. http://middleburycampus.com/wp-content/uploads/2013/01/SteyerLetter.pdf.
[167] Suzanne Goldnberg, "San Francisco and Seattle Lead US Cities Pulling Funds from Fossil Fuel Firms," *The Guardian,* 25 April 2013.
[168] Dan Kern. "Fossil Fuel Free Portfolios: The Challenges and The Opportunity," Advisor Partners, 19 June 2013.
[169] Leslie Lowe, Tom Sanzillo. *Financial Risks Of Investments In Coal.* As You Sow, 2011.

action on climate change.[170] The Carbon Tracker Initiative report highlights the 200 companies with the greatest carbon reserves, as well as a more detailed analysis of the bubble characteristics of the fossil fuel market.[171] A January 13 HSBC report revealed similar findings to the Carbon Tracker Initiative, concluding that companies such as BP, Shell, and Statoil stand to lose up to 60% of value in the case of substantial government action.[172]

While it is not feasible for Fossil Free Yale students to precisely calculate risk or projected returns for the Yale endowment, the information available to us strongly suggests that divesting a portion of public equities representing the worst emitting companies in the industry would not be 'self-sacrificial' by the University.

iii. Impact

Yale has a uniquely responsible place in the fossil fuel divestment movement. Yale is in fact a pioneer of socially responsible investing, as the Ethical Investor was a "blueprint for the ethical policies of a number of universities"[173] and many other investors. Additionally, due to the prestige and respect associated with Yale's Investments Office and David Swenson, "The Yale Model" has an influence on its peer universities' investment policies. Though other universities, of course, will exercise their independent judgement regarding divestment, they will take Yale's actions into consideration. A similar argument applies to influencing some institutional investors; divestment will at least make them consider the full effects of investments in fossil fuels.

Yale University's reputation and the size of its endowment allows, and obligates, it to target this social injury by any appropriate means available. At this moment, when students, faculty, and affiliates at over 300 other colleges and universities are encouraging their institutions to

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[170] "Unburnable Fuel: Either Governments are Not Serious about Climate Change Or Fossil-Fuel Firms are Overvalued." *The Economist,* May 4 2013, b, .

[171] The Carbon Tracker Initiative, "Unburnable Carbon." August 2012. http://www.carbontracker.org/wp-content/uploads/downloads/2012/08/Unburnable-Carbon-Full.pdf

[172] HSBC, "Oil and Carbon Revisited: Value at Risk from 'Unburnable Reserves,' 25 January 2013, http://gofossilfree.org/files/2013/02/HSBCOilJan13.pdf

[173] John G. Simon, "Ethical Investing Policy," Yale Law School, http://www.law.yale.edu/documents/pdf/cbl/Simon_Yale_Endowment.pdf (2013).

reconsider their investments in fossil fuels, Yale's actions could and should have a uniquely powerful national impact, especially considering the fact that Yale's endowment of approximately 20 billion dollars amounts to about one twentieth of all U.S. university endowment money.[174][175]

Although it may be impossible to quantify the true effect of fossil fuel divestment, empirical evidence provides some indication of the impact. Divestment can precipitate desired business practices and legislative policy to further address social harm. Investors may adopt negative screens, and businesses may take steps to diversify business practices away from the socially stigmatized fields.[176]

Divestiture campaigns cause some impacts on business practices. When certain industries lose a "social license" for operation, they will "dilute" their stigma by expanding to other business models. For example, studies have credited advocacy campaigns with Philip Morris' (a tobacco company) decision to expand into food and beverages, which diluted its negative stigma through recognition across more brands.[177] To address their stigma, fossil fuel companies could expand business into alternative energy sources.

The success of divestiture campaigns in attracting public opinion has been an effective strategy for inducing legislation to redress the social harms. In fact, a recent Oxford study (October 2013) that analyzed the impacts of divestment campaigns historically, concluded that:

> "In almost every divestment campaign we reviewed from adult services to Darfur, from tobacco to South Africa, divestment campaigns were successful in lobbying for restrictive legislation. For example, increasing

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[174] Yale University Investments Office "The Yale Investments Office" http://investments.yale.edu. (accessed 11 Mar. 2013).
[175] United States Accountability Office, *College And University Endowments Have Shown Long-Term Growth, While Size, Restrictions, And Distributions Vary, 2010* (Washington, DC: GAO-10-393).
[176] Atif Ansar, Ben Caldecot, James Tilbury, *Stranded Assets and the Fossil Fuel Divestment Campaign: What does Divestment Mean for the Valuation of Fossil Fuel Assets?* (Oxford: Stranded Assets Programme, 2013) http://www.smithschool.ox.ac.uk/research/stranded-assets/SAP-divestment-report-final.pdf, page 71
[177] Ibid., page 66

> awareness about the health risks of smoking and the stigmatisation of the tobacco industry led to several rounds of restrictive legislation beginning with the 1969 Public Health Cigarette Smoking Act and progressing to state-led litigation."[178]

The nationwide campaign to divest from companies operating in apartheid South Africa is widely credited with helping to direct public attention toward the social harms of apartheid, and influencing the passage of the Comprehensive Anti-Apartheid Act of 1986, which imposed sanctions on South Africa by restricting U.S. exports and loans. Stigmatization of alcohol and tobacco as 'sin stocks' resulted in higher taxes to depress demand.

Five schools have already divested their endowments. The Brown University Advisory Committee on Corporate Responsibility in Investment Policies, which is analogous to Yale's ACIR, endorsed divesting from coal.[179] Ten American cities, including Seattle, San Francisco, and Madison, Wisconsin, have already begun to divest public funds from the fossil fuel industry.[180] The San Francisco city pension fund, in particular, is comparable in size to the Yale Endowment - San Francisco voted to divest 583 million from its 16 billion dollar pension fund.[181] A national movement has already garnered significant attention, with media appearances in such publications as *The Nation, The New York Times*, *Time*, *MSN Finance*, and *Rolling Stone.*[182] Large scale divestment will increase national focus on climate change.

A national movement showing a shift in collective shareholder tolerance can also have an influence on corporate practices. In January of this year, the New York Times reported that former Governor of Utah and U.S. Ambassador to China Jon Huntsman said about fossil fuel divestment campaigns: "I think it's a good thing, and I can tell you, as serving on some big

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[178] Ibid., page 66
[179] "Brown University Investment Committee Recommends Divestment from Coal."The Nation Magazine, http://www.thenation.com/blog/173770/brown-university-investment-committee-recommends-divestment-coal#.
[180] "10 Cities Divest from Fossil Fuel Investments." *SustainableBusiness.Com,* April 26 2013, a.
[181] Suzanne Goldenberg, "San Francisco and Seattle Lead US Cities Pulling Funds from Fossil Fuel Firms," *The Guardian,* 25 April 2013.
[182] "Fossil Fuel Divestment Campaign Wraps Up First Semester on 192 Campuses."The Nation, http://www.thenation.com/blog/171971/fossil-fuel-divestment-campaign-wraps-first-semester-192-campuses#

corporate boards, that when things like that happen, it's taken seriously."[183]

Though some may suggest lobbying for carbon pricing and more rigorous regulation of greenhouse gas emissions as a more effective avenue for efforts, trillion dollar oil and gas companies (not including coal) have spent over 100 million dollars each year since 2008 on lobbying.[184][185] Divestment, paradoxically, would be a more cost efficient method for reaching these targets of standard lobbying.

d. Last Resort

The Ethical Investor states that the "failure to act because one hopes someone else will act--or because one is trying to find out who is the last resort--may frequently lead to a situation in which no one acts at all. This fact places more weight on the first three features of the Kew Gardens Principle and it creates a presumption in favor of taking action when those three conditions are present."[186]

Although many Americans are becoming aware of the causes and effects of climate change, fossil fuel companies have not yet lost their social license to operate, and so far government institutions have not taken the necessary measures to address climate change. A report released by the Yale Project on Climate Change Communication found that a "large majority of Americans (88%) say the U.S. should make an effort to reduce global warming, even if it has economic costs."[187] Despite the will of the people, however, the federal government has not taken appropriate action to move the country towards a sustainable energy future. Neither the Democratic nor Republican parties have been able to address the social harms of the fossil fuel

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[183] Bill McKibben, "Turning Colleges' Partners into Pariahs," *The New York Times.* January 29, 2013.
[184] Eric Lipton and Clifford Krauss, "Fossil Fuel Industry Ads Dominate TV Campaign," *The New York Times*, sec. Politics, September 13, 2012.
[185]"Lobbying."OpenSecrets Center for Responsible Politics, http://www.opensecrets.org/lobby/top.php?indexType=i. (2013).
[186] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 25
[187] Anthony Leiserowitz et al., *Public Support for Climate and Energy Policies in September, 2012* (New Haven, CT: Yale Project on Climate Change Communication, 2012).

industry, nor have they been able to sufficiently bolster a renewable energy industry that would replace the steadily falling number of jobs in the coal industry. The United States has not yet ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which is to date the most stringent and binding international greenhouse emissions agreement. Congress also failed to pass the American Clean Energy and Security Act in 2009, which would have enacted a "cap-and-trade" emissions reduction scheme. No similar legislation is currently being considered.

On a global level, the most recent proposed international climate treaties from the United Nations Climate Change Conference in 2011 will not take binding effect until 2020. Current proposed action is not binding, not urgent enough, and not strong enough to avert the worst scenarios for climate change, considering that an estimated 300,000 people die from climate change related causes each year.[188] [189] [190] Individuals, especially those most affected by climate change, have very little power to change this situation. While Yale University has made commendable steps toward building a sustainable campus, the severity of the climate crisis necessitates additional action.

Absent an effective global or political avenue for action, we must evaluate other methods institutions such as Yale can adopt to address this change. One alternative is shareholder advocacy. *The Ethical Investor* itself discusses the potential efficacy and concerns of active shareholder management, addressing the legitimacy, fairness, and competence of shareholder advocacy. Shareholder activism can take two forms; voting on or passing shareholder resolutions, and direct engagement with managements (direct executive engagement). Both forms of shareholder advocacy suffer from a theoretical lack of effectiveness that is supported by

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[188] Harvey, Fiona, and John Vidal. "Global Climate Change Treaty in Sight after Durban Breakthrough." www.guardian.co.uk. N.p., 11 Dec. 2011.

[189] Drew Shindell, et al. "Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security." *Science* 13 January 2012: Vol. 335 no. 6065, pp. 183-189. http://www.sciencemag.org/content/335/6065/183.full

[190] Global Humanitarian Forum, "*Human Impact Report: Climate Change — the Anatomy of a Silent Crisis"* (Geneva: Global Humanitarian Forum, 2009).

examples, but after one examines the categories of legitimacy, fairness, and competence, direct executive engagement holds an edge over shareholder resolutions.

i. Legitimacy

The *Ethical Investor* separates ownership and corporate control: "in the case of management control, the ownership interest held by the controlling group amounts to but a very small fraction of the total ownership."[191]

There is a case to be made that the shareholder is solely a customer of management, in which the "product he buys is the future profitability of the company."[192] Thus, shareholders do not buy into the management stake of the company. A corporation does not need the consent of the shareholders when making business decisions. To sum, "a priori, there is no reason for them to have any voice, direct or representational, in the catalog of corporate decisions…on prices, wages, investment."[193] On a theoretical basis at least, shareholders possess little control over management decisions; at most, they exert influence.

It is also important to note that managers take input from other sources when making decisions. *The Ethical Investor* gives convincing theoretical arguments against shareholder resolutions; in most cases, shareholder power is obstructed, fractional, and slow to take effect.

On the other hand, it is not the duty of the shareholder to direct company action, but to alert the company of a social harm, in line with the proximity aspect of Yale's moral minimum obligation. This obligation would be fulfilled through either shareholder engagement procedure. If the company fails to address the concerns raised by shareholder engagement, it would then be Yale's duty to avoid continued participation in social injury through divestment.

ii. Fairness

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[191] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 47
[192] Ibid., 47.
[193] Ibid., 48.

Firms worry that they will be unfairly be harassed by a barrage of "unreasonable and arbitrary demands" related to shareholder advocacy.[194] To compensate, these firms strategically place obstacles in their bylaws to inhibit the effectiveness of shareholder resolutions, limiting their prevalence and diminishing their importance.[195] Problems arise when investors have to pass through these obstacles to pass a shareholder resolution that might be suppressed by the resolution policies of the company. A direct executive engagement, such as by letter-writing, would not encounter these problems with shareholder resolutions. There are no procedures in place to diminish the importance or prevalence of any letters a company may receive. The company would be obliged to respond to the concerns raised by substantial institutional shareholders in direct executive engagement.

iii. Competence

The Ethical Investor raises concerns about the competence of shareholder activism, questioning whether shareholders are best equipped to deal with social problems that the company faces. It notes that a company is best suited to handle its own business problems because it likely has the best access to information. If Yale were to vote on or propose a shareholder resolution, it would have to rely on a majority shareholder vote. *The Ethical Investor* makes it clear that most investors do not have enough access to relevant information to make an informed decision for the company. Private engagement, on the other hand, is the only way to ensure that Yale communicates its moral minimum obligation with company managements.

iv. Effectiveness

Fossil fuels cause social injury, and reduction of fossil fuel production is in direct contradiction with these companies' model for short term profitability. As shareholder management is unlikely to be capable of forcing fossil fuel companies into a whole different business model that meets

[194] Ibid., 59.
[195] *Rule 14a-8, Securities and Exchange Commission*.

the required urgency to alleviate grave social harms, the opportunities for shareholders to use their investments to influence the industry into a more sustainable direction are limited.

In the December article published by the *Yale Daily News*, Boston College economics professor Eyal Dvir "said most economists are skeptical that campaigns such as [the fossil fuel divestment movement] affect how firms behave, and added that stated goal of [divestment, towards] getting the energy companies to commit to not using their reserves will not succeed because it does not align with the long-term interests of those firms. Dvir added that investing more in firms like Shell and Exxon will allow universities to have a stronger voice on the boards of those companies — a voice universities could use to push firms into more sustainable practices."[196]

If companies are responsive to a request from Yale to disclose emissions in order to work together towards mitigation, then continued engagement with that company may be productive, and supporting sustainability experts on board positions may help to address the problem. Staying invested in these firms to have a "stronger voice," however, is a weak strategy for companies that make it clear they have no intention to work to redress social harm by refusing to simply disclose their emission levels. In that case, where the company management has made it clear that it will not work to redress the social injury, divestment appears as a last resort to avoid ownership in that social harm.

If Yale were to successfully introduce or vote on a resolution that would commit these firms to a higher environmental standard, that resolution would have a slim chance of passing. Shareholder power is usually fractional and not controlling; this power must be understood in terms of concerted action. Other investors in fossil fuel companies may not share the same commitment to responsible investing that Yale does.[197] Management often possesses a majority, giving it the power to block most advocacy.

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[196] Sophie Gould. "Students Push for Fossil Fuels Divestment." *Yale Daily News*. December 2012. http://yaledailynews.com/blog/2012/12/05/students-push-fossil-fuels-divestment/

[197] Australian Securities & Investments Commission, "Company Resolutions" http://www.asic.gov.au/asic/asic.nsf/byheadline/Company+resolutions?opendocument (accessed 13, March 2013).

Though statistical evidence to pinpoint the most effective means of shareholder engagement is scant, certain examples show that past shareholder resolutions have been unsuccessful at spurring fossil fuel companies to address the social problems of climate change by transitioning away from greenhouse-gas emitting energy sources. One of the most illustrative examples of this came in 2008, when members of the Rockefeller family supported a shareholder resolution asking Exxon to reduce company greenhouse gas emissions.[198] Even though the resolution discussed was non-binding, Exxon's board rejected it.[199] This is but one example in a string of related failed or ineffective shareholder resolutions throughout the industry. Even in cases where a few companies have signed on to shareholder resolutions,[200] comprehensive shareholder efforts have not yet been effective at requiring emissions disclosure or spurring institutional change appropriate to curtail the rate of expansion of greenhouse gas emissions.[201]

This discussion concludes the application of the Kew Gardens Principle to the question of whether or not Yale University should be invested in the fossil fuel industry. Fossil fuel investments cause grave social harm which calls for remedy. Yale is in close proximity to this problem, and is capable of addressing the problem at minimal risk by reconsidering its investment policies. Though shareholder resolutions may not be very effective, communicating in a letter to management (direct executive engagement) is an important part of an engagement process because they are more legitimate, fair, and competent, and may be more effective. *The Ethical Investor* puts it best, noting that it is worthwhile to participate in shareholder engagement:

"We conclude, then, that on the basis of the shareholder's unique relation to the corporation and

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[198] Clifford Krauss, "Exxon Rejects Proposals Backed by Rockefellers," *The New York Times*, sec. Business, May 29, 2008.
[199] Ibid.
[200] Investor Network on Climate Risk, "Shareholder Resolutions," Ceres, http://www.ceres.org/incr/engagement/corporate-dialogues/shareholder-resolutions#!/subject=Climate%20Change&year=&company=&filer=&sector=Oil%20and%20Gas&status=&memo=&all=
[201] "Global Emissions."The United States Environmental Protection Agency, http://www.epa.gov/climatechange/ghgemissions/global.html

his power to influence management and change corporate practice, the shareholder bears responsibility for harm resulting from corporate business practices; further, we conclude that shareholder activity consistent with this responsibility does not represent a major problem from the standpoint of fairness and competence."[202]

While shareholder engagement may be minimally effective, it is nevertheless important for Yale to attempt to use its voice because, as *The Ethical Investor* says, "to argue that fractional power should not be exercised would radically undermine the principle of democratic voting."[203] Though the *Ethical Investor* acknowledges the analogy between voting for government differs from voting for resolutions in many important ways, the principle that it is important to use a voice holds, no matter how small the voice. In the following sections, we outline a set of procedures aimed at fulfilling any potential role for the University to exert its voice as concerned shareholder, while making sure that action taken is timely and appropriate; it is not productive to continue to rely upon a small voice in the case where that voice is not listened to and met with response. In the case where engagement with shareholders proves to be ineffective, divestiture would be the remaining last resort.

VIII. Plans for Action

One of the most prevalent approaches to divestment from fossil fuels is to focus on the 'worst of the worst' companies. A number of groups, including Brown University students and the Rainforest Action Network have targeted a list of the "Filthy Fifteen"[204] coal and utility companies. According to advocates, the "Filthy Fifteen" are "some of the largest, dirtiest coal companies in the U.S. These companies are jeopardizing public health, damaging the

[202] John G. Simon, Charles W. Powers, and Jon P. Gunnemann. *The Ethical Investor: Universities and Corporate Responsibility*. Yale University Press, 1972. p. 63
[203] Ibid., 51.
[204] We Are Powershift, "The Filthy 15" http://www.wearepowershift.org/campaigns/divestcoal/filthy-15

environment, and placing an unfair burden on low-income and minority communities, and they are becoming an increasingly risky investment."[205] This list, however, focuses on American private companies, and thus does not take into account the global industry and the global scope of the climate problem. Swarthmore College groups have targeted the "Sordid Sixteen."[206] This second list focuses on local environmental impacts as well as global climate change, by identifying companies that are geographically close to their school. Though both lists contain companies with reprehensible practices, it is not necessarily clear that the metrics involved in creation of those lists are the most appropriate metrics to use.

A more holistic approach would consider the 200 largest carbon-reserve holding companies, as researched by the Carbon Tracker Initiative's spring 2012 report. This is what the City of San Francisco has targeted through divestment.[207] Half of the list are the oil and gas companies with the largest carbon reserves, and half of the list are the coal companies with the largest carbon reserves. The reserves of these 200 entities, when combined, exceed the 'allowable carbon' budget which would lead to surpassing the internationally agreed upon threshold of 2 degrees Celsius warming globally.[208] 745 gigatons of carbon dioxide are represented on just this list, far exceeding the global budget of 565 gigatons of carbon dioxide. This approach, compared to the other actions outlined here, directly and more rigorously addresses the root causes of the social harm. Deterring the consumption of these fuels would begin to redress the grave social injuries incurred through climatic change.

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[205] Ibid.

[206] Swarthmore Mountain Justice, "The Sordid Sixteen of Fossil Fuels." http://swatmountainjustice.wordpress.com/the-sordid-sixteen-of-fossil-fuels/

[207] Suzanne Goldenberg, "San Francisco and Seattle Lead US Cities Pulling Funds from Fossil Fuel Firms," *The Guardian,* 25 April 2013.

[208] *World Energy Outlook 2012,* International Energy Agency,[2012]).

4. Top 200 listed companies by estimated carbon reserves

Fig.5

Rank	Coal Companies	COAL (GtCO2)	Oil & Gas Companies	OIL (GtCO2)	GAS (GtCO2)
1	Severstal JSC	141.60	Lukoil Holdings	42.59	0.97
2	Anglo American PLC	16.75	Exxon Mobil Corp.	38.14	2.89
3	BHP Billiton	16.07	BP PLC	32.68	1.92
4	Shanxi Coking Co. Ltd.	14.98	Gazprom OAO	14.87	13.96
5	Exxaro Resources Ltd.	13.37	Chevron Corp.	20.11	1.11
6	Xstrata PLC	11.60	ConocoPhillips	18.11	1.03
7	Datang International Power Generation Co. Ltd.	11.21	Total S.A.	16.90	1.12
8	Peabody Energy Corp.	10.23	Royal Dutch Shell PLC	14.11	2.09
9	Mechel OAO	8.90	Petrobras	11.45	0.17
10	Inner Mongolia Yitai Coal Co. Ltd.	7.78	Rosneft	10.70	0.08
11	China Shenhua Energy Co. Ltd.	6.91	ENI S.p.A.	7.51	0.53
12	Coal India Ltd.	6.69	Occidental Petroleum Corp.	7.36	0.22
13	Arch Coal Inc.	5.57	Bashneft	7.25	0.01
14	Rio Tinto	5.23	SINOPEC Shandong Taishan Petroleum Co. Ltd.	6.61	0.22
15	Evraz Group S.A.	4.86	Canadian Natural Resources Ltd.	4.35	0.14
16	Public Power Corp. S.A.	4.56	Devon Energy Corp.	3.77	0.42
17	Consol Energy Inc.	4.50	Suncor Energy Inc.	3.74	0.07
18	Yanzhou Coal Mining Co. Ltd.	4.46	Apache Corp.	3.32	0.33
19	Mitsubishi Corp.	4.31	Anadarko Petroleum Corp.	3.14	0.33
20	Datong Coal Industry Co. Ltd.	4.30	Hess Corp.	3.01	0.12
21	Bumi Resources	3.28	Repsol YPF S.A.	2.75	0.29
22	United Co. Rusal PLC	3.02	BG Group PLC	2.29	0.48
23	Vale SA	3.01	Marathon Oil Corp.	2.51	0.12
24	Pingdingshan Tianan Coal Mining Co. Ltd.	2.97	Inpex Corp.	2.44	0.10
25	Tata Steel Ltd.	2.96	Statoil ASA	2.23	0.25
26	Teck Resources Ltd.	2.70	BHP Billiton	1.82	0.20
27	Banpu PCL	2.55	CNOOC Ltd.	1.85	0.09
28	Sasol Ltd.	2.51	Husky Energy Inc.	1.76	0.06
29	United Industrial Corp. Ltd.	2.48	YPF S.A.	1.68	0.12
30	Polyus Gold OAO	2.47	Novatek	-	1.73
31	Alpha Natural Resources Inc.	2.29	Talisman Energy Inc.	1.47	0.19
32	Magnitogorsk Iron & Steel Works	2.20	Pioneer Natural Resources Co.	1.50	0.11
33	Raspadskaya OJSC	2.09	SK Holdings Co. Ltd.	1.56	-
34	Kuzbassenergo	2.03	Petroleum Development Corp.	-	1.51
35	RWE AG	1.94	Cenovus Energy Inc.	1.40	0.06
36	Massey Energy Co.	1.93	Nexen Inc.	1.40	0.02
37	Eurasian Natural Resources Corp. PLC	1.93	EOG Resources Inc.	0.97	0.38
38	Wesfarmers Ltd.	1.86	Noble Energy Inc.	1.04	0.12
39	Churchill Mining PLC	1.74	OMV AG	1.02	0.06
40	Idemitsu Kosan Co. Ltd.	1.58	Chesapeake Energy Corp.	0.39	0.57
41	Tata Power Co. Ltd.	1.49	Penn West Petroleum Ltd.	0.91	0.03
42	Alliance Resource Partners L.P.	1.47	Oil Search Ltd.	0.91	-
43	NACCO Industries Inc. (Cl A)	1.33	Woodside Petroleum Ltd.	0.54	0.27
44	Novolipetsk Steel OJSC	1.30	Canadian Oil Sands Ltd.	0.78	-
45	New Hope Corp. Ltd.	1.30	Imperial Oil Ltd.	0.75	0.01
46	TransAlta Corp.	1.23	Murphy Oil Corp.	0.69	0.03
47	Sherritt International Corp.	1.15	Whiting Petroleum Corp.	0.70	0.01
48	PT Bayan Resources	1.14	EnCana Corp.	0.24	0.47
49	New World Resources N.V.	1.07	Plains Exploration & Production Co.	0.67	0.04
50	Mitsui & Co. Ltd.	1.03	Newfield Exploration Co.	0.53	0.11

Rank	Coal Companies	COAL (GtCO2)	Oil & Gas Companies	OIL (GtCO2)	GAS (GtCO2)
51	Kazakhmys PLC	0.99	Denbury Resources Inc.	0.60	0.00
52	African Rainbow Minerals Ltd.	0.95	Continental Resources Inc. Oklahoma	0.54	0.02
53	International Coal Group Inc.	0.95	Linn Energy LLC	0.49	0.03
54	Patriot Coal Corp.	0.94	Pacific Rubiales Energy Corp.	0.50	0.02
55	Aston Resources Pty Ltd.	0.93	Crescent Point Energy Corp.	0.47	0.00
56	AGL Energy	0.89	Concho Resources Inc.	0.44	0.02
57	Tokyo Electric Power Co. Inc.	0.89	Quicksilver Resources Inc.	0.36	0.08
58	Cloud Peak Energy Inc.	0.85	PTT PCL	0.33	0.12
59	CLP Holdings Ltd.	0.83	Berry Petroleum Co. (Cl A)	0.40	0.03
60	Polo Resources Ltd.	0.82	Range Resources Corp.	0.27	0.11
61	Whitehaven Coal Ltd.	0.79	Energen Corp.	0.34	0.04
62	Mongolian Mining Corp.	0.75	Enerplus Corp.	0.34	0.03
63	PT Adaro Energy	0.74	Tullow Oil PLC	0.36	0.01
64	Allete Inc.	0.72	Ecopetrol S.A.	0.35	0.01
65	Optimum Coal Holdings Ltd.	0.67	Santos Ltd.	0.19	0.17
66	ArcelorMittal	0.62	SandRidge Energy Inc.	0.33	0.03
67	Coal of Africa Ltd.	0.59	Cairn Energy PLC	0.35	0.00
68	James River Coal Co.	0.57	Arc Resources Ltd.	0.30	0.03
69	Westmoreland Coal Co.	0.56	El Paso Corp.	0.23	0.10
70	Aquila Resources Ltd.	0.53	Pengrowth Energy Corp.	0.30	0.02
71	Macarthur Coal Pty Ltd.	0.53	Lundin Petroleum AB	0.31	0.00
72	FirstEnergy Corp.	0.50	Petrobank Energy & Resources Ltd.	0.31	0.00
73	Western Coal Corp.	0.49	Baytex Energy Corp.	0.30	0.00
74	Cliffs Natural Resources Inc.	0.47	Forest Oil Corp.	0.22	0.07
75	Wescoal Holdings Ltd.	0.46	Mariner Energy	0.27	0.02
76	Walter Energy, Inc.	0.45	ATP Oil & Gas Corp.	0.24	0.01
77	Huolinhe Opencut Coal Industry Corp. Ltd.	0.41	Bankers Petroleum Ltd.	0.25	-
78	Gujarat NRE Coke Ltd.	0.40	Soco International PLC	0.25	-
79	Straits Asia Resources Ltd.	0.39	Zhaikmunai L.P.	0.22	0.01
80	Capital Power Corp.	0.38	Cimarex Energy Co.	0.18	0.05
81	Fushan International Energy Group Ltd.	0.34	Questar Corp.	0.12	0.11
82	Noble Group Ltd	0.34	GDF Suez S.A.	0.17	0.05
83	Itochu Corp.	0.34	Swift Energy Co.	0.20	0.01
84	Jizhong Energy Resources Co. Ltd.	0.30	Compania Espanola de Petroleos S.A.	0.21	-
85	Northern Energy Corp. Ltd.	0.29	PetroBakken Energy Ltd.	0.21	0.00
86	NTPC Ltd.	0.28	Premier Oil PLC	0.18	0.03
87	Prophecy Resource Corp.	0.28	Bonavista Energy Corp	0.18	0.03
88	Mitsui Matsushima Co. Ltd.	0.28	MOL Hungarian Oil and Gas Plc	0.19	0.01
89	Fortune Minerals Ltd.	0.28	SM Energy Co.	0.17	0.02
90	Black Hills Corp.	0.27	Williams Cos.	-	0.18
91	Jindal Steel & Power Ltd.	0.26	EQT Corp.	0.01	0.17
92	Grupo Mexico S.A.B. de C.V.	0.26	Oil & Natural Gas Corp. Ltd.	-	0.18
93	Gansu Jingyuan Coal Industry & Electricity Power	0.26	Global Energy Development PLC	0.17	0.00
94	Bandanna Energy Ltd.	0.25	Oil India Ltd.	0.16	0.01
95	Irkutskenergo	0.23	Venoco Inc.	0.16	0.01
96	Alcoa Inc.	0.23	INA-Industrija Nafte	0.17	-
97	Homeland Energy Group Ltd.	0.23	PA Resources AB	0.16	-
98	Neyveli Lignite Corp. Ltd.	0.19	Ultra Petroleum Corp.	-	0.16
99	Zhengzhou Coal Industry & Electric Power Co. Ltd.	0.15	Resolute Energy Corp.	0.16	0.00
100	Gujarat NRE Coking Coal Ltd.	0.12	Southwestern Energy Co.	0.00	0.16
Grand Total		**389.19**	**Grand Total**	**319.13**	**37.34**

Figure 21: Carbon tracker list of 100 coal and 100 oil/gas companies with the largest carbon reserves

A sensible way to proceed would be to differentiate the companies based on performance relative to their peers. However, it is extremely difficult to measure the environmental performance of fossil fuel companies. Though reporting varies widely per specific metric, in general 20-40 % of corporations report relevant environmental data (a figure determined through sifting through University-subscribed Bloomberg and Thomson Reuters financial terminals).

ESG (Environmental, Social, and Governance) data detailing greenhouse gas emissions per assets give a sense of the nature and future of each company. Higher ratios of emissions per unit of energy produced (measured in BOEs, barrel of oil equivalents) indicate companies that are proportionally more harmful to the environment than companies with lower ratios. Also, high ratios indicate that the particular companies devote comparably fewer resources to transitioning to clean energy companies, thus contributing to greater social harm in the future. Graphs made by compiling Bloomberg ratings of all reporting companies in the Carbon Tracker Initiative list were presented to the Yale Advisory Committee on Investor Responsibility.

The information on commitments to emissions reduction and climate change innovation was determined qualitatively by the CDP (Carbon Disclosure Project). That questionairre can be found here https://www.cdproject.net/CDP%20Questionaire%20Documents/Investor-CDP-2013-Information-Request.pdf. These indicators allow for greater insight into a company's commitment to future sustainability and emissions reduction that will reduce the amount of social harms to which it contributes.

IX. Proposal

While not the only method for responsibly addressing fossil fuel investments, we submit this proposal as a reasonable pathway to address the grave social injury of the fossil fuel industry. In the following document, we have outlined a procedure while explaining the reasoning behind each step.

As Yale's ultimate goal is to reduce participation in grave social injury, not just punish companies, this procedure identifies a set of metrics to identify and engage with the worst performers, and to allow for continued investment or reinvestment in companies if practices improve.

Although we demonstrated earlier in this report that shareholder resolutions do not seem to be particularly effective in the case of fossil fuel industry emissions reductions, it is important for Yale to communicate with the company before taking further action. Furthermore, it is necessary for the company to communicate with Yale and its other shareholders about its practices before work can be done to improve those practices. For these reasons, the first section of the proposal focuses on communication which we have suggested may be appropriately pursued, consistent with past practice, through writing a letter. In order to make sure this action does not fall into the traps that shareholder resolutions may face, we have tried to make sure this procedure could not be derailed by slow or overly weak responses, remaining consistent with the urgency demanded by the situation.

A large portion of the Carbon Tracker 200 companies do not disclose the data that describes their full impact. For those companies that do not disclose data, the first step of this proposal begins with opening communication about transparency and performance. We, as much as anyone, want Yale to be able to work with the companies to improve their impact on climate change and transition to cleaner fuels. If the company refuses to disclose emissions data, however, it is hard

to take seriously any stated intent to improve emissions.

Though throughout the report we have noted that divestment is unlikely to have an impact on the companies' short-term profits and therefore individual company action, public companies have to be responsive to shareholders. The standards determined by the proposal set an attainable target for company improvement and provide the incentive of retaining Yale's investments. Unconditional divestment does not incentivize individual company improvement like the following proposal does. This proposed procedure aims to make use of the any potential that leveraging one's investments might have at creating incentives for ethical behavior.

With any actionable plan, some cutoff lines and timeframes must be employed, and specific lines and dates can seem arbitrary. Indecision as to these specifics, however, should not prevent action altogether. We have chosen timeframe and cutoff numbers to be as reasonable and straightforward as we think possible. To present this proposal as forthrightly as possible, and to underline our intention to work constructively with the Committee to redress a shared problem, we have bracketed these numbers and dates, to distinguish them as variables that the investments office must help to fill in.

Additionally, the bracketed numbers and dates serve to meet the capability condition of divestment. Because we do not have access to the specifics of Yale's investment portfolio, we hope to work with Yale Investments Office to adjust these cutoff lines to sensible levels.

For additional clarity on the procedure, please refer to the flow chart (Appendix 1) after the proposal.

Proposal for Responsible Energy Investment:

Presented to the Yale Advisory Committee On Investor Responsibility

This proposal outlines a procedure to determine the ethical standing of energy investments, and to engage with companies that do not meet Yale's ethical investing standards. By applying this procedure, Yale can come to a conclusion on the ethical standing of particular companies, and then take appropriate action regarding those companies for Yale's direct holdings, and Yale's indirect holdings through fund managers. Many fund managers are willing to establish Separately Managed Accounts for large institutional investors to tailor investment strategies - for firms that offer this or similar services, due diligence obliges Yale to request negative screening for the socially irresponsible companies identified through the procedure.

I. Companies to Consider

For a company to receive consideration, it must be creating grave social injury. For this reason, considered companies must be among the largest contributors to climate change through greenhouse gas emissions. The 2011 Carbon Tracker Initiative report, *Unburnable Carbon,* identified the 100 coal and 100 oil and gas companies with the largest total carbon reserves. This list of 200 companies is the most complete list of top carbon reserves currently available; Yale should use the following procedures to evaluate and engage with those 200. If new information becomes available, Yale may decide that the list of 200 does not sufficiently address the social injury of climate change and may alter the scope of considered companies.

II. Emissions Metrics

Purpose: To gauge the social harms from the firms, Yale must use some metrics. Without relevant data, Yale has little way to evaluate whether a company is producing more or less social injury than its peers. Failure to disclose this data obstructs efforts to redress these social harms, thus is itself a social injury.

Methodology (relevant indicators): A large set of company-specific environmental data is available for reporting. Among the indicators reported, the most relevant data points are those relating to greenhouse gas emissions. There are three categories of greenhouse gas emissions that are reported: Scope 1, Scope 2, and Scope 3.

*Greenhouse Gas Emissions, Scope 1***:** As defined by The Carbon Disclosure Project, Scope 1 greenhouse gas emissions measure "direct emissions from GHG sources owned or controlled by the reporting organization." These emissions come from company operations such as fossil fuel extraction.

*Greenhouse Gas Emissions, Scope 2***:** The Carbon Disclosure Project defines Scope 2 greenhouse gas as "Emissions that do not physically occur from within the organization's reporting boundary and are therefore 'indirect' emissions. Scope 2 emissions are caused by the organization's consumption of electricity, heat, cooling or steam brought into its reporting boundary. This category is often called 'purchased electricity' because it represents the most common source of Scope 2 emissions."

Greenhouse Gas Emissions, Scope 3: Greenhouse Gas Emissions Scope 3, includes all downstream emissions. The Carbon Disclosure Project defines GHG Scope 3 as "An organization's indirect emissions other than those covered in Scope 2. They are from sources that are not owned or controlled by an organization, but which occur as a result of its activities. The Scope 3 emissions subcategories considered by the CDP Supply Chain Information Request are: (1) business travel emissions, (2) distribution and logistics emissions, (3) emissions from the use and disposal of a company's products, (4) supply chain emissions."

Greenhouse Gas Emissions Scope 1, Scope 2, and Scope 3, per unit of energy produced (BOE): The sum of Scope 1, 2, and 3 emissions represents the GHG emissions a company causes, which determines total contributions to the social harm of climate change. This number can be compared to the total units of energy produced, already reported by companies in units of barrel of oil equivalents (BOE) to find the emissions intensity of each company. As certain types of energy extraction and consumption are more injurious to the climate than others, this data can provide Yale information on the comparative harm caused by practices across the industry, allowing Yale to identify the most grievous offenders.

Methodology (accessing information): All information on relevant indicators can be found on the Bloomberg Terminal in the CSSSI library at Yale University. Though it is not the only database that companies may report relevant environmental information to, Bloomberg is comparable to other rating systems. Bloomberg uses climate data from the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI). These reporting agencies verify data through independent, third-party consultants.

III. Reporting Emissions Data

Purpose: Communicating with management is among the first steps of engagement outlined in *The Ethical Investor.* Yale's first step regarding companies on the Carbon Tracker list of 200 is to write a letter to companies to communicate Yale's position.

Nonreporting Firms

For those companies on the list of 200 that do not report greenhouse gas emissions, Yale must write a letter to the company communicating its desire for the company to disclose the relevant metrics [within one quarter] by reporting the information to the Carbon Disclosure Project, or another reputable reporting agency.

Action Steps:

If, after the initial [one business quarter], the company has not voluntarily reported the required information, indicating it does not intend to redress the social injury it causes, Yale should give it notice of intent to divest over the course of [two years]. [Three weeks] prior to the end of the initial quarter, Yale may send a notice to the company reminding it of Yale's intent to divest its shares if the company cannot address Yale's concerns as an ethical investor.

To eliminate the risk associated with being forced to sell a stock at a relative low price, if a company indicates it will not report emissions data or fails to respond to Yale's request, and Yale must resort to divestiture, Yale will have [two years] to sell all of its shares in the company.

IV. Engagement With Companies that Report

Purpose: In order to identify the worst contributors to the social harms of climate change, Yale should assess each company's performance relative to the industry.

Methodology (accessing information): All information on relevant indicators can be found on the Bloomberg terminal in the CSSSI library. Though it is not the only database that companies may report relevant environmental information to, Bloomberg uses CDP (Carbon Disclosure Project) data, among other data, and is comparable to other rating systems.

Methodology (relevant indicators): The company's emissions ratio per unit of energy (Sum of Scopes 1, 2, and 3 of GHG emissions, per BOE produced) is important to determine relative social injury caused by fossil fuel companies since it is the most quantifiable among the relevant

indicators to report.

For the [top three quartiles] of Reporting Companies

Companies which are not among the worst (highest emissions ratio) contributors to climate change in their industry are not contributing the most to grave social injury, and as such merit continued investment.

For the bottom [quartile] of reporting companies:

If a company on the list of 200 has an emissions ratio in the bottom [quartile] of reporting companies, (the bottom quartile comprises the companies with the highest magnitude ratios, in other words, the worst emitters), Yale must write a letter to the company communicating its desire for the company to implement a plan to take the company out of the bottom quartile of reporting companies within [two years].

If the company does not adhere to its [annual] goals for reductions in emissions intensity, or does not formulate goals for doing so, it is demonstrating it does not intend to correct the grave social injury it causes, and Yale would be obligated to divest its holdings as a last resort over [two years].

Purpose: If a company creates a grave social injury and the company does not quickly show a commitment to changing its internal practices, then according to *The Ethical Investor* Yale must exit the company through divestment to avoid participation in social injury.

If the company refuses to engage in efforts to redress its social harms, Yale cannot expect the company to improve through shareholder resolutions. Evidence provided earlier in this report and in *The Ethical Investor* highlights the futility of shareholder resolutions. Resolutions capable of passing are usually too weak to create significant company change. Timetables for action from shareholder resolutions are unlikely to be short enough to have a significant impact due to the urgency of climate change.

Action Steps:

If, after the initial [one business quarter], the company has not voluntarily implemented a plan to improve emissions, Yale divests from the company over the course of the next [two years]. [Three weeks] prior to the end of the initial quarter, Yale may send a notice to the company reminding it of Yale's intent to divest its shares if the company cannot address Yale's concerns as an ethical investor. To eliminate the risk associated with being forced to sell a stock at a relative low price, once deciding that investments in a company are unethical and divestment is the best option, Yale will have [two years] to sell all of its shares in the company.

III. Reevaluation

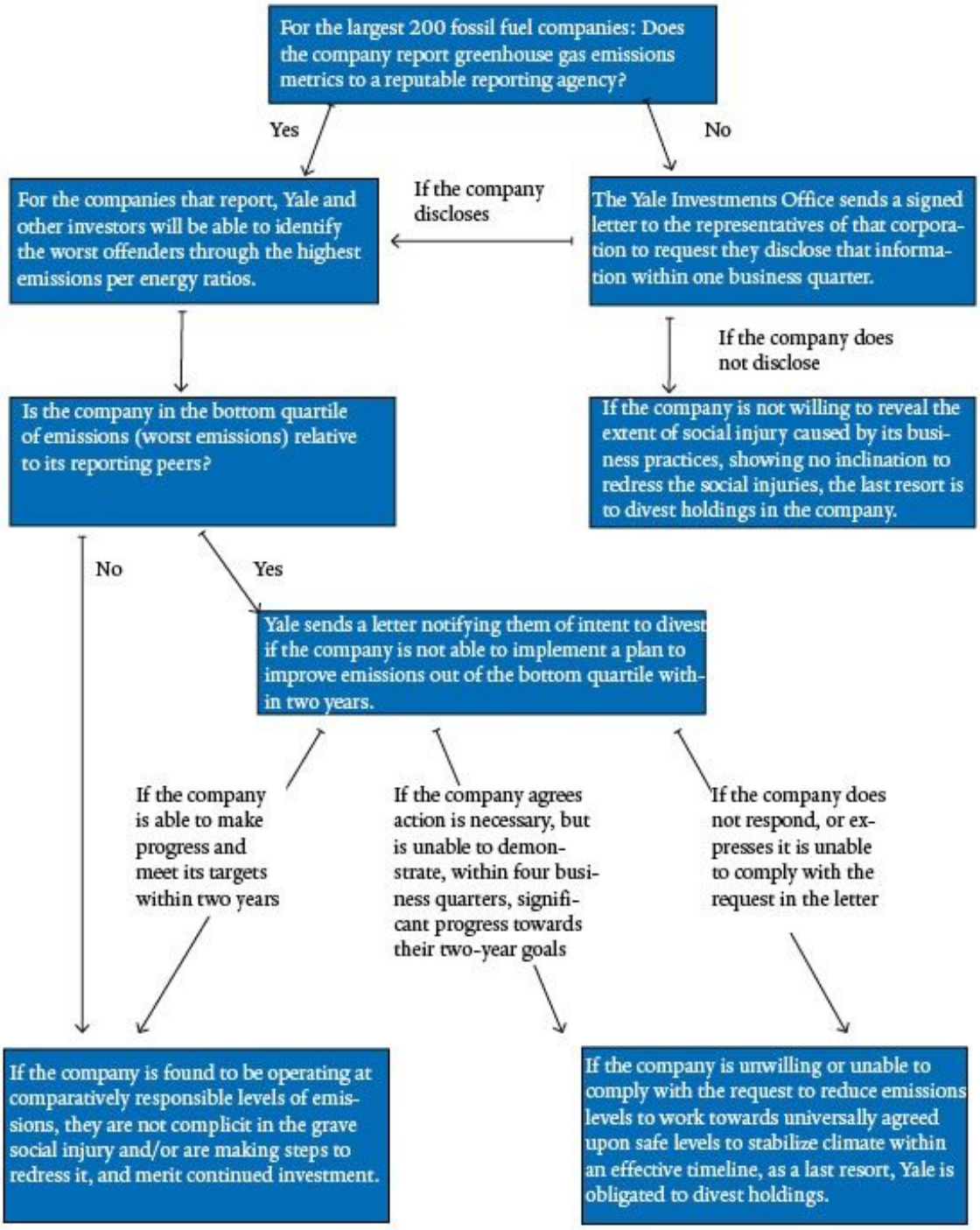
Yale would, every [two years], reevaluate the standing of each of the largest 100 oil & gas and the largest 100 coal companies (sized by carbon reserves) according to this proposal. If, upon reevaluation, a company from which Yale has divested has improved to meet the above criteria for investment, Yale may reinvest in the company.

IV. Amendment Proceedings:

As the the dynamics of climate change and public response are changing, it is to be noted that the procedure outlined in this report may be publicly amended. If at any time the ACIR determines that fossil fuel companies no longer cause grave social injury, or that fossil fuel companies contribute to more social harm than what was presented in this report, the ACIR may publicly amend the proposal after consulting with Yale faculty and independent climate scientists. After announcing intention to amend the proposal, the ACIR would then hold several open meetings

over [one academic year] to bring the reasons for amendment to light within the Yale community, and solicit the Yale community's input before finalizing the amendment.

Proposal on Responsible Energy Investing - A Flowchart



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