Stanford Law School
Law and Policy Lab

Policy Practicum:
What we can do to mitigate catastrophic climate change (Law 807B)

# Assessing Stanford University's Climate-Related Policies and Practices

**March 5, 2020**


**PRACTICUM RESEARCHERS:**

Abby BAUER (BA / MA '21)
Katherine CONNOR (DCI Fellow '20; BS'79 / MS'80)
Chelsey DAVIDSON (JD '21)
Jackie ENNIS (BS / MS '21)
Gabriel FARIA BERNARDES (JSM '20)
Luciana HERMAN, Ph.D. (Policy Lab Program Director)
Taylor JASZEWSKI (JD '21)
David LIOU (JD '22)
Ian McQUEARY (JD '22)
Kavya VARKEY (BS '23)

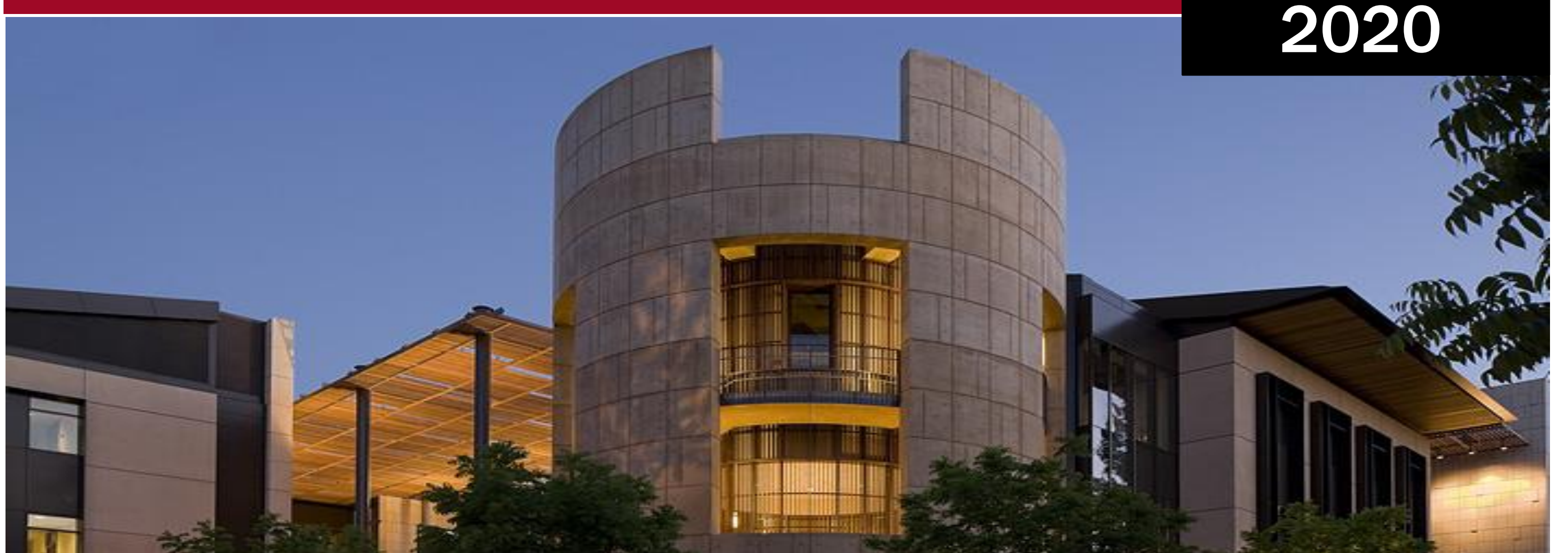
**INSTRUCTOR:**

Paul BREST
Professor of Law, Emeritus (Active); Faculty Director, Law and Policy Lab

**Teaching Assistant:**

Catherine ROCCHI (JD / MS '22)


**WINTER 2020**



# Contents

# I. Introduction

This report examines the effects that certain policies and practices by Stanford University and its communities of students, faculty, and staff might have in reducing greenhouse gas (GHG) emissions and hence in reducing global warming. It represents the work of the Winter, 2019-20, Stanford Law School Policy Lab practicum, *What We Can Do to Mitigate Catastrophic Climate Change*,[1] which continues work done by an Autumn practicum of the same name.

These would be important issues to consider at any time, and they have particular salience right now, for several reasons. First, having made significant progress with respect to Scope 1 and 2 emissions (emissions from generated and purchased energy), the *Sustainable Stanford* program is now turning to Scope 3 emissions—from sources not directly controlled by Stanford but related to its functions. Second, the University is considering improvements in the organizational structures that link sustainability-focused units in schools and institutes. Third, the administration and Board of Trustees are considering a petition by Fossil Free Stanford requesting that the endowment divest its ownership of companies in the fossil fuel industry.

The mandate of Stanford Law and Policy Labs is to conduct impartial, evidence-informed policy analysis. We proceed from two premises that we believe are not in serious doubt.

First, we accept the scientific evidence establishing the causal connection between greenhouse gas (GHG) emissions and global warming. Current trajectories of fossil fuel use are leading to catastrophic climate change.

Second, we acknowledge that, in addition to its global consequences, climate change threatens to compromise Stanford's core missions of teaching and research. Wildfires, environmental degradation, water and power insecurity, and other changes threaten the University's staff, students, and faculty. Last year's wildfires make clear that these harms are not hypothetical. Rather, they threaten the entire State of California, on whose economy and wellbeing we depend.

With these premises in mind, we have considered the possible effects on GHG emissions of Stanford's endowment investment policies and practices and Internal activities by the University and its communities, including transportation, food consumption, emissions by Stanford's hospitals and other health services, the idea of an internal carbon tax, and the coordination of research related to climate change.

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[1] The winter 2020 practicum was taught by Paul Brest, Professor Emeritus, Stanford Law School, and included the following students: Abby Bauer (BA/MA '21), Katie Connor (DCI fellow '20; BS '79/MS'80), Chelsey Davidson (JD '21), Jackie Ennis (BS/MS '21), Gabriel Faria Bernardes (JSM '20), Luci Herman (Ph.D., Policy Lab Program Director), Taylor Jaszewski (JD '21), David Liou (JD '22), Ian McQueary (JD '22), Kavya Varkey (BS '23). Katherine States Burke (DCI Fellow '20; former Deputy Director Stanford Global Health) co-authored the section on Stanford hospitals. Catherine Rocchi (JD/MS '22) served as teaching assistant and general co-editor. Individual students do not necessarily agree with all of the conclusions of this report. The Autumn 2019 practicum was co-taught by Paul Brest and Alicia Seiger. For course description, see https://law.stanford.edu/education/only-at-sls/law-policy-lab/practicums-2019-2020/what-we-can-do-to-mitigate-catastrophic-climate-change/.

Because our research has been conducted in the course of one quarter, it is necessarily secondary. Working in teams, we read widely in the academic and practitioner literature and consulted with the following experts named in the Appendix.

Our fundamental goal has been to identify *effective* strategies for reducing GHG emissions. The ideal strategies are ones that further Stanford's teaching and research missions at the same time as they promise to reduce GHG emissions.

An effective strategy does not require that Stanford's actions alone to make a discernible difference. Rather, change could result from the aggregated actions of multiple institutions. In addition to educating its own students, faculty, and staff, Stanford has great potential as a "thought leader" in this area. Thought leadership depends on the actions of the University and members of its communities—the topic of this report.

We do not seek to deliver a set of specific recommendations, but rather to present a framework to assist the University in assessing strategies aimed at mitigating climate change.

## II. Blameworthiness vs. Harm

Stanford's current Statement on Investment Responsibility, adopted in 2018, states:

> The Trustees recognize that very rare occasions may arise when companies' actions or inactions are so abhorrent and ethically unjustifiable as to warrant the University's dissociation from those investments. … These instances .., must meet [a] very high bar ….[2]

This standard focuses on the blameworthiness of companies. Accordingly, the Fossil Free Stanford petitioners have argued (1) that some individual companies meet this standard because of their human rights abuses, misinformation campaigns, and lobbying for regulations that promote fossil fuels and inhibit renewable energy sources, and (2) that all fossil fuel companies' behavior "should be considered as interconnected and structurally embedded across the fossil fuel industry" so that Stanford "has the duty to assess divestment on an industry-wide level."[3]

Granted that certain companies have engaged in morally reprehensible behavior and could justifiably be sanctioned for that behavior,[4] we believe that the core issue is not the

[2] Stanford University, Statement on Investment Responsibility (2018), https://stanford.app.box.com/v/stmt-investment-responsibility.

[3] Fossil Free Stanford, The Case for Full Fossil Fuel Divestment at Stanford University, 3.

[4] Barnard College offers one model for adjudicating the behavior of particular companies. The College, "in partnership with Fossil Free Indexes (known as FFI) and the Union of Concerned Scientists, developed six rigorous criteria to indicate the extent to which a company's words and actions support climate science, demonstrate an urgency to act with respect to scientific knowledge about climate change, support the free flow of information, and provide transparency about their actions." See https://barnard.edu/sites/default/files/inline-files/ClimateScienceList_12-2-19.pdf. In deciding whether Stanford should adopt a procedure for determining

*blameworthiness* of the fossil fuel industry, but rather whether the production and use of fossil fuels are causing *harm*—about which there is no serious question.

It seems problematic to brand the entire fossil fuel industry as abhorrent when the University and every member of its community rely on fossil fuels, and the global economy would grind to a halt without them. Our pervasive reliance on fossil fuels reflects the technologies currently available to us, our taste for carbon-intensive comforts, and a political infrastructure that subsidizes conventional energy and refuses to put a price on carbon. Even a campaign aimed at stigmatizing fossil fuels would not aim to halt their production and use immediately, but rather to reduce their harms and hasten the transition to a low carbon economy.

In any event, we believe that a threshold question for the Board of Trustees is whether the Statement on Investment Responsibility only permits divestment based on an individual company's "abhorrent and ethically unjustifiable" behavior, or whether divestment decisions may respond to harms that threaten the University's core missions and members of its communities.

We do not find the answer self-evident. Our doubt stems from two aspects of the harms caused by the production and use of fossil fuels.

First, and primarily, it is possible that when the Trustees adopted this provision, they had in mind calls for divestment that were concerned with injuries to the general social welfare.[5] Even if these calls included divestment from fossil fuel industries, it is not evident whether the Trustees focused on their harm to Stanford University itself. Climate change will cause unquestionable harms to the University.

Second, the Board adopted the revised standard partly out of concern that taking positions on controversial social and political issues could compromise academic freedom.[6] However, the

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whether a particular company's ethically abhorrent behavior warrants divestment. Stanford might consider the *Principles and Procedures for Renaming Buildings and Other Features at Stanford University*, adopted in 2019. https://campusnames.stanford.edu/renaming-principles/. Procedural fairness might demand that the company be able to submit evidence that it ceased the offending conduct, made reparations for past wrongdoing, or made contributions to society that offset the harm it did. The University must also consider whether to limit these inquiries to companies creating GHG emissions, or to expand them to companies creating other environmental and social harms. In any event, the University must ultimately compare the costs of implementing a procedure against its possible benefits.

[5] The previous standard was concerned with whether a "company's activities or policies cause substantial social injury," Stanford University, Statement on Investment Responsibility (1971, 2013), https://reports.aashe.org/media/secure/293/6/568/4093/Stanford%20University%20Statement%20on%20Investment%20Responsibility.pdf.

[6] "The Trustees believe that the preservation of a community in which ideas may be freely and openly debated on their merits is central to the University's academic mission and to its assurance of academic freedom. As Stanford's Statement on Academic Freedom states, the 'University's central functions of teaching, learning, research, and scholarship depend upon an atmosphere in which freedom of inquiry, thought, expression, publication and peaceable assembly are given the fullest protection.'" See Stanford University Board of Trustees, Statement on Investment Responsibility (1971, 2018),

climate science on which this report is premised is not the subject of serious dispute. Granted that today's scientific consensuses may be overturned sometime in the future, Stanford's taking institutional actions to reduce GHG emissions does not seem different from its requiring all new students to be immunized against measles, mumps, and rubella,[7] even in the face of arguments that vaccination can cause severe harms.[8]

All of this said, it is beyond our purview to determine whether the "abhorrent and ethically unjustifiable" proviso applies to divestment from fossil fuel industries when that divestment may be justified by self-protection. This is a matter for decision by the Trustees, who are responsible for the University's wellbeing in perpetuity.

A decision by the Trustees that the "abhorrent and ethically unjustifiable provision" is irrelevant to the harms caused by GHG emissions would not necessarily determine the University's investment decisions. Relevant factors would include an investment strategy's effectiveness in mitigating catastrophic harm[9] and its financial costs. The following section provides a framework to guide the Board's exploration of these questions.

## III. Endowment Investment Policies and Practices

After a brief overview of the management of Stanford's endowment, this section considers three policies that the Stanford endowment managers might pursue:

1. Engagement with the management of fossil fuel corporations.
2. Proactive investments in renewable resources and low carbon industries.
3. Divestment for the instrumental purpose of reducing GHG emissions by raising the costs of fossil fuels.

We conclude with a section on evaluating financial risks to Stanford's endowment from fossil fuel investments.

**Overview of the management of Stanford's endowment**

Because SCIR is deeply familiar—far more than we are—with the management of Stanford's endowment, we will just note a few points relevant to the issues at hand:

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https://reports.aashe.org/media/secure/293/7/691/5568/stanford_university_statement_on_investment_responsibility.pdf.

[7] Stanford University, Requesting a Religious / Philosophical Exemption from Required Immunizations, https://vaden.stanford.edu/sites/g/files/sbiybj10461/f/religiousorphilosophicalexemptionfromrequiredimmunizations.pdf.

[8] Notwithstanding political as well as empirical controversies about the right to carry, Stanford also prohibits the possession of firearms on campus. See Stanford Bulletin, Explore Degrees 2019-20, "Dangerous Weapons on Campus," https://exploredegrees.stanford.edu/nonacademicregulations/dangerous-weapons-on-campus/.

[9] Of course, Stanford's actions, viewed in isolation, will have no discernable effects on Stanford. The bet is on the parallel and reciprocal actions of many institutions.

- The Merged Pool (hereafter the "endowment") includes substantially all of Stanford's investible endowment assets.
- The endowment is managed for the sole purpose of supporting Stanford University's mission in perpetuity.
- The overall strategies for managing the endowment are strongly influenced by the successful model that David Swensen has developed for Yale University.
- Stanford seeks diversification of asset classes and diversification of industries within asset classes.
- Stanford regards natural resource holdings generally and fossil fuel holdings in particular as components of a diversified portfolio—particularly as hedges against inflation.
- SMC recognizes that "climate change alters the risk and return characteristics of conventional energy holdings. As a prudent fiduciary, SMC incorporates the risks associated with carbon when considering conventional energy holdings. In economic terms, we try to account for the externalities associated with burning hydrocarbons, which helps us invest sensibly in a sector undergoing significant change."[10]
- SMC's Ethical Investment Framework states: "While certain ethical and social risks rise to the broad level of asset allocation, many risks are best analyzed at the level of specific businesses. Businesses that consistently and willfully mistreat stakeholders usually make poor long-term investments, as stakeholder dissatisfaction, and perhaps even legal sanction, erode the value of the business. We believe the University has more productive places to invest its capital. … Through close dialogue with our external investment partners, SMC reinforces attention to ethical and social factors that impact security-level investments."[11]
- Stanford makes few, if any, direct investments. Rather, its investments are made as a limited partner in funds that own the investible assets.
- Stanford is a limited partner in some private equity partnerships with upstream investments in fossil fuels.
- Stanford is a limited partner in some venture capital partnerships with investments in low carbon technologies.

## Engagement with the management of fossil fuel corporations

One strategy for improving the behavior of publicly traded large cap companies is shareholder engagement: electing company management and proposing and voting on corporate resolutions. Shareholders concerned with climate change might use their voting power to press certain fossil fuel company management to disclose climate risks, reduce GHG emissions, cease misleading the public about the risks of climate change, and develop carbon capture and renewable energy technologies.

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[10] Stanford Management Company: Ethical Investment Framework. https://smc.stanford.edu/wp-content/uploads/2018/12/SMC-Ethical-Investment-Framework.pdf.
[11] Ibid.

Unfortunately, Stanford's potential to influence the management of fossil fuel companies in this way is minimal in the context of other actors in these markets and the attenuated nature of its current investments.

The large majority of voting shares are owned by institutional investors like BlackRock, State Street, and Vanguard:

> Shareholder voting is dominated by institutional investors … [which] own 70 percent of the outstanding shares of publicly traded corporations in the United States. Individual (or "retail") investors own only 30 percent. Institutional investors also have significantly higher voting participation rates, casting votes that represent 91 percent of the shares that they hold compared with only 29 percent for retail investors. The combination of these factors gives institutional investors a disproportionately large influence over voting outcomes.[12]

There is promising news in that the CEOs of BlackRock and State Street recently indicated their intent to press companies to address climate risk and "take appropriate voting action against board members" at companies with poor ESG ratings that do not have plans for improving their scores," respectively [13] The extent to which these firms actually exercise shareholder power with respect to climate risks remains to be seen, however.

Meanwhile, some institutional investors are working to ensure that they have the appropriate information to evaluate the risk that climate change poses to their portfolio. Sir Christopher Hohn of TCI Fund Management has announced his intention to utilize investor pressure to improve disclosure requirements, noting that "Investing in a company that doesn't disclose its pollution is like investing in a company that doesn't disclose its balance sheet… [i]f governments won't force disclosure, then investors can force it themselves." TCI Fund Management controls $28 billion in assets and has returned 18% per year since its inception in 2003.[14]

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[12] James R. Copland, David F. Larcker, and Brian Tayan, The Big Thumb on the Scale: An Overview of the Proxy Advisory Industry (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3188174. See also, Lucian Bebchuk and Scott Hirst, The Specter of the Giant Three (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3385501.

[13] Larry Fink, Letter to CEOs, Blackrock, A Fundamental Reshaping of Finance (2020), https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter; see also, Cyrus Taraporevala, State Street Global Advisors, https://www.wlrk.com/docs/SSgA_CEO_Letter_on_our_2020_Proxy_Voting_Agenda.pdf.

[14] Gillian Tett, "Hedge Fund TCI Vows to Punish Directors over Climate Change," *Financial Times*, Financial Times, 1 Dec. 2019, www.ft.com/content/dde5e4d4-140f-11ea-9ee4-11f260415385. Alicia Seiger, Director of the Steyer Taylor Center for Energy Policy and Finance at Stanford has similarly noted that "investors must integrate sustainability metrics into compensation structures and rethink benchmarking and backtesting. Climate change promises sharp and abrupt turns in the road ahead." Alicia Seiger, "Mother Nature is Not Calling for Divestment," Stanford Law School, "The Legal Aggregate," 20 May 2019, https://law.stanford.edu/2019/05/20/mother-nature-is-not-calling-for-divestment/.

The proxy advisory industry also is dominated by a handful of firms, including Institutional Shareholder Services (ISS) and Glass Lewis & Co. To date, the industry has not been concerned with climate risks. [15]

A third set of considerations involves the nature of Stanford's fossil fuel investments and the way they are managed. Stanford's fossil fuel holdings tend to be in upstream private partnerships, where the opportunities for influence are attenuated, if only because their businesses may not present significant opportunities to reduce GHG emissions.

Stanford Management Company does not make investments directly. Rather, it invests through managers who own and retain control over voting corporate shares. Although university endowments have limited influence over these managers' decisions, it is possible to engage them in discussing "most effective means of addressing climate change risks in the portfolio."[16] This quote, from a letter from David Swensen, Yale's Chief Investment Officer, goes on to describe the issues that Yale discusses with external managers.[17] Stanford has similar conversations with its managers.

The University might consider making direct investments in publicly traded fossil fuel companies that have the capacity to improve their carbon footprints in order to join other institutions in advocating their reform. If it were to take this approach, however, these investments might best be managed by an internal entity other than SMC, whose mission is appropriately focused on financial returns. Even with minimal ownership, Stanford could be a shareholder activist, giving voice to the expertise of its researchers in the climate arena. We should note, however, that this approach is in tension with the divestment strategy discussed below and might be thought of as a mutually exclusive alternative.[18]

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[15] Copland et al.

[16] David Swensen, Letter to the Yale Community, February 20, 2020, Update on Yale's Approach to Climate Change and Investments, http://investments.yale.edu/.

[17] Ibid., 2. "Assess: the greenhouse gas (GHG) footprint of prospective investments; the direct costs of the consequences of climate change on expected returns; the financial costs of policies (such as a carbon tax) aimed at reducing GHG emissions on expected returns. Discuss with company managements: the financial risks of climate change; the financial implications of prospective, well-crafted government policies to reduce GHG emissions. Encourage company managements: to mitigate financial risks and increase financial returns by reducing GHG emissions. Avoid: companies that refuse to acknowledge the social and financial costs of climate change and that fail to take economically sensible steps to reduce GHG emissions. Members of my [Swensen's] staff speak with each manager about Yale's policies and how they apply to the manager's portfolio. This process communicates Yale's position in a clear and consistent manner and gives Yale and the manager an opportunity to discuss the principles underpinning Yale's policies. Investments Office staff regularly engage managers regarding the risks associated with climate change."

[18] Apart from the difficulty of publicly explaining pursuing both strategies simultaneously, one consequence of divestment is that "divested holdings are likely to find their way quickly to neutral investors. These investors might have less developed corporate engagement toolkits and might be less willing to pressure fossil fuel companies on issues of environmental sustainability." Ansar et al. 2013, 71-73.

## Proactive Investments in Low-Carbon Technologies

A proactive investment strategy is one that allocates investment funds to low-carbon technologies with the goal of reducing GHG emissions by hastening the adoption of those technologies.

To the extent that the Stanford Management Company (SMC) can identify investments that achieve this goal at the same time as they hold the promise of attractive risk-adjusted financial returns for the endowment, this benefits Stanford and the world at large. Unfortunately, our research suggests that such opportunities may be difficult to find.

Let us begin by defining relevant terms:

- Low-carbon technologies refer to the broad category of technologies, resources, and organizations that represent pathways to a low-carbon economy. These include renewable energy resources, energy efficiency, energy storage, transportation, industrial electrification, and alternative food products.
- Additionality refers to investments that increase in the availability of low-carbon technologies that would not have been made by ordinary commercial investors in a business-as-usual scenario.[19] An investment has additionality when it goes beyond being aligned with the investor's values and is likely to contribute to GHG reductions.
- Non-concessionary investments achieve environmental benefits at the same time as they expect market-rate (or better) returns. Concessionary investments sacrifice risk-adjusted returns for environmental benefits.

*Opportunities for impact in low-carbon investments*

There are opportunities to make non-concessionary investments in low-carbon technologies, such as solar and wind energy, in public markets. But investments in secondary public markets are not likely to have additionality: a socially motivated investor's purchase of stocks will have no effect on the price of those stocks or on the company's productivity.

Rather, the possibilities lie in private markets—particularly venture capital and real estate. Investments in these asset classes have the potential to advance low carbon technologies by virtue of the managers' special knowledge and expertise in the sectors. Some of these opportunities are described below.

**Venture capital.** In 2019, SMC had an allocation target of 30% of the endowment to its private equity asset class; of this, venture capital (VC) represents well under 10% of the endowment.[20] Through these allocations, Stanford can invest in VC funds that are pioneering such technologies as electric vehicles, batteries, aircraft engines, and advanced wind turbines. To a certain extent,

[19] Brest, Gilson, and Wolfson, "How Investors Can (and Can't) Create Social Value," Stanford Social Innovation Review, https://ssir.org/up_for_debate/article/how_investors_can_and_cant_create_social_value.
[20] Stanford Management Company, *Stanford University Investment Report*, 2019.

SMC already does this. In addition to vying for space in top-tier venture funds, SMC evaluates potential partners based on their value alignment with the University, among other criteria.[21]

Stanford already has partners with holdings in some of the above low-carbon technologies. Greg Milani, former Senior Managing Director of SMC, notes that one of the benefits of VC investments is that it provides Stanford with a competitive edge in anticipating future technology trends. "Investing in venture capital helps Stanford Management Company get its compass pointing in the right direction a little bit before the rest of the market—and that's invaluable." He cites Stanford's success in following technology trends through partners with early access to PC's, the Internet, and social networking from the 1990's and early 2000's. With respect to the technology industry, Milani also points out that Stanford is in a unique position to access high quality venture capital, referring to

> [Stanford's] edge in venture capital by virtue of the its geography, the mix of faculty and students with the venture and entrepreneurial communities, the relevance of the curriculum to the tech ecosystem, and the number of alumni working at venture capital and technology firms. We're in an advantageous position to get a first look at new and up-and-coming venture firms, to be a helpful partner to them, and to secure meaningful commitments to their funds.[22]

**Real estate.** In 2019, SMC had an allocation target of 8% of the endowment to its real estate asset class, which is "is primarily focused on office, retail, residential, industrial, and leisure assets in the United States."[23] Through its external partners, Stanford may have opportunities to fund retrofits and other upgrades that reduce their energy consumption.[24]

*Creating additionality through minimally concessionary investments*

Even in the realms of venture capital and real estate, however, both Lloyd Kurtz of Wells Fargo and Rob Wallace, the CEO of Stanford Management Company, thought that it was difficult for Stanford's endowment to identify non-concessionary investable opportunities in the low-carbon space. Although we learned a great deal from the report of the Decarbonization Advisory Panel for the New York State Common Retirement Fund,[25] co-authored by Alicia Seiger, we are

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[21] John Glynn and Cameron Lehman, "Stanford Management Company in 2017: Venture Capital and Other Asset Allocation," Case No.SM294, 2018. https://www.gsb.stanford.edu/faculty-research/case-studies/stanford-management-company-2017-venture-capital-other-asset.

[22] The TomKat Center for Sustainable Energy supports early-stage research by Stanford faculty in the area of sustainable energy. https://tomkat.stanford.edu/research.

[23] Stanford Management Company, *Stanford University Investment Report*, 2019.

[24] Though not within SMC's purview, Stanford's endowment includes 8,810 acres of land managed by Land, Buildings & Real Estate. Stanford's land represents an opportunity to reduce internal GHG emissions through investments in retrofits of Stanford-owned buildings and property. These retrofits often pay for themselves in energy cost savings over short time horizons[24]. These retrofits directly impact Stanford's Scope 1 emissions.

[25] https://www.osc.state.ny.us/reports/decarbonization-advisory-panel-report.pdf.

uncertain about the extent to which its recommendations would fit the investment approach of the Stanford endowment.

Since socially neutral investors already fund low-risk investments in existing infrastructure (e.g. existing solar energy), opportunities for impact lie in early-stage technologies that either require taking greater risks than commercial investors would accept and a greater tolerance for volatility, or accepting a smaller share of ownership in the investee companies that commercial investors would demand. These concessionary investments stand to achieve additionality in three ways:

1) They reduce the cost of capital for low-carbon infrastructure projects that otherwise lack sufficient funding.
2) Stanford may invest with partners who provide valuable technical assistance to organizations building low-carbon technologies or promote energy efficiency. The Stanford endowment cannot itself provide this service, but it may be able to partner with low-carbon venture funds that can.
3) Stanford's investments in low-carbon technologies may have a signaling power that encourage investments by other institutions. In aggregation, these investments could have far more impact than the Stanford endowment alone. Stanford's investments also could lower the transaction costs for other endowments to invest in low-carbon technologies.

By definition, concessionary investments in low carbon technologies are likely to reduce endowment income, and could only be justified by their benefits in reducing GHG emissions. The strongest case for Stanford's making concessionary investments is one where the benefit ultimately accrues to the University's core missions of teaching and research by mitigating the harms of climate change described in the introduction. Of course, the direct benefit of any concession to Stanford is likely to be miniscule. But if Stanford can stimulate and contribute to similar investments by other endowments, pension funds, and the like, it may reap reciprocal benefits. It is beyond our purview to determine whether and to what extent this is likely.

## Divesting from fossil fuels and other signaling as a mechanism to decrease GHG emissions

Fossil fuel divestment is typically defined as "eliminating investments in major coal, oil and gas companies and refusing to acquire new investments in such companies moving forward."[26] There are both "direct" and "indirect" mechanisms through which divestment can reduce GHG emissions.[27] See Figure 1. Through either direct financial impacts or indirect changes in perception, policy, and/or behavior, divestment aims to: (1) drive an increase in the cost of capital to fossil fuel companies and (2) increase the cost of fossil fuel products to businesses and

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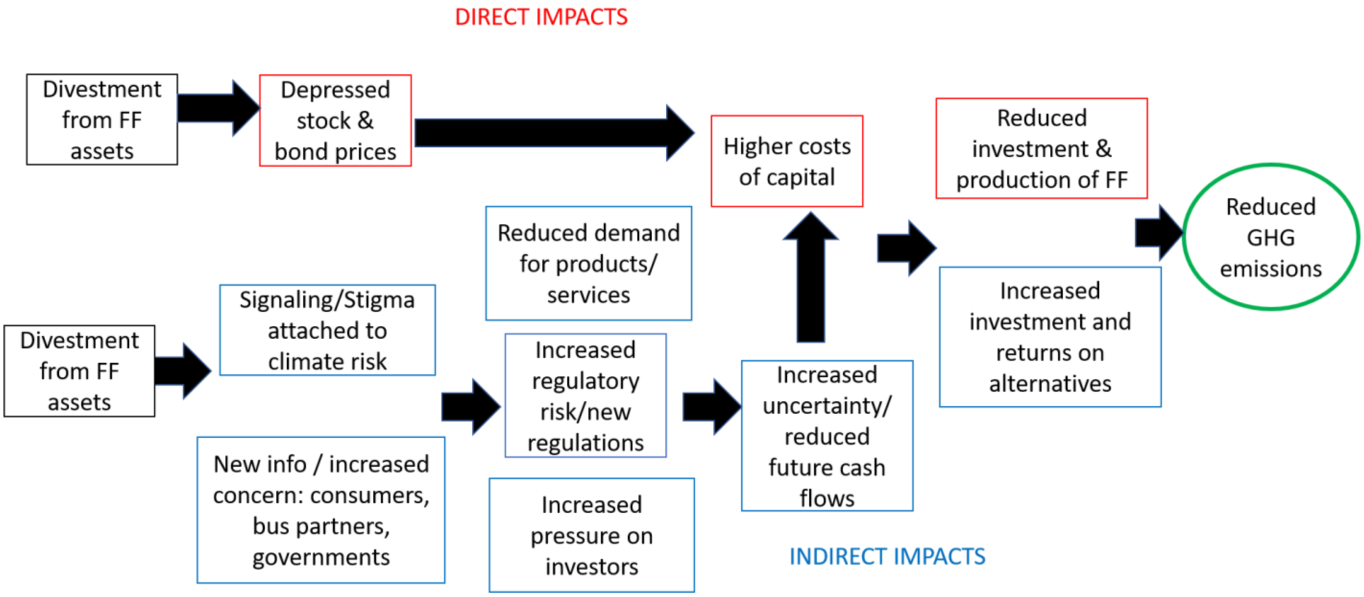
[26] Alison Schultz, "The Financial Impact of Fossil Fuel Divestment: How Does Divestment Affect the Share Price of Targeted Companies?" (MA thesis, University of Kassel, 2017), 1.
[27] Ansar et al., "Stranded assets and the fossil fuel divestment campaign: what does divestment mean for the valuation of fossil fuel assets?," Smith School of Enterprise and the Government – University of Oxford, (2013): 12-13, accessed February 27, 2020, https://www.smithschool.ox.ac.uk/publications/reports/SAP-divestment-report-final.pdf.

consumers, thus leading to a (3) lower demand for fossil fuels, (4) greater use of low carbon alternatives and, ultimately, (5) reduced GHG emissions.

Figure 1. Theory of Change for Divestment Impacts




The objective of divestment is to reduce GHG emissions, thereby mitigating the harm that global warming will impose on Stanford as well as the world at large. This section of our report examines the evidence that divestment is likely to achieve this goal. Related to indirect mechanisms, we also consider other ways that endowments can signal the declining value of fossil fuel investments.

**The Fossil Fuel Divestment Movement**

Like most previous divestment campaigns, the growing fossil fuels divestment movement had its beginnings in the U.S. The movement, started by students at Swarthmore College in solidarity with local citizens protesting coal mining in the Appalachian Mountains, prompted the college to divest from the largest 200 fossil fuel companies and freeze new investment in the industry. Swarthmore was joined by other institutions, and the movement gained significant momentum when Bill McKibben's 2012 article in *Rolling Stone*, "Global Warming's Terrifying New Math," went viral.[28] This article highlighted the difference between the current pace of CO2 emissions and that which would meet the 2009 Copenhagen Accord designed to keep global warming below a 2 degree C target. As part of the solution, McKibben called for a fossil fuel divestment campaign to "force the hand" of companies and governments. The movement was catalyzed by an online network, 350.org, founded by a group of students and funded by McKibben. That organization has played a pivotal role in disseminating information and supporting independent

[28] McKibben, https://www.rollingstone.com/politics/politics-news/global-warmings-terrifying-new-math-188550/.

local groups as part of a grass roots effort to stigmatize the industry, change public opinion, and pressure community and political leaders.

In contrast to previous divestment campaigns, the “Fossil Free” movement has benefitted from the use of technology and social media to allow the rapid sharing of ideas and practices across diverse grass roots efforts. The fossil free campaign has gained scope and scale rapidly with an early group of morally motivated divestors being joined by a second wave concerned with growing financial and fiduciary risks. Building on this momentum, the campaign has expanded beyond the U.S. and now is attracting a growing number of large asset owners including the Fourth Swedish National Pension Fund (AP4), the Fonds de Reserve pour les Rétraites in France (FRR), the United Nations Staff Pension Fund, as well as several large pension and retirement funds in the U.S.[29] In addition, groups of investors, such as the Climate Action 100+ with over $33 trillion in assets under management, have come together to evaluate whether fossil fuel companies are compliant with the climate goals of the Paris Accord and to use their power as shareholders to engage with company management.[30] Other asset managers and endowments are using environmental, social and governance (ESG) screens to evaluate their holdings, but these measures are broader and do not focus solely on GHG emissions, which is the goal of this research.[31] Figure 2 below shows the typical progression of a divestment campaign over time.[32]

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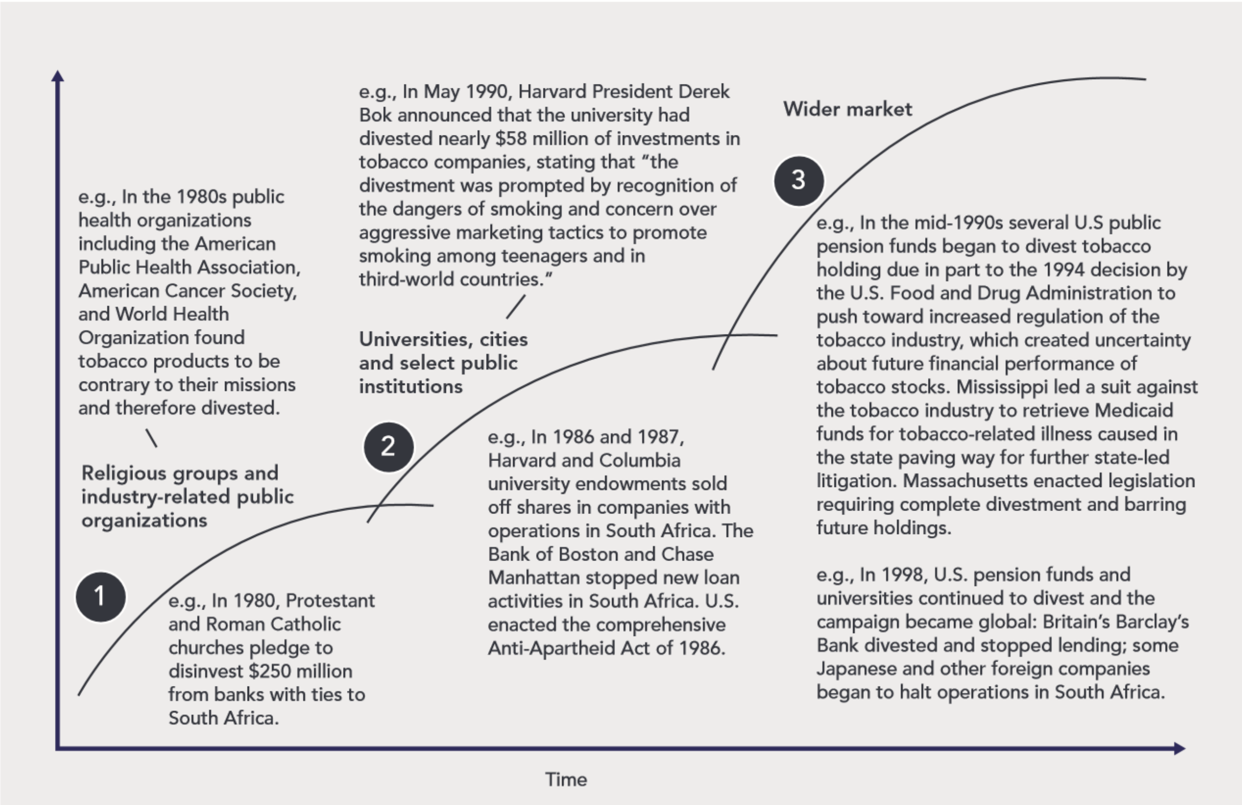
[29] Brian et al., “Beyond Divestment: Using Low Carbon Indexes,” MSCI Research Insight, msci.com, March 2015.
[30] “Helping Energy Investors Understand Climate Risks,” Carbon Tracker Initiative, Annual Review, 2018-2019, September 2019, 16-17.
[31] Aziza Kasumov, “ESG-Friendly Endowments Don’t Pay a Performance Price: Study,” from FundFire, February 24, 2019.
[32] Ansar et al., “Stranded assets and the fossil fuel divestment campaign,” 10.

Figure 2. The Three Waves of a Divestment Campaign




The movement to divest from fossil fuel industries has been likened to the movement to divest from South Africa in the 1970s and 1980s. The earlier campaign employed boycotts and public shaming to induce American companies to cease doing business in the country during the apartheid regime. In *The Effect of Socially Activist Investment Policies on the Financial Markets: Evidence from the South African Boycott*, Siew Hong Teoh et al. captured the general view of students of the movement:

> In all, the evidence from both individual and legislative actions, taken together, suggests that the South African boycott had little valuation effect on the financial sector. Despite the prominence and publicity of the boycott and the multitude of divesting companies, the financial markets' valuations of targeted companies or even the South African financial markets themselves were not easily visibly affected. The sanctions may have been effective in raising the public moral standards or public awareness of South African repression, but it appears that financial markets managed to avoid the brunt of the sanctions. This may be an important point for future activists who are considering using the tools of the boycott for other causes.[33]

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[33] Teoh et al., *Journal of Business* 72 (1999):1, 83, http://www.middlebury.edu/media/view/443860/original/effects_of_socially_activist_investment_policies.pdf

But if the South Africa movement had no direct effect through financial mechanisms, the authors note their possible indirect effects "in raising the public moral standards or public awareness of South African repression." The movement likely contributed to the adoption of the Sullivan principles,[34] "which relied on managerial engagement rather than on divestment," and to Congress's adoption of the Comprehensive Anti-Apartheid Act of 1986, both of which played a role in ending apartheid.

**Direct Impacts of Divestment**

Divestment is unlikely to increase the costs of capital for fossil fuel companies or increase the cost of fossil fuels through purely financial mechanisms.[35] One study associated individual, financially motivated fossil fuel divestment announcements with a stock price reduction of 0.5%.[36] However, the long-term effects on stock prices are unclear. Many entities that are pursuing or considering divestment own too few fossil fuels stocks to affect stock prices.[37] University endowments, in particular, are underexposed to these industries. Indeed, divestment actions undertaken by universities in the United States have been largely ineffective in a direct financial sense because stocks are immediately acquired by value-neutral investors.[38]

We have not seen research evaluating the effects of divestment on non-listed companies or state-owned producers. These entities have substantial stakes in oil and gas reserves and might indeed profit from other institutions' divestment from their publicly traded competitors.[39]

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[34] The Sullivan Principles were developed in 1977 by Rev. Leon Sullivan, an African American minister and member of the board of General Motors. The principles demanded equal treatment of employees regardless of their race both within and outside of the workplace and were eventually adopted by more than 125 U.S. corporations with operations in S. Africa, https://en.wikipedia.org/wiki/Sullivan_principles

[35] Noam Bergman, "Impacts of the fossil fuel divestment movement: effects on finance, policy and public discourse." *Sustainability*, 10 (7), (2018): 6-14, http://sro.sussex.ac.uk/id/eprint/77553/; Rupert F. Stuart-Smith et al., "Fossil Fuel Divestment and Engagement on Climate Change: advice for investors," Smith School of Enterprise and the Government – University of Oxford, (2018): 3, accessed February 27, 2020, https://www.oxfordmartin.ox.ac.uk/downloads/briefings/Fossil%20_Fuel_Divestment_and_Engagement_on_Climate_Change.pdf.

[36] Schultz, "The Financial Impact of Fossil Fuel Divestment," 65-67.

[37] Ansar et al., "Stranded assets and the fossil fuel divestment campaign," 40; Shaun William Davies & Edward Dicksin Van Wesep, "The unintended consequences of divestment," *Journal of Financial Economics*, 128, (2018): 567-571, https://doi.org/10.1016/j.jfineco.2018.03.007; Arjan Trinks et al., "Fossil Fuel Divestment and Portfolio Performance," *Ecological Economics*, 146, (2018): 746, https://doi.org/10.1016/j.ecolecon.2017.11.036.

[38] Christopher Ryan & Christopher Marsicano, "Examining the Impact of Divestment from Fossil Fuels on University Endowments" *Roger Williams Univ. Legal Studies Paper No. 195* (2020): 5-14, http://dx.doi.org/10.2139/ssrn.3501231

[39] If it were to lead to a significant reduction from fossil fuel supply following reduced production from divested companies. Schultz, "The Financial Impact of Fossil Fuel Divestment," 68; Christophe McGlade et al., "The Oil and Gas Industry in Energy Transitions Insights from IEA analysis," International Energy Agency, (2020), https://www.oecd-ilibrary.org/energy/the-oil-and-gas-industry-in-energy-transitions_aef89fbd-en.

Divestment that reduces access to debt would be more likely to affect companies in poorly functioning financial markets, and thus hinder projects with larger capex.[40] However, there is insufficient evidence to know whether this has occurred.

**Indirect Impacts of Divestment**

Previous divestment movements—including those focused on apartheid in South Africa, tobacco companies and other "sin stocks," and political regimes in Darfur and Sudan—have worked to stigmatize an industry or government.[41] Negative perceptions of an industry or regime can result in behavior change among consumers, investors, lenders, business partners, and other stakeholders.[42] A negative reputation can lead to decreased demand for an industry's products, reduced access to capital, and stringent regulations.

Stigmatization of the fossil fuel industry might result in a reduction in GHG emissions through one or a combination of the following mechanisms: (1) increasing the likelihood of more stringent regulation or adverse political action; (2) market signaling; or (3) creating the momentum for a "tipping point" that would galvanize consumer and investor action. We describe below each of these mechanisms and the evidence about their efficacy in the context of fossil fuel divestment.

***Increased Regulatory Risk***. Ansar et al. write: "One of the most important ways in which stigmatization could impact fossil fuel companies is through new legislation,"[43] such as a carbon tax or stringent regulation of methane emissions.[44] In almost every campaign they reviewed, "from adult services, to Darfur, from tobacco to South Africa, divestment campaigns were successful in lobbying for restrictive regulation." Even prior to the actual adoption of regulations, stigma can inflict harm on its targets by increasing investors' *perceived risk of regulation*.[45] To the extent that this perceived risk is widely shared, estimates of the value of future cash flows (CFs) of firms will be negatively impacted, reducing stock price and increasing the cost of capital for these companies.

On this theory, the adoption of principles or practices to reduce the carbon footprint of endowment holdings by a leading group of universities could influence other endowments and

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[40] Ansar et al., "Stranded assets and the fossil fuel divestment campaign," 63.
[41] Ibid.; Schultz, "The Financial Impact of Fossil Fuel Divestment."
[42] Ansar et al., "Stranded assets and the fossil fuel divestment campaign," 37-38.
[43] Ibid., 14. See also Neil Gunningham, "Building Norms from the Grassroots Up: Divestment, Expressive Politics, and Climate Change," *Law & Policy*, 39 (4), (2017): 375, https://doi.org/10.1111/lapo.12083.
[44] In a similar vein, scholars have suggested that divestment may contribute to institutional change by making proposals such as a carbon tax more appealing to moderate and conservative constituencies. Luis E. Hestres & Jill E. Hopke, "Fossil fuel divestment: theories of change, goals, and strategies of a growing climate movement," *Environmental Politics*, (2019): 5-6, https://doi.org/10.1080/09644016.2019.1632672.
[45] In fact, it is possible that the perception of such risk may be changing across the fossil fuel industry, as following statement from Royal Dutch Shell, "Shell Annual Report and Form 20-F 2018 – Strategic Report," (2019): 16, accessed February 27, 2020, https://reports.shell.com/annual-report/2018/servicepages/downloads/files/strategic_report_shell_ar18.pdf. See also Occidental Petroleum Corporation, "2018 Annual Report," (2019): 8, accessed February 27, 2020, https://www.oxy.com/investors/Reports/Documents/Occidental-Petroleum_2018_Annual_Report_Bookmarked.pdf..

policy makers. Ultimately, if the actions of these investors change neutral investors' assessment of regulatory risks, their estimates of demand and future production will be revised downward, thus reducing the value of fossil fuel companies and lowering future production.

***Market Signaling.*** Some commentators assert that investors' "herding behavior" accounts for an overvaluation of fossil fuel companies, despite the regulatory risks to which they are subject. On this view, a coordinated divestment movement could change investors' estimates of the value of future cash flows for these firms and trigger a sell-off that would result in reduced future production.[46] Marsicano and Ryan suggest that "to the extent that multiple institutional investors with holdings in a targeted company divest at the same time, it is conceivable that declines in valuation would persist in the longer term."[47]

As noted above, this mechanism may be most effective if undertaken by multiple well-respected investors and, in addition, if the rationale for the decision is widely publicized, enhancing public pressure on other investors. The importance of media coverage of such actions was highlighted in one study of divestment from Sudan, which noted that the "intensity" of the campaign (as measured by media coverage) "significantly depresses the stock price of four companies collaborating with the Sudan government."[48] However, while a short-term effect was noted, there is no evidence of longer-term impact.

The impact of environmental activism on the perception of risks was studied by Vasi and King who found, "…risk is subjectively shaped by the political and social contentiousness of the market… we show that activists can influence risk perceptions by generating market signals about the underlying environmental activities in which a firm is or is not engaged."[49] In particular, they found that primary stakeholders (e.g., shareholders or investors whose interests are aligned with the firm's) are likely to have a stronger impact on perceptions, which is consistent with Marsicano and Ryan.

The impact of market signaling is likely to be highly context specific and, although theoretically possible, no evidence of long-term impacts has been documented to date in upstream oil and gas production or as a result of divestment from "sin industries."

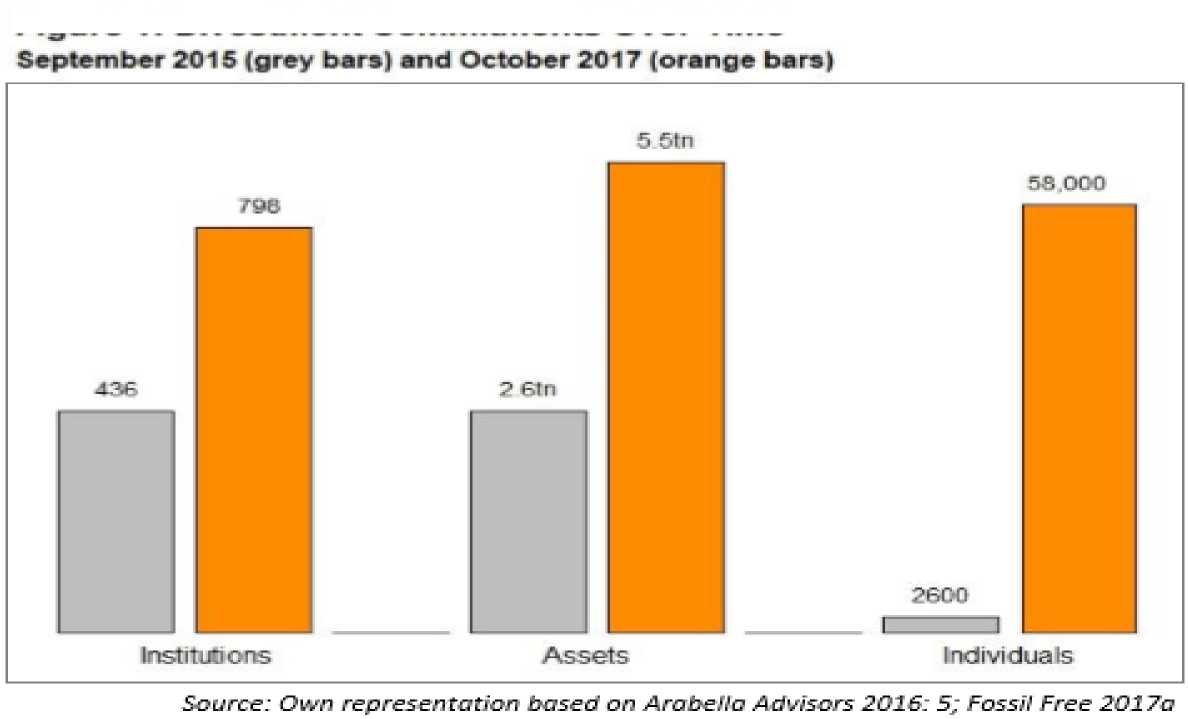
***"Tipping-point."*** At some point, the momentum and quantity of divestment commitments—whether for financial or environmental reasons—may reach a "tipping point" that results in a change in market norms that reduces the availability of capital for fossil fuel companies. Several large, financially motivated investors—including insurance companies, pension funds, and banking institutions (primarily in Europe)—have recently announced their intention to decrease

[46] Schultz, "The Financial Impact of Fossil Fuel Divestment," 35.
[47] Ryan & Marsicano, "Examining the Impact of Divestment from Fossil Fuels on University Endowments," 6.
[48] Ding et al. (2014), in Schultz, "The Financial Impact of Fossil Fuel Divestment," 15.
[49] Ian Bogdan Vasi and Brayden G. King, "Social Movements, Risk Perceptions, and Economic Outcomes: The Effect of Primary and Secondary Stakeholder Activism on Firms' Perceived Environmental Risk and Financial Performance," *American Sociological Review* 77, no. 4 (2012): 590.

investment in the fossil fuel industry.[50] These announcements suggest that investors are factoring into their decision making the financial risks associated with the fossil fuel industry and climate change more broadly. Increased skepticism of financially motivated investors, in addition to action by environmentally motivated investors, could increase the momentum and scope of financial impacts on the industry.

The figure below shows the number of institutions, the total assets, and the number individuals that have committed to divestment between 2015 and 2017.[51] If this pace continues, it is possible that the divestment movement will reach a "tipping point" at which business as usual becomes a liability for investors and business partners. The arrival of financially motivated "divestors" or sellers may send a stronger signal than purely socially motivated divestment in the early phases of the divestment campaign.

Figure 3. Divestment Commitments Over Time




If the movement continues to gain momentum, stigmatization of fossil fuels may create pressure on consumers, policymakers, investors, and business partners, increasing the likelihood of regulations, reducing consumer demand and triggering a downward assessment of financial returns. Stigmatization appears to have its greatest potential for reducing GHG emissions through coordinated messaging and action by respected investors.

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[50] "Helping Energy Investors Understand Climate Risks," Carbon Tracker Initiative, Annual Review, 2018-2019, September 2019, 18-19.
[51] Schultz, "The Financial Impact of Fossil Fuel Divestment," 5.

**Implementation Strategies**

An endowment that decides to divest from fossil fuel companies may consider a number of implementation strategies. Alternative divestment strategies may focus on: (1) targeted fuels (e.g. limited to coal or including all fossil fuels); (2) activities across the energy value chain (exploration and production, or including downstream activities, including carbon-intensive industries such as utilities, airlines and car manufacturers); and (3) thresholds apt to trigger divestment, such as carbon intensity.[52] The range of these alternatives is represented in Figure 4 below.[53]

Different approaches reflect trade-offs between ease of implementation, communication with stakeholders, and impacts on the volatility of returns. For example, focusing on a single fuel, such as thermal coal or tar sands, has the benefit of being relatively easier to implement (by facilitating coalition building on a specific issue) and communicate. As such, it may be more likely to create a "tipping point" within a narrow sector, than a broader approach based on carbon intensity. Perhaps divesting in this category could be used as a "proof of concept" that can be applied to other fuels/industries moving forward.

Setting the scope and guidelines about which companies to include in a divestment strategy will demand balancing likely GHG emissions reductions against potential impacts on the portfolio.[54] For instance, focusing on carbon intensity (a strategy that may include energy-intensive industries, such as cement and public utilities) can lead to a more significant GHG abatement than an approach centered exclusively on upstream production companies. However, the former requires more comprehensive and comparable information about $CO_2$ emissions than is typically available and will likely lead to divestment from a larger number of companies, negatively impacting portfolio diversification. Hence, the scope of the divestment strategy will affect its feasibility from the investors' perspective.

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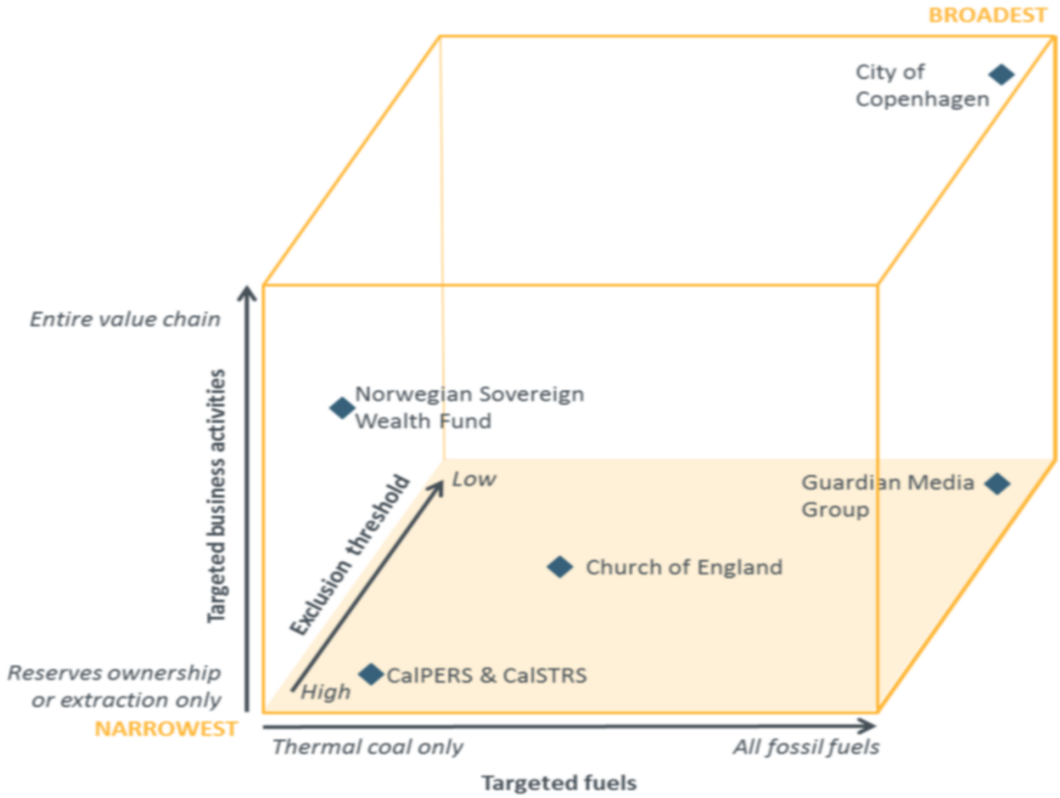
[52] Sibylle Braungardt et al., "Fossil fuel divestment and climate change: Reviewing contested arguments," Energy Research & Social Science, 50 (2019): 193-197, https://doi.org/10.1016/j.erss.2018.12.004; Meggin Thwing Eastman, "Fossil Fuel Divestment: a practical introduction," MSCI ESG Research Inc. (2016): 7-10, https://www.msci.com/documents/10199/759575ba-929f-4d7b-b9f3-fa7cfec7e9d2; John Hill, *Environmental, Social, and Governance (ESG) Investing: A Balanced Analysis of the Theory and Practice of a Sustainable Portfolio* (Cambridge: Academic Press, 2020), 16; Jean-Francois Mercure, "Toward Risk-Opportunity Assessment in Climate-Friendly Finance," *One Earth*, 1, (2019): 397, https://doi.org/10.1016/j.oneear.2019.11.007; William J; McNally, "Divestment and Climate Change," *Economics Faculty Publications*, (2017): 2-7, http://scholars.wlu.ca/econ_faculty/3; Stuart-Smith et al., "Fossil Fuel Divestment and Engagement on Climate Change," 2.

[53] Eastman, "Fossil Fuel Divestment," 9.

[54] Eastman, "Fossil Fuel Divestment," 14-20.

Figure 4. Approaches to Divestment




**Signaling the Declining Value of Fossil Fuels Without Divestment**

Yale University has not divested from its fossil fuel holdings. But since 2014, its Investment Office has worked actively with its external managers to address climate risks in the endowment portfolio. In a recent letter to the Yale community, Yale Chief Investment Officer David Swensen wrote:

> Yale's investment approach to climate change contributes to the broader societal goal of transitioning to clean energy. Under Yale's approach, which asks managers to incorporate the costs of carbon emissions in investment decisions, investments with large greenhouse gas footprints are disadvantaged relative to investments with small greenhouse gas footprints. When taking into account the full costs of climate change, investment capital flows towards less carbon-intensive businesses and away from more carbon-intensive businesses.
>
> Yale's investment policy regarding climate change reduces portfolio risk and supports our fiduciary responsibility – to provide substantial, stable financial support for current and future scholars through the prudent management of Yale's Endowment. This support

> enables Yale to pursue its mission and to contribute to climate change solutions through its greatest areas of strength: research, scholarship and education. ….[55]

Swensen's focus on the financial consequences of investments in fossil fuel industries may have more sway with financially motivated investors than investment decisions based on environmental concerns, however great they may be. As mentioned earlier, Stanford has similar conversations with its managers. Perhaps publicizing the process, as Yale does, could influence other endowments.

Previous studies have highlighted the importance of communication and media attention in social movements. For example, activist shareholders use the power of communication with corporate management and other shareholders to increase perceptions of risk and change behavior, without divesting. As noted in Vasi, "protests that do not receive media coverage are unobservable and therefore have less informational value to the public and investors." Lipsky sums up the importance of media attention, "If protest tactics are not considered significant by the media…protest organizations will not succeed. Like a tree falling unheard in the forest, there is no protest unless protest is perceived and projected."[56] By making its voice heard to investment managers, and the Yale community at large, the Yale Investment Office is lending its credibility to the financial risks associated with climate change, which may influence not only the behavior of its investment managers, but also of other investors and community members.

**Conclusion**

For divestment to be an effective strategy for reducing GHG emissions, it must lead to changes in: (1) consumers' and businesses' behaviors; or (2) public policies that will affect companies' capital costs and consumers' demand for fossil fuels.

Based on academic literature and previous campaigns, we have little confidence that divestment will have any significant direct financial impact on the fossil fuel industry. The unique characteristics of the fossil fuel industry—the size of its market capitalization, its integral role in the global economy, and the outsize role of state-owned enterprises—in conjunction with the relatively small fossil fuel holdings of most large endowments (2-5%) represent challenges for a divestment campaign aimed at reducing GHG emissions.

Rather, the potential of the divestment movement lies in stigmatizing the fossil fuel industry based on its contribution to the societal harm created by GHG emissions. As in previous campaigns, the success of this approach will depend on increasing the likelihood of more stringent regulations or signaling new information about risks, thereby increasing the financial uncertainty of the sector.

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[55] Swensen, Letter to the Yale Community, February 20, 2020.
[56] From Baron 2005; King 2008a, King and Soule (2007) and Lipsky (1968): 1151, in Vasi et al. (2012), 581.

The adverse effects of divestment-related stigmatization, "while likely to cost fossil fuel companies billions, is unlikely to threaten their survival."[57] Putting the industry out of business is neither practical nor desirable in the near-term, because a lack of alternative energy sources. However, if divestment can impose costs on the industry that reflect the harms caused by GHG emissions, then it may reduce these emissions. Like a government-imposed tax, the additional costs incurred by fossil fuel companies will affect businesses and consumers, potentially accelerating the transition to renewable energy resources.

If well-respected and financially motivated investors begin divesting, their signaling value is likely to be stronger than if only environmentally motivated investors divest. Schultz concludes that divestment as a signal of over-valuation and the potential "synchronization of trading strategies" in reaction to new information, should be "most effective when divestment is financially motivated and promoted by well-known reputable investors."[58] The potential for investor action to have an impact, through shareholder resolutions or engaging with company management, has been documented for other environmental movements. "Shareholder activism sends a clearer signal to investors about the potential liabilities of unsound environmental practices. These signals…translate into higher levels of perceived risk and, ultimately, into weaker financial performance."[59]

The mechanisms through which a divestment campaign might increase the cost of fossil fuels and ultimately reduce GHG emissions are fraught with uncertainty. However, given the severity of the climate crisis and divestment's potential for impact, if the Board of Trustees believe that divestment has the potential to make a statement that will influence others and is costless (or nearly so) to the endowment, the strategy is worth their serious consideration.[60] An approach, like Yale's, that recognizes the growing risks of investments in fossil fuel on the endowment's financial returns not only avoids imposing costs on the endowment, but may create financial benefits. We believe that Stanford has adopted a similar strategy to evaluating climate risks. If so, SMC's publication of its policies in this respect may have influence with the Stanford community and beyond.

[57] Ansar et al., "Stranded assets and the fossil fuel divestment campaign," 39.
[58] Schultz, "The Financial Impact of Fossil Fuel Divestment," 67.
[59] Vasi et al 2012, American Sociological Review 77(4), 588.
[60] The point may be obvious, but to the extent that divestment succeeds in increasing fossil fuel companies' cost of capital, these costs will likely be passed on to consumers who, in the short term, may not have cost-effective substitutes for fossil fuels. Low-income consumers may be particularly affected by higher fuel prices. But this true of any strategy, including a carbon tax, aimed at increasing the cost of fossil fuels in order to hasten the transition to a low carbon economy. To date, the adverse consequences of climate change have disproportionately injured poor people.

## Assessing the Financial Impact to Stanford's Endowment of a Decision to Reallocate from Fossil Fuels

### A. Introduction

Natural Resources, and more specifically fossil fuels, have historically constituted a significant part of a diverse asset portfolio. Under Modern Portfolio Theory, managers purchase real assets with unique risk components, including infrastructure, fossil fuels, metals and mining, and real estate, in order to add diversity to a portfolio. This section (1) assesses the historical rationale underlying the inclusion of fossil fuels in the class of real assets; (2) analyzes the impact of various divestment strategies on risk and return; and (3) evaluates risks and rewards for various paths forward should the Board decide to reduce fossil fuel holdings in Stanford's endowment.

### B. Modern Portfolio Theory

**Basic Tenets**

Modern Portfolio Theory, as advanced by Harry Markowitz, provides a mathematical framework that allows investors to create portfolios that maximize return for a given level of risk. In this analysis, variance is used as a proxy for risk. Rather than considering the risk and return of an asset in isolation, Modern Portfolio Theory evaluates how the addition of that asset to the portfolio impacts the risk and return characteristics of the broader portfolio. If the contemplated asset includes variance that is uncorrelated with the assets in the portfolio, its addition can reduce the overall variance of the portfolio. This framework integrates expected returns, variances, and covariances to produce an asset allocation that delivers maximized returns for a given level of portfolio volatility.[61]

**Implications for Endowments**

In 2018, distributions from Stanford's endowment accounted for 22% of the University's operating budget.[62] The necessity of providing a predictable budget for the university imposes restrictions on the portfolio's volatility and on the minimum liquidity. An endowment's performance can significantly affect the university operations. Harvard has noted that endowment funding "is increasingly important as the University faces decreasing federal research support and increasing economic pressures."[63] This sentiment is confirmed by a study that found "a 10 percent negative endowment return is associated with an 8.2 percent reduction

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[61] G. M. Constantinides and A. G. Malliaris, "Portfolio Theory," *Handbooks in OR & MS*, vol. 9, Elsevier Science B.V., 1995, 1–30.
[62] "Stanford University Investment Report 2018," *Stanford Investment Office*, Stanford Management Company, https://smc.stanford.edu/communications/.
[63] Harvard University, "Annual Endowment Report" (Sept. 2014), 3, https://www.harvard.edu/sites/default/files/content/Annual_Report_Endowment_2014.pdf.

in payouts."[64] Keeping overall portfolio volatility in check is essential to insulating university operations from changing market conditions.

**Practical Limitations**

The Markowitz model shows high sensitivity to inputs. Slight changes in expected returns for an asset can concentrate allocation in only a few assets. Managers use modified strategies such as the Black-Litterman model to avoid this pitfall.[65] The Black-Litterman model generates an asset allocation based on the assumption that assets will continue to perform in the future as they did in the past, and then provides a framework to adjust the allocation based on the managers predictions about how asset performance will change in the future.[66] This leaves the asset allocation and risk/return profile of the portfolio heavily dependent on predictions of future returns and future volatility.[67]

### C. The Historical Role of Natural Resources in the Modern Portfolio

**Theoretical Justification**

Many managers consider natural resource holdings to offer a unique growth opportunity and a hedge against inflationary pressures. Natural resources, as inputs to a significant portion of economic activity, are highly sensitive to increases in GDP.[68] Despite poor performance in recent years, natural resource investments retain a role in modern portfolios because they are subject to a unique set of price drivers. As noted by Commonfund:

> Natural resource inputs underlie many facets of the economy. These inputs come in many forms: oil inputs in transportation, natural gas inputs in electricity, and metals and mining inputs in manufacturing, infrastructure and technology, for example. While each individual commodity experiences its own volatility based upon their respective supply and demand curves, there are opportunities to generate attractive relative returns by targeting higher growth and/or lower marginal cost investment opportunities, which can be resilient regardless of the point in the cycle and offer greater return potential.[69]

Natural resources investments also limit the volatility of a portfolio through diversification. Historically, rather than tracking with the broader equities market, natural resources tend to

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[64] Jeffrey R. Brown., et al., "How University Endowments Respond to Financial Market Shocks: Evidence and Implications," *American Economic Review*, 104, no. 3 (2014): 931–962., doi:10.1257/aer.104.3.931.
[65] Wikipedia, "Black-Litterman Model," https://en.wikipedia.org/wiki/Black%E2%80%93Litterman_model.
[66] Thomas M. Idzorek, "A Step-by-Step Guide to the Black-Litterman Model," July 20, 2004, https://faculty.fuqua.duke.edu/~charvey/Teaching/BA453_2006/Idzorek_onBL.pdf.
[67] Edwin J. Elton and Martin J Gruber, "Modern Portfolio Theory, 1950 to Date," *Journal of Banking & Finance*, vol. 21, no. 11-12, 1997, 1743–1759, doi:10.1016/s0378-4266(97)00048-4.
[68] "Revisiting the Rationale for Natural Resources and Commodities." *VanEck*, Nov. 1, 2017, www.vaneck.com/insights/blogs/natural-resources/revisiting-the-rationale-for-natural-resources-and-commodities.
[69] "Making the Case for Natural Resources Investing." *Commonfund*, May 7, 2019, www.commonfund.org/news-research/blog/post-natural-resources-investing/.

move in concert with inflation.[70] As noted by Commonfund, "natural resource related assets have historically shown a positive relationship with inflation. While there are no pure hedges to inflation (i.e. correlation of 1), natural resources have historically exhibited a higher correlation relative to other asset classes."[71] In the context of modern portfolio theory, natural resources provide variance that is hypothetically less correlated to the variance of other asset classes, thereby decreasing volatility.

Stanford describes the role that natural resources play in its endowment as follows: "Natural Resources provides important diversifying benefits to the Merged Pool, particularly in inflationary environments. The University's resources holdings span timber, metals, conventional and renewable energy, and agriculture."[72] Yale justifies its holdings in the natural resources space on similar grounds: "Equity investments in natural resources – oil and gas, timberland, metals and mining, and agriculture – share common risk and return characteristics: protection against unanticipated inflation, high and visible current cash flow, and opportunities to exploit inefficiencies. At the portfolio level, natural resource investments provide attractive return prospects and significant diversification."[73]

### D. The Impact of Fossil Fuels on Various Portfolios

#### Literature Review

While divesting from fossil fuels would reduce the diversity of the portfolio and thus theoretically increase volatility, academic literature suggests that divestment does not have a statistically significant impact on risk-adjusted returns.

Trinks et al. analyzed the impact of various divestment strategies by evaluating the performance and volatility of several hypothetical portfolios over the period 1927-2016. The study compared four portfolios: a market portfolio, a portfolio divested from coal, a portfolio divested from oil and gas, and a portfolio divested from all fossil fuels. The portfolio divested from coal showed slightly higher returns and slightly less variance in returns than the entire market portfolio, while the other divested portfolios showed slightly lower returns and slightly greater variance than the market portfolio. However, all the differences in measures of risk and performance were not statistically significant over the number of periods observed.[74]

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[70] "Revisiting the Rationale for Natural Resources and Commodities." *VanEck* (Nov. 1, 2017), www.vaneck.com/insights/blogs/natural-resources/revisiting-the-rationale-for-natural-resources-and-commodities.

[71] "Making the Case for Natural Resources Investing." *Commonfund* (May 7, 2019), www.commonfund.org/news-research/blog/post-natural-resources-investing/.

[72] Stanford Investment Office, "Stanford University Investment Report 2018," Stanford Management Company, https://smc.stanford.edu/communications/. Historically, the SMC has assumed an expected return for Natural Resources of 6% over the Commonfund Higher Education Price Index (HEPI). https://www.commonfund.org/commonfund-institute/higher-education-price-index-hepi-2/.

[73] Yale Investment Office, "2016 Endowment Update," Endowment Reports, http://investments.yale.edu/reports

[74] Arian Trinks et al., "Fossil Fuel Divestment and Portfolio Performance," *Ecological Economics*, 146 (2018): 740–748., doi:10.1016/j.ecolecon.2017.11.036. The authors suggest several possible reasons for the negligible impact of divestment. First, the original market portfolio contains a broad array of firms. This means that the diversification

The Grantham Research Institute at the London School of Economics & Political Science similarly found that excluding energy stocks from the S&P over the short-term (1989-2017), medium-term (1957-2017) and long-term (1925-2017) had less than 0.07% deviation in absolute annualized returns.[75] The review noted that divestment from energy--or any other single sector of the 10 major S&P sectors excluding real estate--did not substantially reduce in absolute returns over the short, medium or long-term .

Henriques and Sadorsky compared an optimized portfolio including fossil fuels with one excluding them. They created each portfolio by choosing from a basket of US industry indices and using the modern portfolio theory framework to allocate amongst the indices in a manner that minimized portfolio volatility for a given level of risk. The study found no statistically significant difference between the risk-adjusted returns of the two portfolios. However, the results of the study are limited because it only evaluated performance from 2005-2016. Additionally, the study was limited to US equities and allowed for the short selling of equities across specific industries.[76]

Platinga and Scholtens perform a similar analysis over a longer time frame: 1980-2015. They used a similar methodology to form portfolios, but they also optimized portfolios to different levels of risk-tolerance and compared divested portfolios to control portfolios at each level of risk tolerance. The study found no statistically significant difference between the volatility of the control portfolio and the volatility of the divested portfolio at any risk level. There was weak evidence of difference in returns that varied with the risk level. At the lowest risk level, the control portfolio outperformed the divested portfolio in a portion of the time periods, while at the highest risk level, the divested portfolio outperformed the control portfolio in a portion of the time periods.[77]

On the other hand, a study funded by the Independent Petroleum Association of America found that portfolios including the oil and gas sector outperformed divested portfolios on a risk-adjusted basis over the period from 1995-2015 by 0.23% annualized. The study, which sought to determine the impact of divestment on portfolios with asset allocations that mimicked those of five major university endowments, also found the non-divested portfolio to have greater volatility than a comparable divested portfolio.[78] Leaving aside possible biases based on the

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impacts of divestment are relatively small. As there are diminishing marginal returns to diversification, the impact on portfolio variance would likely be more significant for a smaller portfolio. Second, the fossil fuel sector did not generate returns in excess of risk over the study period.

[75] See Jeremy Grantham, *The Mythical Peril of Divesting from Fossil Fuels*. Grantham Research Institute on Climate Change & the Environment at the London School of Economics (June 13, 2018), www.lse.ac.uk/GranthamInstitute/news/the-mythical-peril-of-divesting-from-fossil-fuels/.

[76] Irene Henriques and Sadorsky Perry, "Investor Implications of Divesting from Fossil Fuels," *Global Finance Journal*, 38 (2018):30–44., doi:10.1016/j.gfj.2017.10.004, http://www.sciencedirect.com/science/article/pii/S1044028317300169.

[77] A. Platinga and B. Scholtens, *The Financial Impact of Divestment from Fossil Fuels* (Groningen: U. Groningen (March 29, 2016), https://www.rug.nl/research/portal/nl/publications/the-financial-impact-of-divestment-from-fossil-fuels(15db3398-6663-4918-8747-b32b25bca4c9).html.

[78] B. Cornell, "The Divestment Penalty: Estimating the Costs of Fossil Fuel Divestment to Select University Endowments" (Sept. 3, 2015), https://dx.doi.org/10.2139/ssrn.2655603.

funding source, the study has significant methodological limitations. First, the mutual funds selected are imperfect proxies for the classes of investments that they are intended to represent. Second, university endowments adjust their asset allocation on a regular basis. Mapping a fixed allocation over the time period of the study does not accurately simulate the endowments' investment practices.

### E. Limitations and Applicability to Stanford's Endowment

Backtesting as a methodology has inherent limitations. As noted by Dennis Logue, "we all know how to torture the data until it confesses."[79] It takes few methodological variations to randomly produce statistically significant results or to obscure a trend where one is present.[80] Malleable backtesting results requires substantial scrutiny in the context of the politically fraught issue of divestment. Where the *Journal of Ecological Economics* published a study finding that divestment had little impact on a market portfolio, a contrasting study funded by the Independent Petroleum Association of America unsurprisingly claimed divestment had a detrimental impact on portfolio performance. Researchers with an agenda and results with a susceptibility to manipulation deserve healthy skepticism in both methodology and outcomes.

Additionally, the impact on any portfolio is very sensitive to the assets of the portfolio in question. The results of the studies are therefore limited in their direct applicability to Stanford's Endowment, as they evaluate the impact of divestment on whole market portfolios, portfolios of industry sector indices, and portfolios of mutual funds representing major asset classes. In addition, all of the backtesting studies are necessarily derived based on historical data, and may not reflect estimates of the forward-looking impact to a portfolio. Forward looking analysis is more probative, but presents its own difficulties. Due to the limitations of Modern Portfolio Theory, asset allocation in investment funds is highly sensitive to the expected returns and expected variances used as inputs. Consequently, the forward-looking impact of divestment on fund performance is very sensitive to any assumptions made about the future returns of fossil fuel investments, and to the future volatility of these investments.[81]

However, despite their limitations, we believe that aggregate findings of backtesting studies, especially those with substantial data over extensive time frames, still have probative value. A broad review of the literature generally indicates that divestment would have had a minimal impact on the studied types of portfolios in the past. This lends support to the qualified inference that pursuing divestment in the future may have a minimal impact on risk-adjusted portfolio performance. However, only the Stanford Management Company ("SMC") has the complete information required to provide the forward-looking analysis of impact to the Stanford endowment specifically. Beyond individual memorandums on risks associated with specific investments, a detailed assessment of the overall impact of divestment to the risk-adjusted

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[79] Robert L. Hagin, "What Practitioners Need to Know…About Backtesting." *Financial Analysts Journal*, 46 (1990), no. 4: 17–20, doi:10.2469/faj.v46.n4.17.
[80] Ibid.
[81] Edwin J. Elton and Martin J. Gruber, "Modern Portfolio Theory, 1950 to Date." *Journal of Banking & Finance*, 21 (1997), no. 11-12: 1743–1759, doi:10.1016/s0378-4266(97)00048-4.

returns of the broader portfolio will be critical in guiding the decision the SMC Board of Directors and Stanford Board of Trustees in their decision-making process.

### F. Peer Decisions to Divest

While most universities have not divested their endowments from fossil fuels, a few have recently decided to eliminate fossil fuel assets to varying degrees. Although many have cited financial reasons, others have divested to have "clean hands" or in response to protests. Peer institutions have been split in their approaches to divestment.

In September 2019, the University of California announced its intention to sell all fossil fuel-related holdings from its $13.7 billion endowment and more than $70 billion pension fund, citing the long-term financial risk associated with retaining fossil fuel investments. In February 2020, Georgetown University similarly committed to divest direct oil & gas holdings in the next ten years in view of the "increasing the risk of investing in oil and gas companies," and a "more volatile range of financial outcomes" resulting from climate change. Both decisions were made under politically charged circumstances.

Other institutions, while noting concerns about the future value of fossil fuel investments, have opted for an intermediate approach in managing the diversification/return trade-off. In its 2019 Annual Report, Harvard noted its intention to "reduce our exposure to natural resources," citing "persistent negative returns in this legacy part of our portfolio." As previously noted, Yale Chief Investment Officer David Swensen directed the Yale endowment's external investment managers as follows:

> Yale asks that when making investment decisions on the University's behalf, you assess the greenhouse gas footprint of prospective investments, the direct costs of the consequences of climate change on expected returns, and the costs of policies aimed at reducing greenhouse gas emissions on expected returns. Simply put, those investments with relatively small greenhouse gas footprints will be advantaged relative to those investments with relatively large greenhouse gas footprints.[82]

### G. Alternative Paths Forward

As mentioned above, studies indicate divestment may have minimal impact on portfolio volatility and returns. However, additional practical considerations inform the costs and benefits of different potential responses to fossil fuel holdings. There are two dimensions in which a divestment strategy can vary: the extent to which a divestment strategy is pursued and the immediacy of execution.

In terms of the extent of divestment, one end of the spectrum would entail Stanford's Board of Trustees choosing to divest fossil fuel holdings across all public and private asset classes. While creating the clearest social signal, this strategy would pose greater difficulty in execution in view of the endowment's diverse holdings of asset classes and structure. Micromanaging external fund

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[82] Swensen, Letter to the Yale Community, Feb. 20, 2020.

managers may be infeasible, and could also impact top fund managers' willingness to work with Stanford. Moreover, active divestments from public equities would likely require reallocation from broad index strategies in favor of more actively managed funds with explicit mandates to avoid fossil fuels, potentially causing an increase in management fees or loss of access to certain high-performing funds.

At the other end of the extent spectrum, reallocating fossil fuel investments from the Natural Resources pool provides a more measured approach. This approach is more feasible in the context of the fund-of-funds structure of Stanford's portfolio, but would potentially limit the signaling value of divestment. The Natural Resources asset class "focus[es] primarily on private producers of resources, rather than outright holdings of commodities themselves."[83] This narrowed approach would focus on these specific partnerships dedicated to fossil fuels rather than scrutinizing the behavior of all external managers with broad portfolios that include fossil fuel holdings. Given the private nature of the holdings in Natural Resources, it is difficult to evaluate the exact extent to which this strategy would impact the risk and return characteristics of the portfolio, but SMC could likely minimize volatility changes by reinvesting in similarly positioned funds focused on other real assets, such as non-fossil fuel resources, real estate, or clean infrastructure.[84]

In terms of the speed of any contemplated action, immediate divestment represents one end of the spectrum. This would provide the clearest signaling value but would also incur significant transaction costs such as breakage and withdrawal fees. At the other end of the immediacy spectrum, gradually reducing exposure would provide lower signaling value but potentially mitigate monetary and relationship costs, as choosing not to renew future fossil fuel investments should impose minimal additional transactional costs compared with a strategy of choosing to divest.

### H. Final Thoughts

The analysis provided here assumes that Stanford Management Company and its chosen fund managers are able to fully and continuously account for the physical and regulatory risks posed by climate change. Based on these assumptions, our literature review supports the qualified inference that a decision to divest from fossil fuels may have minimal impact on the risk-adjusted performance of the endowment portfolio, although differences in the immediacy and the extent of any divestment strategy will incur varying amounts of near and long-term transactional costs. A detailed assessment by SMC of the overall impact of various strategies to the returns and volatility of the entire portfolio, as well as accounting for any transaction costs, will be critical in informing the decision the SMC Board of Directors and Stanford Board of Trustees.

Regardless of which path forward the Board chooses, the benefits and risks of natural resource holdings warrant careful monitoring. Divestment is only one of several potential responses to the emerging financial risks posed by climate change. Climate-driven financial and regulatory risks

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[83] Stanford Investment Office, "Stanford University Investment Report 2019," Stanford Management Company, https://smc.stanford.edu/communications/.

[84] This strategy would be an extension of the Board's 2014 decision to divest thermal coal.

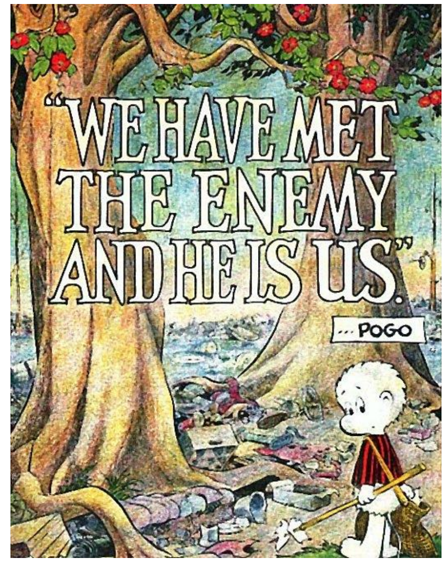
might have an outsized impact on the asset class. Stanford is uniquely positioned to facilitate conversations and request information from its partners about the evolving risks posed by climate change. Doing so would ensure that the Stanford Management Company is able to operate with a complete picture of the risks as it continues to protect the University's endowment for generations to come.

## Conclusion to Discussion of Investment Policies

To sum up the relationship of investment policies to the reduction of GHG emissions:

- Stanford University is not immune from harms caused by climate change. Hence, the University's efforts to reduce GHG emissions—whether through teaching, research, investment policies, or internal practices—are self-interested as well as altruistic. In isolation, any actions that the University takes will have only a miniscule impact on the University. Rather, their benefits that accrue to Stanford will depend on reciprocal actions by other institutions.
- The Statement on Investment Responsibility's "abhorrent and ethically unjustified" standard does not apply to proactive investments in renewable resources and low-carbon industries or to engagement with the management of fossil fuel companies. Whether it applies to divestment from fossil fuels with the aim of protecting Stanford, among others, from the harms of climate change is a question of interpretation for the Trustees.
- SMC may be able to engage its external managers on climate risk issues. However, the University can only be a bit player in efforts to engage the management of publicly held fossil fuel companies to reduce GHG emissions. Such engagement would be outside the purview of SMC and would likely best be done by a new entity within the University. It would also require owning stock in the companies to be engaged rather than divesting from them.
- While SMC should be, and *is*, open to making investments in renewable resources and low-carbon industries that offer good risk-adjusted financial returns, the opportunities for non-concessionary investments that have additionality (i.e., that are likely to increase the availability and use of low carbon resources) are quite limited. There may be some opportunities for minimally concessionary investments—typically, investments that incur somewhat greater risks given their likely returns. Whether the potential benefit in reducing GHG emissions is worth the concession is a matter for the Trustees' decision.
- Although divestment is highly unlikely to have any effects on fossil fuel companies through purely financial mechanisms, it is possible that it could have impact as part of a social movement to stigmatize fossil fuel use with the aim of changing the behaviors of consumers (by moving them toward greater energy efficiency and renewable resources); policy makers (by enacting regulations aimed at reducing GHG emissions); and other investors (by increasing the uncertainty of revenues from fossil fuel companies). While the movement to pressure South Africa to abandon apartheid provides an analogy, there are enough differences that one should not too readily consider it an encouraging precedent. Nonetheless, if divestment imposes no, or negligible, costs on the endowment, and the Trustees believe it is permitted by the Statement on Investment Responsibility, it is worth their serious consideration. Yale's approach, which does not divest from fossil fuel industries but asks managers to incorporate the costs of carbon emissions in investment decisions, not only incurs no costs but may reap financial as well as environmental benefits.
- Without second-guessing SMC's investment decisions, we wonder whether divestment from oil and gas companies would have a discernible effect on the endowment. However, we do not know how divestment would jibe with SMC's critically important relationships with external fund managers.

# IV. Internal activities by the University and its communities




Whether or not Stanford can hasten the transition to a low-carbon economy through shareholder activism, or by investing in renewable resources or by divesting from fossil fuels, we believe that the University and its communities of faculty, students, and staff can improve our own practices in ways that reduce GHG emissions.

The gist of this section is captured by Walt Kelly's iconic cartoon, captioned, "We have met the enemy and it is us," which was created for the first Earth Day in 1970.[85] We consider:

- Travel
- Food
- Healthcare
- A Stanford carbon tax
- Coordination of Climate Mitigation Research

[85] Copyright1970 by Okefenokee Glee & Perloo, Inc. Used by permission.

# Travel

**Introduction**

**Business Travel**. Based on an initial screening conducted by the Office of Sustainability, business travel is one of Stanford's highest Scope 3 emissions categories. Travel associated with university business—such as students getting to and from campus and attendance at conferences by faculty and staff—is estimated to emit over 26 million metric kilograms of $CO_2$ per year, a significant percentage of which is attributed to air travel.[86] As it has done with Scope 1 and 2 emissions, Stanford will need to set evidence-based targets to reduce its carbon footprint from business travel and develop a comprehensive strategy to reach them. But strategies to reduce university-related air travel will not realistically preclude, for instance, a student who lives on the East Coast from booking a cross-country flight home for Thanksgiving Break. Anticipating a non-trivial gap between air travel emissions that can be mitigated through reduction strategies and those that cannot, we hope to explore the following questions:

- Can Stanford reduce *some* of its GHG emissions from air travel by implementing a sustainable travel policy?
- Should Stanford compensate for GHG emissions that cannot be reduced by internal policies?
- What strategies are key industry players and peer institutions employing to reach carbon neutrality or related targets?
- What strategies are viable, feasible, and aligned with institutional priorities that Stanford can consider to reduce the impact of GHG emissions from business travel? In particular, we aim to evaluate:
  - Purchasing voluntary carbon offsets
  - Developing mission-linked carbon offset projects
  - Charging a carbon price for flight itineraries purchased and investing the funds in on-campus energy-efficiency projects[87]
- Are there strategies that enable Stanford to provide educational and research opportunities to students, faculty, and staff while also mitigating GHG emissions from business travel?

**Reducing GHG Emissions from Air Travel**

**Sustainable Travel Policy**. As we explain below, the university has two broad paths in *how* it seeks to mitigate travel emissions. A "quick win" approach would use carbon offsets to reduce net emissions quickly in the short-term, while a "last resort" approach uses offsets only to

[86] Information provided by Stanford Office of Sustainability.
[87] Note that these strategies are not mutually exclusive and can be used in parallel with each other.

mitigate residual emissions, with the goal of achieving net zero emissions in the long-term.[88] Although it is unlikely that Stanford can reduce travel emissions to net-zero, it should nonetheless aim to reduce emissions as much as possible and use offsets as a last resort.

The Office of Sustainability is currently working to quantify the amount of emissions per year from university business travel. Segmenting the total travel emissions by population (e.g. School of Earth faculty) and activity (e.g. traveling for an academic conference) would enable Stanford to identify "high emitting" populations and target them with internal policies. While we are still collecting this data, we believe that three main population-activity categories are high contributors to total business travel emissions each year:

1. Faculty flying to and from campus to attend meetings and conferences.
2. Students flying to and from campus for breaks and at the beginning/end of the school year.
3. Students flying to and from campus for study/research abroad programs.

There are several avenues Stanford can consider to reduce air travel. We will research the feasibility, cost, design, and implementation of the following travel-reduction strategies:

- *Consolidate Breaks* – Stanford's current academic calendar encourages students to fly home for Thanksgiving break, fly back to campus for final exams, and fly home again for the holidays.[89] Other quarter-system schools, like Dartmouth College, start the fall term a couple weeks earlier. Students take their final exams before Thanksgiving and enjoy a single, longer December break.[90] Stanford might significantly reduce student air travel at minimal cost by adopting a similar schedule.

- *Promote Virtual Conferencing* - Faculty and staff can be prompted to consider virtual conferencing before booking travel to attend a conference, meeting, or event in person. Stanford can ensure that all faculty and staff are adequately trained to use the Zoom video conferencing platform. Stanford administration can also create a decision-tree guide that encourages faculty and staff to factor carbon emissions into their decision to travel to a conference, meeting, or event.

- *Make Travel Emissions Data Public* - Stanford can make travel emissions data publicly available for each school/division and provide financial reward incentives for schools/divisions that meet specific, pre-determined reduction targets. Administrators can generate customized reports for each faculty and staff member detailing their travel emissions in a given year, helping create a sense of accountability for each individual's

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[88] Barreto et. al., "A study of carbon offsets and RECs to meet Boston's mandate for carbon neutrality by 2050," *MIT Sustainability Lab* (2018), http://sites.bu.edu/cfb/files/2019/05/MIT-S-Lab-Final-Report.pdf.
[89] Stanford Student Affairs, Stanford University, "Stanford Academic Calendar, 2019-2020," https://registrar.stanford.edu/academic-calendar.
[90] Office of the Registrar, Dartmouth College, "2019-20 Key Dates Academic Calendar," https://www.dartmouth.edu/reg/calendar/academic/19-20.html.

personal carbon footprint. These personal reports can also include guidelines for reducing travel, such as encouraging them to combine multiple trips.

- *Educate Students and Faculty on Climate Impact of Flying* - Stanford can use data to educate faculty and staff about the effects of flying on global warming. Websites, such as Shame Plane, provide visual information on how much Arctic ice will be lost and what lifestyle changes would be needed to compensate for flight emissions for a given trip.

- *Provide Local Alternatives* - Stanford can invest in more educational programs and experiences on or close to campus that students can participate in during breaks, thereby reducing the number of students who travel home or go on vacation. Northern California is abundant in recreational opportunities for every season. This tactic could also help foster a sense of place in the student body.

- *Highlight Alternatives for Short-Haul Routes* - Stanford can encourage staff, faculty, and students to consider traveling by train or bus on short-haul routes, particularly to destinations in Southern California. For some programs, chartering a bus may make this option more attractive for groups of students and faculty.

Stanford can also take the following steps to improve the efficiency of unavoidable air travel:

- *Encourage Climate-Oriented Options and Flight Offsets* - Stanford can work with Egencia—the university's travel booking and reimbursement system—to create an algorithm that prioritizes the most efficient flight options when faculty and staff use the system to book their flights.

    - Egencia already has a feature that calculates carbon emissions for each trip. It can use its carbon calculator feature to recommend the lowest carbon emissions flight options.
    - Since about 25 percent of airplane emissions comes from landing, takeoff, and taxiing,[91] Egencia can prioritize direct flights or flights with the fewest number of stops from flight options available.
    - Some airlines, such as Delta and Southwest, are offsetting emissions from all of their flights while others, such as JetBlue, are offsetting emissions from domestic flights.[92] Egencia can suggest and highlight airlines that offset flights for faculty and staff booking their trips. Importantly, this would reduce costs that Stanford would otherwise incur to offset flight emissions.

- *Make Sustainable Travel a Norm* - Through online content and meetings, Stanford can work to make sustainable travel practices a university-wide norm. Stanford can also

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[91] Yoon Jung, "Fuel Consumption and Emissions from Airport Taxi Operations," NASA Ames Research Center, https://flight.nasa.gov/pdf/18_jung_green_aviation_summit.pdf.
[92] "Delta is going carbon neutral," *The Verge*, https://www.theverge.com/2020/2/14/21137782/delta-carbon-neutral-greenhouse-gas-emissions-climate-change-airlines.

encourage students, faculty, and staff to only fly in economy class, since emissions associated with flying in business class are about three times as great as flying in coach.[93]

### Offsetting GHG Emissions from Air Travel

**Purchasing Voluntary Carbon Offsets.** A carbon offset is a reduction in GHG emissions external to an individual's or organization's activities that compensates for ("offsets") emissions from those activities. Carbon offsets are commoditized and traded in a private market based on the carbon dioxide equivalent that is 'removed' from the atmosphere. Offset projects range in substance and size from small-scale tree-planting to massive industrial methane capture.

Unfortunately, offset projects and the carbon offset market have faced considerable challenges in reaching their full potential as a means to mitigating climate change. Offset developers are incentivized to use the sale of offsets to make existing projects more profitable rather than create a new 'additional' project, which can cloud the true value of offset projects.[94] Moreover, current certification practices can involve a financial conflict of interest as project developers are often hiring their own auditors and certifiers to calculate offset values.[95] Finally, there are general technical difficulties in reliably measuring carbon removed from the atmosphere.[96] For these reasons, offset credits have fallen into disfavor with some climate-conscious corporate entities, such as Microsoft – who focuses on an internal carbon charge instead.[97]

Nonetheless, carbon offsets represent a low-cost investment that likely results in *some* emissions reductions, along with positive environmental and societal co-benefits. The Clean Development Mechanism (CDM) Gold Standard and the Voluntary Carbon Standard (VCS) have developed standards for certifying and registering carbon offsets. In order to be considered "high-quality," offsets must satisfy the following criteria:

- *Additional*: Carbon offset projects must lead to a carbon reduction that would not otherwise happen. Additionality underpins an offset's ability to drive change in net emissions; emissions can only be "offset" if it is clear that but-for the specific project those emissions would have occurred. Importantly, this means that the project cannot be compelled by any existing or pending regulation. Additionality has proven to be a source of uncertainty because emissions reductions from offset projects are compared to a counterfactual, unobservable baseline scenario of "business-as-usual" emissions that is inherently unpredictable. For instance, a polluter may pay a landowner to reduce deforestation as part of an offset program. But would one know with certainty which

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[93] The World Bank, "Calculating the Carbon Footprint from Different Classes of Air Travel," 2013, http://documents.worldbank.org/curated/en/141851468168853188/pdf/WPS6471.pdf.
[94] Umair Irfan, "Can You Really Negate Your Carbon Emissions? Carbon Offsets, Explained." *Vox* (February 27, 2020), https://www.vox.com/2020/2/27/20994118/carbon-offset-climate-change-net-zero-neutral-emissions.
[95] Barreto, "A study of carbon offsets and RECs to meet Boston's mandate for carbon neutrality by 2050."
[96] Cullenward et. al., "Managing Uncertainty in Carbon Offsets: Insights from California's Standardized Approach." Working Paper. Stanford Law School. August 2019.
[97] Brad Smith, "Microsoft Will Be Carbon Negative by 2030," Official Microsoft Blog, Microsoft (January 16, 2020), https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/.

trees were saved because of such projects, and which would have survived without them?[98]

- *Permanent:* Reductions from carbon offset projects must last in perpetuity.
- *Real*: Carbon offset projects must result in real, net reductions in greenhouse gas emissions.

| | **Additional** | **Not Additional** |
|---|---|---|
| **Real** | An offset project developer preserves trees that would have otherwise been cut down and mitigates the release of the 3 million tonnes of carbon dioxide emissions it promised. | An offset project developer preserves trees that wouldn't have been otherwise cut down and mitigates the release of the 3 million tonnes of carbon dioxide emissions it promised. |
| **Not Real** | An offset project developer preserves trees that would have otherwise been cut down and mitigates the release of 2.8 million tonnes of carbon dioxide emissions, 200,000 less than what it promised. | An offset project developer preserves trees that wouldn't have been otherwise cut down and mitigates the release of 2.8 million tonnes of carbon dioxide emissions, 200,000 less than what it promised. |

- *Verifiable:* A third-party verifier must be able to examine the project data and confirm that the volume of the emissions reduction truly occurred and is matched appropriately to the issued offsets.
- *Enforceable*: Once a project is verified by a third-party investigator, it must be enforced through crediting mechanisms to ensure that credits are not double-counted.
- *Co-Benefits*: The best offsets have additional benefits, such as sustainable and inclusive economic development.

Based on these criteria, it is unclear whether offsets currently available for purchase are a reliable means to achieve emissions reductions. A detailed evaluation of the European Union's (EU) Certified Emissions Reduction program found that at least 73% of the projects credited were likely to not be additional or would be over-credited for emissions reductions. The authors concluded that climate mitigation efforts should focus on "forms of carbon pricing that do not

[98] Lisa Song, "Why Carbon Credits for Forest Preservation May Be Worse Than Nothing," *ProPublica* (2019), https://features.propublica.org/brazil-carbon-offsets/inconvenient-truth-carbon-credits-dont-work-deforestation-redd-acre-cambodia/.

rely extensively on credits."[99] Joint Implementation, one of two offsetting mechanisms under the Kyoto Protocol, similarly found that about 75% of the 872 million Emission Reduction Units (ERUs) it issued in 2015 are unlikely to represent additional emissions reductions.[100]

Some organizations have reached the same conclusion in their sustainability programs. A carbon-neutral feasibility study by the University of Dayton rejected carbon offsets for two reasons, namely, (1) the university could not trace each dollar spent on offsets, and thus could not ensure climate impact, and (2) offsets do not "address the systemic dependence on fossil fuels."[101] Many others, such as the University of California system, are only willing to purchase offsets when they cannot otherwise reduce emissions to achieve an existing emissions target.[102]

Stanford must be clear-eyed about the challenges associated with the offset market. Given the information asymmetry between project developers and offset purchasers, it is essential to conduct rigorous research to ensure that offsets meet predetermined standards for environmental integrity, specifically additionality.[103] Such industry players as Google purchase offsets in order to meet their carbon-neutrality targets, and importantly, use robust screening mechanisms to ensure the credibility of the offset project investments.[104] If Stanford elects to enter the offset market, it should similarly verify that the projects linked to the offsets can meet the criteria outlined above.

If Stanford lacks the resources to evaluate projects itself it might consider working with an offset provider, such as Terra Pass or Element Markets, that funds, oversees, and obtains verification for projects. Even so, the University may be concerned that the inherent uncertainty of additionality assessments and the effects of perverse financial incentives would cause over-credited offset projects that do not reduce the promised emissions.[105]

**Developing Mission-Linked Carbon Offset Projects.** An alternative, or perhaps complementary, carbon offsets strategy is implementing and documenting projects for which Stanford itself acts as the project manager. Both Duke University and American University have developed their own carbon offset projects. These projects have local, state, and regional co-benefits and engage members of the academic community in the research, design, and implementation process. The Duke Carbon Offset Initiative (DCOI) prioritizes three criteria

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[99] Martin Cames, "How additional is the Clean Development Mechanism?" Berlin (2016), https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf.
[100] Kollmuss et al., "Has Joint Implementation Reduced GHG Emissions?" Stockholm Environment Institute (2015), https://mediamanager.sei.org/documents/Publications/Climate/SEI-WP-2015-07-JI-lessons-for-carbon-mechs.pdf.
[101] Ryan Shea, "'A Lifecycle Cost Analysis of Transitioning to a Fully-Electrified, Renewably Powered, and Carbon-Neutral Campus at the University of Dayton," Sustainable Energy Technologies and Assessments, 37 (February 2020), https://doi.org/https://doi.org/10.1016/j.seta.2019.100576.
[102] TomKat Natural Gas Exit Strategies Working Group, "University of California Strategies for Decarbonization: Replacing Natural Gas" (February 2018), https://www.nceas.ucsb.edu/files/research/projects/UC-TomKat-Replacing-Natural-Gas-Report_2018.pdf.
[103] Cames.
[104] Google Sustainability, *Google's Carbon Offsets: Collaboration and Due Diligence*, report (2011), https://static.googleusercontent.com/media/www.google.com/en//green/pdfs/google-carbon-offsets.pdf
[105] Cullenward.

when evaluating carbon offset projects: (1) the ability to definitively document a project's climate impact, (2) whether a project provides co-benefits beyond GHG reductions to the local community, and (3) a project's replicability throughout North Carolina and within Duke.[106]

DCOI's offset projects include a waste management system on a local swine farm, an employee residential energy efficiency program, and a tree-planting urban forestry project. In addition to hedging against the risk of over-crediting or not achieving additionality, these offset projects further the educational and research mission of the university. Such projects, however, require ample resources and technical expertise and will likely need to be supplemented by purchased offsets to reach carbon neutrality targets. Without a sustainable funding stream, DCOI predicts that these projects will remain small-scale "learning experiences" that will spur innovation and enable the University to make intelligent purchases from the offset market.

**Charging a Carbon Price for Air Travel.** Several higher education institutions, including University of California, Los Angeles (UCLA) and Arizona State University (ASU), charge a carbon fee for air travel. Since January 2018, UCLA has charged a mandatory carbon mitigation fee for every business travel flight itinerary: $9 per domestic trip and $25 per international trip. The traveler's university department pays the fee during the travel reimbursement process. An Air Travel Mitigation Fund (ATMF) then uses those fees to invest in on-campus energy-efficiency projects and renewable installations that reduce UCLA's Scope 1 and 2 emissions. In its first year of operation, the ATMF collected $187,000 from all university business travel, excluding study abroad programs and student travel for UCLA Athletics charter flights.[107] Rather than purchasing verified offsets from other locales and organizations, the ATMF exclusively funded emissions-reducing projects on UCLA's campus in order to "keep funds within the UC system and maintain oversight."[108] UCLA departments and schools are eligible to apply for funding from the ATMF to implement their own emissions-reducing projects, thereby creating opportunities for engagement, education, and research within the academic institution.

ASU also implemented a price for all ASU-sponsored travel at a rate of $8 per round-trip flight. The University made the fee mandatory in 2007 after a voluntary fee experienced minimal adoption. Raised funds finance the ASU Carbon Project, which develops local, community-based offset projects that "reduce the need to purchase offsets in the future and support ASU education and research."[109] ASU decided to charge a flat fee regardless of emissions quantity and cost for each traveler because (1) without the required information technology, it would be technically unwieldy to charge different rates and (2) the flat fee method would inherently reduce the burden on study abroad and other international travel relative to domestic flights. ASU helped departments that would be most affected by the carbon price to plan their budgets accordingly.

The funds collected from an internal carbon fee on air travel need not fund internal offset projects. For example, Microsoft has instituted a $15 per metric ton internal carbon tax to help fund its climate innovation fund, which supports work to accelerate the use of direct air capture

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[106] Duke Office of Sustainability, Carbon Offsets Initiative, https://sustainability.duke.edu/offsets/projects
[107] Nurit Katz and Renee Fortier, UCLA Air Travel Mitigation Fund, Case Study, October 2019.
[108] Ibid.
[109] Mick Dalrymple, ASU Price on Carbon for Air Travel, Case Study, August 2018.

(DAC) carbon removal.[110] Stanford could apply air travel fees to fund the purchase of third-party offsets or invest in renewable energy projects.

## IV. Conclusion

With increasing external pressure for organizations to demonstrate responsibility by accounting for, reporting on, and reducing their carbon footprint,[111] Stanford has an opportunity to position itself as a leader in mitigating climate change. Stanford should consider the following conclusions when developing a GHG reduction strategy for business air travel:

- Stanford can be a leader in higher education by implementing a policy to reduce GHG emissions from university air travel. The University can offset unavoidable travel emissions as a last resort.

- Key industry players like Microsoft and peer institutions like UCLA use an internal carbon fee to reduce GHG emissions while funding research and innovation.

- Purchasing carbon offsets is a low-cost and feasible strategy for offsetting emissions that are otherwise impractical to reduce. However, universities are beginning to develop their own local offset projects that leverage faculty and students in the design and implementation process.

- No single strategy is a silver bullet. Stanford must assess the tradeoffs of each strategy based on the criteria outlined in the matrix below and institutional priorities:

| | **Cost** | **Feasibility** | **Effectiveness** | **Educational/Research Mission Alignment** |
|---|---|---|---|---|
| **Purchasing Carbon Offsets** | Low | High | Low | Medium |
| **Developing Local Carbon Offset Projects** | High | Low | High | High |
| **Charging a Carbon Price for Air Travel** | Medium | Medium | High | High |

[110] Smith, "Microsoft Will Be Carbon Negative by 2030."
[111] The Microsoft Carbon Fee: Theory and Practice, December 2013. See also Tamara "TJ" DiCaprio, Making an Impact with Microsoft's Carbon Fee," March 2015.

# Food

## Introduction

Agriculture alone accounts for around 9% of United States greenhouse gas emissions.[112] In this report, we consider Stanford's options for reducing emissions related to food consumption, especially beef. Possibilities include: (1) tracking carbon emissions from food consumption, (2) supporting ranchers using sustainable methods, (3) reducing food waste, and (4) deploying Stanford's intellectual resources to develop policies and technologies that could reduce food based GHG emissions.

## Measuring food-based carbon emissions

Accurate carbon accounting is crucial for establishing a baseline to assess Stanford's endeavors to reduce food based GHG emissions. Dave Karlsgodt of Fovea, a company offering sustainability-focused services to universities, emphasizes the complexity of these measurements. The challenge arises from the multiple sources of food based GHG emissions. In order to accurately measure the life-cycle carbon footprint of the dining system, Stanford must account for the GHG emissions associated with land use change, farming, animal feed, processing, transportation, packaging and retail, and waste. Understanding the many facets of food-based emissions will yield the greatest chance of reducing GHGs and mitigating climate change.

Some steps in the food supply chain are far more carbon intensive than others. Land use and farming far outweigh other parts of the life cycle in terms of GHG emissions (see Figure 1). Accordingly, we focus on land use and farming emissions in our analysis below.

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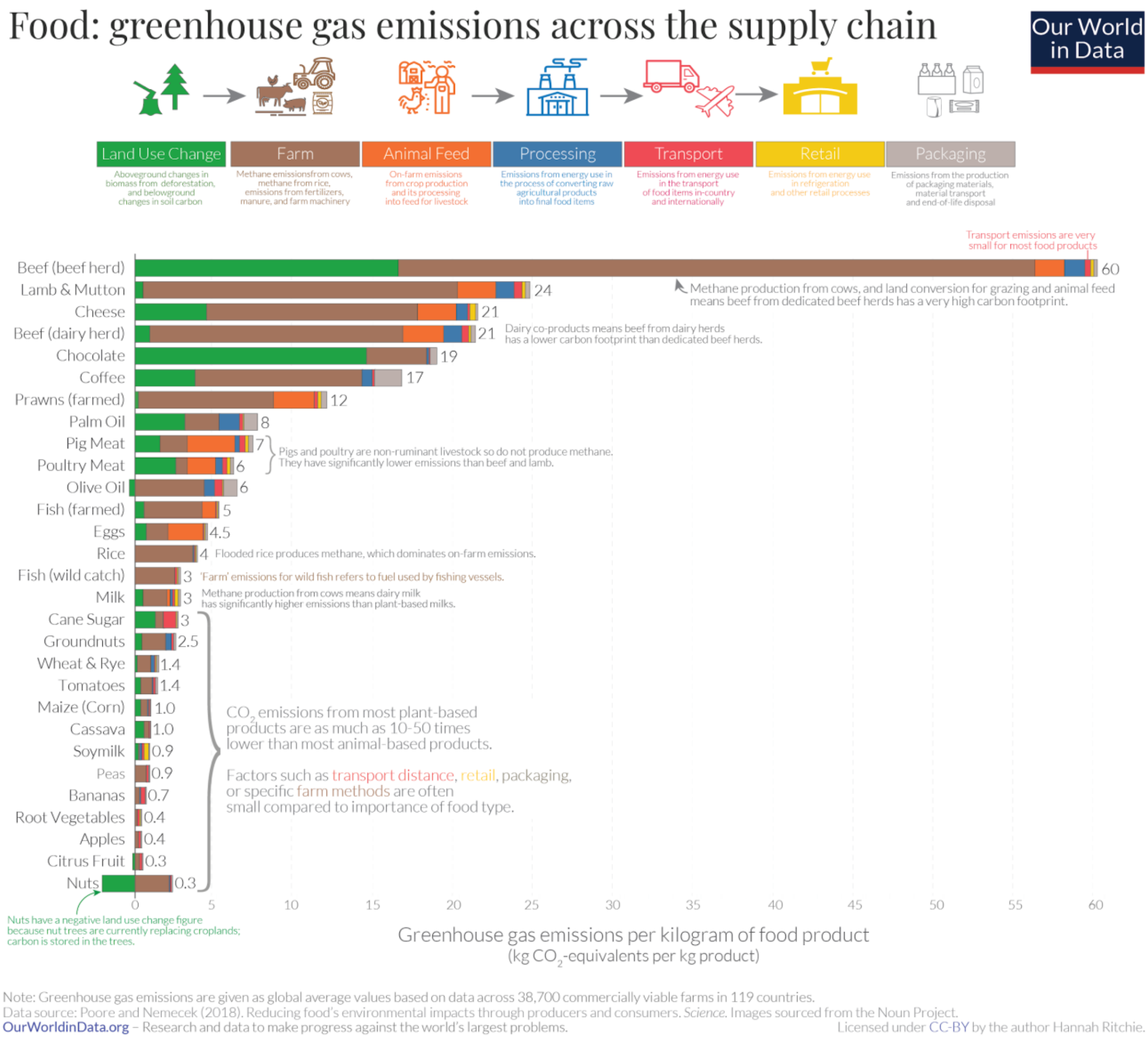
[112] Environmental Protection Agency, "Understanding Global Warming Potentials," February 14, 2017, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

Figure 1: GHG Emissions Across the Supply Chain[113]




*Land use and farm operations make up the vast majority of food-related GHG emissions. Note that, while "eating local" is a common recommendation, GHG emissions from transportation make up a very small amount of total emissions from food. Beef is by far the most carbon-intensive food product.*

## I. Land Use

Agriculture-driven land use change emits GHGs in two ways. First, industrial farms or ranches may not have the same carbon sequestration capacity as the forest or grassland they replace.

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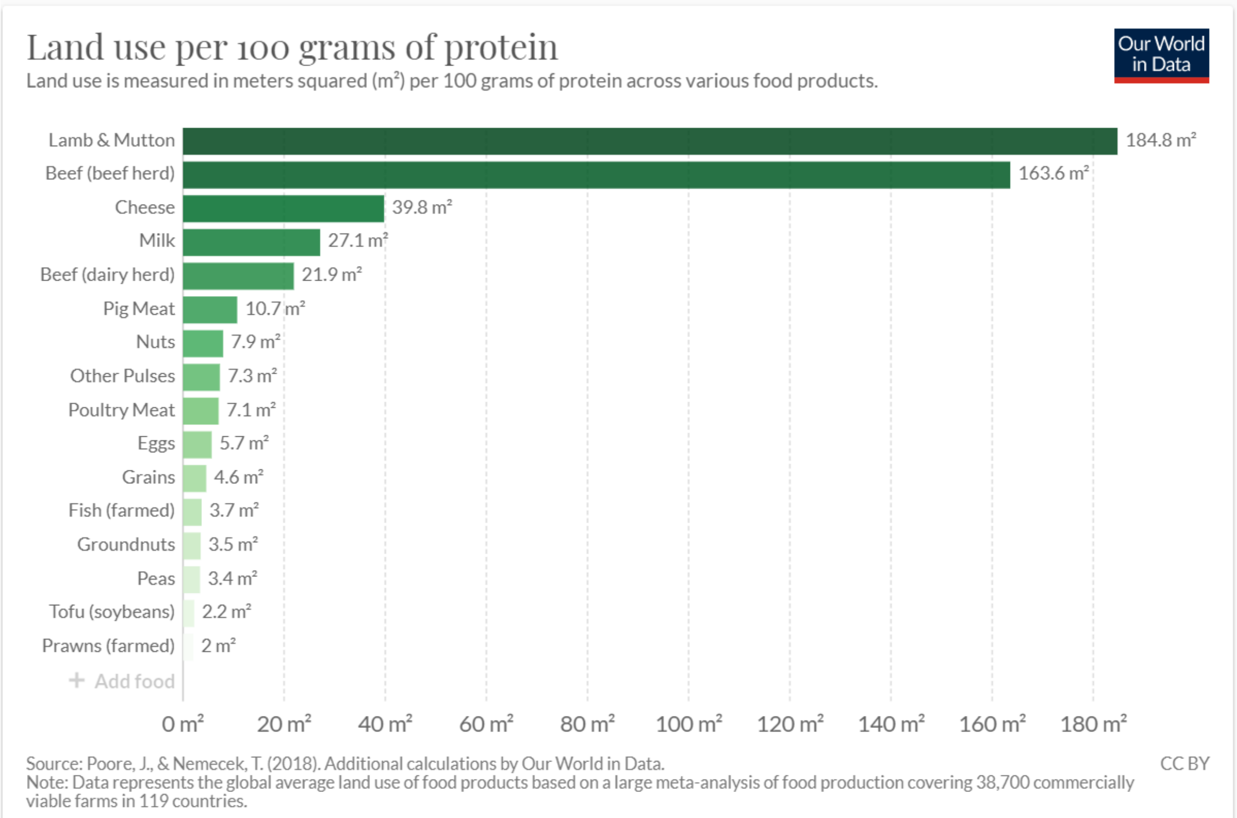
[113] Hannah Ritchie, "You Want to Reduce the Carbon Footprint of Your Food?" (Jan. 24 2020), https://ourworldindata.org/food-choice-vs-eating-local.

Raising cattle requires more land than other kinds of food production because cattle require a much higher volume of feed in order to convert grain into meat protein.[114] Producing beef is thus a "land extensive" practice because it requires land on which to raise cattle and, in the case of concentrated animal feeding operations (CAFOs), land on which to grow feed for those cattle. Indeed, over 90 million acres of land in the US are used to grow corn, of which 48% is used for livestock feed.[115] Extensive land use is one of the reasons that beef has a much higher carbon footprint than other foods. (Perhaps counterintuitively, grain-fed cows are less land extensive than grass-fed cows because grain is denser in energy than grass. Much more land is needed for cows that exclusively eat grass.[116] Organic beef has a similar impact on land use because organic feed, by nature, takes more land to grow.)

Figure 2. Land Use Across Food Products




Second, the process of clearing forest to create farmland or grazing pasture may release, over a matter of days, the carbon sequestered over hundreds or thousands of years. Although the United States and countries from which we import the most beef do not engage in "slash and burn"

[114] Global Forest Atlas, "Cattle Ranching in the Amazon Region," Yale U., https://globalforestatlas.yale.edu/amazon/land-use/cattle-ranching.
[115] "Feedgrains Sector at a Glance," USDA ERS - Feedgrains Sector at a Glance, https://www.ers.usda.gov/topics/crops/corn-and-other-feedgrains/feedgrains-sector-at-a-glance/.
[116] Tara Felix et al., "Grass-Fed Beef Production." Penn State Extension, https://extension.psu.edu/grass-fed-beef-production.

practices,[117] clearing land for agriculture nonetheless leads to some carbon that trees, plants, and soil were storing, escaping into the atmosphere.
Some food products require far more land than others, and the GHG emissions associated with converting an area of land vary widely depending on the preexisting natural landscape and the conversion method. Thus, Stanford may seek to reduce the GHG emissions associated with land use change by 1) reducing consumption of land-extensive foods such as beef and 2) by sourcing food from regions or individual farms that do not engage in the most carbon-intensive forms of land use change.

### II. Farming and Ranching

Many kinds of farming and ranching produce GHG emissions. For example, some farmers use fertilizers that release nitrogen dioxide, the next most potent GHG after carbon dioxide and methane.[118] However, the GHG emissions associated with raising ruminants such as cows and sheep far exceed those from other agricultural sectors (see Figure 1). Ruminants release methane, a greenhouse gas with a global warming potential 28-36 times higher than carbon dioxide, during their digestive process.[119] In addition, cattle raising is responsible for a significant portion of crop raising because of how much is used for feed. This means that producing beef involves methane, nitrogen dioxide, and carbon dioxide emissions.

However, the CO2 emissions associated with raising cattle varies widely with different farming practices. Some ranchers utilize farming methods that increase the carbon sequestration capacity of soil by promoting the growth of native grasses. This kind of ranching has co-benefits including promoting biodiversity and protecting grasslands from development. In addition to temporarily sequestering carbon, improved pasture management can reduce life-cycle ruminant emissions by as much as 22 percent.[120] The disparity in GHG emissions for different farming practices within the same food product creates opportunities for targeted mitigation.

## Solutions

### III. Reducing Beef Consumption

Agricultural scientists Joseph Poore and Thomas Nemecek believe that “today, and probably into the future, dietary change can deliver environmental benefits on a scale not achievable by

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[117] OECD Statistics Directorate. OECD Glossary of Statistical Terms - Slash-and-burn agriculture Definition, September 25, 2001. https://stats.oecd.org/glossary/detail.asp?ID=2471. Burning tropical rainforest in the Amazon is far more carbon-intensive than setting cows out to pasture in the natural grasslands of the Western United States. “Cattle Ranching in the Amazon Region .” Global Forest Atlas. Yale University. Accessed February 28, 2020. https://globalforestatlas.yale.edu/amazon/land-use/cattle-ranching.
[118] Robert Sanders, “Fertilizer Use Responsible for Increase in Nitrous Oxide in Atmosphere,” Berkeley News, July 9, 2015, https://news.berkeley.edu/2012/04/02/fertilizer-use-responsible-for-increase-in-nitrous-oxide-in-atmosphere/.
[119]“Sources of Greenhouse Gas Emissions,” Environmental Protection Agency, September 13, 2019. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
[120] Poore and Nemecek.

producers."[121] Indeed, diets that eliminate beef are far less carbon-intensive than other diets (Figure 3). For the United States, where per capita meat consumption is three times the global average, dietary change has the potential for an even greater impact.[122]

Stanford has already made an effort to serve less beef in dining halls and to offer many healthy, vegetarian options. Dining services have placed graphics on napkin holders and on the walls of some dining halls about serving "plant forward" foods and "less red meat less often." These are considered behavioral nudges which subtly encourage students to be mindful of their beef consumption. While beef patties are almost always an option in the dining halls, 30% of the patty is ground mushrooms to reduce the volume of beef used. In addition, turkey burgers and veggie burgers are always offered as are many vegetarian entrees and side dishes. For most meals, only one or at most two beef dishes are served.

However, "leakage" could remain an issue. Anecdotally, undergraduate members of our policy lab have observed friends seek out beef products at off-campus restaurants when they are unavailable in dining halls. The extent of leakage with regard to beef consumption on Stanford's campus warrants additional research.

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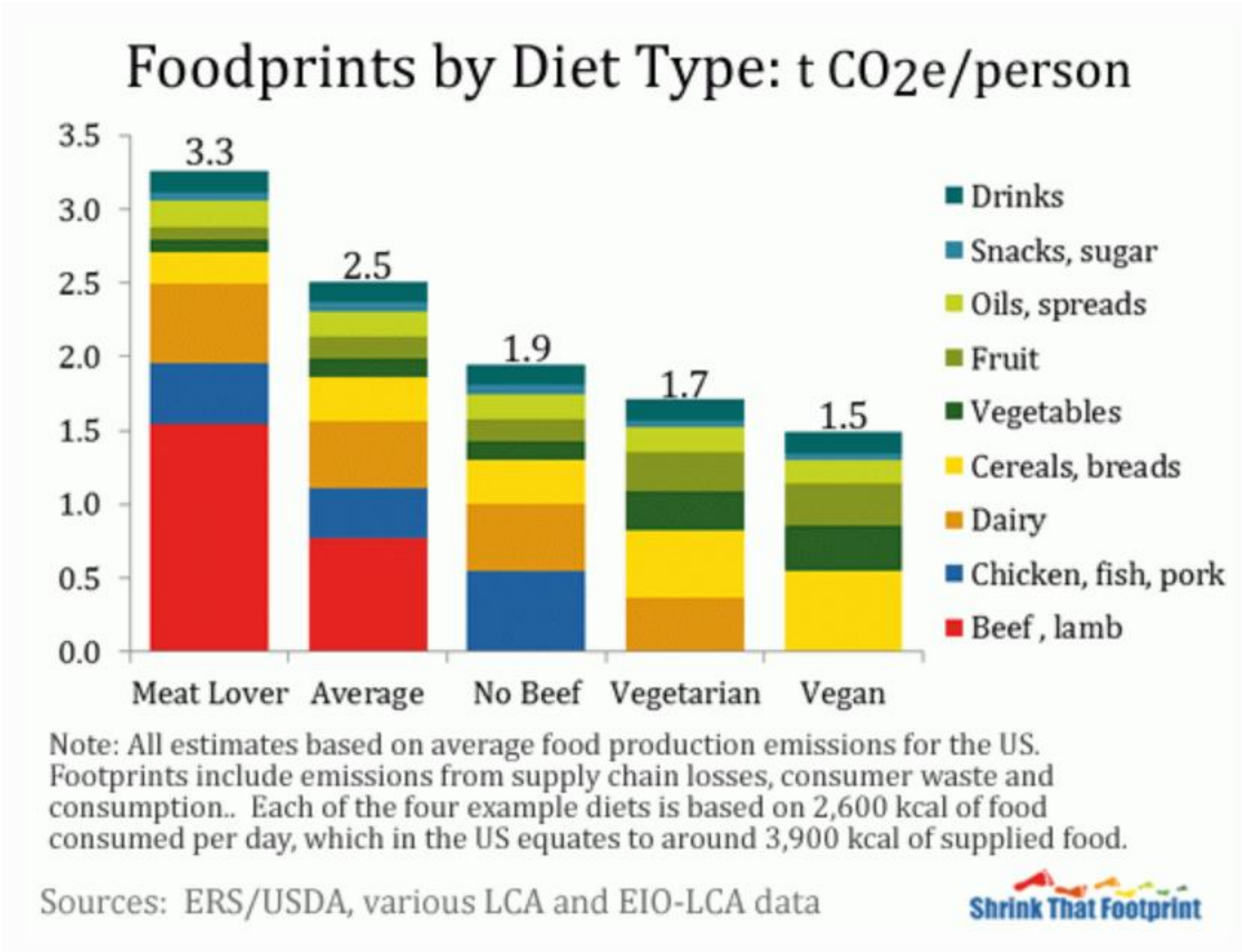
[121] J. Poore and T. Nemecek, Reducing Food's Environmental Impacts Through Producers and Consumers, Science, June 1, 2018), vol. 360, issue 6392, pp. 987-992. DOI: 10.1126/science.aaq0216, https://science.sciencemag.org/content/360/6392/987.

[122] Ibid.

Figure 3: Diets[123]




## IV. Selective Sourcing

Sourcing from producers who emit minimal GHGs requires information about the farming practices and impacts of providers. Moreover, it relies on the premise that "high-impact production is not simply purchased elsewhere in the market."[124]

This strategy can also be effective through a second mechanism: higher prices for sustainable production could incentivize low-impact producers to increase output or high-impact producers to change practices.[125] Stanford's change alone would not drive up sustainable beef practices.

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[123] "The Carbon Foodprint of 5 Diets Compared," shrinkthatfootprint.com, http://shrinkthatfootprint.com/food-carbon-footprint-diet.

[124] Poore and Nemecek.

[125] Poore and Nemecek.

## V. Reducing Food Waste

In addition to the land use change and farming impacts discussed above, wasted food causes 8% of all anthropogenic greenhouse gas emissions.[126] Around one third of all food produced in the world is wasted at various stages in the production and consumption process. Jason Clay, an executive director at the Markets Institute of the World Wildlife Fund, recommends incentivizing students to reduce their food waste. This could be achieved by measuring food waste and rewarding the student body for keeping waste under a certain amount.

A study undertaken by the Autumn Quarter Policy Lab on Climate Change recommends focusing on waste that happens at the consumer level on campus. One way to make these changes are through education or through nudges: "subtle policy shift that encourages people to make decisions that are in their broad self-interest"[127]. If students will serve themselves only the food that they actually eat, dining halls will adjust the quantities served and purchased accordingly. These changes would lower our carbon footprint and help create a more efficient food system on campus.

## VI. Aggregation, and Changing Habits and Mindsets

Changing consumption habits at any single institution will not make an appreciable dent in global GHG emissions. Rather, as is true for any efforts to change consumers' behavior, the potential lies in the aggregate impact of the efforts of many institutions.

Institutions of higher education, like Stanford, have a particular advantage. Changing the eating habits of young people and educating them about the relationship between food and climate change can affect their behavior throughout their adult lives. Moreover, many Stanford graduates go on to influence local, state, national, and international policy. Increasing the salience of agriculture-based GHG emissions could inspire students to work toward a low-carbon food system at Stanford and beyond.

## VII. Academic innovation

As a research institution, Stanford has a unique capacity to develop technologies and policies that could reduce food-based GHG emissions on a global scale. Stanford might encourage such innovation by hiring faculty or researchers interested in food systems, directing additional resources toward that research, or spearheading academic initiatives.

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[126] Sindhu Nathan, Isabel Vasquez, and Vivian Oliveira, Working Paper, Stanford Law School, January 20, 2020.
[127] Ben Chu, "This Is What Nudge Theory Means – and Why You Should Care about It," The Independent, Oct. 9, 2017, https://www.independent.co.uk/news/business/analysis-and-features/nudge-theory-richard-thaler-meaning-explanation-what-is-it-nobel-economics-prize-winner-2017-a7990461.html.

***Earth Systems Academic Tracks***

Making the student body aware of all the possible tracks within the Earth Systems program would expose more students to the option to specialize in Land Systems or Sustainable Food and Agriculture.

***Supporting Research and Innovation***

An example of innovation in this field is found in the team that Joan King Salwen leads. Salwen is a visiting scholar at the School of Earth and leads a team that is researching how feeding cows seaweed can reduce their methane emissions by 75-99%.

***Encouraging Participation in Clubs and Initiatives***

Student groups such as Students for a Sustainable Stanford put on many events throughout the year which promote environmental awareness. Supporting these groups could widen their reach and may help to recruit more students to environmental causes.

## VIII. Co-Benefits

While the objective of this report is to inform on options the university has when addressing greenhouse gas emissions, there are external benefits that can be drawn on.

***Health***

Reducing beef consumption over one's lifespan may have health benefits, including less fat consumption and lowering the risk of heart disease, stroke, and diabetes[128]

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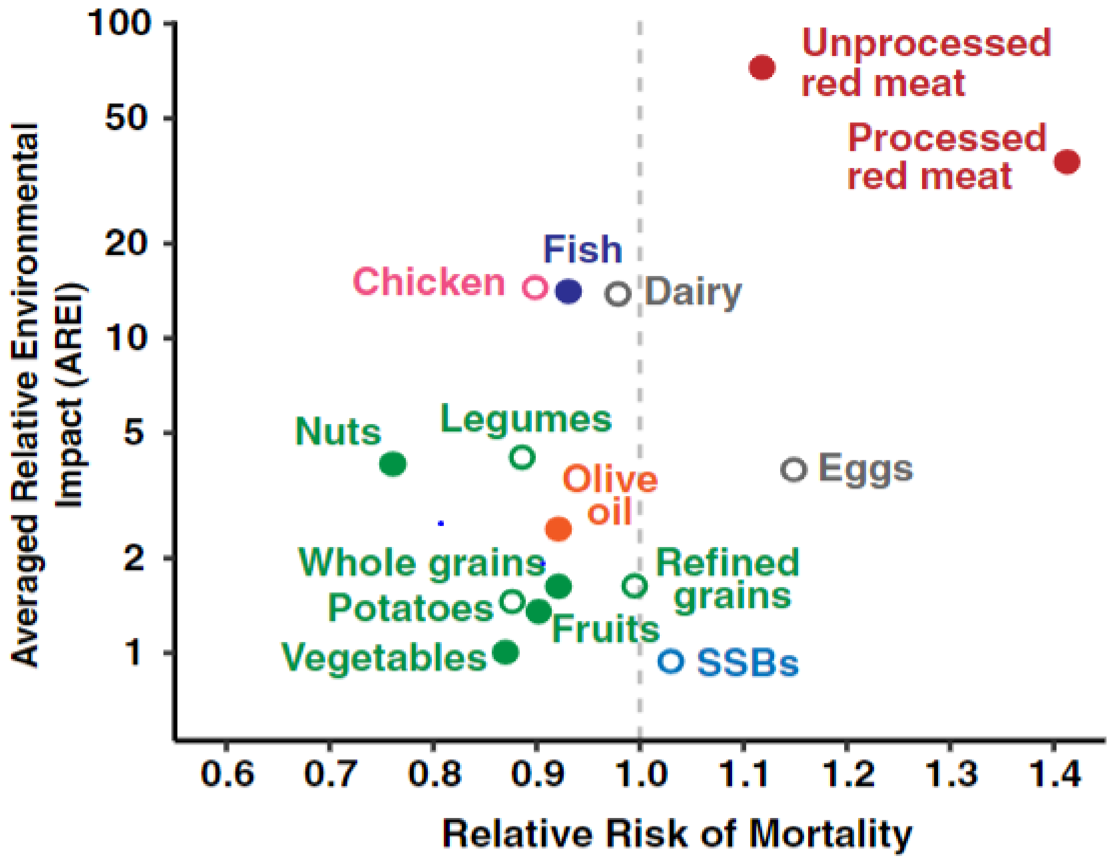
[128] "It's Time to Try Meatless Meals," Mayo Clinic, Mayo Foundation for Medical Education and Research, July 26, 2017, https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/meatless-meals/art-20048193.

Figure 4. Association between a food group's impact on mortality and its AREI[129]




***Lowering water consumption***

Beef is both an emission and water intensive food. The total water used to produce one pound of beef is 1,910 gallons. This number includes the rainfall that waters the fields that grow the feed for the cattle (see Fig. 5).[130]

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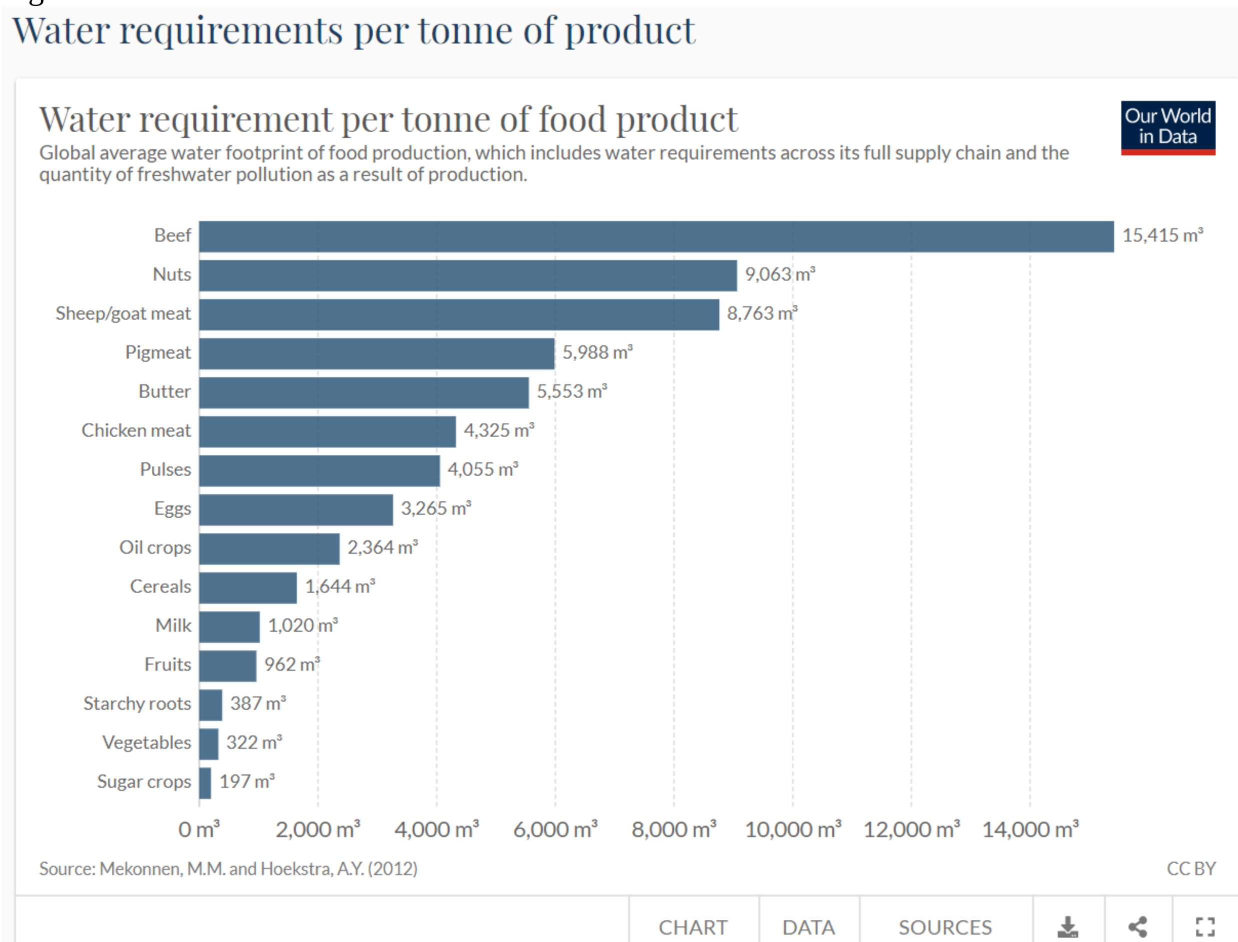
[129] Michael Clark et al., "Multiple health and environmental impacts of foods," PNAS November 12, 2019 116 (46) 23357-23362; first published October 28, 2019, https://doi.org/10.1073/pnas.1906908116, https://www.pnas.org/content/116/46/23357.

[130] "How Much Water Is Used to Make a Pound of Beef?" Beef Cattle Research Council Blog, Feb. 27, 2019, https://www.beefresearch.ca/blog/cattle-feed-water-use/.

Figure 5


Water requirements per tonne of product
Water requirement per tonne of food product
Global average water footprint of food production, which includes water requirements across its full supply chain and the quantity of freshwater pollution as a result of production.
Our World in Data
Beef 15,415 m³
Nuts 9,063 m³
Sheep/goat meat 8,763 m³
Pigmeat 5,988 m³
Butter 5,553 m³
Chicken meat 4,325 m³
Pulses 4,055 m³
Eggs 3,265 m³
Oil crops 2,364 m³
Cereals 1,644 m³
Milk 1,020 m³
Fruits 962 m³
Starchy roots 387 m³
Vegetables 322 m³
Sugar crops 197 m³
0 m³
2,000 m³
4,000 m³
6,000 m³
8,000 m³
10,000 m³
12,000 m³
14,000 m³
Source: Mekonnen, M.M. and Hoekstra, A.Y. (2012)
CC BY
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DATA
SOURCES

## Healthcare

### Introduction

This section of the Climate Mitigation Practicum report describes the roles of Stanford Healthcare (SHC) and Lucile Packard Children's Hospital (LPCH) in greenhouse gas emissions (GHGs) and their mitigation.[131] Across the U.S., the health sector accounts for 18% of gross domestic product and nearly 10% of GHGs. [132] At Stanford, in FY18, healthcare operations contributed 19% of total university revenues of $5.9 billion but there is no publicly available data on the hospitals' carbon footprint as a contributor to Stanford University.[133]

Climate change escalates direct and indirect health harms caused by extreme weather events, heat, fires, pollution, drought, vector-borne diseases, water-related illnesses, food security, and other effects.[134] Such effects challenge providers and may strain the resources needed for Stanford Healthcare to maintain its core mission of "Precision Health."[135] We believe that Stanford Healthcare and LPCH have a unique opportunity to join with the University's vision of climate action and play a leading role among peer institutions in promoting innovative practices that address the climate crisis, and in educating and engaging stakeholders, including regulators, employees, patients and communities. Indeed, like Stanford University,[136] Stanford hospitals may benefit from long-term cost-savings and return on investments by adopting green practices, programs, and technologies.[137]

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[131] Stanford Healthcare is an important financial component of Stanford University, with total combined assets and liabilities valued in 2018 at $7,214,849. See Annual Disclosure Statement, 2018, Price-Waterhouse-Coopers "Consolidated Balance Sheet," 2, Dec. 31, 2018. LPCH is overseen by the LPCH Foundation with combined total assets valued at $213,685,588. See KPMG Statement of Independent Auditor's Report (2016), https://www.lpfch.org/sites/default/files/f_541469_15_lucilepackardfoundation_childrenshealth_fs.pdf. In 2018, the Stanford endowment merged pool managed $1,400,839 for SHC.
[132] M. J. Eckelman, J. Sherman, *Environmental Impacts of the U.S. Healthcare System*, PLOS One, 2016, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0157014. For a definition of scope 1, 2, 3 GHG emissions, see Environmental Protection Agency, https://www.epa.gov/greeningepa/greenhouse-gases-epa.
[133] See Figure 1, Annual Financial Report (2018), https://bondholder-information.stanford.edu/pdf/SU_AnnualFinancialReport_2018.pdf. Indeed, note that Stanford hospitals produce approximately the same percent of revenue as does the health sector in total GDP. In rough terms, do the hospitals also then produce 10% of Stanford's GHG emissions? Carbon emissions statements could reveal that information.
[134] See, for example, GlobalChange.gov, U.S. "Climate and Health Assessment," https://health2016.globalchange.gov/. See also, American Public Health Association, "Climate Changes Children's Health," https://www.apha.org/-/media/files/pdf/topics/climate/childrens_health.ashx?la=en&hash=02D821C65EDCAB093A48AD7B101EC73080A216BF.
[135] Stanford Healthcare operates under a theme of "Precision Health: Predict, Prevent, Cure, Precisely," unifying the School of Medicine, SHC and LPCH.
[136] For the benefits of sustainability programs across Stanford, see Sustainable Stanford, https://sustainable.stanford.edu/.
[137] This research on which this section is based includes a literature review of both theoretical and practical green clinical practices, as well as 20 qualitative interviews with administrators, clinicians, engineers, architects, legislators and government officials, medical school students and faculty, and administrators, across Stanford and at peer institutions. The research precedes a more comprehensive study by the Stanford Health Consulting Group

## Findings

**Climate-friendly buildings and infrastructure.** Hospitals are 24/7 operations with high levels of energy use, labor, transport and waste. The new Stanford Hospital, opened in 2019, and Lucile Packard Children's Hospital, opened in 2017, both benefit from using thermal energy generated by the Stanford Energy System Innovations (SESI) and electricity sourced from Palo Alto Utility, both 100% carbon-neutral sources.[138] In addition, LPCH, and to a lesser extent SHC, incorporated energy-saving features in their designs. Because energy use is the largest factor in Scope 1 and Scope 2 emissions, SHC and LPCH rank fairly well relative to their former buildings and in relation to many of their peer institutions.

LPCH is a LEED Platinum building with climate-friendly infrastructure and technologies integrated throughout the facility and grounds. From conception, the hospital's board and administrative leadership focused on sustainable infrastructure and design, believing such efforts would be cost-efficient and enhance patient care.[139] Thus, the building also includes a climate-efficient HVAC system, rooftop placement of servers to help disperse heat, on-site water cisterns to reduce the use of pumped water, solar panels to power internal equipment in ambulances, and innovative architecture to optimize lighting, heating, and cooling.[140] The building's architect, Robin Guenther, is a leading figure in sustainable hospital architecture and has published a case study of LPCH's design features in her scholarly treatise, *Sustainable Healthcare Architecture* (2013). In an interview, Guenther credited the LPCH board with thinking about cost-efficiencies over a ten-year or more timeline – something that she has found unusual in her work with most hospital boards.

Stanford Hospital qualifies for LEED Silver status with its state-of-the-art HVAC system and reliance on SESI for thermal energy but has not sought certification. Mazzetti, an engineering firm that worked with both hospitals, installed similar systems. A lead engineer said that the SHC board "accepted about 70% of what we described from our work at LPCH," especially in those areas in which costs could be recouped within a few years. Other interviews confirmed that the Stanford Hospital board and management prioritized cost-efficiency, with little direct attention to climate-related investments, risks, or costs. The two hospitals now represent sunk costs, and senior administrators do not anticipate retrofitting in the near term to reduce GHGs.

**Carbon and energy reporting.** By virtue of receiving power from Palo Alto Utility, the new Stanford Hospital is tasked with reporting its Scope 1 emissions annually. Those annual reports are not publicly available and, according to sources at the utility and at SHC, SHC is "a few

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(SHCG) advising SHC on developing a task force to assess how shifts in transportation, supply chain, and in clinical and lab practices can reduce greenhouse gas emissions. On March 11, 2020, SHCG will present findings to key stakeholders in engaging sustainability practices at SHC.

[138] https://www.cityofpaloalto.org/gov/depts/utl/residents/resources/pcm/default.asp

[139] Interview with former LPCH board member, Susan Packard Orr, 12-17-19.

[140] Interviews with the hospital's lead architect, Robin Guenther; engineering firm, Mazetti's; and head administrator, Jill Sullivan, and chief systems engineer Michael Zader. Tour of the hospital's systems with Chief Engineer, Michael Zader, on November 6, 2019. LPCH case study in Robin Guenther and Gail Vittori, *Sustainable Healthcare Architecture* (2013), 154-157.

years" behind schedule. Moreover, an SHC administrator said that the benchmarking protocol accounts for "only some" of the overall GHGs. Reporting is limited to facilities in Palo Alto, a fraction of the overall operations across Stanford Healthcare and LPCH.[141] Under SB 802, Palo Alto Utility also now requires a second benchmarking report for commercial buildings to document energy usage, but there is no report publicly available for SHC Palo Alto facilities.[142]

**LPCH efforts towards scope 3 reductions.** At LPCH, senior operations administrators are seeking to optimize performance on energy efficiency. They are also focused on lowering single-passenger commutes for staff and patient families, with a collateral benefit in reducing GHG scope 3 transportation emissions. LPCH operations are also attentive to food sourcing, emphasizing local growers and suppliers; and food waste, relying on composting and recycling. Administrators note that Palo Alto Utility's goal of becoming nearly zero-waste by 2030 serves as pressure to reduce waste.[143] Although its ambulances use combustion engines, the hospital does charge ambulance equipment through solar panels installed in part to ensure a constant power supply to these crucial systems. Across departments, LPCH is beginning to consider green practices and programs that are cost-effective and result in lower GHGs. Senior staff acknowledge that more needs to be done to reduce Scope 3 emissions and look to senior management and the board of trustees for further direction.

**SHC efforts towards scope 3 reductions.** At Stanford Hospital, the Director of Sustainability and Energy, developed a climate action report that is now several years old. She is raising awareness in departments to recycle and to reduce waste and water usage. SHC is a member in the Practice Greenhealth network, which guides hospitals nationally in efforts to lower GHGs and reduce costs. Like LPCH, SHC looks to senior leadership and its board of trustees for guidance. According to some of our interviews, SHC thus far has not made environmental sustainability or reducing GHGs priorities. These stakeholders said that building planning decisions are driven by cost, along with the mission of providing preeminent patient care.

**Sustainable Stanford practices.** On the main campus, Sustainable Stanford continues to make strong inroads to engage the university's schools and centers in practices that reduce their carbon footprints.[144] Although participation in Sustainable Stanford is optional, many university entities

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[141] Stanford Healthcare includes operations in Palo Alto and Redwood City, as well as at Stanford. Interviews with Palo Alto Utility and SHC were not successful in discovering whether the methodology for reporting emissions breaks out different scopes or sectors within hospital operations.

[142] See, Palo Alto Utility SB 802 Benchmarking, https://www.cityofpaloalto.org/gov/depts/utl/business/benchmarking_your_building/ab_802_faqs.asp

[143] As part of its Sustainability/Climate Action Plan, the Palo Alto City Council adopted a goal of 95% diversion of materials from landfills by 2030, and 80 % reduction of greenhouse gases by the same year. See the *City of Palo Alto Zero Waste Plan* (Aug 2018), https://www.cityofpaloalto.org/civicax/filebank/documents/66620.

[144] Across seven schools, Sustainable Stanford reduced GHG emissions 72% since the peak emissions year of 2011 (Progress), or 140,000 metric tons of carbon (A Carbon-Free Energy Supply). Sustainable Stanford posts its progress publicly in its Annual Report, which draws on information across the seven schools. Stanford Healthcare does not produce a similar report and is not part of Sustainable Stanford's report. See https://sustainability-year-in-review.stanford.edu/2019/.

are finding value in joining these practices, which are designed, in part, to reduce operating costs as well as carbon use.

Perhaps because of their regulatory environment and legacy as independent entities, SHC's hospitals and clinics have not yet joined Sustainable Stanford. The hospitals operate under codes and regulations at the federal, state, and local level, which may constrain GHG reduction. Building codes confine innovations for healthcare operations, and regulations for clinical programs and practices may limit green healthcare practices. Not all practices that work well in the university setting will apply in healthcare operations. Nevertheless, our interviews suggest that partnership with Sustainable Stanford can provide opportunities to learn practices and strategies that may be adapted to healthcare settings. Moreover, such a partnership would enable truly cross-campus initiatives on sustainability.

**Boards of Trustees and Communication Lines.** Each hospital has its own CEO and board of trustees which, in turn, report to the Stanford University President through the president's liaison, Stanford CFO Randy Livingston.[145] Conversations with a past board member and senior staff surfaced the crucial institutional role of the board and University leadership in guiding sustainability efforts. Some respondents suggested that more robust communications between the two boards and with the Stanford University board and president's office would help strengthen a general commitment to sustainable climate practices.

**Peer institutions as guides.** Peer institutions such as Harvard's medical network and UCSF are developing climate action plans and protocols that may also serve as models for Stanford Healthcare. Locally, UCSF, as part of the California Governor's vision for all state enterprises, is at the forefront of healthcare systems focused on sustainability and publicizes practices through its Advisory Committee website.[146] UCSF is publicizing case studies that track not only the carbon reduction but the economic benefits associated with sustainable healthcare practices.[147]

**Model climate action plans.** In *The Climate-Smart Emergency Department: A Primer*, Stanford resident Hannah Lindstadt and colleagues outline an action plan for one department that may be adapted across hospital departments. The plan tracks resources to help departments "reduce, reuse, and recycle" in the areas of waste management, purchasing, chemical and pharmaceutical use, food, energy, and water use. The plan encourages hospital departments to adopt both Practice Greenhealth's Sustainable Procurement Toolkit and Energy Star benchmarking and tracks the healthcare's carbon footprint in transportation, pharmaceuticals, and the life-cycle associated with prolific single-use plastics. In an interview, one author noted that each department has particular needs and should develop its own climate action plan. This article offers a strong starting place. While some greening practices may require capital investment or culture shift, the authors highlight many practices feasible in the near term, even in cost-driven

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[145] See Stanford Profile, Randy Livingston, https://businessaffairs.stanford.edu/people/randy-livingston.
[146] Kate Gordon, Senior Advisor to the California Governor's Office of Planning and Resources, said that the governor sees climate mitigation as woven throughout the state budget and vision (interview at SLS 2/19/20). See also California Executive Order N-19-19, https://www.gov.ca.gov/wp-content/uploads/2019/09/9.20.19-Climate-EO-N-19-19.pdf; and UCSF Advisory Committee, https://sustainability.ucsf.edu/about_us/cacs_membership.
[147] UCSF "Sustainability Stories," https://sustainability.ucsf.edu/greening_the_health_system/case_studies.

environments.[148] Healthcare Without Harm also offers guidelines to shift healthcare facilities towards sustainable climate practices.[149]

**SMS interest among students and faculty.** Just as momentum is building across campus to reduce campus GHGs, so too are students and faculty at Stanford Medical School (SMS) coming together to think about green healthcare practices.[150] As part of that effort, Stanford Health Consulting Group,[151] a SMS course, is researching resources for SHC's sustainability team to reduce its overall carbon footprint. The team is focusing on scope 3 emissions – business-related travel, procurement and supply chain, food and some medical waste, and water usage. Scope 3 emissions – especially transportation and procurement – are significant drivers in public health and environmental outcomes.[152] This research team anticipates a report to SHC leadership at the end of the winter quarter. More broadly, SMS Climate and Health, a new group of Stanford undergraduate, graduate, medical students, as well as residents, staff, and faculty, is scoping research projects to elevate and incentivize innovations in climate-friendly healthcare practices. A fall SMS elective on Climate and Health drew weekly attendance of about 90 students.

## Conclusion

Our research reveals that the two hospitals – and Stanford's overall healthcare operations - have made significant strides towards reducing carbon footprints through built infrastructure. Yet, as momentum accelerates across Stanford University to lower the campus carbon footprint and assume a leadership role as an educator and role model, there is an opportunity for both SHC and LPCH to join that effort—and learn from Sustainable Stanford, each other, and peer institutions, to build resilience in their healthcare networks to manage imminent climate-related challenges. Conversations with members of healthcare boards reveal the importance of leadership at a high level, and the role of trustees and top management cannot be overstated. Even one voice among the trustees can play an instrumental role in shifting board-level decisions towards long-term sustainability. Such action, moreover, aligns with a growing grassroots effort among students, faculty, and staff to join together to make Stanford a leading actor in sustainable climate practices and innovations.

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[148] Lindstadt, et al., Annals of Emergency Medicine, Jan. 23, 2020, https://www.ncbi.nlm.nih.gov/pubmed/31983497.
[149] HCWH, https://noharm.org/.
[150] SMS student-initiated climate efforts include both a new course focused on climate and healthcare and a student interest group oriented around both research and activism.
[151] Med 279, https://explorecourses.stanford.edu/search?q=MED+279%3a+Stanford+Heath+Consulting+Group+-+Core&view=catalog&filter-coursestatus-Active=on&academicYear=20192020.
[152] For more information on direct and indirect GHG emissions and Scopes 1, 2, and 3: https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf.

## A University Carbon Tax

Pricing carbon is one of the most straightforward paths to reducing global GHG emissions. The economist William Nordhaus, among others, proposes a national and international carbon tax. Conceptually, a carbon tax is a Pigouvian tax[153] that assigns a price to carbon emissions. Policymakers might specify a carbon price predicted to limit GHG emissions to "safe" levels, or one that would induce an "efficient" level of emissions.[154] In either form, a carbon tax provides an economic incentive for corporate actors and individual consumers to reduce their GHG outputs.

Frank Wolak, Professor of Economics and Director of the Program on Energy and Sustainable Development (PESD), and Mark Thurber, Associate Director of PSED, advocated such a program for the University in their 2014 proposal entitled "A Stanford Carbon Tax." Wolak and Thurber envision a system that tracks the carbon emissions of faculty, staff, and students. Departments, administrative units, and other entities within the University that exceed an allotted emissions "baseline" would pay a tax, while entities that emit less would receive a rebate. All in all, the system would be revenue-neutral—that is, the University as a whole would neither gain or lose money.[155]

Wolak and Thurber identify four advantages to a such a carbon-pricing scheme:

First, "it would enable the students and faculty to use the university as a laboratory for working through the technical and practical challenges of a carbon tax." The process of developing a successful carbon pricing scheme at Stanford might yield lessons that would inform and facilitate carbon taxes in other jurisdictions.

Second, many Stanford alumni assume positions of power across the globe. The experience of working to implement a carbon tax at the University could empower them to advocate and engineer carbon taxes elsewhere. These first two advantages comprise a "demonstration effect" targeted at other institutions.

Third, implementing a carbon tax at Stanford would require that the University develop or refine tools that enable individuals to assess their own carbon footprints. These tools could increase the salience of climate change for participating community members and lead to a better understanding of leverage points for reducing individual GHG emissions.

Fourth, a University-wide carbon tax could provide an educational and community-building opportunity. Thurber and Wolak suggest developing an interdisciplinary course that would bring

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[153] A tax on any market activity that generates negative externalities (costs not included in the market price).
[154] William D. Nordhaus, "To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming," *Review of Environmental Economics and Policy*, vol. 1, no. 1 (Winter 2007): 26–44, https://doi.org/10.1093/reep/rem008.
[155] Wolak and Thurber, "A Stanford Carbon Tax," Working Paper, 2017. See also Jazzy Kerber, Carbon Taxation Explained, Sustainable Stanford Blog (March 21, 17), https://studentsforasustainablestanford.weebly.com/blog/carbon-taxation-explained.

students and faculty together to design and implement the tax. Teams of students could conduct research into relevant content areas—for example, campus transportation, faculty/staff travel, and approaches that have been used successfully for allocating emissions responsibility in other contexts—that informs and shape the carbon tax plan. Such a strategy would both take advantage of Stanford's unique intellectual resources and advance the University's educational mission.

A number of questions remain regarding the efficacy and feasibility of a University-wide carbon tax:

First, how could the tax avoid feeling punitive and thus engendering resistance among affected community members? Wolak and Thurber suggest (1) adopting a modest carbon price, (2) examining the distributive effects of the tax, and (3) conducting surveys to assess willingness to pay for different types of emissions reductions and reactions to different approaches for allocating emissions responsibilities. The program designers might also consider a "sliding scale" of carbon allowances for different categories of community members or buildings. These strategies may also help the University avoid placing an undue burden on those engaged in activities that emit significant GHGs but also provide broadly distributed benefits.

Second, how will we surmount the technical challenge of measuring the carbon impact of various activities? Wolak and Thurber do not answer this question, other than noting that Stanford's exceptional capacity to address this challenge is precisely what makes the demonstration effect of this project compelling.

Wolak and Thurber recommend applying a carbon tax to the following spheres:

- Electricity use by buildings on campus
- Heating and cooling of buildings on campus
- Direct greenhouse gas emissions from buildings on campus (for example, research laboratories that vent greenhouse gases)
- *Campus food systems*
- Waste disposal
- *Transportation on campus*
- *Transportation to bring Stanford employees to and from work*
- *Stanford-related travel by faculty, staff, and students*
- Construction of new building and facilities
- Durable goods used on campus
- Computational equipment, services and general IT infrastructure
- Consumable goods used on campus
- Land management activities, including watering of lawns, trees, and gardens

The italicized categories comprise areas that our policy research has studied this term. We believe that a University-wide carbon tax has the potential to align disparate efforts to address multiple facets of climate sustainability under one program.

## Coordination of Climate Mitigation Research

In December 2019, President Marc Tessier-Lavigne expressed pride in Stanford's research and teaching aimed at "averting the most catastrophic climate impacts," and noted that "the challenge looms large and increasingly imminent, impelling us to determine how to maximize our contributions in both the near and the long term. Put simply, Stanford's ambition and commitment must be as large as the challenge." He asked "whether our many individual contributions could be enhanced by revisiting how we are organized to educate students; to make fundamental discoveries about the Earth, its environment and the resources necessary for humanity; and to translate those discoveries into actionable solutions."

To explore new structures, MTL convened a faculty committee, chaired by Noah Diffenbaugh and Arun Majumdar, to "explore possible changes to the organizational structures linking our sustainability-focused units in schools and institutes."[156]

We believe that this initiative holds great promise in mobilizing Stanford's core activities of research and teaching to address the existential threat that motivated the work of our Policy Lab described above.

[156] Parallel with this initiative, a team of students in the Autumn quarter 2019 Climate Policy Lab mapped the coordination mechanisms between the different energy policy hubs at Stanford.

# Appendix: Experts Consulted for this Report

- Jesse Avery, Principal Electrical Engineer, Mazzetti Engineering
- Micah Babbitt, Resource Planner, City of Palo Alto Utilities
- Fahmida Bangert, Director, Sustainability and SEM Business Services, Stanford University
- Kate Brandt, Chief Sustainability Officer at Google
- Nancy Bsales, Carbon Consultant for The Good Traveler and Bonneville Environmental Foundation, Strategic Advisor for Rocky Mountain Institute
- Michael Callahan, Executive director of the Arthur and Toni Rembe Rock Center for Corporate Governance and Professor of the Practice of Law
- Gary Cohen, President and Co-Founder, Healthcare Without Harm
- Danny Cullenward, Research Associate with the Carnegie Institution for Science, Lecturer in Law
- Darrell Duffie, The Dean Witter Distinguished Professor of Finance, Stanford GSB
- Terry Duffina, Director of Sustainability, Stanford Healthcare
- Jason Elliot, Associate Director at Sustainable Duke, Duke University
- Renee Fortier and Dave Karwaski, UCLA Air Travel Mitigation Fund
- Kate Gordon, Director, California Governor's Office of Planning and Research
- Joseph Grundfest, W.A. Franke Professor of Law and Business, Stanford Law School
- Robin Guenther, Architect, Perkins & Will
- Heather Henriksen, Chief Sustainability Officer, Harvard University
- David Karlsgodt, Consultant at Fovea
- Lauren Koch, Associate Director of Mitigation and Resilience Initiatives, Healthcare Without Harm
- Lloyd Kurtz, senior portfolio manager at Wells Fargo Private Bank; Lecturer, UC-Berkeley Haas School of Business
- David Lobell, Professor, Department of Earth System Science and the Gloria and Richard Kushel Director of the Center on Food
- Gail Lee, Sustainability Director, UCSF
- Ana Marshall, Chief Investment Officer, William and Flora Hewlett Foundation
- Ashley McClure, M.D., Kaiser Permanente
- Jaclyn Olsen, Associate Director of Harvard Office for Sustainability
- Jason Oppler, Manager of Business Environmental Sustainability at Microsoft
- Susan Packard Orr, former director Lucile Packard Children's Hospital Board of Trustees
- Rob Reich, Professor, Political Science, Stanford University
- Alicia Seiger, Managing Director, Steyer-Taylor Center for Energy Policy and Finance, Managing Director, Precourt Sustainable Finance Initiative, Lecturer in Law
- Robyn Rothman, Climate and Health Policy Manager, Healthcare Without Harm
- Lisa Shieh, M.D., and members of the Stanford Health Consulting Group
- Sarah Soule-Morgridge Professor of Organizational Behavior, Stanford GSB
- Jill Sullivan, Vice President at Lucile Packard Children's Hospital
- Joe Stagner, Executive Director, Stanford Energy Systems Innovation
- Robert Wallace, CEO, Stanford Management Company

- Frank Wolak, Holbrook Working Professor of Commodity Price Studies, Department of Economics at Stanford University
- Mark Wolfson, Founder and Managing Partner of Jasper Ridge Partners, Adjunct Professor, Stanford GSB
- Mick Zader, Administrative Director of General Services, Lucile Packard Children's Hospital