Proposal for the Formation of an Ad Hoc Advisory Committee on Divestment from Coal and Tar Sands Holdings

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Prepared for the University Council Steering Committee

By Fossil Free Penn

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Table of Contents

1. Overview

In accordance with the "Guidelines and Procedures for Consideration by the Trustees of Proposals for Divestment from the University Endowment or Other Holdings Based Upon Social Responsibility Concerns of the Penn Community" ("Trustees Guidelines and Procedures"), Fossil Free Penn chooses to "present [a divestment] proposal to the University Council Steering Committee for consideration."

Specifically, this proposal "document[s] the basis for the presenters' belief that the proposal meets the 'social responsibility' Guidelines," discussed in depth below. As mandated by the Trustees Guidelines and Procedures, the "Steering Committee will make a determination as to whether there is a sufficient basis for further consideration of the proposal."

Thus, the purpose of this document is to establish a *prima facie* case for divestment from the coal and tar sands companies listed herein, and the question under review is whether there is sufficient evidence to warrant further study by an Ad Hoc Committee.

1.1 Proposal

Fossil Free Penn recommends that the University:

1. stop new investments in the coal and tar sands industries;
2. remove holdings in the top 100 coal and top 20 tar sands companies (listed in Table 1) within 5 years; and,
3. reinvest a portion of the extricated funds into clean energy assets.

We recommend that the transition of investments from coal and tar sands into clean energy be undertaken under the expertise of the Office of Investments and its asset managers.

1.2 Companies Identified for Divestment

The companies identified for divestment include 100 public coal companies and 20 public tar sands companies. These rankings were compiled by Fossil Free Indexes and are based on the gigatons (Gt) of carbon dioxide that the combustion of each company's proved reserves would emit into the atmosphere. Recognizing that processing oil sands to produce synthetic crude requires immense inputs of energy, Fossil Free Indexes also calculated tar sands companies' "Total Emissions," accounting for extraction, transport, refining, and distribution emissions.

Top 100 Public Coal Companies	Potential CO_2 Emissions Embedded in Reserves (Gt)	Top 20 Public Tar Sands Companies	Potential CO_2 Emissions Embedded in Reserves (Gt)	Total Emissions (Gt)
1. Coal India	32.039	1. Suncor Energy	0.666	0.733

2. Shaanxi Coal Industry	28.885	2. Imperial Oil	0.604	0.637
3. Adani Enterprises	25.311	3. Canadian Natural Resources	0.507	1.195
4. China Shenhua Energy	22.305	4. Royal Dutch Shell	0.316	4.322
5. Inner Mongolia Yitai Coal	14.849	5. Cenovus Energy	0.279	0.385
6. Yanzhou Coal Mining	10.633	6. ENI	0.235	2.656
7. China Coal Energy	9.492	7. ExxonMobil	0.198	7.035
8. Public Power	9.399	8. ConocoPhillips	0.196	2.065
9. Exxaro Resources	8.928	9. MEG Energy	0.178	0.178
10. Glencore	8.369	10. Total	0.128	3.873
11. Peabody Energy	7.998	11. Chevron	0.121	4.040
12. Bukit Assam	7.844	12. Marathon Oil	0.109	0.628
13. BHP Billiton	7.310	13. PTT	0.090	0.256
14. Foresight Energy	6.759	14. Husky Energy	0.089	0.275
15. Lu'an Environmental Energy	6.443	15. Devon Energy	0.076	0.611
16. BUMI Resources	5.459	16. Athabasca Oil	0.052	0.058
17. Shanxi Xishan Coal and Electricity	5.416	17. Teck Resources	0.050	0.050
18. Mechel	5.308	18. CNOOC	0.047	1.422
19. Mitsubishi	5.128	19. BP	0.039	6.672

20. China Coal Xinji Energy	4.873	20. Inpex	0.028	1.236
21. Raspadskaya OAO	3.968			
22. Alliance Resource Partners	3.893			
23. Arch Coal	3.878			
24. Anglo American	3.592			
25. DaTong Coal Industry	3.508			
26. China Cinda Asset Management	3.316			
27. EVRAZ	3.189			
28. Vale	3.179			
29. Rio Tinto	2.710			
30. Severstal	2.661			
31. Tata Steel	2.643			
32. Westmoreland Coal	2.529			
33. Jastrzębska Spółka Węglowa	2.516			
34. Resource Generation	2.441			
35. Teck Resources	2.376			
36. United RUSAL	2.233			
37. Adaro Energy	2.200			
38. AGL Energy	2.144			
39. Shanghai Datun	2.032			

Energy Resources				
40. Yang Quan Coal	2.023			
41. Shanxi Lanhua Sci-Tech	1.959			
42. Whitehaven Coal	1.946			
43. Kuzbasskaya Toplivnaya	1.890			
44. Cloud Peak Energy	1.886			
45. CONSOL Energy	1.807			
46. South32	1.712			
47. New Hope	1.635			
48. Yancoal Australia	1.622			
49. NACCO Industries	1.450			
50. Huolinhe Coal	1.387			
51. ITOCHU	1.361			
52. Beijing Haohua Energy Resource	1.317			
53. NLC India	1.296			
54. Novolipetsk Steel	1.236			
55. Indika Inti Corpindo	1.182			
56. Datang International Power Generation	1.147			

57. Coal of Africa	1.137			
58. Golden Energy Mines	1.112			
59. Jindal Steel & Power	1.033			
60. Mitsui	0.998			
61. Banpu	0.950			
62. Berau Coal Energy	0.942			
63. Wesfarmers	0.832			
64. Up Energy Development	0.826			
65. Kangaroo Resources	0.794			
66. Shanxi Meijin Energy	0.784			
67. Mongolian Mining	0.767			
68. Jizhong Energy	0.742			
69. Allete	0.723			
70. Aspire Mining	0.670			
71. ArcelorMittal	0.640			
72. Hallador Energy	0.599			
73. Vedanta	0.599			
74. LG International	0.595			
75. Rhino Resource Partners	0.560			
76. Ramaco	0.555			

Resources				
77. Lubelski Węgiel Bogdanka	0.554			
78. CLP Holdings	0.552			
79. Bayan Resources	0.529			
80. Steel Authority of India	0.515			
81. Vimetco	0.512			
82. Indo Tambangraya Megah (Banpu)	0.508			
83. Black Hills	0.495			
84. Monnet Ispat & Energy	0.492			
85. Kinetic Mines and Energy	0.463			
86. Feishang Anthracite Resources	0.463			
87. FirstEnergy	0.463			
88. Sasol	0.456			
89. Prairie Mining	0.428			
90. Tata Power	0.424			
91. American Energy	0.415			
92. Coal Energy	0.414			

93. Agritrade Resources	0.414			
94. Beijing Jingneng Thermal Power	0.411			
95. African Rainbow Minerals	0.400			
96. Huadian Power International	0.397			
97. Golden Eagle Energy	0.386			
98. JSW Energy	0.369			
99. Wollongong Coal	0.353			
100. TBEA Co	0.329			

Table 1: Coal and tar sands companies identified for divestment.[1,2,3]

1.3 Analysis of Social Responsibility Criteria

According to the Trustees Guidelines and Procedures, there are four criteria of social responsibility required for divestment considerations. Throughout this document, we will demonstrate that coal and tar sands divestment meets these criteria.

[1] Fossil Free Indexes, The Carbon Underground 200 (September 2017 list), October 4, 2017.
[2] Fossil Free Indexes, The Tar Sands 20 (September 2017 list), July 6, 2017.
[3] In order to ensure the safety and continued reliability of the data presented in FFI's indices, provided below are the Terms of Use FFI attaches to its investment products upon distribution: "This report is for information purposes only. It is not an offer to sell or a solicitation to buy any investment, nor is it an offer to provide any form of investment advice. The information herein has been obtained from sources that Fossil Free Indexes LLC believes to be reliable; however, Fossil Free Indexes LLC does not guarantee its accuracy, timeliness or completeness, and it is subject to change without notice. This information is provided solely for personal, informational, and non-commercial use, provided the materials are not modified. Any use of these materials beyond the licenses or rights expressly granted herein without prior written permission of Fossil Free Indexes LLC is strictly prohibited. The trademarks, logos and service marks displayed on this Web Site and in this reports are the property of Fossil Free Indexes or other third parties. Users are not permitted to use these Marks without the prior written consent of Fossil Free Indexes or such third party which may own the Mark."

I. Criterion 1: *"There exists a moral evil implicating a core University value that is creating a substantial social injury."*

In the Trustees' document "Statement on Responsibility Concerning Endowment Securities," substantial social injury is further defined as follows:

> With regard to corporate behavior, substantial social injury is defined as the excessive or deliberate injurious impact on employees, consumers, and/or other individuals, or groups resulting directly from specific actions or inactions by a company. Included in this category are actions that violate, subvert, or frustrate the enforcement of rules of domestic or international law intended to protect individuals and/or groups against deprivation of health, safety, basic freedoms or human rights.

First, a precedent on this issue was set by the Trustees in responding to the Darfur divestment proposal by the Social Responsibility Advisory Committee.[4] During this case, divestment was warranted since the companies in question contributed significantly to the regime's genocidal activities, but relatively insignificantly to the victim population's benefit. Thus, one sufficient standard for achieving Criterion 1 is when there exist particular populations who suffer from harms (net of benefits) from the companies in question.

Second, a sufficient standard for achieving Criterion 1 is the violation, subversion, or frustration of laws. Note that the phrasing of "included" means that the standard of net harms is independent of the illegality standard.

II. Criterion 2. *"There must be a specific company or companies identified for divestment, rather than a broad proposal directed at an industry or activity more generally."*

We have provided a specific list of 120 target companies, consisting of the companies holding the top 100 coal reserves and top 20 tar sands reserves by their carbon dioxide emission potential.

III. Criterion 3. *"The company or companies identified for divestment must have a significant, clear, and undeniable nexus to the moral evil."*

In light of their central nexus to coal and tar sands extraction, the companies listed above have a significant, clear, and undeniable nexus to the moral evils outlined in §§2.1, 2.2, 2.3, and 2.4. This proposal does not include an exhaustive list of company-specific moral evils, because the negative social and environmental externalities of coal and tar sands production are not company-specific; they are inherent to these industries' operations and existence. Nevertheless, a number of the discussions below make reference to specific companies listed in Table 1 that typify the coal and tar sands industries' nexus to moral evil. The companies mentioned in this regard include, but are not limited to: CONSOL Energy, Royal Dutch Shell, Chevron,

[4] Social Responsibility Advisory Committee, University of Pennsylvania, "Report on Investing in the Sudan," March 3, 2006.

ExxonMobil, Alliance Resource Partners, Suncor, Coal India, Shaanxi Coal Company, Arch Coal, and Raspadskaya OAO.

IV. Criterion 4. *"The proposal for divestment must have the support of a broad and sustained consensus of the University community reflected over a sustained period of time."*

Since the inception of Fossil Free Penn in late 2014:

- dozens of students, faculty, and alumni have formally expressed support for fossil fuel divestment (see Appendix);
- a spring 2015 Nominations & Elections Committee referendum revealed 87.8% of participating undergraduates in support of fossil fuel divestment, with student voter-turnout far greater than the required minimum (see Appendix A); and,
- on September 10, 2018, the Undergraduate Assembly passed by supermajority a resolution endorsing divestment from the 120 coal and tar sands companies listed in Table 1 (see Appendix B).

2. Moral Evil of the Coal and Tar Sands Industries

2.1 Social Injury Regarding Local Impacts of the Coal Industry

All stages in coal-fired electricity generation -- mining, transport, combustion, and waste management -- harm workers and local populations. Below, the operations that cause social injury and the particular social groups most impacted by the coal industry are discussed.

I. Coal Mining

a. Air Pollution

The first group of people that the coal industry harms is the workers. Due to coal's brittle structure, coal miners breathe in the toxic coal-dust particles that are liberated during mining and transportation. Once in the lungs, these dust particles cannot escape, causing potentially fatal nodes and lesions to form around the particulate matter. According to the Center for Disease Control and Prevention, this illness, called *pneumoconiosis* or 'black lung disease,' accounted for 42.7% of the deaths in the coal industry in 2014.[5]

Extraction-related air pollution also impacts the communities situated in proximity to coal mines. In West Virginia, for example, in order to reveal hard-to-reach coal seams, coal-mining companies detonate as many as 1,500 tonnes of explosives per day,[6] (in a process called mountaintop removal or MTR). Upon detonation, "CO_2, CO, NO, SO_2, and ammonia", along with other particulate matter embedded underground are released into the air, diminishing air quality.[7] Medical research using particulate matter collected from coal-mining sites in Appalachia has demonstrated that inhalation of dust particles released by MTR can induce microvascular dysfunction and promote "tumor development and progression in human lung cells."[8,9] The Journal of Rural Health concludes "chronic [cardiovascular disease] mortality rates were significantly higher in... mining areas compared to nonmining areas and significantly highest in [MTR] areas."[10]

b. Water Pollution

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[5] NIOSH 2017. Work-Related Lung Disease Surveillance System (eWoRLD). 2017-891 U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Respiratory Health Division, Morgantown, WV. Available at: <https://wwwn.cdc.gov/eworld/Data/891> July 11, 2018.

[6] Michael Hendryx, "The Shocking Danger of Mountaintop Removal -- and Why It Must End," TED: Ideas worth Spreading. Accessed July 17, 2018. https://www.ted.com/talks/michael*hendryx*the*shocking*danger*of*mountaintop*removal*and*why*it*must*end#t-159616.

[7] Laura Kurth et al. "Atmospheric Particulate Matter in Proximity to Mountaintop Coal Mines: Sources and Potential Environmental and Human Health Impacts." Environmental Geochemistry and Health 37, no. 3 (2014): 529-44.

[8] Travis L. Knuckles et al, "Air Pollution Particulate Matter Collected from an Appalachian Mountaintop Mining Site Induces Microvascular Dysfunction." *Microcirculation* 20, no. 2 (2013): 158-69. doi:10.1111/micc.12014.

[9] Michael Hendryx, "The Public Health Impacts of Surface Coal Mining." *The Extractive Industries and Society* 2, no. 4 (2015): 820-26.

[10] M. S. Hendryx, and L. Esch. "Chronic Cardiovascular Disease Mortality in Mountaintop Mining Areas of Central Appalachian States." *The Journal of Rural Health* 27 (2011): 350-357. Accessed July 17, 2018.

In 2013, CONSOL Energy, one of the companies from which FFP recommends Penn divest, ran underground longwall mines beneath Ryerson State Park, dewatering a number of its streams. In a letter to CONSOL,[11] the Pennsylvania Department of Environmental Protection said that company's activity had not only "irreparably damaged" six of the park's streams, but had also cracked a dam, resulting in the draining of the 62-acre Duke Lake.[12]

i. Water Pollution from Surface Mining

Mountaintop removal has a profoundly negative impact on water quality. Coal excavators store the large volume of debris displaced during MTR in nearby valleys, through which streams often run. Hence, rainwater runoff must percolate through the MTR debris before reaching proximate water bodies. This specific type of polluted runoff has "negatively impact[ed] stream biota in as much as 22% of streams in central Appalachia", where degradation is seen "decades after mine reclamation."[13] Furthermore, according to the Environmental Protection Agency (EPA), coal-debris pollution decreases oxygen levels and increases metal concentration in water bodies, destroying aquatic habitats and disrupting the "metabolic and reproductive systems" of fish, respectively.[14] Together, these factors reduce the overall health and utility of water sources, creating food and income insecurity for communities dependent on water bodies for their nourishment and livelihood.

c. Overall Impact of Coal Mining on Human Health

The air and water pollution generated by surface mining poses significant threats to human health. The research of Fulbright Distinguished Chair Dr. Michael Hendryx has found that cardiovascular diseases, kidney diseases,[15] fetal defects,[16] and fatality due to respiratory cancer are common in communities located near MTR sites in Appalachia.[17,18] Controlling for pre-existing health conditions, deleterious behavior, and socioeconomic status, Hendryx demonstrated that these trends can be reliably attributed to the coal industry. He estimated, furthermore, the number of coal-mining-related deaths in Appalachian communities near MTR sites to be in "excess of approximately 1,200 … per year."[19]

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[11] "Stream Investigation." Brian Lohr to CONSOL Pennsylvania Coal Company. February 28, 2012. 1000 CONSOL Energy Drive, Canonsburg, PA.
[12] "Longwall Mining." Spirit of America - SourceWatch. Accessed July 17, 2018.
[13] Fabian Nippgen et al, "Creating a More Perennial Problem? Mountaintop Removal Coal Mining Enhances and Sustains Saline Baseflows of Appalachian Watersheds." *Environmental Science & Technology* 51, no. 15 (2017): 8324-334. doi:10.1021/acs.est.7b02288.
[14] "Southern Coal Corporation Clean Water Settlement." EPA. September 30, 2016. Accessed July 17, 2018. https://www.epa.gov/enforcement/southern-coal-corporation-clean-water-settlement.
[15] Michael Hendryx, "Mortality from Heart, Respiratory, and Kidney Disease in Coal Mining Areas of Appalachia." *International Archives of Occupational and Environmental Health* 82, no. 2 (2008): 243-49.
[16] Michael Hendryx et al, "The Association between Mountaintop Mining and Birth Defects among Live Births in Central Appalachia, 1996–2003." *Environmental Research* 111, no. 6 (2011): 838-46.
[17] Michael Hendryx and Benjamin Holland, "Unintended Consequences of the Clean Air Act: Mortality Rates in Appalachian Coal Mining Communities," *Environmental Science & Policy* 63 (2016): 1-6.
[18] Ibid.
[19] Ibid.

I. Coal Combustion

Coal combustion is inherently harmful to human health. Aside from its well-known carbon dioxide emissions, burning coal pollutes the air with sulfur dioxide, nitrogen oxides, and mercury. A study published in *Environmental Health Perspectives* in 2015 found that exposure to high concentrations of fine-particle pollution, such as sulfur dioxide and nitrogen oxides, increases one's risk for heart disease and premature death.[20] Furthermore, thermal coal stations emit more than a third of the United States' mercury air pollution, making coal-fired electricity generation the single largest emitter of airborne mercury in this country.[21] According to the Clean Air Task Force, exposure to airborne mercury can have "toxic effects on children...including delayed developmental milestones, reduced neurological test scores, and, at high doses, cerebral palsy."[22]

The overall human cost of burning coal is immense. Indeed, for every petawatt-hour of electricity thermal coal produces, 100,000 people die globally, a death toll twenty times greater than that caused by burning natural gas (see Table 2).[23] In 2014, coal accounted for 40.7% of the 10.4 PWhs of electricity consumed globally.[24] If the above estimate of thermal coal combustion's mortal impact is correct, coal burning would have contributed to 420,000 air-pollution-related deaths that year.[25]

Energy Source	Mortality rate (deaths/PWh)
Coal	100,000
Oil	36,000
Natural Gas	4,000
Wind	150
Nuclear	90

[20] George D. Thurston et al, "Ischemic Heart Disease Mortality and Long-Term Exposure to Source-Related Components of U.S. Fine Particle Air Pollution." *Environmental Health Perspectives* 124, no. 6 (2015).
[21] Clean Air Task Force, "Non-CO2 Pollution from Coal - Clean Air Task Force (CATF)." Clean Air Task Force. Accessed July 17, 2018. http://www.catf.us/fossil/problems/nonco2/.
[22] Ibid.
[23] James Conca,. "How Deadly Is Your Kilowatt? We Rank The Killer Energy Sources." *Forbes*. March 28, 2017. Accessed August 26, 2018. https://www.forbes.com/sites/jamesconca/2012/06/10/energys-deathprint-a-price-always-paid/#3e6a1e16709b.
[24] "Energy - Electricity Generation - OECD Data," TheOECD. Accessed August 26, 2018, https://data.oecd.org/energy/electricity-generation.htm.
[25] "Electricity Production from Coal Sources (% of Total)." GDP Growth (annual %) | Data. Accessed August 26, 2018. https://data.worldbank.org/indicator/EG.ELC.COAL.ZS.

Table 2. Mortality rates for energy production from different sources.[26]

III. Waste Management

In the United States, coal ash is one of the most abundant forms of industrial waste produced, totalling 140-million tonnes in 2014.[27] Coal companies store this solid waste by mixing it with water in impoundments (or 'ponds'), creating the potential for serious health concerns for nearby communities.

Coal ash contains mercury, cadmium, and arsenic,[28] toxic substances that can cause nervous system damage, cardiovascular issues, and cancers of the urinary tract, lungs, and skin.[29] According to a 2016 Duke University study examining twenty-one unlined ash-storage sites in five states, "strong evidence" suggests that "coal ash ponds [leach into or otherwise contaminate] adjacent surface water and shallow groundwater."[30] In fact, the study found evidence of water contamination at all of the twenty-one tested sites,[31] with 29% of surface water samples containing contamination levels above the EPA's safe drinking water standards.[32] Furthermore, when there is no lining beneath ash ponds, mercury, cadmium, and arsenic particles seep into the ground and are subsequently ingested by microbial organisms. Traveling up the food chain, these chemicals are ultimately ingested by humans. Given that approximately 90% of coal ash ponds are unlined,[33] the risk ash ponds pose to human health is great.

IV. A Note on Clean Coal

What about 'clean coal'? Does 'clean coal' reduce the health and environmental impacts of coal mining and combustion?

As it stands today, the answer is effectively 'no.' While, by capturing and storing the carbon dioxide emitted during combustion, clean-coal stations do reduce the environmental impact of burning coal, only one clean-coal station exists in the United States.[34] Furthermore, the costliness of retrofitting existing coal plants makes it unlikely that the number of these stations

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[26] Ibid.
[27] "Coal Ash Basics." EPA. April 26, 2017. Accessed July 17, 2018. https://www.epa.gov/coalash/coal-ash-basics.
[28] Ibid.
[29] "The Coal Ash Problem." Earthjustice. September 01, 2015, accessed July 17, 2018, https://earthjustice.org/features/the-coal-ash-problem.
[30] Jennifer S. Harkness et al, "Evidence for Coal Ash Ponds Leaking in the Southeastern United States." *Environmental Science & Technology* 50, no. 12 (2016): 6583-592.
[31] Ibid.
[32] "Coal Ash Ponds Found to Leak Toxic Chemicals," *Duke Today*, accessed July 17, 2018, https://today.duke.edu/2016/06/ashpondlea.
[33] "Coal-Ash Chemicals in Your Drinking Water: Y/N?" Sierra Club. April 25, 2018, accessed July 17, 2018. https://www.sierraclub.org/sierra/coal-ash-chemicals-your-drinking-water-y-n.
[34] Brad Plumer, "What 'Clean Coal' Is - and Isn't," *The New York Times,* August 23, 2017, accessed July 17, 2018, https://www.nytimes.com/2017/08/23/climate/what-clean-coal-is-and-isnt.html?rref=collection/sectioncollection/climate.

will significantly increase in the coming years.[35] Therefore, given the infinitesimal net social benefit of clean-coal, and given that clean coal does nothing to counteract the staggering social injury caused by standard coal combustion, its existence cannot serve as a pretext under which the University of Pennsylvania's investments in the coal industry are morally justified.

2.2 Social Injury Regarding Local Impacts of the Tar Sands Industry

I. Introduction: What are Tar Sands?

Tar sands, or oil fields, are areas of near-surface soil that contain high levels of bitumen, which is a substance that can be converted to synthetic crude oil. Most of the world's reserves are located in Venezuela and Alberta, Canada.[36]

Unlike crude oil, tar sands are not extractable in the common understanding of the term. They are first mined, or "steamed", from the ground, meaning that companies need access to large expanses of land above tar sands stores.[37] All forests, rivers, lakes, and other prohibitive natural areas must be cleared prior to mining, and mining requires a significant amount of water from surrounding sources.[38] Next, tar sands mining companies extract bitumen -- the toxic, sludge-like substance in which tar sands are so rich -- from the raw sands. Before being pumped or processed anywhere, tar sands bitumen must be mixed with a diluting agent to lower its viscosity and make it transportable. Each company uses a different proprietary formula for this thinning substance, but they all contain volatile pollutants.[39] A final and optional step on the mining companies' part is sending bitumen to upgrading facilities, where it can be made easier to refine before it is sent to refineries.[40]

Mixing tar sands bitumen with thinning agents and running it through various mechanical processes results in synthetic crude oil, which is pumped, driven, or otherwise transported to refineries (usually in the United States) to be converted to fuel. Once it reaches the refinery, synthetic crude oil is processed much like conventional crude oil.

II. The Environmental Impact of the Tar Sands Industry

a. Water pollution

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[35] Plumer, Brad. "What 'Clean Coal' Is - and Isn't." The New York Times. August 23, 2017. Accessed July 17, 2018. https://www.nytimes.com/2017/08/23/climate/what-clean-coal-is-and-isnt.html?rref=collection/sectioncollection/climate.

[36] Richard E. Meyer et al., "Heavy Oil and Natural bitumen resources in Geological basins of the World" 14, Table 1 (2007), U.S. Geological survey, https://pubs.usgs.gov/of/2007/1084/OF2007-1084v1.pdf.

[37] "Unconventional Fossil Fuels Factsheet." Wind Energy Factsheet | Center for Sustainable Systems. Accessed July 20, 2018. http://css.umich.edu/factsheets/unconventional-fossil-fuels-factsheet.

[38] "Yale University." Roads & Forests | Global Forest Atlas. Accessed July 20, 2018. https://globalforestatlas.yale.edu/boreal-forest/land-use/mining-boreal-tar-sands.

[39] Phyllis Fox, "Comments on initial study/Mitigated Negative Declaration (IS/MND) for the Valero Crude by rail Project" 25 (July 1, 2013), http://www.thegoodman.com/pdf/TGG20130701_NRDC_BeniciaValeroCBR.pdf.

[40] "Oil Sands 101: Process Overview." Oil Sands Magazine. September 01, 1970. Accessed July 19, 2018. http://www.oilsandsmagazine.com/technical/oilsands-101.

The water surrounding mines often contains high concentrations of damaging pollutants, such as toxic methylmercury and benzene.[41] This pollution not only affects wildlife, but also the indigenous communities situated proximate to mining and processing facilities in Alberta that rely on that wildlife for sustenance.[42,43]

Tar sands tailing ponds, the result of runoff from the mining and extracting processes, are some the most toxic of any industry, containing naphthenic acids, PAHs, and residual bitumen.[44] These ponds, with which tar sands regions are littered, are incredibly toxic. In fact, in 2010, a group of 500 birds landed on a Syncrude tailing pond and only three survived.[45] Like coal ash ponds, tailings leak heavily into surrounding soil and groundwater systems, at least partially accounting for the water pollution in the areas surrounding tar sands facilities.[46]

b. Air Pollution

Every step in the processing of tar sands -- mining, upgrading, and refining -- contributes to air pollution.[47] Unsurprisingly, as tar sands mining activity increases in a given area, so does air pollution.[48] Worse, the pollutants released during tar sands production tend to accumulate easily and remain in the atmosphere for long periods of time.[49]

In the Peace River area of Northern Alberta, where CNRL and Shell operate a massive in-situ tar sands extraction effort, the bitumen-rich sands are located further beneath the surface than normal, requiring more energy-intensive mining practices.[50] The air pollution these practices generated was so overwhelming that Peace River citizens began reporting health impacts, including nausea, headaches, and difficulty breathing,[51] even compelling a number of

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[41] Erin N. Kelly, et al., "Oil sands Development Contributes to Polycyclic Aromatic Compounds to the Athabasca river and its Tributaries" 2, Proc. Natl. Acad. Sci. U.S. (Oct. 23, 2009), www.pnas.org/content/early/2009/12/04/0912050106.full.pdf.

[42] Carrie Tait and Kelly Cryderman, "Alberta First Nations band Wins right to Trial Over Oil sands' Effect on Treaty rights,"Globe & Mail (June 4, 2013), https://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/alberta-first-nations-band-wins-right-to-trial-over-oil-sands-effect-on-treaty-rights/article12353571/.

[43] California Office of Environmental Health Hazard Assessment, Methylmercury in Sport Fish: Information for Fish Consumers (Aug. 1, 2013), https://oehha.ca.gov/media/downloads/fish/fact-sheet/hgfactsheet.pdf.

[44] Pembina institute, Oil Sands: Tailings (accessed Nov. 21, 2013), www.pembina.org/oil-sands/os101/tailings.

[45] "Oil Sands Could Threaten Millions of Migratory Birds," Climate Change Will Worsen Hunger, Study Says | *Worldwatch Institute*, Accessed July 20, 2018. http://www.worldwatch.org/node/6052.

[46] Environmental Defense Canada, 11 Million Litres a Day: The Tar Sands' Legacy 2 (Dec. 2008), https://environmentaldefence.ca/report/report-11-million-litres-a-day-the-tar-sands-leaking-legacy/.

[47] Pembina Institute, Oil Sands: Air Pollution (accessed Nov. 21, 2013), www.pembina.org/oil-sands/os101/air-pollution.

[48] The Lung Association, Air Quality Issues in Alberta & NWT, www.ab.lung.ca/site/air_quality_issues_in_alberta__nwt.

[49] USEPA, Persistent Bioaccumulative and Toxic (PBT) Chemical Program: Benzo(a)pyrene (April 18, 2011), https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-rules-under-tri.

[50] "Peace River." European Use of Wind Power - Electricity & Alternative Energy - Alberta's Energy Heritage. Accessed July 21, 2018. http://www.history.alberta.ca/energyheritage/sands/underground-developments/in-situ-development/peace-river.asp.

[51] Meagan Wohlberg, "Alberta regulator investigates Health Complaints Around Peace river Oilsands Projects," Northern Journal (Oct. 14, 2013), http://norj.ca/2013/10/alberta-regulator-investigates-health-complaints-around-peace-river-oilsands-projects/.

Peace River families to relocate entirely. In fact, between 2011 and 2016, in-part because of air pollution, Peace River's population fell from 4,078 to 3,924. On behalf of residents of Peace River, Wilson Law stated that the scale of the health crisis in his community has been "unprecedented in the history of Alberta's oil industry and landowners."[52]

Compared to extracting and processing crude oil, extracting and processing tar sands bitumen is more polluting in every respect. Tar sands bitumen contains more heavy metals and dangerous sulfur compounds than standard crude. Upon combustion, these compounds are released into the air.[53] While crude oil contains 5-7% unrefined by-product (i.e. petroleum coke) by weight, tar sands bitumen contains 15-30%, which not only makes the exhaust more polluting during extraction, but also makes it feasible for refining companies to sell petroleum coke (a sort of artificial, pollutant-ridden coal) for profit, further increasing tar sands' net carbon emissions.[54, 55] In addition, tar sands production requires three times as much water as crude production, and synthetic crude emits 15% more carbon per gallon of gasoline than regular crude.[56]

III. The Human Health Impacts of the Tar Sands Industry

a. On Employees

The vapors released during the processing and transportation of tar sands (from both the bitumen itself and the dilution agents) are deleterious to human health. At every stage of production, workers risk exposure to "fugitive emissions" -- unpredictable spurts of potentially carcinogenic gases imbedded in the volatile substances necessary for bitumen extraction and processing.[57] Uncoincidentally, tar sands industry employees suffer from elevated rates of leukemia and respiratory cancers.[58]

b. On Residents

In addition to suffering the consequences of the spills, leaks, and unpredictable accidents that rack tar sands regions, communities neighboring tar sands facilities report high rates of cancer due to residents' exposure to the carcinogenic substances released during tar sands

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[52] Statistics Canada. "Census Profile, 2016 Census Peace River, Town [Census Subdivision], Alberta and Alberta [Province]." Census Subdivision of Prince George, CY (British Columbia). April 24, 2018. Accessed July 21, 2018. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4819038&Geo2=PR&Code2=48&Data=Count&SearchType=Begins&SearchPR=01&B1=All&TABID=1.

[53] Richard E. Meyer et al., "Heavy Oil and Natural bitumen Resources in Geological basins of the World" 14, Table 1 (2007), U.S. Geological survey, https://pubs.usgs.gov/of/2007/1084/OF2007-1084v1.pdf.

[54] British Petroleum, How Calcined Petroleum Coke Is Produced (2014), www.bp.com/extendedsectiongenericarticle.do?categoryid=9037970&contentid=7069740.

[55] Oilchange International, "Petroleum Coke: The Coal Hiding in the Tar sands" 6 (Jan. 2013), http://priceofoil.org/2013/01/17/petroleum-coke-the-coal-hiding-in-the-tar-sands/.

[56] "What Are Tar Sands?" Union of Concerned Scientists. Accessed July 21, 2018. https://www.ucsusa.org/clean-vehicles/all-about-oil/what-are-tar-sands#.W1OLfi2ZNmA.

[57] Diane Bailey and Danielle Droitsch, "Tar Sands Crude Oil - Health Effects of a Dirty and ..." *NRDC,* February 2014. Accessed July 21, 2018. https://www.nrdc.org/sites/default/files/tar-sands-health-effects-IB.pdf.

[58] David J. Tenenbaum, "Oil Sand Development: A Health Risk Worth Taking?" *Advances in Pediatrics* 117, no. 4 (April 2009), accessed July 21, 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2679626/.

processing (such as benzene and styrene).[59] In general, people who live in communities proximate to tar sands facilities are unhealthier than people who do not.[60]

2.3 Social Injury Regarding Climate Change

I. Societal Destabilization

Anthropogenic climate change poses a severe threat to the safety and survival of human civilization. According to the World Health Organization (WHO), climate change currently contributes to an estimated 150,000 premature deaths every year.[61] By 2050, due to heat stress, malnutrition, and the spread of infectious diseases like malaria, the WHO expects this number to rise to 250,000.[62]

Climate destabilization is also expected to cause an unprecedented refugee crisis. The World Bank estimates that, by 2050, climate-change related factors will displace 143 million people within their own countries.[63] By 2100, due to rising sea levels alone, up to 2 billion people could become domestic or international climate refugees.[64]

II. Agricultural Decline

In the next several decades, during which population growth is projected to require at least a 50% increase in global food production,[65] climate-change related factors are expected to significantly impact agricultural productivity. The Intergovernmental Panel on Climate Change (IPCC) forecasts precipitous reductions in crop yields over the next 50 years, contributing to half-a-million premature deaths worldwide by 2050.[66] Furthermore, the United Nations Human Development Report states that "although low HDI [human development index] countries contribute the least to global climate change, they are likely to endure the greatest loss in annual rainfall and the sharpest increase in its variability, with dire implications for agricultural

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[59] Gina Solomon, "The Other Disaster: Cancer and Canada's Tarsands," Switchboard, Natural resources Defense Council blog (May 3, 2010), switchboard.nrdc.org/blogs/gsolomon/the_other_oil_disaster_cancer.html.

[60] Yiqun Chen, "Cancer incidence in Fort Chipewyan, Alberta, 1995-2006" 25 (Feb. 2009), Alberta Cancer Board Division of Population Health and Information Surveillance, www.ualberta.ca/~avnish/rls-2009-02-06-fort-chipewyan-study.pdf.

[61] "Climate Change." *World Health Organization.* December 7, 2010. http://www.who.int/heli/risks/climate/climatechange/en/.

[62] "Climate Change and Health." *World Health Organization.* February 1, 2018. http://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health.

[63] "Climate Change Overview." *The World Bank.* June 21, 2018. https://www.worldbank.org/en/topic/climatechange/overview.

[64] Friedlander, Blaine. "Rising Seas Could Result in 2 Billion Refugees by 2100," *Cornell Chronicle,* June 19, 2017. http://news.cornell.edu/stories/2017/06/rising-seas-could-result-2-billion-refugees-2100.

[65] Amos P. K. Tai et al, "Threat to Future Global Food Security from Climate Change and Ozone Air Pollution." *Nature Climate Change* 4, no. 9 (2014): 817-21.

[66] Marco Springmann et al, "Global and Regional Health Effects of Future Food Production under Climate Change: A Modelling Study." *The Lancet* 387, no. 10031 (2016): 1937-946.

production and livelihoods."[67] Conversely, adopting climate-stabilizing strategies could reduce these potential deaths by 29 to 71%.[68]

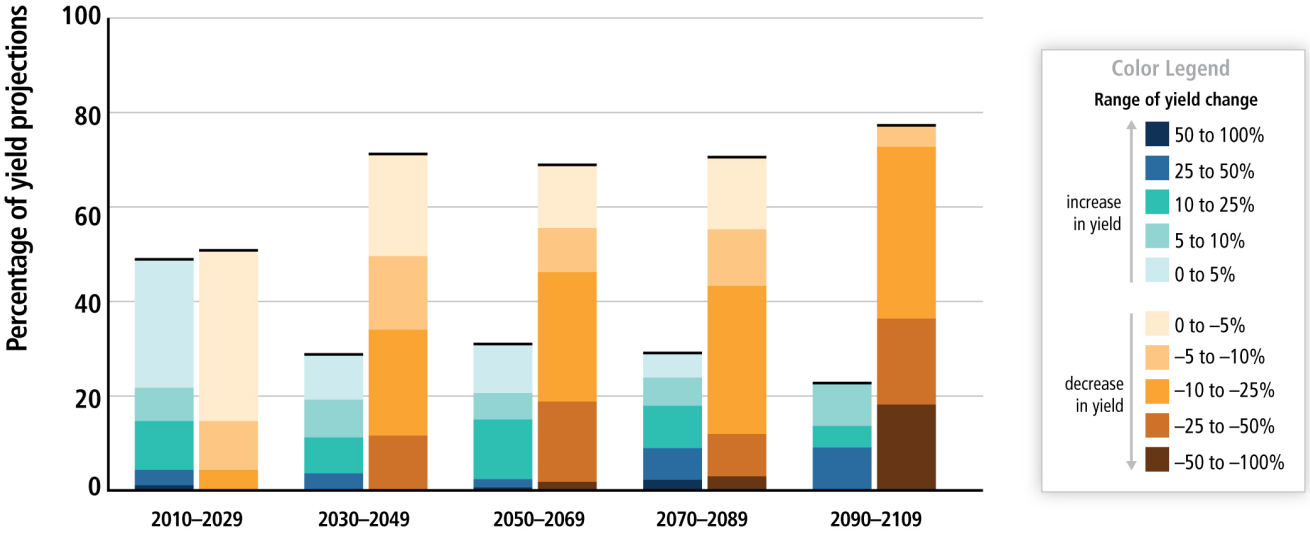

Figure 1: Global Agricultural Yield Projections 2010-2110.[69]

III. Ecosystem Destabilization

In addition to sea level rise, biodiversity loss, and climate destabilization, one of the most alarming and rarely-discussed consequences of increased levels of atmospheric carbon dioxide is ocean acidification. Coral reefs, whose myriad ecological and civilizational virtues provide $375-billion in value every year,[70] are among the ocean ecosystems most impacted by ocean acidification. The recent decline of Australia's Great Barrier Reef demonstrates the detrimental impact of acidifying oceans, with 50.7% of its coral cover having disappeared between 1985 and 2012.[71] According to a 2010 report from the United Nations Environment Programme (UNEP), "[i]f ocean acidification continues, disruptions to food chains... are considered likely with consequent risk to food security." Unsurprisingly, the report identified reductions in anthropogenic CO_2 emissions as the "obvious solution" to the ever-worsening problem.[72]

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[67] United Nations Development Programme, Human Development Report 2013: The Rise of the South: Human Progress in a Diverse World, p. 6.
[68] Marco Springmann, "Global and Regional Health Effects…"
[69] IPCC Assessment Reports, Chapter 7.
[70] National Oceanic and Atmospheric Administration. "Heat Stress to Caribbean Corals in 2005" Worston Record. 2010.
[71] De'ath, Glenn et al. "The 27–year decline of coral cover on the Great Barrier Reef and its causes." In: Proceedings of the National Academy of Sciences (Oct. 2012).
[72] United Nations Environment Programme. Environmental Consequences of Ocean Acidification: A Threat to Food Security. 2010.

2.4 Social Injury Regarding Political Influence and Lobbying

Actively denying the incontrovertible fact of anthropogenic climate change is academically dishonest and obstructs the democratic process of creating and implementing solutions to the social ills it creates. Furthermore, climate-change denial contradicts Penn's values as an academically-rigorous university and its reputation as the "Civic Ivy." By investing in coal and tar sands companies, Penn implicates itself in the social injury perpetrated by these companies.

Companies that own and/or profit from coal and tar sands production have a long and well-documented history of funding the denial of anthropogenic climate change. According to the Oxford Handbook of Climate Change and Society, "individual corporations such as ExxonMobil and Peabody Coal...provided funding for individual contrarian scientists, conservative think tanks active in climate change denial, and a host of front groups."[73] The fossil fuel industry in general, which, of course, includes the coal and tar sands industries, spends an enormous amount of money and resources on lobbying. In 2017, for example, the coal mining industry donated $5,661,500 to politicians who, almost without fail, vote against environmental regulations.[74,75]

Funding climate-change denial obstructs both political efforts to curb environmental destruction, and also the wider democratic system of which Penn is a civic participant. Scott Pruitt's brief tenure as administrator of the EPA shows how this influence can break down governmental institutions. Pruitt's personal and political ties to the coal industry are vast. One of the more egregious examples is his friendship with Joe Craft, CEO of the American coal company Alliance Resource Partners. Craft and his wife regularly donated to Pruitt's campaigns in Oklahoma, and more recently gave over $2 million to Trump's presidential campaign and inaugural fund.[76] As EPA chief, Pruitt met with Craft on seven different occasions.[77, 78] Correlatively, as we have witnessed, the EPA under both Scott Pruitt and Andrew Wheeler has not demonstrated even marginal interest in protecting the American people from environmental harm, not to mention protecting the environment itself.

The fossil fuel industry's political influence is not just restricted to the United States. In Canada, for instance, fossil-fuel-industry lobbyists, such as those working for the tar sands giant Suncor Energy, have impeded attempts to curb fossil fuel subsidies.[79] Although removing subsidies for fossil fuel companies was a part of the Liberal Party Platform, such influence has stymied Trudeau and his government's success. The Ontario Lobbyist Registry shows that

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[73] John S. Dryzek, Richard B. Norgaard, and David Schlosberg, "Organized Climate Change Denial". *Oxford Handbook of Climate Change and Society.* Aug 2011. Web. October 20, 2015

[74] "Coal Mining Industry Profile: Summary, 2017." *Open Secrets.* Accessed July 24, 2018.

[75] "Coal Mining Summary." Open Secrets. Accessed July 24, 2018

[76] President Trump appointed Scott Pruitt as EPA administrator.

[77] Steve Eder, "A Courtside View of Scott Pruitt's Cozy Ties With a Billionaire Coal Baron," *The New York Times,* June 02, 2018. Accessed July 24, 2018.

[78] Kroh, Kiley, "New Report Details Scott Pruitt's Cozy Relationship with a Billionaire Coal Baron," *ThinkProgress,* June 2, 2018. Accessed July 24, 2018.

[79] Patrick DeRochie,"CANADA'S LARGEST TAR SANDS PRODUCER IS LOBBYING THE ONTARIO GOVERNMENT ON FOSSIL FUEL SUBSIDIES." *Environmental Defence*, August 02, 2018. Accessed August 26, 2018.

Suncor specifically lobbied to influence what a subsidy ban would look like, directly connecting the current government's inaction with tar sands industry influence.[80]

In the United States, coal-industry lobbying results in direct social injury. Peabody Energy and Arch Coal have been lobbying for a tax cut that, if achieved, would threaten the Black Lung Disability Trust Fund, which funds ex-miners' treatment for the incurable disease caused only by coal dust inhalation.[81] The fund, which is already substantially underfunded, helps pay for medical expenses when the organization liable no longer exists or is unable to pay. Thus, financially supporting these companies and their lobbying efforts means that Penn, a regional and global leader in health sciences, is implicated in the coal industry's deliberate assault on vital healthcare services.

[80] Ibid.

[81] Snyder, Brian. "Coal Lobby Fights Black-lung Tax as Disease Rates Surge." *Reuters.* June 4, 2018. Accessed July 24, 2018.

3. Fiduciary Responsibility

Divestment from the coal and tar sands companies listed in Table 1 is consistent with the Trustees' fiduciary responsibility. As demonstrated below, the coal and tar sands industries are riskier and costlier than nearly all other sources of primary and secondary energy, and, with the rise of electric vehicles and renewable energy resources, are becoming increasingly unattractive investments to governments and utilities (with respect to coal), as well as international oil corporations (with respect to tar sands).

3.1 Financial Justification for Divestment from Coal

I. Introduction

Coal is in terminal decline. The high environmental and financial costs of coal-fired power generation are leading governments and utilities across the world to invest in alternative power generation resources, such as renewables and natural gas. Below, the impact of these factors on the American coal industry, where the impact of coal's decline is the most pronounced, is discussed. Then, examining the coal industry's grim future prospects in the emerging markets of China and India, the high likelihood of future decreases in coal demand is demonstrated. In turn, these analyses render Penn's investment in the coal industry not merely unwise, but a violation of the Trustees' fiduciary responsibility.

II. American Coal: An Industry in Decline

Representing the ways in which the shifting energy economy has damaged coal's competitiveness, the expansion of the natural gas and renewable energy markets in the United States and abroad has profoundly impacted the American coal industry. By the end of 2017, following a mere 2.4% drop in domestic coal consumption, U.S. coal production dropped 38% below its level a decade earlier. In that same time period, the number of domestic coal-fired power plants in the United States fell from 600 to 360,[82] and, notwithstanding the Trump administration's pro-coal, "Energy Dominance" agenda,[83] twenty-seven of those closures took place in 2017.[84] As former CEO of James River Coal Peter Socha attested in his company's April 2014 bankruptcy filing, the American coal industry finds itself in such dire straits, "because alternative sources of energy have become increasingly attractive to electricity generators in light of declining natural gas prices and more burdensome environmental and other governmental regulations."[85]

While (as discussed later in this section) "environmental and other governmental regulations" have contributed and will continue to contribute to coal's decline, the power of the free market has played a major role in promoting the expansion of cheap natural gas and

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[82] Clifford Krass, "Coal's Decline Seems Impervious to Trump's Promises," *The New York Times,* January 24, 2018. https://www.nytimes.com/2018/01/24/business/energy-environment/coal-miners.html.
[83] Ibid.
[84] Silvio Marcacci, "Utilities Closed Dozens of Coal Plants In 2017. Here Are The 6 Most Important," *Forbes,* December 18, 2018, https://www.forbes.com/sites/energyinnovation/2017/12/18/utilities-closed-dozens-of-coal-plants-in-2017-here-are-the-6-most-important/2/#3fc17d687059.
[85] Taylor Kuykendall, "Roster of US coal companies turning to bankruptcy continues to swell," *SNL,* June 4, 2015. https://www.snl.com/interactiveX/Article.aspx?cdid=A-32872208-12845&FreeAccess=1.

renewable energy generation resources, beleaguering coal's competitive edge. The following list references a selection of three coal plants whose failure occurred (i) since Trump took office, and (ii) in large part due to the aforementioned economic forces:

- In July 2017, New Mexico's largest utility company Public Service Company of New Mexico (PNM) published the results of a Most Cost-Effective Portfolio (MCEP) analysis, concluding that retiring coal would be the best option for low-cost power.[86] According to the analysis, while coal makes up 58.7% of PNM's most cost-effective portfolio in 2018, it makes up only 12.3% in 2025, and 0% in 2035.[87] In pursuit of the most cost-effective portfolio, PNM will retire its 783-megawatt (MW) San Juan Generating Station by 2022 and its 200 MW Four Corners Power Plant by 2031.[88,89]

- In August 2017, Colorado's Xcel Energy, which has eliminated 1.1-gigawatts (GW) of coal-fired capacity since 2011,[90] announced an agreement to retire two out three units at the Comanche Generating Station totaling 660 MW of capacity by 2025. Around the same time, Xcel requested competitive bids for 1,000 MW of additional wind, 700 MW of solar, and 700 MW of natural gas. Speaking to the company's shift towards renewable generation resources, Colorado Xcel Energy president David Eves said: "The fundamental economics of these technologies (wind and solar) is what is making these dramatic changes possible and beneficial to consumers."[91]

- In the first days of October 2017, Texas power provider Luminant announced its plans to retire the 1.8 GW Monticello Power Plant. According to Curt Morgan, CEO and President of Vista Energy, Luminant's parent company, "the market's unprecedented low power price environment [had] profoundly impacted [the plant's] revenues and no longer supported continued investment."[92] A week later, amid "sustained low wholesale power prices, an oversupplied renewable energy market, and low natural gas prices,"[93] Vistra announced its plans to also close its two-unit Sandow Power Plant and its two-unit Big Brown power plant – together totaling 2.3 GW in capacity.[94]

According to a May 2018 report by the American Coalition for Clean Coal Electricity, almost 115,000 MW (or 115 GW) of generating capacity across 43 states has been retired or announced to retire through 2030, a staggering quantity equivalent to almost 40% of the U.S.

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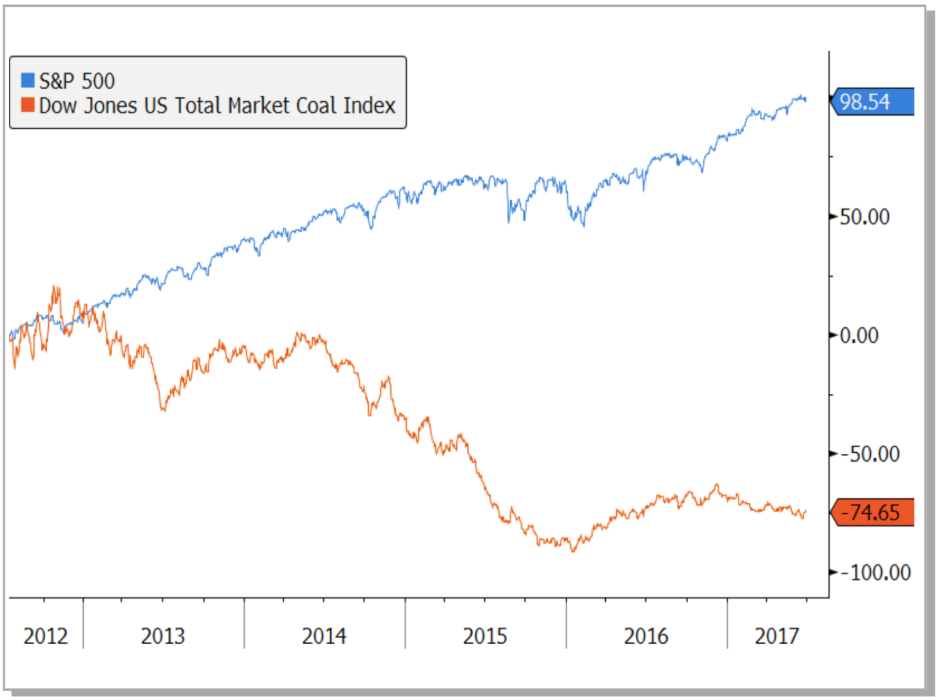
[86] Public Service Company of New Mexico, "Integrated Resource Plan: Balancing Cost and Reliability While Reducing the Impact on the Environment," July 3, 2017, 142.
[87] Ibid., 133-134.
[88] "Table 14. PNM's Existing Generating Resources," Ibid., 44.
[89] "Coal," PNM, accessed August 7, 2018, https://www.pnm.com/reducing-coal.
[90] Marcacci, "Utilities Closed Dozens of Coal Plants…"
[91] Aldo Svaldi, "Xcel plans to retire two coal-fired plants in Pueblo, increase renewables," *The Denver Post,* August 29, 2017, https://www.denverpost.com/2017/08/29/xcel-energy-pueblo-coal-plants-retiring/.
[92] "Luminant to Close 1,800-MW Coal-Fired Monticello Power Plant," Power Engineering, accessed August 7, 2017, https://www.power-eng.com/articles/2017/10/luminant-to-close-1-800-mw-coal-fired-monticello-power-plant.html.
[93] "Luminant to Close Two Texas Power Plants: Decision Result of Challenging Plant and Market Economics," Luminant, accessed August 7, 2018, https://www.luminant.com/luminant-close-two-texas-power-plants.
[94] Ibid.

coal fleet that operated in 2010.[95] The precipitous decline in coal power production has been so damaging to the coal industry that, according to SNL Energy data, 44.3% of coal produced in the U.S. (at the time of the April 2016 report) came from companies that had filed for bankruptcy court protection since 2012.[96] Utilities' migration towards natural gas and renewable power generation has contributed to decreases in domestic demand amounting to only a few percent (4.2% since 2014),[97] and yet the impact of these decreases has significantly impacted coal companies' stock prices. Take the Dow Jones U.S. Coal Index, for example. Between 2012 and 2017, investors in the Dow Coal Index would have lost 75% over the last five years versus a positive 99% return on the S&P 500 (see Figure 2).[98]

Figure 2: Total Return of Dow Jones U.S. Coal Index versus S&P 500 since 2012.[99]



Source: Bloomberg

III. Imminent Coal Phase-Outs in China and India

While the fate of the U.S. coal industry – the world's second largest producer of coal in 2013 –[100] has and will continue to impact the global coal industry and thus reduce investors'

[95] "Retirement of U.S. Coal-Fired Electric Generating Units," American Coalition for Clean Coal Electricity, May 1, 2018, 1.
[96] Taylor Kuykendall and Ashleigh Cotting, "Companies recently filing bankruptcy produce more than 2/3 of PRB coal," *SNL,* April 13, 2016, https://www.snl.com/InteractiveX/Article.aspx?cdid=A-36118340-12086.
[97] "Coal 2017," *International Energy Agency,* December 18, 2017. https://www.iea.org/coal2017/.
[98] Choate Investment Advisors LLC. "2017 Second Quarterly Review." https://www.choateinvestmentadvisors.com/uploads/1178/doc/2017_Q2_Review.pdf.
[99] Ibid.

returns, whether global demand will dramatically increase or decrease in the future depends largely on the needs of emerging markets, specifically China and India. Although it has historically driven economic growth in both countries, long-term coal-fired power generation in China and India is environmentally unsustainable and economically unwise. First, coal combustion contributes significantly to both countries' severe air-pollution crises, preventing their societies from functioning normally and, more importantly, causing tens to hundreds of thousands of premature deaths every year. Second, as the production and operational costs of wind and solar power generation continue to decline, renewable energy sources will supplant coal as preferred power generation resources in the years to come (see §IV below). Together, these factors will contribute to a dramatic decline in the global demand for coal going forward, impacting coal companies all over the world and creating inauspicious economic circumstances similar to those that the U.S. coal industry is currently suffering.

a. The Pollution Crisis in China

In the Fall of 2017, in light of the United States withdrawing from the Paris climate agreement and reneging on many of its mitigation goals, China's President Xi Jinping declared that, in America's stead, China would take "a driving seat in international cooperation to respond to climate change."[101] While China's nominal commitment to fighting climate change may very well lead the government to more conservatively use fossil fuels, Xi Jinping's 2017 order to close 27 coal mines in the nation's largest coal-producing region of Shanxi had virtually nothing to do with his concern for the climate:[102] It was to curb coal-smoke pollution. In spite of the short-term economic cost of doing so, Minister for Environmental Protection Li Ganjie says, "[w]inning the blue-sky battle is high on the agenda."[103] Although unexpectedly high demand for residential heating and cooling has slowed the government's efforts,[104] Ganjie says the government plans to extend the moratorium on industrial and municipal coal-combustion to other coal-heavy regions like Beijing, Shaanxi, and Shanghai in a continued effort to address the crisis.[105]

Pollution has become such a severe health hazard across China that, at its worst, to quote a report published by the Shanghai Academy of Social Sciences, it can make cities nearly "uninhabitable for human beings."[106]Although the social and environmental consequences of the pollution crisis have already proved serious enough to compel government action, its economic cost is also becoming an issue of growing concern to the country and its citizenry. An associate

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[100] Akanksha Gupta, "Coal giants: the world's biggest coal producing countries," *Mining Technology,* March 3, 2014, https://www.mining-technology.com/features/featurecoal-giants-the-worlds-biggest-coal-producing-countries-4186363/.

[101] Lisa Friedman, "As U.S. Sheds Role as Climate-Change Leader, Who Will Fill the Void," *The New York Times,* November 12, 2017. https://www.nytimes.com/2017/11/12/climate/bonn-climate-change.html.

[102] Steven Lee Myers, "In China's Coal Country, a Ban Brings Blue Skies and Cold Homes," *The New York Times,* February 10, 2018, https://www.nytimes.com/2018/02/10/world/asia/china-coal-smog-pollution.html.

[103] Ibid.

[104] Ibid.

[105] Frank Tang, "China expands battle against pollution to its top coal producing province," *South China Morning Post,* February 5, 2018. https://www.scmp.com/news/china/article/2131952/china-expands-battle-against-pollution-northwest-region

[106] Jonathon Kaiman, "China's toxic air pollution resembles nuclear winter, say scientists," *The Guardian,* February 25, 2014, https://www.theguardian.com/world/2014/feb/25/china-toxic-air-pollution-nuclear-winter-scientists.

professor at China's Agriculture University said that, if it persists at current levels, China's severe smog could cause agriculture to suffer conditions "somewhat similar to a nuclear winter," threatening the very capacity for crops to photosynthesize and grow.[107] Furthermore, during "red-alert" periods, when the quantity of dangerous particulate matter (PM 2.5) can surge to 40 times the World Health Organization's maximum guideline,[108,109] the government suspends airport and highway operations, tourists stay in their homes, and factories shut down. These costs – literally – add up. RAND Corp estimates that the cost of managing pollution in China reduces the country's GDP by 6.5% annually.[110]

Burning coal has the worst health impact of any source of air pollution in China. In 2013, out of 916,000 total premature, air-pollution-related deaths, coal combustion was responsible for 366,000.[111] Independent of the free-market forces that will totally obsolesce the use of thermal coal worldwide (see §IV below), the need for China to protect its populace and maintain sociopolitical order will reduce the country's use of coal, and will thus lead the country to substitute a major portion of its power-generation capacity, and meet future generation needs, with alternative energy sources.

b. The Pollution Crisis in India

Like China, India's reliance on coal as a driver of economic growth has contributed to a pollution crisis that presents nearly unparalleled health hazards to the nation's citizenry. For instance, based on air-quality data gathered from 4,300 towns and cities in 108 countries between 2010 and 2016, the World Health Organization concluded that fourteen out of the top fifteen most polluted cities in the world are in India.[112] Furthermore, the Health Effects Institute reports that air pollution is the second most serious risk factor for public health in India,[113] contributing to 1.1 million premature deaths in 2015.[114] While poor air quality is a fact of life year-round in both urban and rural areas, levels of dangerous airborne pollutants periodically skyrocket. One such event took place in November 2017, when air quality in Delhi reached levels 30 times what the WHO considers safe (exceeding 700 micrograms of PM 2.5 per cubic meter).[115] In fact, the

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[107] Ibid.

[108] "China Pollution: First ever red alert in effect in Beijing," *BBC News,* December 8, 2015, https://www.bbc.com/news/world-asia-china-35026363.

[109] PM 2.5 refers to infinitesimal particles that are 2.5 microns or less in width. PM 2.5 particles are small enough to easily travel into the respiratory tract and reach the lungs, affecting lung function and worsening medical conditions such as asthma and heart disease. "Fine Particles (PM 2.5) Questions and Answers," Department of Health, New York State, accessed August 24, 2018, https://www.health.ny.gov/environmental/indoors/air/pmq_a.htm.

[110] Constance Gutske, "Pollution crisis is choking the Chinese economy," *CNBC,* February 11, 2016, https://www.cnbc.com/2016/02/11/pollution-crisis-is-choking-the-chinese-economy.html.

[111] Edward Wong, "Coal Burning Causes the Most Air Pollution Deaths in China, Study Finds," *The New York Times,* August 17, 2016, https://www.nytimes.com/2016/08/18/world/asia/china-coal-health-smog-pollution.html.

[112] "India tops world in bad air quality: Kapur, Delhi among 15 worst cities, Mumbai 4th most polluted megacity," *Times of India,* May 2, 2018, https://timesofindia.indiatimes.com/india/india-tops-world-in-bad-air-quality-kanpur-delhi-among-top-15-mumbai-4th-most-polluted-megacity/articleshow/63997130.cms.

[113] Dan Greenbaum and Bob O'Keefe, "Air Pollution from Many Sources Creates Significant Health Burden in India," Health Effects Institute, January 11, 2018, 2.

[114] Ibid., 1.

[115] Hari Kumar and Kai Schultz, "Delhi, Blanketed in Toxic Haze, 'Has Become a Gas Chamber,'" *The New York Times,* November 7, 2017, https://www.nytimes.com/2017/11/07/world/asia/delhi-pollution-gas-chamber.html?_r=0.

air quality in Delhi was so poor: (i) the deputy chief minister of Delhi State Manish Sisodia ordered the closure of all Delhi's schools, suspending academic operations for 4 million children; (ii) State officials halted a number of construction projects; and (iii) certain classes of heavy duty trucks were banned from entering the city.[116] On November 7, 2017, Delhi State's chief minister Tweeted: "Delhi has become a gas chamber."[117]

While vehicle emissions and crop burning contribute substantially to India's pollution problem, coal-fired power plants are among the country's chief polluters. The Health Effects Institute attributes 169,000 of the total 1.1-million air-pollution-related deaths that occurred in 2015 to thermal and industrial coal combustion,[118] and according to India's Center for Science and the Environment (CSE), coal combustion is responsible for 80% of mercury pollution, 60% of particulate matter pollution, 45% of sulfur dioxide pollution, and 30% of nitrogen oxide pollution in India.[119] In addition to being fundamentally hazardous and polluting in nature, an additional explanation for coal combustion's substantial contribution to the pollution death toll is that almost all of the country's coal-fired power plants are in violation of national emissions standards. In June 2017, the Union power ministry reported that 165.9 out of 187.1 GW of India's coal-fired generation resources (89% of the country's total capacity) were not in compliance with sulfur dioxide emissions limits.[120]

While it is by no means an extravagant objective, the campaign to provide India's citizenry with access to electricity has increased the number of coal-fired power plants, and worsened the country's pollution problem, which, in the words of executive director of CSE Anumita Roy Chowdhury, has reached the point of being "a national public health crisis."[121] If the genocidal human cost of burning coal in India, estimated to cause 1.2 million deaths in 2050 under business-as-usual conditions,[122] does not motivate the government to curb its use of coal, the economic costs will. In a recently published study, the World Bank reports that the myriad societal hindrances air pollution causes contributed to a 7.69% reduction of India's 2013 GDP.[123] An earlier World Bank study found that the economic costs of fossil fuel combustion alone (associated specifically with the release of the toxic pollutant PM 10) reduced the country's GDP by 3%.[124,125] Thus, given:

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[116] Kai Schultz and Hari Kumar, "In India, Air So Dirty Your Head Hurts," *The New York Times,* November 8, 2017, https://www.nytimes.com/2017/11/08/world/asia/india-air-pollution.html.

[117] Hari Kumar and Kai Schultz, "Delhi, Blanketed in Toxic Haze…"

[118] Dan Greenbaum and Bob O'Keefe, "Air Pollution…," 3.

[119] "India's Coal-Fired Power Units Will Spew Toxic Fumes For Longer," *Bloomberg Quint,* November 26, 2017, https://www.bloombergquint.com/business/2017/11/26/indias-coal-fired-power-units-will-continue-spewing-toxic-fumes-for-longer.

[120] Anil Sasi, "Clean Energy Push: Time to power down old thermal plants, open exit route for legacy PPAs," *The Indian Express,* January 3, 2018, https://indianexpress.com/article/india/clean-energy-push-time-to-power-down-old-thermal-plants-open-exit-route-for-legacy-ppas-5009201/.

[121] "India tops world in bad air…," *Times of India.*

[122] Dan Greenbaum and Bob O'Keefe, "Air Pollution from Many Sources…," 3.

[123] Urvashi Narain et al, "The Cost of Air Pollution: Strengthening the Economic Case for Action," The World Bank and Institute for Health Metrics and Evaluation (2016), 96.

[124] "India: Green growth is necessary and affordable for India, says new World Bank report," The World Bank, July 17, 2013, http://www.worldbank.org/en/news/press-release/2013/07/17/india-green-growth-necessary-and-affordable-for-india-says-new-world-bank-report.

[125] PM 10 refers to infinitesimal particles that are 10 microns or less in width.

1. that 90% of the country's coal-fired power generation capacity violates 2015 emissions standards; and
2. that it will cost the government millions of dollars and take at least seven years to retrofit India's existing capacity with flue gas desulphurization systems and comply with legal emission standards;[126] and, as discussed more fully below,
3. that building new wind and solar in India is now 20% cheaper than the existing coal-fired generation's average wholesale price, and 65% of coal power generation is being sold at higher rates than new renewable energy bids,[127]

India will seek alternative power generation resources in the years to come, and, as a result, cause global coal demand to decrease and coal companies' stock prices to suffer.

IV. The Increasing Affordability of Renewable Energy

If the environmental and economic costs of coal-fired power generation do not independently disincentivize its use all over the world -- from the United States, to China, to India -- the ever-decreasing costs of wind and solar power generation will. In the United States, the mean subsidized levelized cost of energy (LCOE)[128] for utility-scale solar fell 72% between 2009 and 2017 (from $178/MWh to $50/MWh), while the mean LCOE for wind fell 47% (from $85/MWh in 2009 to $45/MWh in 2017).[129] Meanwhile, the LCOE for coal fell by merely 8% ($111/MWh to $102/MWh) in that same timeframe (see Figure 3). Furthermore, future LCOEs for utility-scale solar and onshore wind forecast a continuation of this cost-decline trend. While it projects little or no decline in thermal coal's LCOE, the National Renewable Energy Laboratory anticipates onshore wind's mid-range LCOE to fall from $39/MWh in 2020 to $28/MWh in 2050, and utility-scale solar's mid-range LCOE to fall from $51/MWh to $37/MWh within that same period (see Figure 4).[130]

While the global shift towards renewable power generation has already begun, forecasts show the wind and solar markets growing exponentially in the coming years. In 2017, $297 billion were invested in renewable energy worldwide (over $150-billion more than the amount invested in coal and gas generation capacity combined),[131] making 2017 the eighth consecutive year in which global investment in renewables exceeded $200 billion.[132] With 53GW of installations, China alone installed more than half of last year's global total, and although the Trump administration's tariffs are projected to slow the country's PV manufacturing and installation rate, IHS Markit expects the global solar market to increase by 11% in 2018 due to a

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[126] Anil Sasi, "Clean Energy Push…"

[127] Silvio Marcacci, "India Coal Power is About to Crash: 65% of Existing Coal Costs More Than New Wind and Solar," *Forbes,* January 30, 2018, https://www.forbes.com/sites/energyinnovation/2018/01/30/india-coal-power-is-about-to-crash-65-of-existing-coal-costs-more-than-new-wind-and-solar/#514999964c0f.

[128] "LCOE accurately compares the economics of different generation technologies by measuring the total cost of first building a power plant, then operating it over its assumed lifetime," Silvio Marcacci, "Cheap Renewables Keep Pushing Fossil Fuels Further Away From Profitability - Despite Trump's Efforts," *Forbes,* January 23, 2018. https://www.forbes.com/sites/energyinnovation/2018/01/23/cheap-renewables-keep-pushing-fossil-fuels-further-away-from-profitability-despite-trumps-efforts/#6fb7cf2c6ce9

[129] Ibid.

[130] Ibid.

[131] "World Energy Investment 2017," International Energy Agency, July 11, 2017. Accessed September 14, 2018.

[132] Erik Solheim, "In case you missed it, renewable energy is our future," *World Economic Forum,* April 26, 2018. Accessed September 14, 2018.

35% decrease in solar module pricing.[133] In India, where Greenpeace estimates that 65% of current coal powered generation is being sold to utilities at rates higher than the cost of new solar and wind (see Figure 5),[134] 15.7 GW of renewable energy capacity were installed in 2016-2017 versus 7.7 GW of coal.[135] (As mentioned, any reluctance on China and India's part to supplant thermal coal with renewables will only worsen their respective pollution crises and beset their governments with even greater political and economic challenges.) Over the next five years, the International Energy Agency estimates that 1,000 GW of renewables will be installed,[136] a quantity of electricity greater than the annual energy consumption of China, India, and Germany combined.[137]

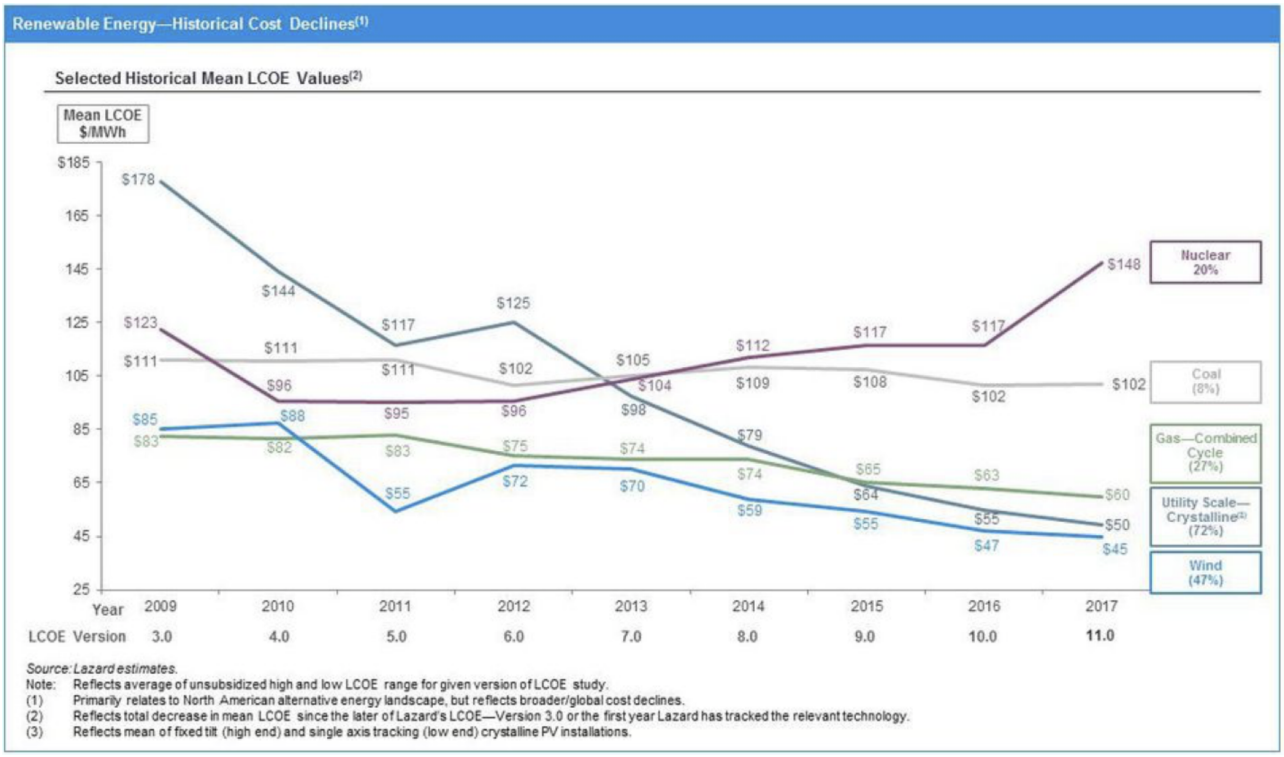

Figure 3: Selected historical mean LCOE values for electricity generation technologies between 2009 and 2018.[138]

[133] Joshua S. Hill, "Global Solar Demand to Increase 11% Despite China Cuts, Predicts HIS Markit," *Clean Technica,* June 11, 2018, https://cleantechnica.com/2018/06/11/global-solar-demand-to-increase-11-despite-china-cuts-predicts-ihs-markit/.

[134] Ashish Fernandez and Nandikesh Sivalingam, "Uncompetitive: Coal's cost disadvantage grows as renewable tariffs plummet," Greenpeace India Society (December 2017), 2.

[135] Marcacci, "India Coal Power…"

[136] Hirtenstein, Anna. "Solar Power Grew Faster than All Other Forms of Power for the First Time." *Bloomberg*, October 4, 2017. https://www.bloomberg.com/news/articles/2017-10-04/dawn-of-solar-age-declared-as-pv-beats-all-other-forms-of-power

[137] Ibid.

[138] Marcacci, "Cheap Renewables Keep Pushing…"

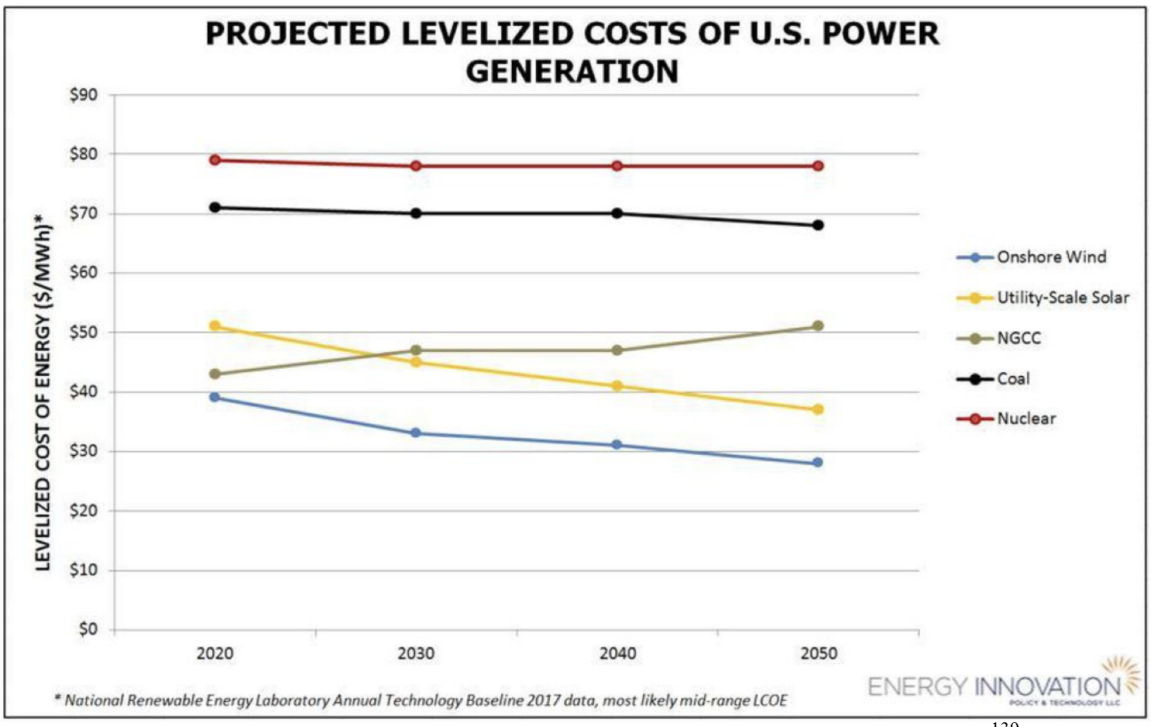

Figure 4: Projected LCOE for different generation technologies between 2020 and 2050.[139]

	Coal Power Plants selling electricity above Rs3/kWh	Coal Power plants selling electricity above Rs.3kWh & older than 20yrs
Installed capacity	94GW	30GW
% of total coal capacity	48%	15%
Generation (million kWh)	456351	140315
% of total coal power generation	65%	20%
Potential annual savings from replacement with RE	**54,730 crores ($8.3 billion)**	**20,486 crores ($3 billion)**

Figure 5: Potential annual savings by replacing coal with renewable energy (note: Rs3/KWh represents the assumed hybrid PV/wind tariff for 2015-2016).[140]

IV. Conclusion

The era of coal has reached its end. Renewable energy is the future of power generation technology. As utilities all over the world begin readily choosing cost-efficient solar and wind over coal, the global demand for coal will decrease. And while decreases in US coal demand between merely 1% and 4% devastated US coal stocks (see Figure 2), one can only imagine how greatly coal-invested portfolios will suffer when the market reflects once-and-for-all what is already so clear – coal is a bad investment.

[139] Ibid.
[140] Ashish Fernandez and Nandikesh Sivalingam, *"Uncompetitive…,"* 4.

3.2 Financial Justification for Divestment from Tar Sands

I. Introduction

Tar sands production is exorbitant, unpredictable, and risky. Profitability in the tar sands industry (also known as the 'oil sands industry') requires an extended production period of up to several decades in an economic environment in which oil prices are high and/or rising. Only by ignoring or entirely rejecting the impact of oil price volatility are tar sands projects' high initial capital expenditure and high marginal cost of operation economically justified. Thus, the market conditions necessary to justify the expansion of the industry are fundamentally and empirically unsustainable. The growth in tar sands production that occurred between 2010 and 2014, for example, was driven by anomalously high oil prices in excess of $100/barrel,[141] and, by extension, the erroneous assumption that the unusually-high oil prices would remain as such over an extended period of time to allow developers to recover development and production costs.

In 2015, an IHS Energy study put the required break-even oil price range for a new tar sands mine at $85-95/barrel,[142] and, according to an Oil Change International report, 89% of capacity additions approved between 2010 and 2014 expected to begin production after 2015 were sanctioned before the 2014 oil crash.[143] After OPEC overproduction sent oil prices far below the threshold necessary for most mines and in-situ operations to produce at full capacity, only one project was approved in 2015, and just two in 2016.[144] Even today, four years later, oil prices have remained substantially below the all-time highs that both warranted expanding the industry, and also made economical operation possible.

Below, the consequences of the 2014 oil-price collapse are examined, demonstrating the tar sands industry's vulnerability amid inevitable economic downturns. Ultimately, it is demonstrated that the inordinate cost of production across the industry, combined with a concentration of production capacity in recent years, puts the industry at risk of incurring substantial losses in the event of another oil collapse -- one that could potentially harm investors' portfolios.

II. Industry Troubles Before the Oil-Price Nosedive

The collapse that, between June 2014 and February 2016, brought the price of oil down to $27/barrel (bbl) from $108/bbl,[145] exacerbated the circumstances of an industry already suffering the consequences of its high production and operational costs. Indeed, even before the

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[141] Lorne Stockman et al, "Reality Check: The End of Growth in the Tar Sands?" *Oil Change International,* June 2017. 5. http://priceofoil.org/content/uploads/2017/06/endOfGrowth_In Briefing.pdf.

[142] Meaning that the price of oil needed to be between $85 and $95/barrel in order for a new mind to produce at full capacity and thus recover capital expenditures. "IHS estimates that on average in 2015 a new oil sands mine required a WTI price between $85 and $95/bbl to cover all the costs associated with a project with capacity to produce 100,000 b/d of diluted bitumen." Kevin Burn and Jeff Meyer "Oil Sands Cost and Competitiveness," IHS Energy, December 2015, 13.

[143] "Only one project was approved in 2015 and two in 2016, the largest of which is a brown field capacity addition to a long-running existing project that can be considered an unusually low-cost outlier compared to other brown field projects" Stockman et al. "The End of Growth in the Tar Sands?" 2.

[144] Ibid.

[145] Charles Riley, "Oil crash taking stocks down…again" *CNN Money,* February 11, 2016. https://money.cnn.com/2016/02/11/investing/oil-price-crash/index.html

severe market downturn, unforeseen costs and contingencies had already precipitated numerous cancellations and postponements of large-scale oil sands projects. For example:

- In March 2013, after spending $3.5 billion on construction, Suncor Energy Inc. and Total E&P Canada announced the cancellation of the $11.6 billion Voyager Upgrader joint-venture, forcing the company to book a $1.49-billion after-tax impairment in the fourth-quarter of 2012.[146] One of the central harbingers of the project's demise was the unexpected surge in light oil production from the U.S. Bakken oil fields, of which, one oil refining executive said, "nobody in the whole business in North America or the world two years ago saw the growth rate…"[147]
- In February 2014, Royal Dutch Shell announced an indefinite halt to the development of the Pierre River oil sands mine.[148] With a required market price of $165/bbl,[149] it was unlikely at the time of Shell's announcement that the project would ever reach completion. (Pierre River's ultimate demise is noted below in §III.)
- In May 2014, an industry-wide increase in labor and material expenditures forced Total E&P and Suncor to indefinitely halt the development of the $11-billion Joslyn mine project. An executive officer of Total's Canadian division André Goffart was quoted saying of the announcement: "Joslyn is facing the same challenge most of the industry world-wide [is], in the sense that costs are continuing to inflate when the oil price and specifically the netbacks for the oil sands are remaining stable at best -- squeezing the margins."[150] (Joslyn's ultimate demise is also noted in §III.)
- In September 2014, citing transportation difficulties and unexpected increases in operational costs, Statoil announced that it would postpone development of its Corner thermal in-situ project.[151] That Statoil's announcement regarded an in-situ operation, generally considered a more economical method for bitumen extraction than mining, made the event especially notable.[152]

III. The Collapse

The precipitous decline of the oil prices that began in June 2014 not only precipitated the demise of many of the projects that were expected to flourish amid high and/or rising oil prices. The vicissitude also resulted in some of the largest oil companies in the world divesting from the

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[146] Alberta Oil Staff, "The cancellation of the voyager leaves an uncompleted megaproject near Fort Murray," *Alberta Oil,* March 20, 2014. https://www.albertaoilmagazine.com/2014/03/economic-ruins-suncor-voyageur/.
[147] Jeff Lewis, "Suncor scraps Voyageur oil sands project." *Financial Post,* March 27, 2013. https://business.financialpost.com/commodities/energy/suncor-scraps-voyageur-oil-sands-project
[148] Jeff Lewis, "Shell halts work on Pierre River oil sands mine in Northern Alberta," *Financial Post,* February 12, 2014. https://business.financialpost.com/commodities/energy/shell-halts-work-on-pierre-river-oil-sands-mine-in-northern-alberta
[149] Andrew Grant et al, "Oil Sands: Fact Sheet," *Carbon Tracker Initiative,* November 4, 2014, 12. http://www.carbontracker.org/wp-content/uploads/2014/11/Oil-Sands-FactSheets-Designed.pdf
[150] Carrie Tait, "Total shelves $11-billion Alberta oil sands mine." *The Globe and Mail,* May 29, 2014. https://www.theglobeandmail.com/report-on-business/joslyn/article18914681/
[151] CBC News, "Norway's Statoil shelves Alberta oil sands project," *CBC,* September 25, 2014. https://www.cbc.ca/news/business/norway-s-statoil-shelves-alberta-oilsands-project-1.2778131.
[152] Grant et al. "Oil Sands: Fact Sheet," 12.

increasingly-risky energy source -- in some cases removing all oil sands from their lists of proven reserves. For example:

- In February 2015, after a year on hold, Royal Dutch Shell announced the cancellation of the Pierre River oil sands mine in light of the oil price collapse. (The cancellation occurred a month after: oil-sands giant Cenovus Energy Inc. reduced its 2015 budget by $700 million; Canadian Natural Resources Inc. reduced its 2015 budget by $2.4 billion; and Suncor Energy cut its workforce by 1,000 and its budget by $1 billion.)[153]
- In March 2015, a month following a $2.2-billion write-off on its Canadian oil sands operations and a report of a 62% net profit decline for 2014, Total E&P sent a letter to the Alberta Energy Regulator, declaring that the company would not pursue its request for an amendment of its Joslyn North Mine approval "[i]n light of," reads the letter "the current significant changes to global energy market conditions."[154]
- In October 2015, Royal Dutch Shell reported a write-off-induced charge of $8.2 billion, comprising, among other costs, a $2.6-billion write-off of Alaskan Arctic projects and a $2-billion write-off of its Carmon Creek oil sands project.[155] Although we are particularly interested in the latter event, the former also exemplifies the incredible financial risk companies take on when they invest in high-cost energy ventures – like arctic drilling.

The initial June 2014 price collapse reached a relative nadir in March 2015, when the price of oil settled at around $50/bbl. After rising slightly in April, the price plunged again, reaching its lowest point in over a decade in February 2016 at $27/bbl.[156]Amid this second decline, oil companies invested in high-cost industries (like tar sands production), began reorganizing their portfolios with a greater respect for the price volatility that was damaging their profit margins. The results were as follows:

- By December 2016, Statoil, after years of grappling with the poor performance of its embattled projects, sold off the majority its oil sands assets to the Athabasca Oil Corp. at a loss.[157] (Perhaps not coincidentally, after several turbulent years and a significant decline in stock price, Statoil reported a revenue increase of 40% year-over-year after the first quarter of 2017.)[158]
- In February 2017, ExxonMobil reported a 4.8-billion-barrel reduction of its total proven reserves (20 billion down from 24.8 billion), equal to a massive 19.3% of the company's total proven reserves. 3.5 of the 4.8-billion abandoned barrels had been located in

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[153] CBC News, "Shell Canada backs out of Pierre River Oil oilsands project," *CBC,* February 23, 2015. https://www.cbc.ca/news/business/shell-canada-backs-out-of-pierre-river-oilsands-project-1.2968498.

[154] Dan Healing, "Total pulls Joslyn North oil sands mine amendment application," *Calgary Herald,* March 9, 2015. https://calgaryherald.com/business/energy/total-pulls-joslyn-north-oilsands-mine-amendment-application.

[155] Karolin Schaps and Ron Bousso, "Shell's profits hit by big Arctic, Canadian write-offs," *Reuters,* October 29, 2015. https://www.reuters.com/article/us-shell-results-idUSKCN0SN0KN20151029.

[156] https://www.macrotrends.net/1369/crude-oil-price-history-chart

[157] Claudia Cattaneo, "Statoil's exit is the starkest sign yet Canada's oilsands resource has lost its lustre," *Financial Post,* December 15, 2017. https://business.financialpost.com/news/economy/statoils-exit-starkest-sign-canadas-oilsands-resource-has-lost-its-lustre.

[158] Michael Fitzsimmons, "Statoil Has Turned the Corner," *Seeking Alpha,* May 7, 2017. https://seekingalpha.com/article/4070276-statoil-turned-corner.

Canada's Kearl oil-sands field, whose uneconomical performance had begun threatening the company's growth strategy.[159]

- In March 2017, in an effort to invest more in renewable energy and protect its assets from future events like the recent oil collapse, Shell, in an $8.5-billion deal, agreed to sell the entirety of its oil sands prospect to Canadian Natural Resources and to cut its share in the Athabasca Oil Sands Projects from 60% to 10%.[160] In the same month, ConocoPhillips sold off the larger part of its oil sands assets to Cenovus Energy for $17.7 billion.[161]

By April 2017, so many international companies had sold off their assets or written down their reserves, decreasing capital investment in the Canadian energy sector by 62% in two-years,[162] that just four Canadian companies -- Canadian Natural Resources, Cenovus Energy, Imperial Oil, and Suncor -- controlled 70% of oil sands production.[163]

IV. Implications for the Future

1. Oil collapse will always harm high-cost industries (like tar sands) first and with significant impact.

The high initial and operational capital expenditures that tar sands production requires puts the industry at greater risk of suffering the financial consequences of declines in oil prices than almost any other industry. The reason for this is simple: the price of oil changes, and, periodically, it drops precipitously. The 2014 price-drop was in no way unusual. In fact, there is a strong historical precedent for similar oil price collapses. Even in the last thirty years, the price of oil -- West Texas Intermediate (WTI), adjusted for inflation -- has dropped by more than $20 within a short time frame on four different occasions: between September 1990 and February 1991 by almost $30 (from $75/bbl to $36/bbl); between December 1996 and November 1998 by around $24 (from $42/bbl to $17/bbl); between June 2008 and January 2009 by over $100 (from $161/bbl to $30/bbl); and, as discussed, between June 2014 and January 2016 by over $80.[164]

Only when oil companies determined that the price of oil would continuously rise, or at least remain very high, did tar sands investments appear attractive. As the 2014 reckoning reminded these investors, however, the problem with basing oil investment decisions on that expectation is that the price of oil has never continuously risen without falling substantially at *any point in history*. The financial chaos that ensued for companies invested in tar sands after the most recent oil collapse offers just a glimpse of the grim future with which companies invested in high-cost, high-risk energy sources will have to reconcile when the price of oil drops again.

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[159] Steve LeVine, "Exxon has wiped a whopping 19.3% of its oil reserves off its books," *Quartz,* February 22, 2017. https://qz.com/917178/exxon-wiped-19-3-of-its-oil-reserves-off-its-books-in-2016/.

[160] The Guardian, "Shell sells oil sands assets as boss warns on clean energy challenge," *The Guardian,* March 9, 2017. https://www.theguardian.com/world/2017/mar/10/shell-sells-canadian-oil-sands-as-boss-warns-of-losing-public-support.

[161] Claudia Cattaneo, "Flight of foreign capital means more challenging times are ahead in the oil sands," *Financial Post,* March 30, 2017. https://business.financialpost.com/commodities/energy/flight-of-foreign-capital-means-more-challenging-times-are-ahead-in-the-oilsands.

[162] Nia Williams and Ethan Lou, "Canada oil sands exodus imperils future development," *Reuters,* March 9, 2017. https://www.reuters.com/article/us-canada-shell-oilsands-idUSKBN16G2VB.

[163] Ibid.

[164] https://www.macrotrends.net/1369/crude-oil-price-history-chart

And while unforeseen circumstances induced the collapse in 2014, recent developments in the renewable energy sector – such as increased production of electric vehicles, massively reduced LCOEs (levelized cost of electricity) for PV solar and onshore wind (see above, 'The Increasing Affordability of Renewable Energy') ,[165,166] and innovations in lithium-ion-battery technology that are predicted to usher in "the end of the fossil-fuel age" --[167,168] could "wreck oil markets within a decade."[169]

2. The concentration of production capacity in the Canadian tar sands region has made the industry more vulnerable to the damaging impact of oil-price collapses.

As stated, by April 2017, so many foreign oil companies had sold off parts, or all, of their tar sands assets in the wake of the 2014 collapse that 70% of production capacity rested in the hands of just four companies -- Canadian Natural Resources, Cenovus Energy, Imperial Oil, and Suncor. Although their retreat from the region surely bore negative financial consequences,[170, 171] major companies like Royal Dutch Shell and ExxonMobil, which deal in numerous resources and resource-extraction methods, weathered the 2014 collapse without suffering irrevocable damage. Now that a mere handful of Canadian companies dominate the industry, however, there will be fewer parties to share the financial burden of oil-price decline. Therefore, when the next oil collapse *does* occur, there is an increased likelihood that costs incurred by Canadian Natural Resources, Cenovus Energy, Imperial Oil, and Suncor will be large enough to alter their respective stock prices, and thus harm shareholders' portfolios.

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[165] "LCOE accurately compares the economics of different generation technologies by measuring the total cost of first building a power plant, then operating it over its assumed lifetime," Silvio Marcacci, "Cheap Renewables Keep Pushing Fossil Fuels Further Away From Profitability - Despite Trump's Efforts," *Forbes,* January 23, 2018. https://www.forbes.com/sites/energyinnovation/2018/01/23/cheap-renewables-keep-pushing-fossil-fuels-further-away-from-profitability-despite-trumps-efforts/#6fb7cf2c6ce9

[166] Ibid.

[167] Mark Chediak, "The Battery Will Kill Fossil Fuels – It's Only a Matter of Time," *Bloomberg,* March 8, 2018, https://www.bloomberg.com/news/articles/2018-03-08/the-battery-will-kill-fossil-fuels-it-s-only-a-matter-of-time.

[168] Mike Scott, "Half of All Power Set to Come From Renewable Energy by 2050, While Coal Recedes to Just 11%," *Forbes,* June 22, 2018. https://www.forbes.com/sites/mikescott/2018/06/22/half-of-all-power-set-to-come-from-renewable-energy-by-2050-while-coal-recedes-to-just-11/#471197c04a1d

[169] Tom Randall, "Another Oil Crash is Coming, and There May Be No Recovery," *Bloomberg,* February 24, 2016. https://www.bloomberg.com/news/articles/2016-02-24/another-oil-crash-is-coming-and-there-may-be-no-recovery

[170] "The sale will result in Shell taking a US$1.3 billion to US$1.5 billion post-tax impairment charge after completion, according to the statement," Bloomberg News, "Shell to sell Canada oil sands assets to Canadian Natural Resources in $7.2 billion deal," *Financial Post,* March 9, 2017. https://business.financialpost.com/commodities/energy/shell-to-sell-all-but-10-of-canada-oilsands-assets-to-canadian-natural-resources-for-7-2-billion.

[171] "The U.S.'s biggest oil company may not, in its heart, have completely said farewell to oil sands (some of the volumes could be rebooked as proved reserves if current price levels hold). But the market already has factored in the loss of those reserves: Exxon's shares are down 15% since July," Geoffrey Smith, "Exxon's Big Oil Sands Write-Off Could Help It Dodge SEC Troubles," *Fortune,* February 23, 2017. http://fortune.com/2017/02/23/exxon-mobil-oil-sands-sec/.

4. Challenging the Case Against Divestment

In this section, two common arguments used to challenge divestment as an effective strategy for combating the ills committed, engendered, or otherwise exacerbated by the coal and tar sands industries are addressed and refuted.

Argument #1: Shareholder involvement through proxy voting is a better strategy than divestment, because it gives Penn a direct channel through which it can positively influence a company's behavior.

This argument wrongly assumes: first, that proxy voting can significantly influence coal and tar sands companies' conduct and/or alter their core business model; and second, that, by banding together with other shareholders, Penn can vote at shareholder meetings to deter fossil fuel companies from engaging in immoral business practices.

Proxy voting is only effective when an investor believes that, with input and oversight, a company can operate ethically. Given, however, that the coal and tar sands companies' operations center on the destructive extraction and exploitation of natural resources, no amount of proxy voting can make individual companies within the industry substantially more ethical. In order to enact real change, Penn would have to use proxy voting to pressure each company into completely reshaping their business models -- an eventuality as unlikely as it is absurd. Neither Penn nor any shareholder can change the fundamental nature of a company through proxy voting.

The number of coal and tar sands shares owned by concerned investors is very small, and presenting an environmentally-conscious resolution at shareholder meetings -- even one of minimal impact -- is a long and arduous process. In the United States, for example, the Securities and Exchange Commission (SEC) details that "the proposal must win the support of at least 3 percent of the shares voted in its first year, 6 percent in its second and 10 percent in its third year and all years thereafter"[172] to be considered, going on to say that "if a proposal fails to meet the requisite resubmission thresholds, the filer must wait three years to resubmit it."[173] In other words, not only must a proposal win the support of 3% of a given company's shares upon its first vote, but it must also somehow double those votes upon the next vote, and thereafter garner sustained support until a majority votes in its favor.

Data from the shareholder breakdowns of the 100 highest-emitting companies demonstrates this is highly unlikely to occur because the influential shareholders of these companies have interests in opposition to climate change mitigation. The major stakeholders across our targeted list of companies are: (i) promoters and company management, and (ii) financial institutions/mutual funds. As detailed below, shareholders in both of these categories have strong incentives to vote against policies that curb emissions.

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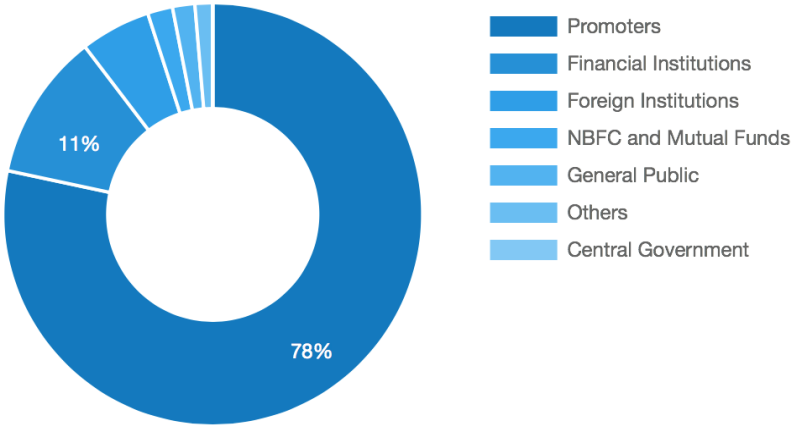
[172] "Shareholder Resolutions." *The Forum for Sustainable and Responsible Investment*, Naylor Association Management Software, www.ussif.org/resolutions.
[173] ibid

I. Category 1: Promoter-Controlled Companies

Coal India (#1 on our list of 100 Coal Companies) has the following shareholding pattern:



Category	No. of shares	Percentage
Promoters	4,861,680,228	78.32
Financial Institutions	698,496,277	11.25
Foreign Institutions	336,111,612	5.41
NBFC and Mutual Funds	119,739,112	1.93
General Public	106,889,038	1.72
Others	84,444,007	1.36
Central Government	48,903	0.00

Figure 6: Coal India Shareholding Pattern 2018[174]

As the above table depicts, promoters, who manage both the incorporation and direct oversight of the company, comprise the majority shareholding group. Since promoters are intimately linked to the company's day-to-day activities, they quite literally vote with the management. Management has no incentive to vote in favor of environmentally-conscious proposals that pose extra costs (both short and long-term, if structural changes are proposed) and potentially threaten future business. Even if all members of the General Public and all those in the 'Other' category take concerted actions to vote for radical shareholder resolutions -- a gross overestimation of worldwide awareness and involvement regarding climate change -- that is only 3.08% of votes. This case is not region-specific. At Foresight Energy, a US coal company, the chairman and his trust own 51.4% of shares, and Murray Energy (on the board of which the chairman of Foresight Energy once served) owns another 12.3% of Foresight's shares.[175] In Russia, Raspadskaya OAO is largely owned by a competing coal company, EVRAZ (also listed in Table 1).[176]

Coal and tar sands companies consistently invest in one another, blocking any efforts from outside interests to internally influence their problematic practices or general social impact. The smaller the number of restrictions placed on coal companies' practices, the better they perform. There is no incentive for coal companies to impinge upon their profitability, and thus there is little likelihood that they would, of their own volition, enact environmentally-conscious resolutions, much less ones that call for dramatic fundamental changes.

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[174] "Coal India Ltd." *The Economic Times*, Economic Times, 29 Aug. 2018, 1:08AM, economictimes.indiatimes.com/coal-india-ltd/stocks/companyid-11822.cms.

[175] Market Screener. Foresight Energy LP (FELP) . SuperPerformance SAS, www.marketscreener.com/FORESIGHT-ENERGY-LP-16717112/?type_recherche=rapide&mots=foresi.

[176] "Raspadskaya OAO Company." *Market Screener*, SuperPerformance SAS, www.marketscreener.com/RASPADSKAYA-OAO-9664688/company/.

II. Category 2: Financial Institutions and Mutual Funds

Overall, financial institutions and mutual funds own the third-largest portion of the shares of companies mentioned in Table 1. Though some have made headlines for votes supporting environmental disclosure initiatives, the notion that financial institutions are effectively putting pressure on companies to curb emissions is grossly misleading. As their success rests on maximizing returns, they have logical reason to vote down any proposal that jeopardizes production value. The two US companies with the most assets under management, Blackrock and Vanguard (for whom the 2016-2017 fiscal year was their first time *ever* voting in support of a climate resolution), only voted for two of the ~90 climate-related shareholder resolutions that went to vote at US company meetings during the 2016-2017 proxy season. Not only does this indicate extreme reticence in the face of pressing need, but the proposals of which they voted in favor did not call for setting greenhouse gas emission goals and reducing methane leaks (which generally augur actual change), but those calling for "analyses of the business impact of a scenario in which global average temperatures are kept from rising more than 2 degrees Celsius above pre-industrial levels."[177] Thus, even in the unlikely event that a climate-change-based shareholder resolution is voted upon, it is clear that the potential impact of these resolutions is minimal at best, paling in comparison with the impact of divestment.

Argument #2: A more effective approach lies in research into alternative energy sources and the pursuit of on-campus sustainability programs.

Committing more resources to academic research on climate science and solutions, as well as on-campus sustainability efforts, does not represent a viable alternative to divestment because these actions and divestment are not mutually exclusive. In fact, divestment can improve the risk-adjusted returns of the endowment and protect its long-term financial value, meaning that divestment would help Penn better conduct more research and fund more impactful sustainability programs. In addition, as long as coal and tar sands companies continue to lobby against fundamental science and the implementation of real climate solutions, any positive impact from Penn's own climate actions would be negated. In other words, Penn's laudable contributions to the climate would be annihilated by Penn's financial complicity in coal and tar sands companies' stance against science.

[177] Berridge, Rob. "Here's How Mutual Fund Giants Stand on Climate-related Shareholder Proposals." GreenBiz. February 06, 2018. https://www.greenbiz.com/article/heres-how-mutual-fund-giants-stand-climate-related-shareholder-proposals.

Appendix

A. Results of 2015 Undergraduate Student Referendum on Comprehensive Fossil Fuel Divestment

The Nominations and Elections Committee held an undergraduate referendum on fossil fuel divestment and clean reinvestment from February 23rd to February 27th, 2015. It was the first student referendum in six years, and Fossil Free Penn gathered over 500 signatures to initiate the ballot initiative. To ensure a high turnout, Fossil Free Penn mobilized eighty volunteers during the referendum voting period. The results of the referendum demonstrate resounding support for our proposal among the student body, with 87.8% of participants voting in favor.

Referendum Language:

"We, the undergraduates at the University of Pennsylvania, call upon the Undergraduate Assembly to recommend formally that the Trustees of the University of Pennsylvania:

1. Stop new investments in the fossil fuel industry;
2. Remove direct and commingled holdings in the top 200 fossil fuel companies within 5 years;
3. Reinvest a portion of the extricated funds into clean energy assets."[178]

Votes For
2866
Votes Against
397
Voter Turnout
33%

[178] "Referendum Results," Nominations & Election Committee, February 27, 2015.

B. 2018 Undergraduate Assembly Resolution in Favor of Coal and Tar Sands Divestment

On September 10, 2018, by a vote of 17-1 with 2 abstentions, the elected representatives of the Undergraduate Assembly, passed by supermajority a resolution endorsing divestment from the 120 coal and tar sands companies listed in Table 1.

Resolution Language:

Seeing that the University of Pennsylvania is a leader in the academic realm, any policy action pursued by the university will encourage fellow institutions of higher learning to follow suit. With billions of dollars in its endowment and a powerful public voice, it is important that Penn supports efforts that are in the best interest of the world and humanity. Currently, Penn has a percentage of its endowment invested in the coal and tar sand industries, two of the most polluting and least competitive markets in the world. It is important that Penn acknowledges this fact and leads the way towards supporting industries that will accrue a higher return on investment while also having a positive societal impact.

Transferring funds away from coal and tar sands companies is a necessary and overdue step for Penn to take. Coal mining specifically incurs huge damages on the health of humans and endangers all who are within a certain distance from coal mines. Additionally, coal production and necessity has been declining rapidly over the past few years due to natural gas expansion, a trend that is not expected to change. Coal infrastructure is aging and, when coal-fired power plants are taken out of commission, they are not replaced by new coal plants instead being replaced with natural gas plants or renewable energy ventures. Tar sands are also extremely negative both from an investment-based perspective and social perspective. Tar sands extraction is extremely energy intensive and the extraction process emits far more greenhouse gases than even oil production. With these facts evident, the Undergraduate Assembly endorses the effort to end Penn's fiscal support for the top 100 companies involved in coal and top 20 companies involved in tar sand.

The Undergraduate Assembly resolves to:

1. Urge the University of Pennsylvania Board of Trustees to commit to remove its endowment from investments in the top 100 companies involved in coal extraction and top 20 companies involved in tar sands extraction.[179]

[179] Ben May, "Resolution Concerning UA Endorsement of Removing Endowment Funds from the Coal and Tar Sands Industries," Undergraduate Assembly GBM Meeting Minutes for September 9, 2018. accessed September 15, 2018. https://docs.google.com/document/u/1/d/e/2PACX-1vSfLShIH_b4TQR579RxFmkQDILvr40BSmoTGt45VtbQQnXwCaiG1H4KX-zQ-D3bOCKuj8LV8CXwwxd5/pub.

C. Alumni Statements Supporting Full or Partial Fossil Fuel Divestment

“Available scientific evidence indicates strongly that most fossil fuels must be left in the ground if there is to be any hope of meeting the 2°C goal regarded as the limit beyond which irreversible climate change can become catastrophic. At the same time, the major energy corporations are quite openly declaring their intentions of exploiting all the reserves available, and unearthing new ones. These decisions are driving the world to disaster. There is every reason to take whatever actions we can to divert them from this disastrous course. University disinvestment would be a welcome and significant step in this direction.”

-Noam Chomsky, ‘55

“It is critical that we do everything we can to combat climate change!”

-Emily Orrson, ‘13

“Reducing institutional investor demand for shares of companies which are not diversifying away from fossil fuel at an acceptable pace creates a shareholder value-driven incentive to increase alternatives.”

-John Terwilliger, ‘83

“This is one of the most important issues of our time, and I feel it's absolutely imperative that the university take a stand and be on the right side of history. As such a powerful institution within the Philadelphia community and beyond, Penn should absolutely divest from fossil fuels if the university wants to support their claims about protecting and supporting future generations and our planet. Sending all the support to everyone involved and working hard on this!”

-Dani Castillo, ‘15

“Bad science and bad policy is not a basis for progress or good investments. Climate change requires institutional change. If we don't want the University under water 100 years from now our concept of ROI must change now.”

-Robert Brand, ‘72

“If Penn wants to be able to say it cares about innovation and civic engagement, then it has to divest.”

-Laura Cofksy, ‘13

“The extraction and combustion of fossil fuels is driving economic, social, and ecological crises on an unprecedented scale. It is unconscionable for any institution purporting to provide global leadership to continue investing in fossil fuel. Please lead us in economic, social, and ecological renewal by completely disinvesting in fossil fuel financing and supporting truly renewable forms of energy.”

-Mary Hufford, ‘89

“Millions of people's land, communities and cultures are being sacrificed so the fossil fuel industry can maintain their wealth. It is imperative that we do what we can to disrupt this destructive act. For Penn that means fossil fuel divestment.”

-Peter Thatcher, ‘14

“For the Trustees to take the position that global warming is not an evil on a par with apartheid or genocide--which in itself is a dubiously high bar--is not just inaccurate. It is arguably insane. Short of an all-out nuclear war, global warming is the greatest crisis humankind has ever faced.”

-Charles A. Russell, ‘72

“As a graduate of your master's program in environmental studies and a mother and grandmother, I am painfully aware of and deeply concerned about the consequences of our rampant burning of fossil fuels for our own and future generations. I urge the University to divest from fossil fuels. We should not be investing in products and practices that make the world less livable for the University's students and all life on our planet.”

-Robin Hoy, '96

“Save the earth. It's the only planet with chocolate.”

-Diane Sjolander, ‘69

D. Faculty Signatories of Open Letter Favoring Fossil Fuel Divestment

Letter Language:

Dear President Amy Gutmann and the Trustees of the University of Pennsylvania,

We, the undersigned faculty, write in favor of investing Penn's endowment in a more ethical, sustainable, and rational manner by removing investments from the fossil fuel industry. Funding fossil fuel companies ultimately funds climate change. To limit climate change so as to prevent grave adverse effects, we must limit global warming to two degrees Celsius above preindustrial levels. Scientific consensus indicates that to stay within this 2-degree margin, we must cap carbon dioxide emissions at 394 gigatons between now and 2050.[1] The fossil fuel industry, however, owns enough coal, oil, and gas reserves to produce 2860 gigatons of carbon dioxide.[2] These corporations' business models make them incompatible with a stable climate …

We stand united in calling upon the University Council to bring Fossil Free Penn's proposal before the trustees, and call upon the trustees to act in a timely manner to approve divestment and reinvestment.[180]

1. Coren Apicella
Assistant Professor of Psychology
School of Arts and Sciences

2. Daniel A. Barber
Assistant Professor and Associate Chair of Architecture
School of Design

3. Rita Barnard
Professor of English
School of Arts and Sciences

4. David Barnes
Associate Professor of History and Sociology of Science
School of Arts and Sciences

5. Alan M. Barstow
Director and Senior Organizer, Organizational Dynamics
School of Arts and Sciences

6. Herman Beavers
Professor of English and Africana Studies
Graduate and Undergraduate Chair, Department of Africana Studies
School of Arts and Sciences

[180] Full letter available at https://www.fossilfreepenn.org/faculty.html.

7. David Bell
Xinmei Zhang and Yongge Dai Professor of Marketing
Wharton School

8. Dan Ben-Amos
Professor of Near Eastern Languages and Civilizations
School of Arts and Sciences

9. Etienne S. Benson
Assistant Professor of History and Sociology of Science
School of Arts and Sciences

10. Nancy Bentley
Professor of English
School of Arts and Sciences

11. Richard Berman
Lecturer of Urban Studies
School of Arts and Sciences

12. Charles Bernstein
Donald T. Regan Professor of English and Comparative Literature
School of Arts and Sciences

13. William W. Braham
Professor of Architecture
School of Design

14. Charles Branas
Professor of Epidemiology
Perelman School of Medicine

15. Warren Breckman
Rose Family Endowed Term Professor of History
School of Arts and Sciences

16. Robin Clark
Professor and Department Chair of Linguistics
School of Arts and Sciences

17. Christopher Lance Coleman
Fagin Term Associate Professor
School of Nursing

18. Timothy Corrigan
Professor English and Cinema Studies
School of Arts and Sciences

19. Thadious M. Davis
Professor of English

School of Arts and Sciences

20. Karen Detlefsen
Associate Professor of Philosophy and Education
School of Arts and Sciences

21. Andre Dombrowski
Associate Professor of the History of Art
School of Arts and Sciences

22. David L. Eng
Richard L. Fisher Professor of English
School of Arts and Sciences

23. Russell Epstein
Professor of Psychology
School of Arts and Sciences

24. Lee Erickson
Associate Clinical Professor of Family Medicine and Community Health
Perelman School of Medicine

25. Tulia Falleti
Class of 1965 Term Associate Professor of Political Science
School of Arts and Sciences

26. Siyen Fei
Associate Professor of History, Undergraduate Studies Chair
School of Arts and Sciences

27. Steven M. Finn
Lecturer of Organizational Dynamics
School of Arts and Sciences

28. Lori Flanagan-Cato
Associate Professor of Psychology
School of Arts and Sciences

29. Marybeth Gasman
Professor of Higher Education
Graduate School of Education

30. Toorjo Ghose
Associate Professor of Social Policy and Practice
School of Social Policy and Practice

31. Joan Goodman
Professor of Education, Culture and Society
Graduate School of Education

32. Marie Gottschalk
Professor of Political Science
School of Arts and Sciences

33. Cam Grey
Associate Professor of Classical Studies
School of Arts and Sciences

34. James Richard Hagan
Lecturer and Advisor, Master of Environmental Studies
School of Arts and Sciences

35. Steven Hahn
Nichols Professor of History
School of Arts and Sciences

36. Andrew E. Huemmler
Senior Lecturer of Chemical and Biomolecular Engineering
School of Engineering and Applied Science

37. Nancy J. Hirschmann
Professor of Political Science, Director Gender Sexuality and Women's Studies
School of Arts and Sciences

38. Kartik Hosanager
Associate Professor of Operations and Information Management
Wharton School

39. Amy Kaplan
Edward Kane Professor and Department Chair of English
School of Arts and Sciences

40. Jane Kauer
Lecturer of Anthropology
School of Arts and Sciences

41. Suvir Kaul
A. M. Rosenthal Professor of English
School of Arts and Sciences

42. David Kazanjian
Associate Professor of English
School of Arts and Sciences

43. Ellen Kennedy
Professor of Political Science
School of Arts and Sciences

44. Justin Khoury
Associate Professor of Physics

Undergraduate Chair of Physics and Astronomy
School of Arts and Sciences

45. Anthony Kroch
Edmund J. and Louise W. Kahn Endowed Term Professor in the Cognitive Sciences
School of Arts and Sciences

46. Howard Kunreuther
James G. Dinan Professor
Professor of Decision Sciences and Business Economics and Public Policy
Co-Director of Risk Management and Decision Processes Center
Wharton School

47. Demie Kurz
Adjunct Associate Professor of Sociology
School of Arts and Sciences

48. Douglas Jerolmack
Associate Professor and Graduate Chair of Earth and Environmental Science
School of Arts and Sciences

49. Andrew Lamas
Faculty, Urban Studies
School of Arts and Sciences

50. Kenneth Lande
Professor of Physics
School of Arts and Sciences

51. Robin Leidner
Associate Professor of Sociology
School of Arts and Sciences

52. Andrea J. Liu
Hepburn Professor of Physics
School of Arts and Sciences

53. Ania Loomba
Catherine Bryson Professor of English
School of Arts and Sciences

54. Heather Love
R. Jean Brownlee Term Associate Professor of English
School of Arts and Sciences

55. Elizabeth Mackenzie
Adjunct Assistant Professor and Program Manager of Applied Psychology and Human Development Division
Graduate School of Education

56. Catriona MacLeod
Edmund J. and Louise W. Kahn Term Professor of German
School of Arts and Sciences

57. Edith Ann Matter
Professor of Religious Studies, Emerita
School of Arts and Sciences

58. Justin Mcdaniel
Professor, Department Chair, Religious Studies
School of Arts and Sciences

59. Philippe Met
Professor of French and Francophone Studies
School of Arts and Sciences

60. Luis Moreno-Caballud
Associate Professor of Romance Languages, Graduate Chair in Hispanic Studies
School of Arts and Sciences

61. Projit B. Mukharji
Assistant Professor, History and Sociology of Science
School of Arts and Sciences

62. Carol Muller
Professor of Music
School of Arts and Sciences

63. Sheila Murnaghan
Alfred Reginald Allen Memorial Professor of Greek
School of Arts and Sciences

64. Michael Nairn
Lecturer -----of Urban Studies
School of Arts and Sciences

65. María Paredes Fernández
Lecturer of Romance Languages
Romance Languages Course Coordinator
School of Arts and Sciences

66. Josephine Park
Associate Professor and Associate Chair of English
School of Arts and Sciences

67. Felicity (Litty) Paxton
Lecturer of Communication and Director of Penn’s Women's Center
Annenberg School for Communication

68. Kathy Peiss

Nichols Professor of American History
School of Arts and Sciences

69. Robin Pemantle
Merriam Term Professor of Mathematics
School of Arts and Sciences

70. Alain Plante
Associate Professor and Undergraduate Chair of Earth and Environmental Science
School of Arts and Sciences

71. Kevin M. F. Platt
Professor of Slavic Languages and Literatures
School of Arts and Sciences

72. Adolph Reed, Jr.
Professor of Political Science
School of Arts and Sciences

73. Michele Richman
Professor French Studies
School of Arts and Sciences

74. Simon Richter
Professor of German
School of Arts and Sciences

75. Kermit Roosevelt
Professor of Law
School of Law

76. Pouné Saberi
Assistant Clinical Professor
Perelman School of Medicine

77. Paul Saint-Amour
Associate Professor of English
School of Arts and Sciences

78. Melissa Sanchez
Associate Professor English
School of Arts and Sciences

79. Paul Schmidt
Associate Professor of Biology
School of Arts and Sciences

80. Robert Schnoll
Associate Professor of Psychiatry
Perelman School of Medicine

81. Rebecca Simmons
Hallam Hurt Professor in Neonatology
Perelman School of Medicine

82. Elaine Simon
Adjunct Associate Professor of Anthropology
Co-Director, Urban Studies Program
College of Arts and Sciences

83. Michael Solomon
Professor of Romance Languages
School of Arts and Sciences

84. Peter Steiner
Professor of Slavic Languages, Emeritus
School of Arts and Sciences

85. Andrew Stone
Clinical Associate Professor of Psychiatry
Perelman School of Medicine

86. Mary Summers
Lecturer, Political Science; Senior Fellow, Fox Leadership Program
School of Arts and Sciences

87. Kok-Chor Tan
Professor of Philosophy
School of Arts and Sciences

88. Jorge Tellez
Assistant Professor of Spanish
School of Arts and Sciences

89. Jolyon Thomas
Assistant Professor of East Asian Languages and Civilizations
School of Arts and Sciences

90. John Tresch
Associate Professor, History and Sociology of Science
School of Arts and Sciences

91. Kimberly K. Trout
Assistant Professor of Women's Health
School of Nursing

92. Domenic Vitiello
Associate Professor of City and Regional Planning
School of Design

93. David Wallace
Judith Rodin Professor of English
School of Arts and Sciences

94. Anna Weesner
Professor of Music
School of Arts and Sciences

95. Steven Weitzman
Abraham M. Ellis Professor of Hebrew and Semitic Languages and Literatures
School of Arts and Sciences

96. Bethany Wiggin
Associate Professor of German
School of Arts and Sciences

97. Yin Ling Irene Wong
Associate Professor of Social Policy and Practice
School of Social Policy and Practice

98. Aaron Wunsch
Assistant Professor of Landscape Architecture and Historic Preservation
School of Design

99. Chi-ming Yang
Associate Professor of English
School of Arts and Sciences

100. Takashi Yonetani
Professor of Biochemistry and Biophysics
Perelman School of Medicine

101. Marilyn V. Howarth
Adjunct Associate Professor of Emergency Medicine and Pharmacology
Perelman School of Medicine

102. Ian Thomas Fleishman
Assistant Professor of German
School of Arts and Sciences

103. Gary Survis
Lecturer, Master of Environmental Studies Program
School of Arts and Sciences

104. Caroline Connolly
Senior Lecturer of Psychology
Associate Director of Undergraduate Studies in Psychology
School of Arts and Sciences

105. Abraham A. Gibson

Lecturer, Department of History and Sociology of Science
School of Arts and Sciences

106. Alison Sweeney
Assistant Professor of Physics and Astronomy
School of Arts and Sciences

107. Christina Frei
Executive Director of Language Instruction
School of Arts and Sciences
Adjunct Associate Professor of Education
Graduate School of Education

108. Bekir Harun Küçük
Assistant Professor of History and Sociology of Science
School of Arts and Sciences

109. Daniel Aldana Cohen
Assistant Professor of Sociology
School of Arts and Sciences

110. Daniel Janzen
Professor of Conservation Biology
School of Arts and Sciences

111. David Azzolina
Adjunct Assistant Professor of English
School of Arts and Sciences

112. Peter Sterling
Professor of Neuroscience
Perelman School of Medicine

113. Sally Zigmond
Emeritus Professor of Biology
School of Arts and Sciences

114. S. Walter Englander
Jacob Gershon-Cohen Professor of Medical Science
Professor of Biochemistry & Biophysics
Perelman School of Medicine

115. Monica Calkins
Associate Professor of Psychology in Psychiatry
Perelman School of Medicine

116. Carol Armstrong
Adjunct Associate Professor of Pediatrics
Perelman School of Medicine

117. Robert Johnson
Lecturer in Physics
School of Arts and Sciences

118. Sharon Wolf
Assistant Professor of Education
Graduate School of Education

119. Katherine Margo
Associate Professor of Family Medicine and Community Health
Perelman School of Medicine

120. Erol Akcay
Assistant Professor of Biology
School of Arts and Sciences

121. Nikhil Anand
Assistant Professor of Anthropology
School of Arts and Sciences

122. Benjamin Pierce
Henry Salvatori Professor of Computer and Information Science
School of Engineering and Applied Science

123. Amy Paeth
Teaching Fellow/Lecturer, Center for Programs in Contemporary Writing
School of Arts and Sciences

124. Sanjeev Khanna
Henry Salvatori Professor of Computer and Information Science
School of Engineering and Applied Science

125. Adriana Petryna
Edmund J. and Louis W. Kahn Term Professor of Anthropology
School of Arts and Sciences

126. Janet Monge
Adjunct Professor of Anthropology
School of Arts and Sciences

127. Megan Kassabaum
Assistant Professor of Anthropology
School of Arts and Sciences

128. Maria Rieders
Adjunct Professor of Operations, Information and Decisions
Wharton School

129. Michelle Evans-Chase
Lecturer, Masters of Social Work Program

School of Social Policy & Practice

130. David Grazian
Associate Professor and Graduate Chair of Sociology
School of Arts and Sciences

131. Susie Hatmaker
Mellon Postdoctoral Fellow, Penn Humanities Forum
School of Arts and Sciences

132. John Crocker
Professor of Chemical and Biomolecular Engineering
School of Engineering and Applied Science

133. James Aguirre
Associate Professor of Physics and Astronomy
School of Arts and Sciences

134. Vinayak Mathur
Lecturer in the Department of Biology
School of Arts and Sciences

E. Notable Academic Institutions that Have Fully or Partially Divested from Fossil Fuels

- Columbia University
- Yale University
- Stanford University
- Johns Hopkins University
- Georgetown University
- Kings College London
- London School of Economics
- Oxford University
- Queens College, Cambridge
- University of California
- University of Glasgow