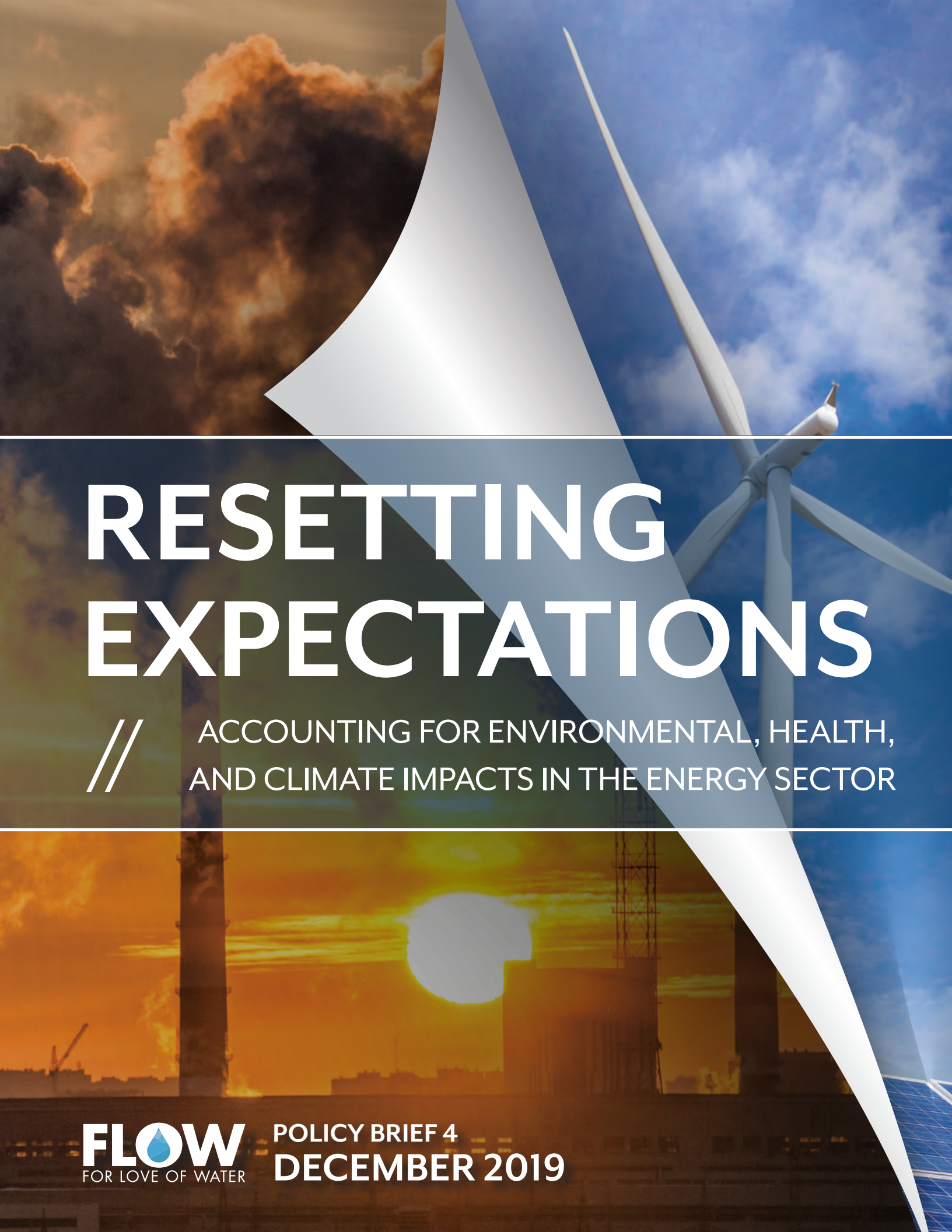

RESETTING EXPECTATIONS

// ACCOUNTING FOR ENVIRONMENTAL, HEALTH, AND CLIMATE IMPACTS IN THE ENERGY SECTOR

FLOW
FOR LOVE OF WATER

POLICY BRIEF 4
DECEMBER 2019

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STANLEY 'SKIP' PRUSS
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EXECUTIVE SUMMARY

Natural systems provide trillions of dollars of economic value annually but are largely unacknowledged as essential to our economic well-being. Government plays a critical role in protecting natural systems that provide wide-ranging economic benefits to industry, commerce, agriculture, recreation, and tourism, for present and future generations.

At the same time, perverse incentives remain in law and policy that are profoundly disruptive to the environment, the economy, social welfare, and a stable climate. Government subsidies for the development and use of fossil fuels undermine and negate the very protections and safeguards sound environmental regulations aim to preserve. These subsidies, some of which date back a full century, are harmful anachronisms that are contrary to the public interest and sound economic policy.

Government subsidies for the development and use of fossil fuels undermine and negate the very protections and safeguards sound environmental regulations aim to preserve. (Platform Harvest, 7 miles off the coast of California. Source: Wikipedia)

Fossil fuel subsidies persist in policy despite being demonstrably inefficient and more costly than clean energy alternatives because they serve powerful, deeply embedded, and influential special interests in global energy markets. The adverse environmental and climate consequences and associated economic costs from the production and use of fossil fuels are "negative externalities" unaccounted for in the price of goods and services. In economic theory, negative externalities are indicators of "market failure."

An optimal regulatory framework would, consistent with established tenets of economics, assess the full range of costs and impacts of competing energy technologies. A rational regulatory framework would quantify and monetize the environmental, public health and economic costs and impacts from the production and combustion of oil, natural gas, and coal, and compare them against clean energy alternatives.

Full accounting of the direct and indirect economic effects of energy subsidies would enable government to make more rational, evidence-based decisions regarding the impacts of energy policy on the environment, the economy, public health, and the climate. It would also align with the fundamental purposes of the Public Trust Doctrine in advancing the most environmentally beneficial, healthful, and economically efficient policies to safeguard present and future generations.

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RESETTING EXPECTATIONS:
Accounting for Environmental, Health, and Climate Impacts in the Energy Sector

Environmental protections and safeguards, implemented through government regulations, provide overwhelming economic and health-related benefits for society at large. Maintaining the functionality, vitality, and resilience of natural systems provides cascading economic benefits to industry, commerce, agriculture, recreation, and tourism, helping to assure these benefits for future generations. The environmental protections afforded by government regulations are substantial but are marginalized and, at times, negated by competing policies that cause environmental and economic harm.

Incentives are deeply embedded in economic policies in the form of subsidies provided to business and industry that degrade and diminish natural systems, resulting in substantial and permanent economic loss. Long established, yet functionally obsolete, energy subsidies produce wide-ranging insidious and harmful effects on the environment, public welfare, and the economy. Despite this, demonstrably inefficient and detrimental subsidies for fossil fuels are pervasive both domestically and globally, and supported by long-standing powerful economic interests that are firmly integrated into our politics and our economy.

Fossil Fuel Subsidies—Dangerous, Obsolete, and Economically Inefficient

Policies that subsidize and provide incentives for fossil fuel development unquestionably fueled rapid economic growth and improved living standards in the 20th century, creating prosperity and new opportunities for Western societies. At the same time, we now know that the use of fossil fuels impairs natural systems, has harmful effects on public health and safety, distorts markets, and is, by far, the predominant cause of the climate crisis.

Present U.S. government policies provide direct subsidies for activities that impair and destroy natural systems and undermine consensus-based climate goals. Supported by numerous financial subsidies long embedded in our laws, the development and production of fossil fuels contaminates soil, surface water, and groundwater, impairs habitats, diminishes ecological services, and results in the loss of recreational opportunities for the public. The combustion of fossil fuels, moreover, results in the emission of carbon dioxide and other acid gases, toxic metals, and particulate pollution impairing public health, degrading ecological services, and accelerating climate change.

Continued use of fossil fuels is profoundly detrimental to the environment and public health, crippling our ability to meet the carbon reductions necessary to keep global temperature rise from exceeding 2° Celsius, the point at which the most catastrophic impacts from climate change can no longer be avoided.

Knowing that the combustion of fossil fuels accounts for 80 percent of anthropogenic greenhouse gas emissions, and now having both the capacity to quantify and measure the relative benefits and burdens associated with energy supplies and the availability of clean energy options, continued government support for fossil fuel use and development is unsound and even irrational.

Fossil fuel subsidies are structural – they are deeply embedded into law and policy. There are two distinct categories of "subsidies" in the realm of fossil fuel policy:

- **Direct Subsidies**—Favorable tax treatments like tax credits, tax exemptions, and deferrals, as well as transfers of public lands, development rights, liability limitations, insurance, and cancellation of royalty payments.[1]
- **Externalities**—Subsidies that impose the financial cost of environmental degradation, public health impacts, and the loss of ecological services on the public when natural systems are impaired. These "externalities" are the costs transferred to third parties and society generally that are not included in the production cost of goods and services but are, nonetheless, real costs that can be quantified and monetized.

Continued use of fossil fuels is profoundly detrimental to the environment and public health, crippling our ability to meet the carbon reductions necessary to keep global temperature rise from exceeding 2° Celsius – the point at which the most catastrophic impacts from climate change can no longer be avoided. (Source: SingularityHub.com)

The societal costs of direct subsidies and "externalities" are enormous, as we shall see.

But first: *Why do we subsidize business activities at all?* Because they work.

Subsidies are particularly useful in introducing new technologies to markets by stimulating investment, competition, and innovation. They provide critical incentives supporting new technologies until such technologies mature and reach economies of scale. Once an energy technology is established in the market, there is less justification for continuing public support.

In the energy sector, subsidies lower the market price of energy resources for consumers, boost investment by energy companies, expand energy sectors, and create jobs. That is why subsidies for renewable energy technologies at this early stage of introduction have been so important—and one reason why fossil fuel subsidies that have been around for the last 100 years must end.

A SHORT HISTORY OF AMERICAN SUBSIDIES FOR OIL, GAS, COAL, AND NUCLEAR

Congress enacted the first excise tax on corporations in 1909, becoming effective in 1913. By 1916, Congress provided for a tax write-off for "dry holes," as well as a deduction for "intangible" costs associated with drilling a well. Ten years later in 1926, the "oil depletion allowance" was enacted into law, allowing for a 27.5 percent deduction from gross revenue. Texas Senator Tom Connally, sponsor of the deduction stated at the time:

Tom Connally

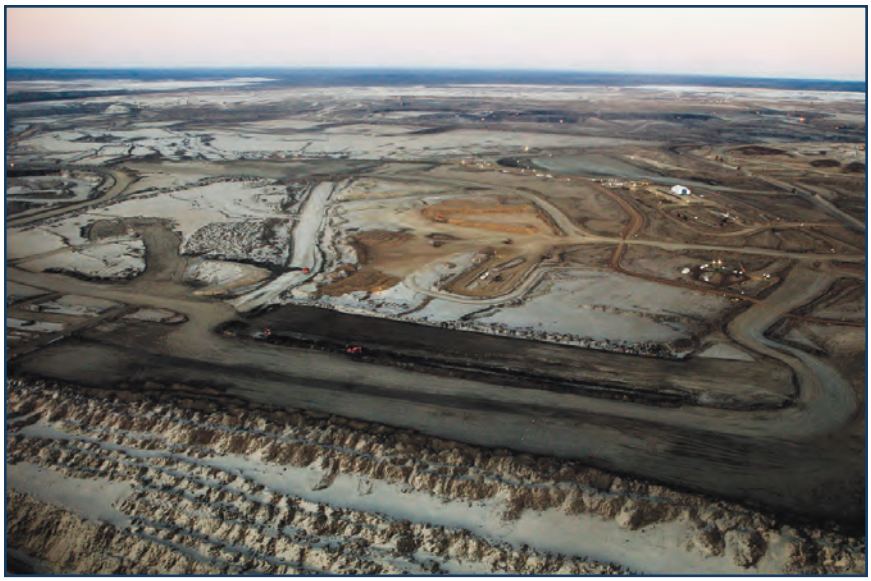
> *"We could have taken a 5 or 10 percent figure, but we grabbed 27.5 percent because we were not only hogs, but the odd figure made it appear as though it was scientifically arrived at."*[2]

The subsidies worked. Today, the oil and gas industry accounts for 7.6 percent of all economic output[3] in the United

States' $22 trillion economy (2018). Yet oil and gas subsidies persist.

The oil depletion allowance is still around in the form of "percentage depletion allowance," where extractive industries can deduct from their taxable income up to 22 percent of the dollar value of material extracted during the year. More broadly, tax preferences for exploration and development allow extractive industries—oil, gas, coal, and hard minerals—to deduct expenses from revenue without regard to the actual remaining value of the asset.[4]

These oil and gas expenses also have special status in the tax code, as they are allowed to be expensed in the year incurred instead of depreciating over the life of the investment. The Congressional Budget Office found that these two special tax treatments alone will cost taxpayers $34 billion between 2014 and 2023.[5] The Council of Foreign Relations indicates that ending these subsidies could both "enhance U.S. influence to advocate for international climate action and generate fiscal savings."[6]



Tax preferences for exploration and development allow extractive industries—oil, gas, coal, and hard minerals—to deduct expenses from revenue without regard to the actual remaining value of the asset. (Fort McMurray tar sands. Source: Flickr)

But these direct oil and gas subsidies are only the tip of the iceberg.

Other direct U.S. tax subsidies for the oil and gas industry include:

- Intangible drilling costs
- Deductions for tertiary injectants
- Passive investment losses
- Domestic manufacturing deductions
- Geological and geophysical expenditures
- Foreign tax credits
- Enhanced oil recovery credits
- Marginal well production credits

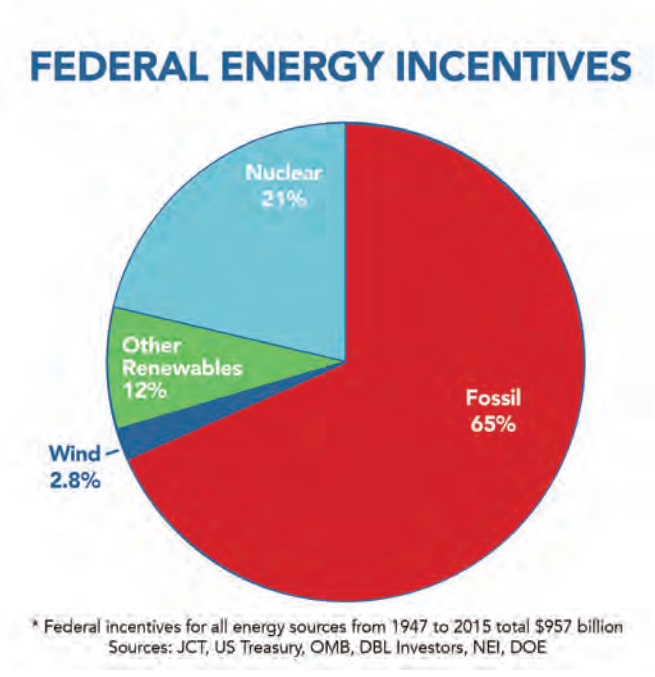
Tax subsidies for coal include:

- Credit for production of nonconventional fuels
- Characterizing coal royalty payments as capital gains
- Other-fuel exploration & development expensing
- Excess of percentage over cost depletion
- Credit for clean coal investment
- Government-backed, low-cost financing for coal plants

Direct fossil fuel production subsidies in the U.S. were valued at approximately $20 billion in 2014.[7] Globally, subsidies have become institutionalized, and the status quo is supported by powerful private and sovereign international interests aimed at ensuring the hegemony of the fossil fuel economy in the 21st century.[8]

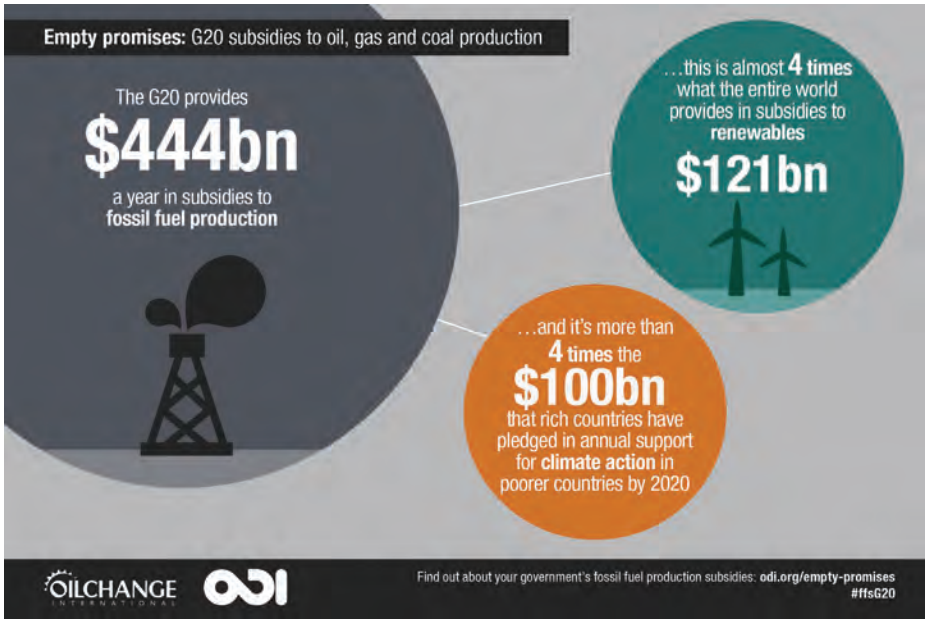
The nuclear industry has also enjoyed massive subsidies. In the 20th century, the preponderance of direct federal energy research and development subsidies was earmarked for the nuclear power industry. For the 71-year period from 1948 through 2018, nearly one-half of the $229 billion appropriated by Congress for research and development benefited nuclear power, while 24 percent benefited fossil fuel production, and renewable energy technologies received 13 percent.[9]

Recent dramatic cost reductions for renewable energy



technologies, particularly wind and solar energy, have undermined the viability of operating nuclear power plants. Unable to compete head-to-head in wholesale electricity markets with clean energy alternatives, nuclear plants are now receiving new operating subsidies in five states—Ohio, Connecticut, Illinois, New Jersey, and New York.[10]

Federal subsidies for renewable energy have been comparatively meager. Bloomberg New Energy Finance estimates that wind and solar energy subsidies for the period 2008-2014 totaled $24 billion.[11] The main subsidies for wind and solar technologies are the investment tax credit, the production tax credit, and accelerated depreciation. While Congress recently extended the tax credits for wind and solar energy for five years (on a diminishing scale), tax credits for other renewable energy technologies like geothermal, microturbines, and combined heat and power have not been extended, stalling innovation, investment, and limiting further market penetration of these important evolving technologies.



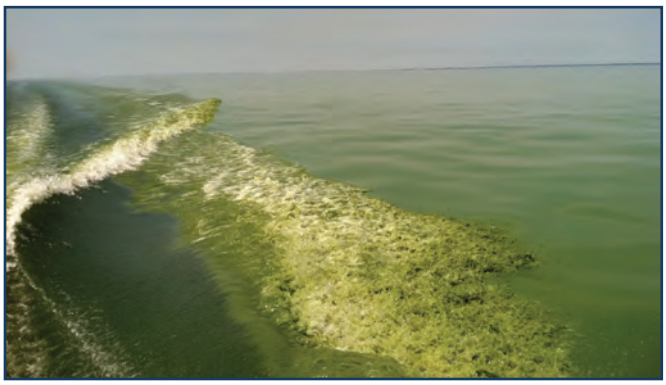
Globally, subsidies remain stacked in favor of fossil fuels in terms of the amount and duration of taxpayer support. But unfair tax subsidies are decidedly minor compared to the quantum negative effect of fossil fuels on our environment, economy and climate—"negative externalities" for which future generations are all destined to pay.

Negative Externalities – The Big-Ticket Subsidies

The fossil fuel industry is responsible for imposing costs on society that are several orders of magnitude higher than the billions of dollars they receive through direct government subsidies. Oil, gas, and coal industries have been largely exempted from paying the costs associated with impacts to human health and the environment caused by the extraction, processing, and burning of fossil fuels and the growing effects of climate change induced by carbon pollution.

Impacts from fossil fuel use include respiratory diseases from air pollution, black lung disease from mining, environmental degradation of surface water and groundwater, and acidification of oceans and lakes. Climate-related human health impacts already beginning to occur in Michigan include higher incidences of respiratory diseases from air pollution and allergenic pollens; heat illness from air mass stagnation, high humidity, and prolonged heat waves; increases in water-borne diseases from flooding, sewage overflows, septic failures, and development of harmful algal blooms; and increases in vector-borne infectious diseases associated with warmer winters, earlier springs, and warmer summers.[12]

In economic theory, the costs associated with these



Climate-related impacts already beginning to occur in the Great Lakes include the development of harmful algal blooms. (Lake Erie in 2011. Source: Wikimedia Commons)

impacts are considered "negative externalities" and are indicative of a market failure, as they impose "spillover" costs on society that are not included in the cost of production. Economists of all stripes generally agree that the cost of goods and services should reflect the full costs of production, including ancillary costs and impacts. Most also agree that government intervention is appropriate to address negative externalities.[13]

Enter Arthur C. Pigou

The concept of "externalities" was introduced by the British economist Arthur Pigou who established the school of economics at Cambridge University. Pigou taught that the most efficient way to address negative externalities is to impose a corrective tax roughly equal to the cost of the social harm created. *Pigouvian taxes* are meant to cure market failures by preventing producers from shifting the cost of production to others. *Pigouvian subsidies*, on the other hand, are intended to promote "positive externalities"—activities that result in additional benefits conferred to society.

Arthur Pigou

The classic illustration of a positive externality is a beekeeper who raises bees and produces honey, but who naturally helps pollinate other plants of surrounding neighbors and farmers. Other examples of positive externalities include government-sponsored research and development, vaccines, renovation of homes that improve neighborhoods, and renewable energy technologies that do not pollute or consume fuels.

Under economic theory, clean technologies should be favored by our taxation system because renewable energy technologies can power our economy without deleterious and costly health and environmental impact and actually improve environmental conditions.

NEGATIVE EXTERNALITIES FROM FOSSIL FUELS

Considerable work has gone into quantifying and monetizing the negative externalities associated with energy production from fossil fuels.

The seminal work in this area was done by Paul Epstein at the Harvard Center for Health and the Global Environment. Epstein and colleagues quantified the impacts of coal use in the United States, examining factors such as local health impacts, land disturbance, emissions from mines and combustion, and waste disposal. Epstein concluded that conservatively, damages from coal externalities ranged between $175 billion and $523.3 billion annually and electricity charges would increase within a range of between 9¢/kWh and 27¢/kWh if these costs had been included in the price of electricity from coal.[14]

An exhaustive analysis from 2015 looked at the social cost of greenhouse gas emissions[15] that extends the social cost of carbon calculated by the Environmental Protection Agency (EPA)[16] for carbon dioxide to a broader range of pollutants and impacts. The study determined that the damages from combustion of coal, natural gas, gasoline, and diesel fuel range from $330 billion to $970 billion annually. This alarmingly large number does not begin to reflect the global economic harm attributable to negative externalities.

In a May 2019 report, the International Monetary Fund (IMF) estimated global energy subsidies at *$5.2 trillion, representing 6.5 percent of global gross domestic product (GDP).* The IMF, comprised of representatives of 189 countries, endeavors to "foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world." The IMF's analysis finds that negative externalities

A 2015 study determined that the damages from combustion of coal, natural gas, gasoline, and diesel fuel ranges from $330 billion to $970 billion annually. (Clark Avenue Bridge, Cleveland, 1973. Source: Wikimedia Commons)

attributed to fossil fuels account for 85 percent of global subsidies. If these negative externalities were included in the price of fossil fuels, carbon emissions would be reduced by 28 percent, fossil fuel air pollution deaths would be reduced by 46 percent, and global government revenue would *increase* by 3.8 percent of GDP.[17] The IMF analysis indicates that in the United States, annual expenditures for fossil fuel subsidies exceed the annual defense budget.

Other Subsidies that are not Part of the $5.2 Trillion Calculus

Yet the IMF estimates of the annual global cost attributable to the production and combustion of fossil fuels, and the resulting climate impacts, do not capture the full universe of costs ultimately transferred to the public. A recent review of econometric models estimating the impacts of climate change undertaken by the Grantham Research Institute on Climate Change and the Environment, Columbia University's Earth Institute, and the Potsdam Institute for Climate Impact Research, argues that the existing econometric models fail to taken into account the potential for massive geopolitical disruptions in the form of climate-induced mass migrations, displacement, conflict, and associated loss of life. "Economic assessments that are expressed solely in terms of effects on output (e.g. gross domestic product), or that only extrapolate from past experience, or that use inappropriate discounting, do not provide a clear indication of the potential risks to lives and livelihoods."[18]

Moreover, there are many more ways environmental and economic costs and responsibilities of the fossil fuel industry are reallocated to the general public and not reflected in the cost of fossil fuels. A few examples:

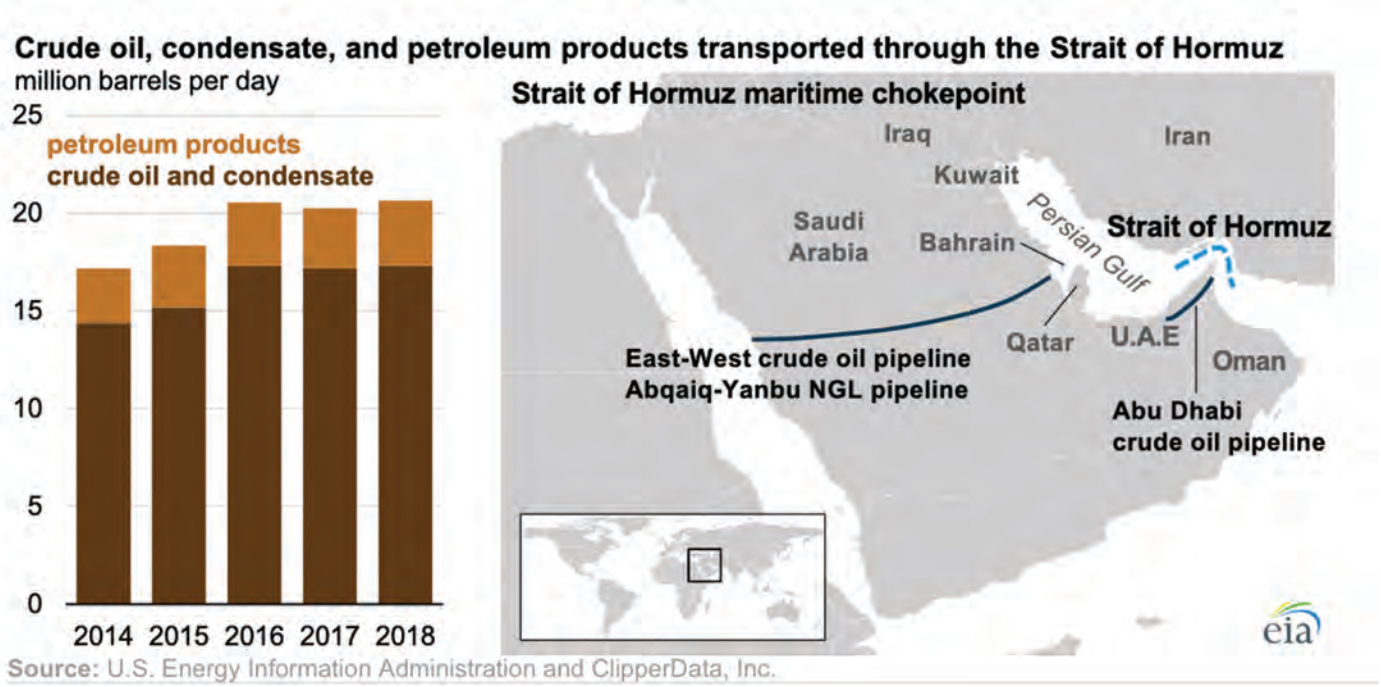
As coal companies proceed through bankruptcy reorganizations or liquidations, they are shedding responsibility for disability payments to miners who suffer from black lung disease and their families. (Black Lung Laboratory, Beckley, West Virginia in 1974. Source: Wikimedia Commons)

> *Coal companies have used the Bankruptcy Code to evade congressionally imposed liabilities requiring that they pay lifetime health benefits to coal miners and restore land degraded by surface mining.*
>
> Stanford Law Review, 2019

COAL

Coal companies are transferring financial responsibility to state and local government on a number of fronts. Between 2012 and the November 2016 U.S. presidential election, 50 U.S. coal companies filed for protection under the bankruptcy code. Since the election, eight more coal companies have filed for bankruptcy, including one of the nation's largest, Cloud Peak Energy.[19] With Cloud Peak's filing, all four of the nation's four largest coal companies—Peabody, Arch Coal, and Alpha Natural Resources—have sought to shed their financial obligations through the bankruptcy courts. These four companies are transferring almost $5.2 billion of environmental and retiree liabilities to taxpayers—$3.2 billion in retiree benefits and $1.9 billion in environmental liabilities.[20]

As coal companies proceed through bankruptcy reorganizations or liquidations, they are shedding, with court approval, billions of dollars of liability for mine reclamation,[21] responsibility for disability payments to miners who suffer from black lung disease and their families, pension and health care benefits,[22] and responsibility for managing other coal-related environmental impacts.[23] As of 2016, coal companies had an estimated $30 billion in combined debt for environmental and worker benefit obligations that may default to taxpayers.[24] In another category of liability transfer, the latest national assessment indicates that 91 percent of 550 regulated coal ash landfill cells are leaching heavy metals into groundwater.[25] Remediating coal ash landfill contamination will cost tens



of billions of dollars—costs that will ultimately be borne by ratepayers and taxpayers.[26]

PETROLEUM

The United States imported 9.93 million barrels of oil per day in 2018, while exporting 7.59 million barrels per day.[27] The cost of importing and exporting transportation fuels goes far beyond the price consumers pay at the pump. American taxpayers pay the cost of ensuring the world's supply of oil flows uninterrupted through the global deployment of U.S. military forces, guaranteeing that the supply, transportation, and logistical pathways for oil are defended and secured. The mission of the U.S. 5th Fleet is to secure and protect the Persian Gulf and specifically, the Strait of Hormuz,[28] the largest "world oil transit chokepoint" through which 21 percent of the world's oil flows.[29] According to the Energy Information Administration, more than three-quarters of the oil that moves through this chokepoint is destined for Asian markets, including Japan, India, South Korea, and China.[30]

By unilaterally shouldering the military expenditures for securing maritime oil transit routes, American taxpayers are subsidizing the price of petroleum for other countries, friend and foe alike, around the globe—another subsidy that does not show up in the price at the pump.

Fossil Fuels Receive Favored Regulatory Treatment

Fossil fuels enjoy regulatory advantages under the National Environmental Protection Act (NEPA). There are more than 4,200 oil leases, 4,000 offshore drilling platforms, and more than 27,000 abandoned oil wells in the Gulf of Mexico alone.[31] One would think that offshore drilling activity would undergo a lengthy review process and receive the highest scrutiny under NEPA, a federal law the purpose of which is to minimize environmental harms. Yet the U.S. Department of Interior routinely grants offshore drilling projects a "categorical exclusion" from the NEPA environmental review process, based upon a finding that offshore drilling is among *"actions which do not individually or cumulatively have a significant effect on the human environment."*[32]

In April 2010, the BP Deepwater Horizon oil drilling platform exploded, releasing 200 million gallons of crude oil into the Gulf of Mexico over 87 days. The BP Deepwater Horizon was the beneficiary of a categorical exclusion under NEPA.

By contrast, offshore wind energy projects, which pose little risk of pollution and constitute a positive externality by providing zero-carbon energy, require much more rigorous environmental reviews than offshore oil rigs. The nation's first offshore wind energy project—Deepwater Wind—required an extensive and expensive three-year environmental assessment, negatively affecting the economics of the project.

Thorough environmental reviews of major projects are both necessary and prudent. The Trump administration is, however, being aggressive in its efforts to weaken environmental regulations and eliminate regulatory hurdles for fossil fuel development while displaying less interest and enthusiasm in the deployment of clean energy projects. Vineyard Wind, the first U.S. utility-scale offshore wind project off the coast of Massachusetts, has been delayed by the Bureau of Ocean Energy Management (BOEM) to allow for a more robust environmental review. As the production tax credit available for wind energy projects is set to expire, the delay jeopardizes the financial viability of the project and undermines efforts of New England states to meet climate and greenhouse gas reduction goals.

Preferential applications of regulatory authority to favor fossil fuel development to the detriment of advancing zero-carbon technologies is not only economically inefficient, it is fundamentally at odds with the global consensus that greenhouse gas emissions must be dramatically reduced to avoid the most catastrophic impacts from the climate crisis.

The regulatory system's essential purpose in safeguarding and protecting the environment, community health, and social and economic justice faces critical challenges under the present administration. Society has the capacity to quantify and measure the relative benefits and burdens of energy resources and the negative externalities associated with fossil fuels. It is important to weigh these burdens and costs because now, for the first time in history, we actually have choices and alternatives in how to power our homes, businesses, and factories. We have the capacity to allow science and economics to inform decisions about energy choices.

We simply cannot continue to invest in fossil fuel development and stay within the carbon budget upon which the long-term stability of our planet depends.

Moreover, if the costs of negative externalities were in fact priced into the cost of fossil fuels, the economic advantages that clean energy technologies already have would be overwhelming.

According to a new paper published in the Proceedings of the National Academy of Sciences, delays in reducing carbon emissions will have profound economic impacts. Delaying implementation of a carbon tax by only one year will cost

Space and Naval Warfare Systems Command Headquarters in San Diego in 2011. For the first time in history, we actually have choices and alternatives in how to power our homes, businesses, and factories. We have the capacity to allow science and economics to inform decisions about energy choices. (Source: Wikimedia Commons)

society approximately $1 trillion, while a five-year delay results in an "equivalent loss of approximately $24 trillion, comparable to a severe global depression." A 10-year delay causes an equivalent loss in the order of $10 trillion per year and approximately $100 trillion over time.[33] Immediate government intervention through targeted regulatory and tax policies would save trillions of dollars and avoid the most catastrophic impacts of climate change.

More fundamentally, continued development and burning of fossil fuels is utterly contrary to the consensus goal, supported by every credible scientific body in the world, that greenhouse gas emissions must be dramatically curtailed if we have any hope of avoiding the most catastrophic impacts of climate change. We simply cannot continue to invest in fossil fuel development and stay within the carbon budget upon which the long-term stability of our planet depends.

An oil pump continues to draw fossil fuels from the ground as the sun sets over Ellis County, in western Kansas.

NEGATIVE EXTERNALITIES IN THE GREAT LAKES

The Great Lakes, extraordinarily vast and deep as they are, have not been immune to the forces affecting the planet. Through time, the Great Lakes have revealed many vulnerabilities that, when exploited, have led to impaired waters and degraded services relied upon by so many. Power generation, agriculture, and climate change are all active forces affecting the quality of Great Lakes waters.

Power Generation Effects on the Great Lakes

Our carbon-intensive energy system affects Great Lakes commerce, agriculture, tourism, and recreational opportunities, and has pronounced physical effects on soil and water chemistry, lake levels, and ecological systems at large.

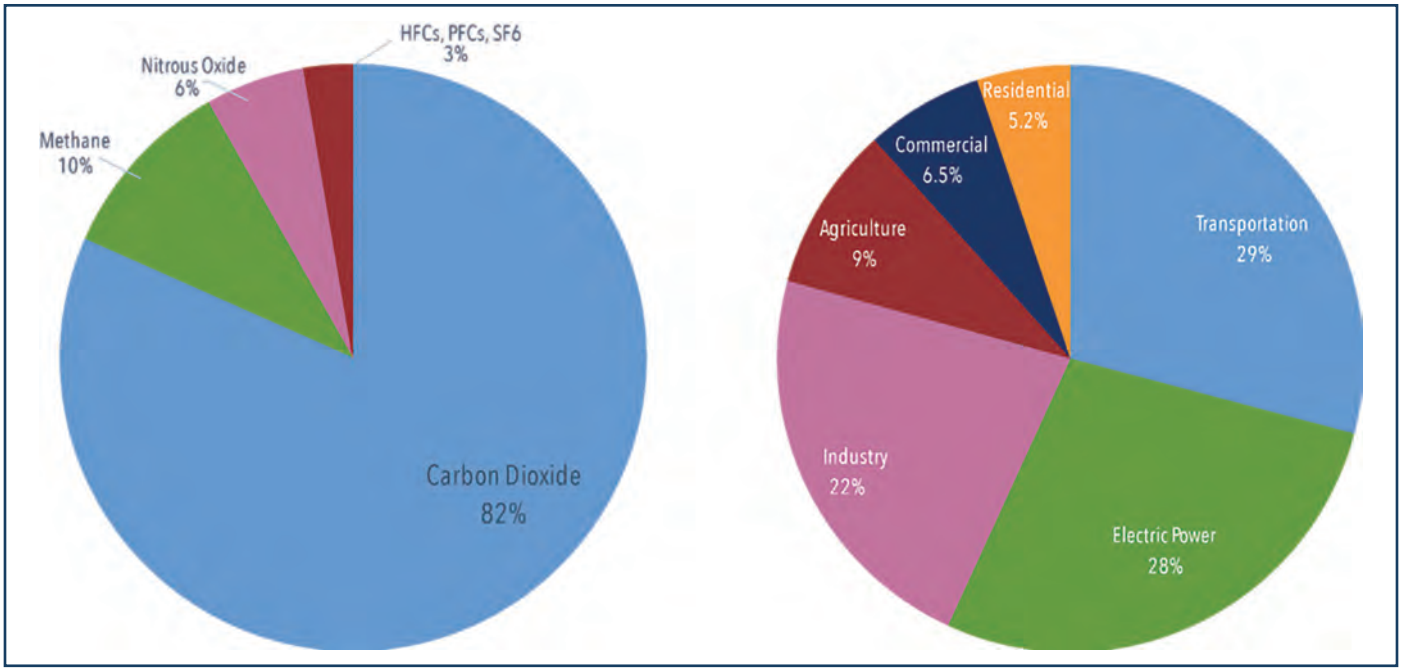
Thermoelectric power generation—the operation of coal, nuclear, and natural gas plants—has historically accounted for 76 percent of water withdrawals in the Great Lakes Region. Because of the near unlimited water availability in the Great Lakes Region, power plants have been preferentially sited in our region. Until recently, there were 583 power plants in the Great Lakes Basin,[34] including 144 coal-fired plants.[35] The cooling systems for power plants demand a continuous flow from the Great Lakes or their tributary river systems estimated at 25.9 billion gallons per day.[36] The cooling water intakes entrap and kill fish, fish eggs, larva, and other aquatic organisms in the process. The cooling water is typically returned to its source but at a higher temperature. These "thermal loadings" destabilize aquatic communities within the receiving water body, affecting benthic communities, changing local fish populations, reducing dissolved oxygen

levels, and helping to propagate algae and pathogens.[37]

As recently as 2010, the coal-fired plants in the eight Great Lakes states annually emitted over 13,000 pounds of mercury, which occurs naturally in coal.[38] The airborne deposition of mercury from coal-fired plants represents more than 50 percent of all mercury in the Great Lakes.[39] A powerful neurotoxin, mercury bioaccumulates in fish and other organisms and is biomagnified in the flesh and organs of predatory fish and marine mammals. Children, and especially fetuses and infants, are uniquely susceptible to mercury, which can affect the central nervous system and brain development.[40]

As recently as 2010, the coal-fired plants in the eight Great Lakes States emitted over 13,000 pounds of mercury annually. (Avon Lake Power Plant, west of Cleveland on Lake Erie. Source: Wikimedia Commons)

In addition to mercury, power plant emissions contain other metals like arsenic, nickel, and chromium, and acid gases like sulfur dioxide, oxides of nitrogen, and carbon dioxide (CO_2). In 2016, Michigan's energy-related CO_2 emissions were 152.6 million tons.[41] There is concern that the Great Lakes will acidify from the absorption of CO_2, as have the oceans with similar effects on marine ecology.[42] Indeed, a study of freshwater lakes in Germany found that the lakes were acidifying at a faster rate than the oceans.[43] All of these region-specific economic and environmental consequences are further examples of pervasive "negative externalities" that largely go unaccounted for in both governmental policies and public discourse.



In 2017, the United States emitted 6.5 billion metric tons of greenhouse gases (CO_2e). Carbon dioxide accounted for the largest percentage of greenhouse gases (82%), followed by methane (10%), nitrous oxide (6%), and other greenhouse gases (3%). Greenhouse gases are emitted by all sectors of the economy, including electric power (28% of total), transportation (29%), industry (22%), residential and commercial (12%), and agriculture (9%). (Source EPA, 2019) [44]

Agriculture's Effects on the Great Lakes

Agriculture's impact on the water resources of the Great Lakes Region appears to be a persistent and growing problem. The National Water Quality Assessment indicates that "agricultural nonpoint source (NPS) pollution is the leading source of water quality impacts on surveyed rivers and streams, the third largest source for lakes, the second largest source of impairments to wetlands, and a major contributor to contamination of surveyed estuaries and groundwater."[45]

Agricultural activities can affect the quality of Great Lakes waters in many ways.[46] Concentrated animal feeding operations (CAFOs) with large numbers of livestock can produce a greater volume of wastes than cities and counties. Runoff over fields from rainwater, melting snow, and irrigation can transport nutrients and pesticide and herbicide residues to drains, streams, and rivers tributary to the Great Lakes.[47] Sedimentation from plowed fields also affects waters by impairing water quality, degrading aquatic ecosystems, and, in course, diminishing the value of the ecological services the Great Lakes freshwater system provides.

Lake Erie is a case in point. Lake Erie's ecology is severely stressed from excessive nutrient loadings of nitrogen and phosphorus, delivered via non-point sources consisting primarily of runoff from agricultural fields. Harmful algal blooms (HABs) of cyanobacteria, commonly known as blue-green algae, release toxins that can cause illness and even death to people and animals. HABs also cause hypoxia—reduced dissolved oxygen levels in water that stress aquatic communities and kill fish.

In 2019, Western Lake Erie experienced its worst outbreak of algal blooms since 2014, when the Toledo municipal drinking water plant was shut down for nearly 3 days. According to the University of Michigan Water Center, farm fertilizers and manure applications account for 85 percent of phosphorus delivery within the Maumee River watershed, the largest contributor of nutrients to the Western Lake Erie Basin.[48]

These impacts are not priced into the cost of agricultural production. If they were accounted for and properly allocated, farmers would have financial incentives to ensure that their activities did not impair the environment and the transfer of environmental and health costs to the public could be mitigated, if not avoided. Indeed, properly designed and targeted government policies could promote agricultural practices that are restorative to farmland by sequestering carbon in soils—transforming what would otherwise be negative externalities into positive benefits.

Concentrated animal feeding operations (CAFOs) with large numbers of livestock can produce a greater volume of wastes than cities and counties. Runoff over fields from rainwater, melting snow, and irrigation can transport nutrients and pesticide and herbicide residues to drains, streams, and rivers tributary to the Great Lakes. (Source: Wikimedia Commons)

High Lake Michigan water levels in 2019 erode a beach in Michigan's Leelanau County.

Climate Change Effects on the Great Lakes

Michigan's freshwater resources are globally unique—an unparalleled natural endowment existing nowhere else on the planet. The Great Lakes surrounding Michigan comprise 20 percent of the world's fresh surface water, and 84 percent of the fresh surface water in North America. Changing climate conditions will result in specific climate-related vulnerabilities and amplify existing climate-related risks to water quality, lake health, and aquatic communities.

Michigan has experienced measurable increases in temperature since 1951 ranging from 0.6°F in the southeastern Lower Peninsula to 1.3°F in the northwestern Lower Peninsula, as well as an increased frequency of weather extremes and heavy precipitation events. The Great Lakes, like the oceans, are absorbing heat, but at a far faster rate, affecting limnologic health and altering ecosystems. Lake Superior's summer (July–September) surface water temperatures increased approximately 4.5°F (2.5°C) since 1980, warming twice as fast as air temperature.[49] Great Lakes ice cover has decreased by 71% in the past 40 years, although some more recent years defied that trend.[50]

The National Climate Assessment forecasts increased precipitation with a larger percentage of annual rainfall occurring in heavy precipitation events. Periods of intense rain will result in more flooding, increasing soil erosion and nutrient loadings to tributary streams and rivers. More precipitation will also increase the frequency and amount of sewage overflows and further the propagation of algae, including cyanobacteria, resulting in declining water quality and beach health.[51] Technology upgrades to municipal drinking water systems necessary to remove excess nutrients from water supplies will significantly increase water treatment costs.[52]

The warming climate will further challenge agriculture. Prolonged droughts and the loss of soil moisture will lower crop production, and warming temperatures will amplify existing stressors such as invasive species, insect pests, and plant diseases. Increased precipitation will exacerbate erosion, sedimentation, and pollution from fertilizer, pesticide, and herbicide residues.[53] Sediment damages from agricultural erosion have been estimated to be between $2 billion and $8 billion per year (1989 dollars).[54]

Annual economic losses from flood damage in Michigan may in the future exceed $700 million (2008 dollars).[55] Increased flooding will result in damage to infrastructure and property and disruption of transportation and commercial

activity. Recreation and tourism will be impacted as temperature increases will reduce snow and ice cover, affecting winter-related sports activities.[56] Michigan's public health agency projects further systemic health related impacts from climate change, including increased respiratory-related illnesses and increased disease-related impacts.[57]

The negative externalities associated with climate change are concrete, verifiable, and, for the most part, monetizable. Our failure to recognize and account for negative externalities is a monumental market failure and represents a profound breach of our public trust responsibilities to future generations. We are transferring both the environmental consequences and financial responsibility for the damages to our children, as well as the responsibility for implementing the inevitable adaptive and mitigation measures that will become more critical and expensive with each passing year.

Near record-high Lake Michigan water levels in 2019 swamped beaches, eroded hills and destroyed roads in northern Michigan.

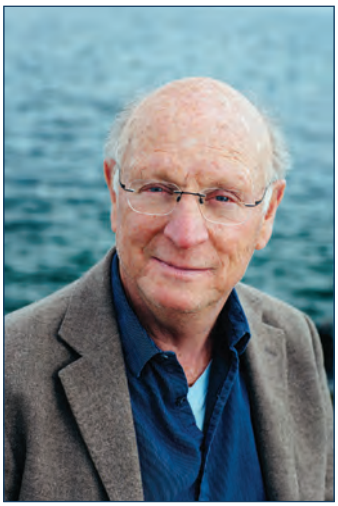
THE PUBLIC TRUST DOCTRINE: A MODEL TO PROTECT FUTURE GENERATIONS

In a rational regulatory framework, the environmental, public health, and economic costs and impacts of the production and combustion of oil, natural gas, and coal would be accounted for in energy markets. Recognizing that negative externalities are indicators of market failure, an optimal regulatory framework would, consistent with established tenets of economics, assess the full range of costs and impacts of competing energy technologies. Alternatives would be better weighed and evaluated with more complete data, and markets would be more efficient and accurate arbiters by taking in the full range of relative costs.

As we have seen in the prior policy briefs, natural resources and high functioning ecological systems underpin the global economy, providing trillions of dollars of ecological services annually. Natural systems and the ecological services they provide are a public trust. Government has a fiduciary responsibility, as trustee, to protect and steward natural resources for the benefit of the public and future generations.

Modern econometric science enables us to measure and value environmental services and recognize and treat impairments that degrade natural systems as avoidable costs inimical to markets and public welfare. As a first principle, public policy should be informed by considerations of the impact of activities affecting natural systems on public welfare and the economy.

In this way, the Public Trust Doctrine aligns perfectly with sound economic theory. When evaluating activities that pose a risk of environmental impairment, the Doctrine requires consideration of potential environmental harm and alternatives that are environmentally benign. Similarly, market activities that provide the most benefits at the least cost should be advantaged in public policy. Those that result in avoidable costs that degrade and diminish natural capital and ecological services should be disfavored.



FLOW founder Jim Olson is a champion of the Public Trust Doctrine. (Credit: Beth Price)

Jim Olson, the founder of FLOW and world-renowned expert on the Public Trust Doctrine, has written extensively on the importance of recognizing the interdependencies of the hydrological system and benefits that accrue to the public by application of public trust principles. Olson suggests *"adoption of a new narrative, with principles grounded in science, values, and policy, that views the systemic threats we face as part of the single connected…whole."*

It is time to expand public trust principles to activities that affect common resources—the atmosphere, oceans, forests, and natural features—applying the Public Trust Doctrine to advance the most environmentally beneficial, healthful, and economically efficient policy for present and future generations.

> *"When pollutants degrade water quality, they impose costs on water users. These costs are in the form of degraded ecosystems that people wish to remain healthy, reduced recreational opportunities, reduced commercial fishing catches and shellfish bed closings, increased water treatment costs, threats to human health, and damage to reservoirs and water conveyance systems."*
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FLOW
FOR LOVE OF WATER

FLOW (For Love of Water) is working to build deeper awareness among all stakeholders—including groups, governments, and citizens—regarding the public trust framework that protects the Great Lakes.

ABOUT THIS REPORT

Environmental standards can also be a strong force for innovation within business and industry by reducing waste and production inefficiencies, inducing technological improvements, lowering costs, and mitigating environmental vulnerabilities. Environmental regulations can level the playing field within business sectors by setting industry-wide standards for protection and safeguards and by fostering competition for improvements among competitors.

This fourth brief—Resetting Expectations: Accounting for Environmental, Health, and Climate Impacts in the Energy Sector—is the last in a series of policy briefs that examines the economic costs associated with government policies that do the opposite—imposing unnecessary and unaccounted for burdens on the environment, public health, and the economy. Obsolete and inefficient government policies and programs impose additional costs on society and taxpayers by directly supporting activities that result in environmental degradation and diminishment of the ecological services provided by healthy and robust natural systems.

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