

CLIMATE TRIAGE: A RESOURCES TRUST TO ADDRESS INEQUALITY IN A CLIMATE-CHANGED WORLD

BY
SHI-LING HSU*

Global climate change poses an existential threat to human civilization because it disrupts the supply of natural resources that provide basic life staples—water, food, and energy. If humankind is unable to adapt to a less abundant and less predictable supply of resources, then the effective scarcity will, as it often has in human history, lead to conflict. There is a chance, if greenhouse gas emissions can be sufficiently reduced to avoid the most serious consequences of climate change, that efficiency and sharing measures can make up for climate-induced shortfalls. Natural resources are not generally managed or consumed very efficiently, so large savings in production and consumption are possible. And humankind has demonstrated a surprising capacity to organize and cooperate to efficiently share resources, even in times of scarcity.

However, a formidable obstacle stands in the way of such arrangements: economic inequality. Organic cooperation requires, if not homogeneity, a certain capacity to recognize and coalesce around a group interest. Sharp economic divisions are an anathema to such group coherence. This Article proposes a form of climate triage, a prospective equalizing measure to address natural resource shortages before economic inequality can sabotage cooperation: the creation of a resources trust to act as a supplier of last resort in case of climate-induced scarcity. A resources trust could be chartered at the federal, state, or regional level, and would acquire rights,

*D'Alemberte Professor and Associate Dean of Environmental Programs, Florida State University College of Law. The author thanks and acknowledges the help and comments of participants at the 2019 Society for Environmental Law and Economics Annual Meeting, a faculty workshop at the University of South Carolina School of Law, the Rocky Mountain Mineral Law Foundation Natural Resource Law Teachers Workshop, and the Celebrating Commons Scholarship Conference at Georgetown Law School. Many individuals offered helpful comments, but I especially thank Brigham Daniels, Josh Eagle, Shelley Welton, Dean Leuck, Michael Pappas, Justin Leroux, Matthew Gentry, Elissa Gentry, Peter Grossman, Joshua Sarnoff, Brett McDonnell, and Gabe Pacyniak for comments that have found their way into this Article. The author would also like to thank Mary McCormick, Katrina Miller, Kat Klepfer, and the rest of the always-outstanding library staff at the Florida State University College of Law for their assistance. Of course, the remaining shortcomings are the sole responsibility of the author.

options, and other assets required to step in and supply basic life staples to ensure reasonable access for the vast majority of individuals in a chartering jurisdiction. Without such an assurance, the pressure to take resources by force and to hoard them could be overwhelming. Hoarding would be the worst possible outcome, as it is grossly inefficient, unjust, and worst of all, self-reinforcing. The nature of hoarding is such that it exacerbates itself, creating ever-stronger incentives to hoard, so that once started, it becomes extremely difficult to stop. Hoarding in a climate-changed future would introduce a new, and potentially dystopic form of inequality, one with the potential for creating unrest.

I.	INTRODUCTION	98
II.	CLIMATE CHANGE, NATURAL RESOURCES, AND LIFE STAPLES	102
III.	ECONOMIC INEQUALITY, VITAL RESOURCES, AND HOARDING	106
IV.	RESOURCES TRUST NOW	114
V.	SUPPLYING RESOURCES	115
	A. <i>Water</i>	117
	B. <i>Food</i>	123
	C. <i>Energy</i>	127
VI.	IMPLEMENTATION OF A RESOURCES TRUST	131
	A. <i>What Government: State, Federal, or Regional?</i>	133
	1. <i>Federal Resources Trust</i>	134
	2. <i>State Resources Trust</i>	135
	3. <i>Regional Resources Trust</i>	138
	B. <i>Sunrise, Sunset: When Resource Trusts Step In and Step Out</i>	138
	C. <i>Governance and Oversight</i>	141
	1. <i>Sovereign Wealth Funds</i>	142
	2. <i>Publicly-Chartered Corporations</i>	143
	3. <i>A Synthetic GSE, and More Cautionary Tales</i>	145
VII.	CONCLUSION	148

I. INTRODUCTION

Global climate change poses an existential threat to human civilization because it disrupts the supply of vital natural resources such as land and water that sustain life.¹ Unusually high temperatures and extreme weather disrupt the functioning of systems, natural and man-made, that have adapted or been designed around specific climate

¹ For a review of the resource impacts of climate change, see THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SPECIAL REPORT: GLOBAL WARMING OF 1.5°C, at 175–311 (2018), <https://perma.cc/6YJQ-4KUH> [hereinafter IPCC SPECIAL REPORT].

conditions.² If predictions from climate models are even roughly accurate (and so far they have been, if even a bit too optimistic),³ then human adaptation must redouble. Climate change threatens the supply of vital natural resources that contribute to the provision of the basic staples of human life: water, food, and energy.⁴ If climate change strikes a society riven by economic inequality, it may overwhelm the capacity of governments to provide for basic human needs.⁵ Resources will be privately hoarded⁶ by force, and unrest may follow.⁷

The worsening news of the coming climate crisis calls for some climate *triage* to anticipate and address shortfalls in vital resources. This Article proposes a measure to head off future shortages, and hopefully unrest: the creation of a government-funded *resources trust* to acquire assets and future rights to natural resources and life staples, for the purpose of supplying them in case of scarcity. The function of such a trust or trust-like entity (hereinafter, a “Resources Trust”) would be to make credible assurances that the vast majority of individuals in a jurisdiction will have access to vital natural resources and life staples

² For a review of the different impacts of climate change and their effects on humans and the biosphere, see ROBERT HENSON, *THE THINKING PERSON’S GUIDE TO CLIMATE CHANGE* 59–230 (2014).

³ Nicholas Stern, *The Structure of Economic Modeling of the Potential Impacts of Climate Change: Grafting Gross Underestimation of Risk onto Already Narrow Science Models*, 51 J. ECON. LIT., Sept. 2013, at 838, 838–39 (“Scientific evidence over the past decade on the scale and nature of the potential risks from human-induced climate change is becoming still more worrying: rapidly rising emissions and concentrations; impacts appearing more rapidly than anticipated; major features omitted from models, because they are not currently easy to characterize, look still more threatening.”); Scott Waldman, *New Climate Report Was Too Cautious, Some Scientists Say*, SCI. AM. (Oct. 11, 2018), <https://perma.cc/C36W-LHLH>.

⁴ IPCC SPECIAL REPORT, *supra* note 1, at 213 (Even in the implausibly optimistic scenario that the temperature increase can be limited to 2°C, an additional 8% of the world’s population (over 600 million) will be exposed to “aggravated” water scarcity, which would include millions of people in North America and Europe limiting themselves to 500 cubic meters of water per year, compared with their current average consumption of 1200 cubic meters per year). Climate change has already reduced yields of wheat, rice, maize and soybean by 3–16% globally, Rita Van Dingenen et al., *The Global Impact of Ozone on Agricultural Crop Yields Under Current and Future Air Quality Legislation*, 43 ATMOSPHERIC ENV’T 604, 617 (2009), and can be expected to decrease another 3–10% for each degree of warming. IPCC SPECIAL REPORT, *supra* note 1, at 236. Because of higher water temperatures and lower summer river flows, European countries will experience a loss of usable hydropower capacity and of thermoelectric power plants using river water for cooling. *Id.* at 214.

⁵ See, e.g., TED G. LEWIS, *CRITICAL INFRASTRUCTURE PROTECTION IN HOMELAND SECURITY: DEFENDING A NETWORKED NATION* xiv (2d ed. 2014) (“[I]f you don’t have food, water, energy, power, and communication, you don’t have a country.”).

⁶ See Martin Weitzman, *Price Distortion and Shortage Deformation, or What Happened to the Soap?* 81 AM. ECON. REV. 401, 402–03 (1991) (discussing hoarding of soap in former Soviet Union in times of economic crisis); KAREN PIPER, *THE PRICE OF THIRST: GLOBAL WATER INEQUALITY AND THE COMING CHAOS* 10 (2014) (discussing hoarding of water in California due to water crisis).

⁷ See, e.g., Christian Almer et al., *Water Scarcity and Rioting: Disaggregated Evidence from Sub-Saharan Africa*, 86 J. ENVTL. ECON. & MGMT. 193, 193–94 (2017).

even in times of climate-induced scarcity. In a worst-case scenario, a Resources Trust must act as a supplier of last resort, providing a lifeline to a vast majority of its populace. With that assurance, the pressure to hoard resources decreases, and hopefully the potential for unrest.

A Resources Trust can be established at national and sub-national levels, and possibly even transnational-regional levels, though there are obvious tradeoffs at each level. As well, the need for a Resources Trust is predicated on the prospect of inequality of life-sustaining resources. This inequality may pose a threat to peace and order at one level or another, so the formation of Resources Trust may be driven by the locus and scale of emerging security threats.

Importantly, a Resources Trust need not *stockpile* reserves of these goods; it must obtain the rights to secure and the capacity to supply these goods in sufficient quantities to pre-empt shortages. This might, for example, involve the acquisition of options on water rights, rather than water rights themselves.⁸ It might involve the acquisition of land with water rights as a hedge against drought.⁹ It might accumulate energy supplies or develop methods of energy generation that are not profitable in normal markets but vital in times of stress.¹⁰ The role of a publicly-chartered Resources Trust would be to be able to step into a situation of near-crisis and proactively calm markets by injecting supplies of vital life staples.

This Article does not set forth a case for a Resources Trust to supplant private markets, but to *supplement* them, infusing supply when needed, albeit in large quantities if necessary. That said, a commitment to ensure that every person within a chartering jurisdiction has access to water, food, and energy is a non-market allocation. As such, it flies in the face of conventional economic wisdom, which generally frowns upon government intervention in the face of shortage, on the grounds that it usually does more harm than good.¹¹ But three things would make climate-induced resource shortages different that may warrant governmental intervention: 1) the potential for long-term shortages, 2) the indispensability of the life-sustaining resources, and 3) economic inequality that concentrates buying power. Climate change

⁸ See, e.g., Claire D. Tompkins & Thomas A. Weber, *Option Contracting in the California Water Market*, 37 J. REG. ECON. 107, 108 (2010).

⁹ See, e.g., Russell Gold, *Harvard Quietly Amasses California Vineyards—and the Water Underneath*, WALL ST. J. (Dec. 11, 2018), <https://perma.cc/Y3W7-RBWT>; see also discussion *infra* note 106 and accompanying text.

¹⁰ See, e.g., Tessa Love, *Solar Power is Being Used for Disaster Relief, Here's How*, WORLD ECON. FORUM (May 14, 2018), <https://perma.cc/6PQJ-FELV>.

¹¹ See, e.g., Milton Friedman, *Blaming the Obstetrician*, NEWSWEEK, June 4, 1979, at 70 (“There is an energy crisis, there are gasoline lines, for one reason and one reason only. Because government has decreed that there shall be.”); see also discussion *infra* Part III (Most economic modeling and studies emphasize the dysfunction of government policies in allocating scarce goods, arguing that removing price signals prevents efficient allocations, and actually causes shortages and hoarding, rather than preventing it).

poses the threat of very broad environmental change¹² that could cause prices of these life staples to rise sharply and set off buying panics—hoarding, made possible by the concentration of wealth.¹³

Governmental action to avert consumer panic is familiar. The Federal Deposit Insurance Corporation was created in 1933 in response to bank failures caused by “bank runs,” the panic withdrawal of money by depositors.¹⁴ Bank runs are particularly unfortunate, because they are driven by a fear of bank failure, which can itself cause a bank failure that might otherwise not have happened.¹⁵ Depositors might prefer to avoid withdrawing their money but still do so, out of fear; in a sense, they are hoarding liquidity at a loss.¹⁶ Similarly, a “run” on vital life staples in a climate-induced shortage might compel people, out of fear, to hoard life staples and exacerbate or even create a shortage.

By preventing hoarding, a Resources Trust accomplishes its other goal: restoring a measure of economic equality. Climate change exacerbates economic inequality¹⁷ because if vital resources run short, prices will rise, and the buying power of consumers will shrink. The wealthy are also worse off but have the means to deal with the uncertainty by buying up life’s necessities, leaving less for everyone else. Hoarding is just the translation of wealth inequality into another currency: vital life staples.

It is thus critical that the creation of Resources Trusts begin now, before shortages actually become widespread. Once resources become scarce, they become expensive or otherwise difficult to acquire.¹⁸ Secondly, a Resources Trust has the potential to affect market prices, so minimizing the interference with markets would require it to acquire resources over long time frame. And finally, developing the capacity to be a supplier of last resort by accumulating the needed assets and rights is a massive undertaking. It is essential to get on with this vital task now.

Part II of this Article reviews the threats posed by climate change to natural resources that provide vital life staples to humans. Part III of this Article lays out how climate change exacerbates economic inequality, leading to shortages and hoarding. Part IV makes the case that the work of constructing Resources Trusts must begin now, before shortages loom too large. Part V describes how a Resources Trust would accumulate assets and rights to enable it to be a supplier of last resort,

¹² See discussion *infra* Part III.

¹³ See discussion *infra* Part III.

¹⁴ *Who is the FDIC?*, FED. DEPOSIT INS. CORP., <https://perma.cc/C2CU-AKMD> (last updated May 3, 2017); Douglas W. Diamond & Philip H. Dybvig, *Bank Runs, Deposit Insurance, and Liquidity*, 91 J. POL. ECON. 401, 401 (1983).

¹⁵ See Diamond & Dybvig, *supra* note 14.

¹⁶ *Id.* at 402–03.

¹⁷ See, e.g., Noah S. Diffenbaugh & Marshall Burke, *Global Warming Has Increased Global Economic Inequality*, 116 PROC. NAT’L ACAD. SCI. 9808, 9808 (2019).

¹⁸ It is axiomatic for normal goods that increased scarcity leads to higher prices. See N. GREGORY MANKIW, PRINCIPLES OF MICROECONOMICS 67–68 (7th ed. 2015).

including a discussion of possible legal instruments that may be used. Part VI discusses some of the implementation issues that come with constituting a Resources Trust. Part VII concludes.

II. CLIMATE CHANGE, NATURAL RESOURCES, AND LIFE STAPLES

Climate change poses such an existential threat to human civilization because changes are projected to occur that are unprecedented in both scale and time. The last time that atmospheric carbon dioxide concentrations were this high—more than 400 parts per million—was three to five million years ago.¹⁹ The temperature was approximately 5°F to 7°F warmer, and sea levels were between sixteen and 131 feet higher than today.²⁰ Human and non-human systems certainly change and adapt to changing conditions, but the pace at which temperatures increase, oceans acidify, and extreme weather intensifies, may be too quick for human societies and natural systems to adapt.²¹

Consider one life staple: water. Climate change is expected to intensify hydrological cycles throughout the world, potentially changing dramatically where, when, and how intense precipitation occurs.²² Nearly every human civilization and every ecological system has

¹⁹ *Graphic: Carbon Dioxide Hits New High*, NAT'L AERONAUTICS & SPACE ADMIN., <https://perma.cc/4EJH-E3AN> (last updated Oct. 9, 2019) [hereinafter NASA GRAPHIC]; Michon Scott & Rebecca Lindsey, *2017 State of the Climate: Atmospheric Carbon Dioxide*, CLIMATE (July 30, 2018), <https://perma.cc/4ZM6-Z2NL> (showing that the 2017 global carbon dioxide level was 405 ppm).

²⁰ NASA GRAPHIC, *supra* note 19.

²¹ IPCC SPECIAL REPORT, *supra* note 1, at 280 (Scenario 3) (One “worst-case” scenario that seems worryingly likely is that uncoordinated action to reduce emissions in the late 21st century is too little, too late to avoid an increase in global mean temperature of 3°C by 2100: “Radiative forcing increases and, due to chance, the most extreme events tend to happen in less populated regions and thus do not increase global concerns. Nonetheless, there are more frequent heatwaves in several cities and less snow in mountain resorts in the Alps, Rockies and Andes. Global warming of 1.5°C is reached by 2030 but no major changes in policies occur. Starting with an intense El Niño–La Niña phase in the 2030s, several catastrophic years occur while global warming starts to approach 2°C. . . . Droughts occur in regions bordering the Mediterranean Sea, central North America, the Amazon region and southern Australia . . . Intense flooding occurs in high latitude and tropical regions, in particular in Asia, following increases in heavy precipitation events. Major ecosystems . . . are destroyed over that period with massive disruption to local livelihoods. An unprecedented drought leads to large impacts on the Amazon rainforest, which is also affected by deforestation. . . . Poverty levels increase to a very large scale, and the risk and incidence of starvation increase considerably as food stores dwindle in most countries; human health suffers. There are high levels of public unrest and political destabilization due to the increasing climatic pressures, resulting in some countries becoming dysfunctional.”) (internal citations omitted).

²² *See id.* at 178; *see also*, 2 U.S. GLOB. CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT: IMPACTS, RISKS AND ADAPTATION IN THE UNITED STATES 37 (2018) [hereinafter USGCRP].

organized itself around access to water.²³ Short-term interruptions to water supply are handled quite routinely in developed countries, but climate change may, quite soon, introduce very large and long-term changes in precipitation patterns. Cape Town, South Africa infamously flirted with “Day Zero” in 2018, a date in which city taps for the prosperous coastal city of over 400,000 residents would be shut off; the city was within months of reaching that date. Water rationing at fifty liters per day—not enough to maintain long-term health—combined with rains has deferred Day Zero,²⁴ but projections of future precipitation are ominous.²⁵

Another case in point involves agricultural systems, which, above all, are vulnerable to both short-term shifts in weather as well as long-term shifts in climate.²⁶ Modern crop and livestock agriculture have become more intensive and productive, exploiting economies of very large scales.²⁷ But this technical efficiency is dependent upon a narrower set of conditions, so that it becomes more vulnerable to disturbances, including those caused by climate change.²⁸ The groundnut, a staple in India, produces far less fruit when exposed to temperatures above 95°F, which has become a common occurrence in India.²⁹ Wheat grain decreases significantly when exposed to 86°F for just eight hours.³⁰ Relatively sudden changes in precipitation can wreak havoc on a carefully-engineered system of production: torrential rains in the Midwestern United States have produced flooding along the Illinois, Missouri, Arkansas, and Mississippi rivers that have devastated the entire region.³¹

²³ H.S. Vuorinen et al., *History of Water and Health from Ancient Civilizations to Modern Times*, WATER SCI. & TECH.: WATER SUPPLY, Mar. 1, 2007 at 49.

²⁴ Ed Stoddard, *Cape Town ‘Day Zero’ Pushed Back to 2019 as Dams Fill Up in South Africa*, REUTERS (Apr. 3, 2018), <https://perma.cc/D5CG-KZWY>.

²⁵ David J. Nash, *Changes in Precipitation Over Southern Africa During Recent Centuries*, in OXFORD RESEARCH ENCYCLOPEDIA, CLIMATE SCIENCE 3, 18 (Oxford Univ. Press 2017).

²⁶ HENSON, *supra* note 2, at 197 (“Food, and the lack of it, could be where a changing climate exerts some of its most troublesome impacts for society. . . . Because of longer dry spells, hotter temperatures, and more climatic uncertainty, the twenty-first century is likely to see major shifts in the crops sown and grown in various regions.”).

²⁷ See, e.g., Shi-Ling Hsu, *Scale Economies, Scale Externalities: Hog Farming and the Changing American Agricultural Industry*, 94 OR. L. REV. 23, 24–25 (2015) (“While agricultural production historically took place on a vast, sprawling potpourri of independent farms, the engine of modern production is a consolidated network of efficient, cost-conscious, and interrelated operations.”).

²⁸ HENSON, *supra* note 2, at 219 (“In recent years, a variety of factors (no doubt including the influence of factory farming) has led to an enormous global reliance on a tiny number of staple crops. Out of some 50,000 edible plant species, a mere three—wheat, rice, and maize (corn)—make up more than half of the world’s current food supply.”).

²⁹ *Id.* at 225.

³⁰ *Id.* at 225–26.

³¹ Julie Bosman & Manny Fernandez, *Flooding in the Midwest: 4 Rivers Surge, Along with Residents’ Worries*, N.Y. TIMES, May 25, 2019, at A14.

Another threat to food supply lies in the way that climate change affects the oceans.³² Oceans buffer temperature increases, absorbing some of the excess energy that might otherwise increase ambient air temperatures,³³ and also carbon dioxide—about 27% of annual emissions.³⁴ The absorbed carbon dioxide forms carbonic acid, a relatively weak acid, but in its massive quantities has already lowered global pH by 0.1, a 30% increase in acidity.³⁵ Further emissions will lower the pH further, attacking coral reefs and shell-forming creatures, which are both food sources for humans and for fish species higher up on the food chain.³⁶ Ocean acidification is a threat to an entire food system that supplies 17% of the world's protein, and 70% in some countries.³⁷

A final life staple that might be affected by climate change is energy. The historically wet Pacific Northwestern United States and the Canadian province of British Columbia have relied on strong and steady annual rainfall and snowpack to fill reservoirs to supply water to run hydroelectric dams to generate electricity.³⁸ Gradual changes in precipitation would induce gradual shifts in electricity generation and water supply, but multi-year droughts cause severe disruption for places like British Columbia, which relies on hydropower for over 90% of its electricity.³⁹ It is impossible to escape the pessimistic thought that much of that lost capacity would be replaced by fossil fuel generation.

Climate change is rarely predictable or straightforward as to how it wreaks havoc. 2017 was the year that California's historic six-year drought finally broke, saturating the state with record rain and snow.⁴⁰ But the record rainfall actually *contributed* to an epic, then-unprecedented wildfire season: about 1.2% of the entire state burned,⁴¹

³² HENSON, *supra* note 2, at 141–70.

³³ LuAnn Dahlman & Rebecca Lindsey, *Climate Change: Ocean Heat Content*, CLIMATE (Mar. 5, 2011), <https://perma.cc/2TGR-85XX>.

³⁴ C. Le Quéré et al., *The Global Carbon Budget 1959–2011*, 5 EARTH SYS. SCI. DATA 165, 166, 176 (2013) (showing that the ocean sink of 2.5 PgC per year equates to about 27% of fossil fuel and cement emissions, plus land use changes).

³⁵ HENSON, *supra* note 2, at 166.

³⁶ *What is Ocean Acidification?*, NAT'L OCEAN & ATMOSPHERIC ADMIN., <https://perma.cc/35GN-5U2G> (last visited Jan. 25, 2020).

³⁷ FOOD & AGRIC. ORG. OF THE U.N., THE STATE OF WORLD FISHERIES AND AQUACULTURE 76, 105 (2014), <https://perma.cc/NXU5-73S5>.

³⁸ See Kevin Lillis, *The Columbia River Basin Provides More Than 40% of Total U.S. Hydroelectric Generation*, U.S. ENERGY INFO. ADMIN. (June 27, 2014), <https://perma.cc/Q7KT-VKRN>.

³⁹ Can. Energy Regulator, *Provincial and Territorial Energy Profiles – British Columbia*, GOV. OF CAN. (Aug. 14, 2018), <https://perma.cc/EE59-JK74> (“About 90% of electricity in B.C. is produced from hydroelectric sources.”).

⁴⁰ Bettina Boxall, *Gov. Brown Declares California Drought Emergency is Over*, L.A. TIMES (Apr. 7, 2017), <https://perma.cc/J597-G47V>.

⁴¹ Cal. Dep't of Forestry & Fire Prot., *Stats and Events: 2017 Statistics and Events*, STATE OF CAL., <https://perma.cc/N4EM-YLD5> (last visited Jan. 25, 2020) (showing 1,248,606 acres burned in 2017). The size of California is 163,694.74 square miles, or 104,764,633.6 acres. U.S. Census Bureau, *United States Summary 2010, Population and Housing Counts*, U.S. DEP'T OF COM. 41 (2012), <https://perma.cc/2ATW-TFB2>.

causing \$180 billion in damages⁴² and forty-three deaths.⁴³ How does record rainfall lead to record wildfires? Heavy rain fueled grassy growth, which dried out over the hot summer to form a new source of fuel for wildfires.⁴⁴ Fire management has always been a fraught policy exercise, and houses continue to be inadvisably built in high-risk areas,⁴⁵ demonstrating again the contribution of human folly to catastrophe. But there is no questioning the effect of climate change, as there is nothing else capable of making such an enormous swath of forested land so dry and vulnerable to fire, so quickly.⁴⁶ This new cycle of rain-fed-grass-fed-wildfire only underscores the complexity and unpredictability of climate change, and how a massive, sudden change could cascade into a myriad of unforeseen effects.⁴⁷

All is not lost, necessarily. Technologies could emerge or develop to expand the supply of resources. Economist Harold Hotelling conceived of the possibility that some exhaustible resources might *not* be exhausted if some “backstop technology” emerges that is more economical than harvesting the very last expensive bits of the resource.⁴⁸ The same might save humankind from a climate-induced shortage of resources. For example, desalination technologies, though expensive and energy-intensive, can be deployed to increase the supply of water, as they have in arid places such as Israel.⁴⁹ The tiny country of the Netherlands is the second-largest food exporter in the world;⁵⁰ its agricultural exports in 2017 were almost three-quarters that of the United States.⁵¹ The

⁴² *AccuWeather Predicts 2017 California Wildfire Season Cost to Rise to \$180 Billion*, ACCUWEATHER, <https://perma.cc/7QKA-7DHY> (last updated July 10, 2019).

⁴³ Phillip Reese, *California Wildfires in 2017: A Staggering Toll of Lost Life and Homes*, SACRAMENTO BEE (Dec. 31, 2017), <https://perma.cc/3DRS-8TSF>.

⁴⁴ Umair Irfan, *How Much Did Climate Change Affect California's Wildfires? Depends on Where You Are*, VOX (Dec. 12, 2017), <https://perma.cc/MVZ3-PR2H>; Priya Krishnakumar & Joe Fox, *Why the 2017 Fire Season Has Been One of California's Worst*, L.A. TIMES, <https://perma.cc/RE7Z-DA45> (last updated Dec. 5, 2017).

⁴⁵ Max A. Moritz et al., *Learning to Coexist with Wildfire*, 515 NATURE 58, 61 (2014), <https://perma.cc/NL64-NTTU>.

⁴⁶ Jennifer Marlon et al., *Wildfire Responses to Abrupt Climate Change in North America*, 106 PROC. NAT'L ACAD. SCI. 2519, 2519 (Feb. 24, 2009), <https://perma.cc/GRA8-PKCN>; see also A. LeRoy Westerling & Benjamin P. Bryant, *Climate Change and Wildfire in California*, 87 CLIMATIC CHANGE 231 (Mar. 2008), <https://perma.cc/24K3-4PM2>.

⁴⁷ USGCRP, *supra* note 22, at 255 (“Physical and biological conditions of ecosystems are constantly changing, and interactions among multiple ecosystem stressors could have unforeseen outcomes on ecosystem composition, structure, and function.”).

⁴⁸ Harold Hotelling, *The Economics of Exhaustible Resources*, 39 J. POL. ECON. 137, 153–54, 175 (1931).

⁴⁹ Nir Becker, *Water Pricing in Israel: Various Waters, Various Neighbors*, in WATER PRICING EXPERIENCES AND INNOVATIONS 181–99 (Ariel Dinar et al. eds., 2015).

⁵⁰ *Agriculture and Horticulture*, GOV'T OF THE NETH., <https://perma.cc/AL2P-FS7K> (last visited Jan. 25, 2020).

⁵¹ The estimated value of U.S. Agricultural exports in 2017, was \$138,160 billion. *U.S. Global Agriculture System*, U.S. DEPT OF AGRIC.: FOREIGN AGRIC. SERV., <https://perma.cc/S3Z2-Z3YN> (last visited Jan. 25, 2020) (follow “Analytics” “Data Analytics” “Standard Query” hyperlink; then search data source field for “FAS U.S. Trade”; then search product type “Exports”; then search product groups “BICO (HS-10)”;

secret to Dutch agriculture? Climate-controlled, low-energy greenhouses project artificial sunlight around the clock, powered by solar panels and producing lettuce at ten times the yield⁵² and tomatoes at fifteen times the yield outdoors than in the United States⁵³ while using less than one-thirteenth the amount of water.⁵⁴

But backstop technologies are not yet widely viable, and their environmental consequences not yet fully understood.⁵⁵ At a minimum, marshaling the technology and the financial resources to deploy backstop technologies at scale is still a long-term prospect. No backstop technology is yet a silver bullet for coping with climate-induced shortages of vital life staples.

III. ECONOMIC INEQUALITY, VITAL RESOURCES, AND HOARDING

Along with climate change, the topic of inequality has also claimed broad public attention. Almost overnight, the subject of economic inequality leapt from the earnest but scruffy “Occupy” movement⁵⁶ to the leading Economics departments of Harvard, MIT, Berkeley, and Chicago (Chicago!).⁵⁷ For good reason: inequality has historically been

the search partners field “world total”; then search products field “Agricultural Products”). With 9.1 million square kilometers in land, *The World Factbook, North America: The United States*, U.S. CENT. INTELLIGENCE AGENCY, <https://perma.cc/PJF4-MURR> (last updated Jan. 22, 2020), the United States has about 220 times the land of the Netherlands. The Netherlands exported €92 billion, the equivalent of about \$102 billion. *News: Agricultural Exports Worth Nearly €92 billion in 2017*, GOV'T OF THE NETH., <https://perma.cc/G57E-VUQ9> (last updated Jan. 31, 2018).

⁵² *Dutch Greenhouses Have Revolutionized Modern Farming*, THE CIVIL ENGINEER (Feb. 6, 2018) <https://perma.cc/FZ6C-9LK3>.

⁵³ Timo Raus, *How on Earth Have the Dutch Done it?*, DUTCH GREENHOUSES BLOG (Mar. 16, 2018), <https://perma.cc/9NXS-EEJ5> (showing Dutch tomato yield at 144,352 tons per sq. mi.). Average tomato yield in the United States was 28,600 pounds per acre in 2015, U.S. DEPT. OF AGRIC., *VEGETABLE 2016 SUMMARY 89* (2017), which translates into 9,152 tons per sq. mi.

⁵⁴ Frank Viviano, *A Tiny Country Feeds the World: Agricultural Giant Holland is Changing the Way We Farm*, NAT'L GEOGRAPHIC, Sept. 2017, at 82.

⁵⁵ Michael Pappas, *Unnatural Resource Law: Situating Desalination in Coastal Resource and Water Law Doctrines*, 86 TULANE L. REV. 81, 86–87 (2011).

⁵⁶ See, e.g., Michael Levitin, *The Triumph of Occupy Wall Street*, ATLANTIC (June 10, 2015), <https://perma.cc/MM5J-MZKT>. The Occupy movement began with the physical occupation by a small, loosely-organized group of protesters of Zuccotti Park in New York City, close to Wall Street, and the target of their protest: increasing economic inequality. Over time, other Occupy protests sprung up around the United States and even other countries, and attracted popular attention to the issue of inequality.

⁵⁷ The singularly prestigious Department of Economics at the University of Chicago has long been widely known for strength in a libertarian, non-interventionist view of economics. Among the most famous and influential of its twenty-five Nobel Laureates is Milton Friedman, one of the most prominent free market advocates in history; see, e.g., Holcomb B. Noble, *Milton Friedman, Free Markets Theorist, Dies at 94*, N.Y. TIMES (Nov. 16, 2006), <https://perma.cc/BPB5-9Z9U>. A free market perspective would imply a reluctance to engage in government intervention to reduce economic inequality. The prominence of this non-interventionist point of view can also be summed up by a much-

worryingly correlated with political turmoil.⁵⁸ Granted, there are entangled issues of corruption and poverty, which interrelate with economic inequality.⁵⁹ But it is safe to assert that economic inequality has its fingerprints over many instances of civil unrest in the history of humankind.⁶⁰ Apart from creating raw feelings of injustice and resentment,⁶¹ economic inequality always creates one inescapable economic relationship between haves and have-nots: the latter have much lower opportunity costs of violence.⁶² Those with wealth may have an *absolute advantage* in violence, by virtue of their ability to buy defense; but those without wealth have so much less to lose from a violent confrontation, and therefore enjoy a *comparative advantage* in violence.⁶³ This relationship holds the troubling potential of creating its own positive feedback, as those with wealth increase their absolute advantage by armoring themselves against violence, widening the chasm between haves and have-nots, widening the comparative advantage in violence, giving rise to more armoring, and so on.

During this most recent, four-decade run-up in inequality,⁶⁴ economic progress has been just strong enough and just broad enough to keep a lid on civil unrest, save for a few corners of the world.⁶⁵ But this lid could fly off once climate change compounds economic inequality by causing shortages of natural resources and life staples. Economic inequality and climate-induced resource shortages are symbiotically harmful because they reinforce each other. Shortages of vital resources magnify economic inequality because as prices of just about everything

quoted passage written by another one of Chicago's Nobel Laureates, Robert Lucas, who wrote: "Of the tendencies that are harmful to sound economics, the most seductive, and in my opinion the most poisonous, is to focus on questions of distribution." Robert E. Lucas, *The Industrial Revolution: Past and Future: 2003 Annual Report Essay*, FED. RES. BANK MINNEAPOLIS (May 1, 2004), <https://perma.cc/RB6Z-MT6B>.

⁵⁸ Alberto Alesina & Roberto Perotti, *The Political Economy of Growth: A Critical Survey of the Recent Literature*, 8 WORLD BANK ECON. REV. 351, 355–359 (1994).

⁵⁹ DARON ACEMOGLU & JAMES A. ROBINSON, WHY NATIONS FAIL: THE ORIGINS OF POWER, PROSPERITY AND POVERTY 364–65 (2012).

⁶⁰ *Id.* at 364–67; see also Robert Barro & Jong-Wha Lee, *Sources of Economic Growth*, 40 CARNEGIE-ROCHESTER CONF. SERIES ON PUBL. POL'Y 1, 2, 25, 43 (1994) (showing that political instability has a negative effect on economic growth); Alex Cukierman, Sebastian Edwards & Guido Tabellini, *Seigniorage and Political Instability*, 82 AM. ECON. REV. 537, 545 (1992).

⁶¹ Judith R. Blau & Peter M. Blau, *The Cost of Inequality: Metropolitan Structure and Violent Crime*, 47 AM. SOC. REV. 114, 119 (1982); Lisa Stolzenberg et al., *Race, Economic Inequality, and Violent Crime*, 34 J. CRIM. JUST. 303, 303 (2006).

⁶² D. Bruce Johnsen, *The Formation and Protection of Property Rights Among the Southern Kwakiutl Indians*, 15 J. LEG. STUD. 41, 42 (1986) (discussing how the aboriginal practice of sharing was connected to the protection of property by equalizing wealth).

⁶³ Shi-Ling Hsu, *Inefficient Inequality*, 5 IND. J.L. & SOC. EQUALITY 1, 19–20 (2016) (describing comparative advantage in violence stems from lower opportunity costs of violent injury).

⁶⁴ Emmanuel Saez & Gabriel Zucman, *Wealth Inequality in the United States Since 1913: Evidence from Capitalized Income Data*, 131 Q.J. ECON. 519, 520 (2016).

⁶⁵ See, e.g., Alexander De Juan & Eva Wegner, *Social Inequality, State-centered Grievances, and Protest: Evidence from South Africa*, 63 J. CONFLICT RESOL. 31, 32 (2017).

increases, budgets of the least wealthy are squeezed the most.⁶⁶ And when it comes to vital resources, economic inequality deepens a resource deficit because in times of uncertainty, those who can, will *hoard* resources and life staples.⁶⁷

It might seem fanciful that people could actually hoard food, water, and energy, as the storage costs would be enormous. Food has a limited shelf-life, water is impossibly difficult to store, and while technologies for energy storage are developing rapidly,⁶⁸ it still seems fanciful to store enough energy to outlast some climate-induced shortage. But those with sufficient wealth can hoard the *means* of supplying food, water, or energy. Land for growing with attendant water rights can be purchased.⁶⁹ Power generation capacity can be purchased. The nature of economic inequality is such that hoarding is not necessarily a chaotic free-for-all among scrambling, panicked masses of people, but a quiet consolidation of the most important assets.

Economists generally regard hoarding as the product of ill-advised government policies that interfere with market clearing, causing prices to remain low, and therefore shortages to occur.⁷⁰ This would include government-imposed rationing, which contributed to consumer hoarding of gasoline during the 1970s oil embargo, and even as recently as 2012, in the New York City area after Hurricane Sandy.⁷¹ Martin Weitzman's seminal model on hoarding was implicitly predicated on price rigidity, using the slightly comical example of soap in the former Soviet Union.⁷² But inequality and climate change introduce three new elements that have not yet been explicitly modeled: 1) the shortage of indispensable, life-sustaining resources, 2) the potential for long-term shortage due to the uncertainty of climate change, and 3) the concentration of wealth that enable massive purchases. Together, these three factors necessitate a more nuanced consideration of hoarding and government policy.

Consider Figure 1 below, a model of the supply and demand of water, for illustrative purposes. In a simplistic sense, the supply of

⁶⁶ Sarah E. West & Robertson C. Williams III, *Estimates from a Consumer Demand System: Implications for the Incidence of Environmental Taxes*, 47 J. ENVTL. ECON. & MGMT. 535, 536 (2004) (showing that higher gas prices would impact the poorest households the most).

⁶⁷ Hoarding has been defined as a situation in which “the consumer’s current inventory . . . exceeds his inventory in previous periods while his expected consumption rate . . . remains constant.” Ronald Stiff et al., *Scarcity and Hoarding: Economic and Social Explanations and Marketing Implications*, 2 ADV. CONS. RES. 203, 204 (1975).

⁶⁸ Haisheng Chen et al., *Progress in Electrical Energy Storage System: A Critical Review*, 19 PROGRESS NAT. SCI. 291, 291–92 (2009).

⁶⁹ See, e.g., *infra* notes 106–109 and accompanying text.

⁷⁰ Weitzman, *supra* note 6, at 401; see also Christopher Hansman et al., *A Sticky-Price View of Hoarding*, KILTS CTR FOR MARKETING AT CHICAGO BOOTH – NIELSEN DATASET PAPER SERIES 1–050, 1 (2019), <https://perma.cc/3YX3-ANE3>.

⁷¹ Friedman, *supra* note 11, at 70; Elizabeth A. Harris, *A Slow Return to Normal Skips the Gas Station*, N.Y. TIMES, Nov. 4, 2012, at A1.

⁷² Weitzman, *supra* note 6, at 401.

water is physically limited,⁷³ so it is perfectly inelastic and represented by the vertical supply curves S_0 , S_1 , and S_2 . These perfectly inelastic supply curves also include backstop technologies,⁷⁴ which only become cost-effective at a certain price. The presence of backstop technologies is assumed, above a certain price point, to produce a typical linear upward-sloping supply curve, reflecting a heterogeneous set of opportunities to deploy them.

Demand for water is, at least in developed nations, elastic and clearing at low prices,⁷⁵ P_0 in Figure 1.⁷⁶ However, that is due to abundance in developed countries, along with the very low usefulness of water once basic needs are met. In times of scarcity, life necessities become highly inelastic, driving up prices.⁷⁷ Hence, the curved shape of the demand curve, reflecting high elasticities at high quantities, and low elasticities at low quantities. Were climate change to effectively contract the available supply of food or water, inelastic supply would shift left from S_0 , to either S_1 or S_2 .

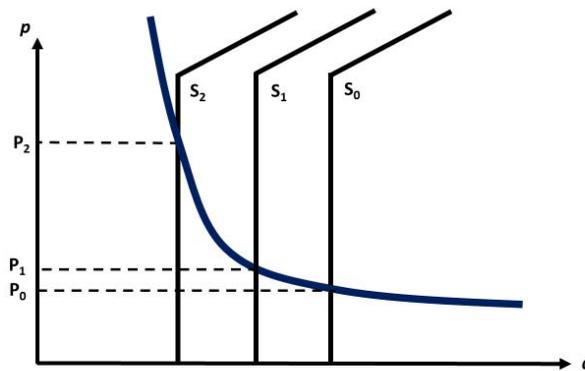


Figure 1

⁷³ “Backstop technologies” exist to increase the supply of water, such as desalination. Desalination converts salty seawater into drinkable freshwater, but at fairly high costs and with some negative environmental impacts. For a review, see Michael Pappas, *Unnatural Resource Law: Situating Desalination in Coastal Resource and Water Law Doctrines*, 86 TULANE L. REV. 81, 86–87 (2011).

⁷⁴ See *id.* at 90 (explaining that desalination can only produce a limited water supply).

⁷⁵ See Sheila M. Olmstead et al., *Water Demand Under Alternative Price Structures*, 54 ENVTL. ECON. MGMT. 181, 183–84 (2007).

⁷⁶ Abstract also, for purposes of exposition, from the reality that water prices are highly distorted by a bewildering array of overlapping and conflicting laws, and are very rarely represented by neat economic models. See, e.g., Richard E. Howitt, *Spot Prices, Option Prices, and Water Markets: An Analysis of Emerging Markets in California*, in *MARKETS FOR WATER: POTENTIAL FOR PERFORMANCE* 119–40 (K. William Easter et al., eds., 1998).

⁷⁷ See, e.g., N. GREGORY MANKIW, *ESSENTIALS OF ECONOMICS* 90 (6th ed. 2008).

Were the climate-induced shortage relatively mild, a shift to S_1 would cause a rise in prices to P_1 that might not represent a crippling increase in prices. But climate change is so unsettling precisely because of the numerous uncertainties, and there is a chance that the contraction could be more severe, causing a shift to S_2 instead of S_1 , and causing prices to increase more dramatically. Under those circumstances, hoarding becomes not only plausible but quite predictable, as the dramatic increase in prices, coupled with uncertainty about the duration of the crisis, generates the fear that gives rise to hoarding.

Even in the absence of uncertainty, hoarding may occur if wealthier consumers wish to smooth their consumption of vital resources over time. If future shortages are anticipated, those with the means may opt to buy up current supplies for future consumption. Hoarding is privately inconvenient for a number of reasons: high storage costs, spoilage and loss, and the need to reduce consumption of other goods. But wealth in an unequal society means that diminutions in wealth due to climate change can be managed with a rebalancing of assets. That would likely not be an option for the vast majority. Again, this kind of hoarding is not necessarily the panic hoarding that precedes hurricanes bearing down on Florida. But it is still dangerous enough if a small enough segment of a population acquires a large enough fraction of important resources, or the means to obtain them. The bottom line is that fewer resources are left over for those that cannot pay the higher prices of vital resources in a climate-changed world.

It is certainly possible that instead of imposing a sudden shock, climate change has the less dramatic effect of just whittling away at resource supply, causing prices to gradually increase, and inducing markets, institutions, and people to gradually adjust. That would be the benign version of the story. However, provision of food, water, and energy are governed by certain legal rules and institutions that impose price rigidities that might inhibit price adjustments. Electricity prices are usually the domain of state and federal agencies regulating retail rates;⁷⁸ water rights are still subject to a complicated and archaic morass of overlapping and often conflicting rules.⁷⁹ Moreover, the behavior of capital markets lately do not provide confidence that markets are able to sniff out shortages and inefficiencies.⁸⁰ This is most spectacularly pronounced with respect to markets for waterfront

⁷⁸ See, e.g., LINCOLN L. DAVIES & JOSEPH P. TOMAIN, *ENERGY LAW IN THE UNITED STATES* 59 (2015).

⁷⁹ See, e.g., Robert W. Adler, *Climate Change and the Hegemony of State Water Law*, 29 *STAN. ENVTL. L.J.* 1, 4–6 (2010).

⁸⁰ See, e.g., Michael Pappas, *Anti-Waste*, 56 *ARIZ. L. REV.* 741, 785 (2014) (“Market-facilitating measures may also become outdated when they fail to adjust themselves to address economic inefficiencies, such as unpriced externalities, in resource uses. In such instances, market-facilitating approaches may still accurately reflect perceived resource underuse and prevailing economic-efficiency values, but the particular measures may need adjustment to address market failures.”).

housing vulnerable to sea level rise.⁸¹ Miami Beach, which floods so frequently that people commonly wear plastic bags over their shoes, plans to spend half a billion dollars to install pumps and raise roads, which incidentally have the unfortunate effect of flooding properties.⁸² Throwing good money in after bad? Hard to say, as Miami Beach is where beachfront condominiums still sell for as much as sixty-million dollars.⁸³ There was also the 2008 global financial crisis, which seemed to catch everybody but a few people by surprise.⁸⁴ In 2018, U.S. stock markets tumbled dramatically on December 20th (“There’s just constant selling pressure It’s just any excuse is an excuse to sell”),⁸⁵ only for the Dow Jones Industrial Average to see its biggest gain ever on the next trading day.⁸⁶

With respect to crucial life-sustaining assets, markets fail too often to not have a backup plan. Hoarding has happened in the past⁸⁷ and can happen again. It is strongest for inelastic goods,⁸⁸ and in a situation of shortage, there is nothing less elastic than life-sustaining goods such as food, water and energy.⁸⁹ The drive to hoard would be more pronounced in the presence of uncertainty as to the duration of the shortage, and above all, climate change introduces uncertainty into resource supply chains.⁹⁰ Finally, a yawning wealth gap introduces a market imperfection that is rarely treated explicitly in economic analysis.⁹¹

⁸¹ See, e.g., FRANZ FUERST & GEORGIA WARREN-MYERS, SEA LEVEL RISE AND HOUSE PRICE CAPITALISATION 1 (2019) (“The results highlight that purchasers do not appear to price sea level rise risk and are under-prepared for the future challenges and implications sea level rise and the ancillary effects of future flooding, inundation and storm surge.”).

⁸² Roben Farzad, *Foreign Investors Shrug Off Miami’s Rising Sea Levels*, NPR (May 21, 2018), <https://perma.cc/D7PA-BQ6S>.

⁸³ Dennis Green, *This \$60 Million Penthouse has Shattered Miami Real-Estate Records*, BUS. INSIDER (Sept. 25, 2015), <https://perma.cc/AC8T-SXW8>.

⁸⁴ Alan Greenspan, *Never Saw It Coming: Why the Financial Crisis Took Economists by Surprise*, FOREIGN AFF., Nov./Dec. 2013, at 88, 89 (“What went wrong? Why was virtually every economist and policy-maker of note so blind to the coming calamity?”).

⁸⁵ Matt Phillips, *Wall St. Tumbles, Bothered by the Fed and Government Shutdown Fears*, N.Y. TIMES (Dec. 20, 2018), <https://perma.cc/KAF3-WT5Y>.

⁸⁶ Emily Flitter, *Stocks Bounce Back from Edge of Bear Market*, N.Y. TIMES (Dec. 26, 2018), <https://perma.cc/8WEH-GVRQ>.

⁸⁷ Weitzman, *supra* note 6, at 401.

⁸⁸ See, e.g., *id.* Inelastic goods are those for which even a large increase in price would fail to reduce demand; see also MANKIW, *supra* note 18, at 92–94.

⁸⁹ Mark W. Rosegrant et al., *Water for Agriculture: Maintaining Food Security Under Growing Scarcity*, 34 ANN. REV. ENV’T & RES. 205, 214 (2009); Louise O. Fresco, *Challenges for Food System Adaptation Today and Tomorrow*, 12 ENVTL. SCI. & POL’Y 378, 382 (2009). Even oil is considered inelastic in the short run; see, e.g., Christian Lutz et al., *Economic Effects of Peak Oil*, 48 ENERGY POL’Y 829, 830 (2012).

⁹⁰ John Mello et al., *Warning Signs for Forecasting Consumer-induced Shortages*, 51 FORESIGHT: THE INT’L J. APPLIED FORECASTING 17, 17 (2018).

⁹¹ Angus Deaton, *Health, Inequality, and Economic Development*, 41 J. ECON. LIT. 113, 113 (2003) (“If . . . income distribution affects population health even indirectly, economic and fiscal policy has effects on well-being that are typically ignored by economists or policy makers. And if economists are skeptical of such mechanisms, many policy makers are not . . .”).

Economists generally believe that arbitrage reduces shortages efficiently by directing resources towards higher prices and, by alleviating demand, reducing prices.⁹² But if vital, life-sustaining resources were to become worryingly scarce in a climate-changed future⁹³ riven by inequality, the opportunities for arbitrage would be limited. In a shortage situation, life staples like food, water, and energy are inelastic, so those with the means would just pay the higher prices, an option unavailable to those without.

Hoarding is tragically inefficient in three ways. First, hoarding is an extremely inefficient means of assuring access to resources, as private stockpiling is costly,⁹⁴ particularly in situations of shortage in which prices are already climbing. Moreover, depending on the resources, hoarding could raise storage and spoilage problems.⁹⁵ Food spoils, water evaporates, and energy is dissipated. Second, hoarding directs resources to low-valued uses: a concentration of resources in a small number of individuals is a far less valuable use than the large number of people who may need it to survive. Much more so than money,⁹⁶ the marginal utility of consuming life-sustaining resources declines sharply after basic needs are satisfied.⁹⁷ The irony of hoarding is that it reduces supply in a shortage, inefficiently storing it when it is most needed for use.⁹⁸ Finally, hoarding begets hoarding, so that once it

⁹² Richard Sexton et al., *Market Integration, Efficiency of Arbitrage, and Imperfect Competition: Methodology and Application to U.S. Celery*, 73 AM. J. AGRIC. ECON. 568, 571 (1991).

⁹³ This is not to say that climate change does not have current impacts, or that climate change is only a problem for the future. 2018 was the fourth hottest year ever and 18 out of the 19 warmest years on record have occurred since 2001. See John Schwartz & Nadja Popovich, *2018 Continues Warming Trend, As 4th Hottest Year Since 1880*, N.Y. TIMES, Feb. 7, 2019, at A1; see also Henry Fountain et al., *2017 Was One of the Hottest Years on Record. And That Was Without El Niño*, N.Y. TIMES (Jan. 18, 2018), <https://perma.cc/3DA6-HR2N> (stating that 17 out of 18 of the warmest years on record occurred since 2001, but that was before 2018 entered into fourth place).

⁹⁴ Brian D. Wright & Jeffrey C. Williams, *Anti-hoarding Laws: A Stock Condemnation Reconsidered*, 66 AM. J. AGRIC. ECON. 447, 448 (1984).

⁹⁵ See, e.g., Frank Asche et al., *Hoarding the Herd: The Convenience of Productive Stocks*, 35 J. FUTURES MKTS. 679, 683 (2015) (modeling conventional hoarding with spoilage case); see also Keith Sharfman, *The Law and Economics of Hoarding*, 19 LOY. CONSUMER L. REV. 179, 192–93 (2006).

⁹⁶ Joshua Greene & Jonathan Baron, *Intuitions About Declining Marginal Utility*, 14 J. BEHAV. DECISION MAKING 243, 243–44 (2001).

⁹⁷ Donald E. Agthe & R. Bruce Billings, *Equity, Price Elasticity, and Household Income Under Increasing Block Rates for Water*, 46 AM. J. ECON. & SOC. 273, 276 (1987) (water); EMIL KAUDER, A HISTORY OF MARGINAL UTILITY THEORY 68 (1965) (ebook) (food); Steve Sorrell, *Reducing Energy Demand: A Review of Issues, Challenges and Approaches*, 47 RENEWABLE & SUST. ENERGY REVS. 74, 78 (2015) (energy).

⁹⁸ The gasoline crisis of the 1970s was as much the product of ill-advised price controls and panic hoarding by consumers, as it was the Middle Eastern oil embargo. See Tyler Priest, *The Dilemmas of Oil Empire*, 99 J. AM. HIST. 236, 242 (2012) (“Motorists, whose consumption of gasoline rose from 243 gallons per capita in 1950 to 463 gallons per capita in 1979, compounded supply problems by hoarding fuel, idling their engines in gas lines, and frantically topping off their tanks with frequent trips to the local filling station.”).

starts, it becomes very difficult to stop. Even if some selfless individuals refrain at first, their fear will build as they see others hoarding, in turn creating enormous pressure to join in the hoarding.⁹⁹

Hoarding is not the stuff of apocalyptic science fiction. In 2007, global prices of vital food commodities rose sharply, spurred by the confluence of a number of factors, some food-related and some not.¹⁰⁰ The problems were compounded by the imposition of export restrictions,¹⁰¹ an understandable but disastrous reaction to shortage, leading to further shortages, inefficient panic-buying,¹⁰² and futures speculation.¹⁰³ Speculation in grain futures had the doubly harmful effect of raising prices on needy populations *and* creating an asset bubble that eventually burst.¹⁰⁴ Unsurprisingly, one prescription for avoiding another global food crisis is the establishment of grain reserves to guard against hoarding,¹⁰⁵ akin to what a Resources Trust might do.

To be sure, hoarding in a climate-changed future could occur even without a large wealth-inequality gap. Hoarding merely reflects a runaway expectation that a shortage will persist, and the increased rents from preparing for it. So even if buying power were not concentrated in a relatively small number of families, one might see an increase in attempts to secure things expected to be valuable in the future. But wealth inequality is poisonous to the cooperative efforts that might stave off hoarding, such as sharing. Wealth inequality makes it both less costly to hoard, and more risky to refrain from hoarding. While preexisting wealth inequality is not a necessary ingredient to hoarding, it is a powerful catalyst.

It is thus not serendipity that a Resources Trust would restore a measure of economic equality when it is needed most. Dystopia is just inequality run rampant in a climate-changed future. As resource bases shrink and prices spiral out of control, those on the lower rungs of the

⁹⁹ Economists are more willing to consider the possibility of hoarding money. Old-fashioned “bank runs,” during which bank depositors line up to withdraw their money from a bank that has lost their depositors’ confidence, is an example. A more modern version, adapted to a world of global finance, is “liquidity hoarding,” in which finance institutions refrain from lending in order to keep more liquid assets. *See, e.g.,* Jean Tirole, *Liquidity Shortages: Theoretical Underpinnings*, FIN. STABILITY REV., Feb. 2008, at 53, 55, <https://perma.cc/8HWA-WSJ4>.

¹⁰⁰ For a review, see DEREK HEADEY & SHENGGEN FAN, INT’L FOOD POL’Y RES. INST., REFLECTIONS ON THE GLOBAL FOOD CRISIS 4–54 (2010), <https://perma.cc/855R-WPWJ>. They included rising oil prices that stimulated rising demand for biofuels, which crowded out crop production for food. *Id.* at xiii.

¹⁰¹ *Id.*

¹⁰² *Id.* at 37.

¹⁰³ MIGUEL ROBLES ET AL., INT’L FOOD POL’Y RES. INST., WHEN SPECULATION MATTERS 2 (2009), <https://perma.cc/URP6-4ER7>.

¹⁰⁴ *Id.* (“[Speculation] impeded the free flow of food to where it is most needed and the free flow of price signals to farmers, these market failures imposed enormous efficiency losses on the global food system, hitting the poorest countries hardest.”).

¹⁰⁵ SOPHIA MURPHY, INST. FOR AGRIC. & TRADE POLICY, GRAIN RESERVES: A SMART CLIMATE ADAPTATION POLICY 18 (2009), <https://perma.cc/DT5M-99ZG>. *But see* HEADEY & FAN, *supra* note 100, at 3.

economic ladder fall off entirely, the culmination of a series of events that continuously shrink the buying power of those less well off.

IV. RESOURCES TRUST NOW

Time is of the essence. The threat of hoarding is reason alone to act quickly, but it is worth appreciating several other reasons to start creating Resources Trusts now. First, once resources become scarce, they become expensive or otherwise difficult to acquire. Already some investment vehicles seem to be hedging against certain scarcities. Harvard University's endowment fund is buying up vineyards in California with good groundwater supply as a hedge against rising water prices.¹⁰⁶ An investment trust belonging to Microsoft founder Bill Gates is accumulating agricultural land in Southern Georgia and Northern Florida, also at significant premiums, and also with water rights.¹⁰⁷ Silicon Valley billionaires have taken to buying land in previously remote places like Idaho¹⁰⁸ and New Zealand¹⁰⁹ in case dystopia arrives sooner than expected. A significant number of people and entities seem to have concluded that acquisition of vast tracts of land is neither exotic nor impractical. These acquisitions also carry the whiff of hoarding, which need not take place in a frenzied panic, but as a gradual construction of a lifeboat or bunker for a world without government.

Second, it is important to bear in mind that acquiring the capacity to act as a supplier of last resort would inevitably affect markets for water, food, and energy. A Resources Trust, if poorly chartered or implemented, might artificially create shortages and lead to the hoarding that it is supposed to prevent.¹¹⁰ It could also destroy private capacity to supply water, food, and energy, as a government-sponsored rival. Again, a Resources Trust need not *stockpile* resources and assets, which would drive up prices by taking them out of service. But the entry of a large player in resource markets, one that would manage them in ways representing a departure from current practices, would inevitably affect prices and markets. Acquiring this capacity over a longer period of time would minimize interference with markets.

Third, acquiring the rights and assets to provide a lifeline at large scales requires time. Assembling large tracts of land, water, energy, and securing the staffing needed to manage it, all while keeping an eye on

¹⁰⁶ Gold, *supra* note 9.

¹⁰⁷ Salem Solomon, *Gates' Cascade Snapping Up Land in Northern Florida*, TAMPA BAY BUS. J. (Oct. 23, 2014), <https://perma.cc/5ZAU-RRLH>; Paul Rusnak, *Bill Gates Uploading Lots of Florida Farmland*, GROWING PRODUCE (Oct. 22, 2014), <https://perma.cc/QF2R-VXYS>.

¹⁰⁸ Evan Osnos, *Survival of the Richest*, THE NEW YORKER, Jan. 30, 2017, at 43.

¹⁰⁹ Olivia Carville, *The Super Rich of Silicon Valley Have a Domsday Escape Plan*, BLOOMBERG (Sept. 5, 2018), <https://perma.cc/MF48-4YYP>.

¹¹⁰ See *supra* notes 70–71 and accompanying text.

climate developments that may impact resource availability, represents a huge logistical, political, and economic challenge. The sheer volume of work and time required to negotiate and consummate transactions alone demands a long time frame.

And finally, but perhaps most importantly, a Resources Trust must establish a formal equality of resources before it is sabotaged by economic inequality. Economic inequality short-circuits one of humankind's most important sources of resilience—the capacity to organize and cooperate. Among relative equals, human groups have demonstrated a remarkable ability to cooperate and institute efficient mechanisms for sharing vital resources, even over long periods of scarcity.¹¹¹ But such organic cooperation requires, if not homogeneity, a certain capacity to recognize and coalesce around a group interest.¹¹² Sharp economic divisions are an anathema to such group coherence.¹¹³ Unless formal rights are established *before* resource shortages are imminent, economic inequality will translate itself into resource hoarding, and the opportunity to publicly charter a Resources Trust will have passed.

V. SUPPLYING RESOURCES

The charge of a Resources Trust would be able to supply, in times of scarcity, basic life staples to people under the jurisdiction of the chartering government. In this Article, life staples are defined as water, food, and energy. These are life staples with low price elasticities at low levels,¹¹⁴ reflecting their vital importance to a meaningful human life. As such, if some climatic change disrupts supply in any meaningful way, prices could rise sharply which, in a world with concentrated wealth.

The Resources Trust need not—indeed should not—be the *sole* supplier as the supplier of last resort. But the goal of a Resources Trust

¹¹¹ One of the most celebrated accounts of cooperation is Elinor Ostrom's *Governing the Commons*, which analyzed a dozen case studies in which groups were able to institute extra-legal cooperative arrangements, sometimes covering thousands of people, and sometimes for very long periods of time. ELINOR OSTROM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* (1990); *see, e.g., id.* at 18–21 (village cooperation in sustainably managing a local fishery); *id.* at 82–88 (irrigation district managed for thousands of farmers in Philippines); *id.* at 58–65 (Swiss mountain forestry cooperative lasting over one hundred years).

¹¹² *See, e.g., id.* at 86.

¹¹³ *See, e.g.,* Steven Hackett et al., *The Role of Communication in Resolving Commons Dilemmas: Experimental Evidence with Heterogeneous Appropriators*, 27 J. ENVTL. ECON. & MGMT. 99, 120 (1994); OSTROM, *supra* note 111, at 88–89; Lore M. Ruttan, *Economic Heterogeneity and the Commons: Effects on Collective Action and Collective Goods Provisioning*, 36 WORLD DEV. 969, 980 (2008) (stating narrow conditions for cooperation under economic heterogeneity).

¹¹⁴ The demand elasticity of price is the percent change in consumption divided by the percent change in price. Low elasticities exist for goods that would be consumed in the roughly the same quantities even if the price rises or falls a large amount. MANKIW, *supra* note 18, at 90–92.

should be to ensure that every individual beneficiary in a jurisdiction would have a claim to vital life staples at a reasonable price. There would not and should not be any prohibition on whether individuals would turn around and re-sell their allotment to others. Even though the Resources Trust might actually make the physical distribution of life staples to individuals, the purpose would still be to supplement markets, not replace them. The net effect of this provision would be to increase supply, and hopefully calm markets, keeping prices low enough to ensure broad access.

Although it is neither necessary nor desirable to stockpile those goods, it is necessary to secure either formal claims to those goods or to develop the *capacity* to produce those goods in sufficient quantity. The latter can be accomplished with existing legal tools, such as the purchase of options and other familiar legal transactions. The former, by contrast, would represent the entry of government into private spheres of production.

One might argue that by depressing prices in shortage situations, a Resources Trust is, in fact, interfering with markets. It might even depress incentives to conserve resources and enable the continuation of some wasteful practices. But this is only true insofar as markets accurately reflect opportunity costs, and markets for food, water, and energy perform very poorly in that regard. To take water as an example, even in drought-plagued California, farmers still receive water under centuries-old contracts at the rate of \$25 per acre-foot.¹¹⁵ Water trading, while theoretically possible, remains bothersome enough to have failed to move water from low-valued uses such as alfalfa growing to higher-valued urban domestic uses.¹¹⁶ Indeed, part of the charge of a Resources Trust would be buy up these under-utilized rights and resources in an attempt to prepare for leaner times.

For those that might blanch at the prospect of funding a Resources Trust, it is also worth remembering how much money is already spent distorting these markets. With respect to food, American farmers (and even more so in other developed countries) have long enjoyed price stabilization programs in the form of direct subsidies and trade protections,¹¹⁷ that have been distinctly nonmarket in their operations.¹¹⁸ Farming, at least for the traditional yeoman farmer, is a

¹¹⁵ CAL. PUB. UTILS. COMM'N, WHAT WILL BE THE COST OF FUTURE SOURCES OF WATER FOR CALIFORNIA? 4 (2016), <https://perma.cc/6NGV-PAMG>.

¹¹⁶ PETER W. CULP ET AL., SHOPPING FOR WATER: HOW THE MARKET CAN MITIGATE WATER SHORTAGES IN THE AMERICAN WEST 11 (2014), <https://perma.cc/JL42-5VKE>.

¹¹⁷ For a history and meta-analysis of agricultural price programs in the United States and elsewhere, see for example Peter H. Lindert, *Historical Patterns of Agricultural Policy*, in AGRICULTURE AND THE STATE: GROWTH, EMPLOYMENT, AND POVERTY IN DEVELOPING COUNTRIES 29–83 (C. Peter Timmer ed., 1991).

¹¹⁸ See, e.g., C. Peter Timmer, *Food Price Policy: The Rationale for Government Intervention*, 14 FOOD POL'Y 17, 17 (1989) ("The structuralist school argues . . . prices should be set to favour income distribution objectives in conjunction with macroeconomic stability.").

risky and uncertain business,¹¹⁹ so ensuring an adequate supply of food seemed to require some government intervention.¹²⁰ Deadweight losses¹²¹ and rent-seeking¹²² are tolerated, as are unintended consequences, like promotion of obesity.¹²³ But if Congress can, as it did in 2018, spend \$867 billion over the next ten years to stabilize prices for farmers,¹²⁴ it does not seem at all perverse to spend a fraction of that to stabilize prices for consumers.¹²⁵

A Resources Trust might also participate in the development of backstop technologies, in the interests of being able to augment supply of vital life staples. Indeed, acquiring backstop technologies may be the ideal role for a Resources Trust. Backstop technologies are more expensive than current means of supplying vital resources, so governments can operate backstop facilities such as desalination plants or high-tech greenhouses without substantially interfering with markets. At the same time, should climate change impose a shock to the supply of vital life staples, the operation of a backstop technology may augment supply and head off or alleviate shortages.

A. Water

Adapting to water shortages seems so daunting because many current water needs already exceed supply,¹²⁶ even without climatic

¹¹⁹ See Joseph E. Stiglitz, *Some Theoretical Aspects of Agricultural Policies*, 2 WORLD BANK RES. OBSERVER 43, 43–44 (1987).

¹²⁰ See, e.g., D.M.G. Newbery & J.E. Stiglitz, *The Theory of Commodity Price Stabilisation Rules: Welfare Impacts and Supply Responses*, 89 ECON. J. 799, 799–800 (1979) (proposing an alternative model of price stabilization analysis and examining the contemporaneous model's shortcomings with regard to consumer welfare and agricultural production).

¹²¹ See, e.g., Richard E. Just, *Making Economic Welfare Analysis Useful in the Policy Process: Implications of the Public Choice Literature*, 70 AM. J. AGRIC. ECON. 448, 449 (1988).

¹²² MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* 152–55 (Harvard Univ. Press 2d prtg. 1971).

¹²³ See Julian M. Alston et al., *Farm Subsidies and Obesity in the United States: National Evidence and International Comparisons*, 33 FOOD POL'Y 470, 470 (2008).

¹²⁴ Jeff Stein, *Congress Just Passed an \$867 Billion Farm Bill. Here's What's in it.*, WASH. POST (Dec. 12, 2018), <https://perma.cc/8WDU-JPP4> (“The passage of the 2019 Farm Bill is good news because it provides a strong safety net for farmers and ranchers, who need the dependability and certainty that this legislation affords,” Agriculture Secretary Sonny Perdue said in a statement . . .”).

¹²⁵ The matter of food price stabilization has always been a more pressing matter in developing countries. Unlike rich consumers, consumers in developing countries cannot buffer against high food prices by cutting back on discretionary expenses. C. Peter Timmer, *The Macro Dimensions of Food Security: Economic Growth, Equitable Distribution, and Food Price Stability*, 25 FOOD POL'Y 283, 284 (2000) (“That rich countries have little to fear from hunger is a simple consequence of Engel's law; consumers have a substantial buffer of non-food expenditures to rely on, even if food prices rise sharply. In a market economy, the rich do not starve.”).

¹²⁶ MARC REISNER, *CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER* 516 (rev. ed., 1993).

changes. But a closer look reveals colossal waste,¹²⁷ which could (and must) be eliminated in a future with climate-induced scarcity. Adaptation to climate change can (and must) include a stripping out of wasteful practices that have persisted through other, less compelling, and less permanent crises.

This is not only possible, but easily visualized, as a number of societies thrive economically while using much less water. On a per capita basis, California is one of the lower consuming states,¹²⁸ but its water usage per capita has been, at comparable times, five-and-a-half times that of the arid-but-prosperous country of Israel.¹²⁹ Even if water usage was measured by contribution to GDP (a favorable metric for an economic juggernaut like California), California fares poorly; Israelis produce the same amount of economic activity with about 28% of the water.¹³⁰ Part of California's water profligacy stems from its agricultural sector, which accounts for less than 2% of the State's GDP¹³¹ while using nearly 80% of its water.¹³² As noted above, some California farmers are still guaranteed water at the absurd price of \$25 per acre-foot,¹³³ leading to water-intensive and climate-inappropriate products, such as

¹²⁷ *Id.* at 514–15.

¹²⁸ See, e.g., Devashree Saha & Michael Carabello, *Which States Use the Most Water? Differences in Water Use Among States*, COUNS. STATE GOV'TS (Dec. 7, 2017), <https://perma.cc/69LU-5AHM> (showing California with low Total Withdrawals Per Capita on a graph comparing states' water consumption).

¹²⁹ Total water usage in Israel for 2013 was estimated to be 2187.1 million cubic meters. ISR. WATER AUTH., WATER SECTOR IN ISRAEL IWRM MODEL 10 (2015), <https://perma.cc/2RVE-JMVP>. The population of Israel in 2013 was 8.059 million. *Israel*, THE WORLD BANK, <https://perma.cc/VUV3-MGYV> (last visited Jan. 25, 2020). Total water usage in California in 2010 was estimated to be 37.9 billion gallons/per day, or 52.45 billion cubic meters per year. *Estimated 2010 California Water Use*, U.S. GEOLOGICAL SURVEY (2010), <https://perma.cc/TZQ4-C76H>. The population of California in 2010 was 37,253,956. *Quick Facts, California*, U.S. CENSUS BUREAU, <https://perma.cc/ACV4-QMJ8> (last visited Jan. 25, 2020). California would appear more frugal with its water if measured in 2013, but by then drought conditions had caused severe cutbacks in water consumption. Consumption was estimated at 24,550 million gallons/day, or 33.9 billion cubic meters per year. *U.S. Water Use from 1950–2015*, U.S. GEOLOGICAL SURVEY, <https://perma.cc/3KLB-7VKJ> (last visited Jan. 25, 2020).

¹³⁰ In 2013, Israel's GDP was \$292.489 billion. *GDP (current US\$)—Israel*, THE WORLD BANK, <https://perma.cc/G6QF-A4QB> (last visited Jan. 25, 2020). The GDP of California in 2010 was \$2.058 trillion. *Real Gross Domestic Product of California*, FED. RESERVE BANK OF ST. LOUIS, <https://perma.cc/D6WF-XYGG> (last visited Jan. 25, 2020).

¹³¹ California's 2017 Gross Domestic Product was \$2.810 trillion, of which agriculture, forestry, fishing, and hunting accounted for \$38.4 billion: 1.39% of the total or 1.57% of all private industry. *SAGDP2N Gross Domestic Product by State*, U.S. BUREAU OF ECON. ANALYSIS, <https://perma.cc/4994-VE4P> (last updated May 1, 2019).

¹³² Irrigation, livestock, and aquaculture combined for a total of 77.7% of all freshwater withdrawals in California. *Estimated Use of Water in the United States County-Level Data for 2015*, U.S. GEOLOGICAL SURVEY (2018), <https://perma.cc/7XXM-UWZ5> (data on file with author).

¹³³ CAL. PUB. UTIL. COMM'N, WHAT WILL BE THE COST OF FUTURE SOURCES OF WATER FOR CALIFORNIA? 4 (2016), <https://perma.cc/W789-HSDL>. An acre-foot of water is a pool an acre in area and a foot deep, the equivalent of 325,851 gallons. *Id.*

alfalfa,¹³⁴ rice, cotton, and livestock.¹³⁵ Producing a ton of alfalfa in California requires about 135,000 gallons of water, and would fetch about \$340; if the water were used by California-based Intel Corporation to produce microprocessor chips, the resulting output would be worth over \$13 million.¹³⁶

By no means is the waste limited to California. Florida-based bottled water company Zephyrhills holds very low-cost permits to extract water from natural springs within the state, which it simply bottles and sells.¹³⁷ In one typical state-issued permit, Nestle pays a biannual fee of \$50 to extract up to twelve million gallons of spring water per month.¹³⁸ Putting aside this shocking gift of a public resource and this solid waste travesty (less than 10% of all plastic water bottles are recycled),¹³⁹ bottling water is above all wasteful: at least three liters of water are lost for every liter of bottled water.¹⁴⁰ Some bottled water companies actually took tap water or groundwater from California during its historic drought,¹⁴¹ even as California municipalities rationed water.¹⁴² The litany of inefficient water uses in California and elsewhere in the United States runs biblically long.¹⁴³

And yet, waste represents both a challenge and an opportunity for a Resources Trust. Clearly, one root cause of these inefficiencies are the

¹³⁴ CULP ET AL., *supra* note 116, at 11.

¹³⁵ REISNER, *supra* note 126, at 515. Reisner is less critical of growing rice in the California Central Valley because flooded rice fields, while inefficient in California because of the rapid evaporation rates, provides habitat for migrating waterfowl. *Id.*

¹³⁶ CULP ET AL., *supra* note 116, at 12.

¹³⁷ *Special Spring Sources*, ZEPHYRHILLS, <https://perma.cc/8DN3-WNLE> (last visited Jan. 25, 2020) (listing five Florida springs from which the company withdraws water).

¹³⁸ NW. FLA. WATER MGMT. DIST., WATER USE PERMIT NO 2B-133-6638-3, at 1 (Sept. 25, 2017).

¹³⁹ Trevor Nace, *We're Now at a Million Plastic Bottles Per Minute – 91% of Which Are Not Recycled*, FORBES (July 26, 2017), <https://perma.cc/5A8B-VNM6>.

¹⁴⁰ PETER H. GLEICK, *BOTTLED AND SOLD: THE STORY BEHIND OUR OBSESSION WITH BOTTLED WATER* 94 (2010). Dasani claims to use 1.63 liters-per-liter produced.

¹⁴¹ Julia Lurie, *Bottled Water Comes From the Most Drought-Ridden Places in the Country*, MOTHER JONES, <https://perma.cc/5DK6-TWYZ> (last updated Apr. 13, 2015).

¹⁴² Alejandra Reyes-Velarde, *California Will Have Water Consumption Limits for the First Time After 'Landmark' Legislation Passed*, L.A. TIMES (June 1, 2018), <https://perma.cc/KC3B-ZMXF>.

¹⁴³ *See, e.g.*, REISNER, *supra* note 126, at 12 (giving a seminal account of wasteful water usage). Reisner quotes Rita Singer, “a lawyer in the Interior solicitor’s office through the 1960s and early 1970s,” as saying: “In effect, we were telling the growers, ‘Go ahead. Do whatever you want.’” *Id.* at 339. In an afterword, Reisner also provides an account of how Central Valley agriculture ultimately bullied the federal and state governments into providing so much water that storage was eventually depleted, ironically resulting in zero deliveries in 1991. *Id.* at 503–08. Fortunately for Central Valley farmers, they could readily turn to depleting groundwater supplies, at least until they are depleted. *Id.* at 506. California farmers grow water-intensive crops that are ill-suited to California’s dry climate and limited water, like rice, cotton, alfalfa, and livestock. In 1985, cotton accounted for \$900 million of goods, and together with alfalfa and livestock, the industries consumed more water than all of California’s urban areas, but could produce the same value of goods in three or four days. *Id.* at 515.

often-comical prices faced by water users. Not coincidentally, the price of water in Israel is by necessity quite high: agricultural uses pay between \$0.55 and \$0.78 per cubic meters (more if produced from desalination),¹⁴⁴ as opposed to the \$0.02 paid by those California farmers still lucky enough to pay \$25 per acre-foot. Certainly, one low-hanging fruit is water price reform.

But if water price reform were easy, these comical inefficiencies would have ceased long ago. Another tack involves another root cause of water waste, and a reason that low water prices remain puzzlingly persistent: the difficulty of pricing or trading water rights. Many legal reforms have been proposed: groundwater withdrawals must at least be quantified (but better still regulated and traded), water rights made more quantifiable and more flexible,¹⁴⁵ and centralized water markets established.¹⁴⁶ Water law, despite its transboundary implications, is largely a matter of state law,¹⁴⁷ and state laws have varied a great deal in how much reform they embody. The appetite to conserve and trade is clearly present among a wide variety of water stakeholders: Arizona law allows water users to acquire transferable credits by injecting it into underground aquifers, with the advantage that water stored underground does not evaporate, and serves to recharge an important and heavily-used resource.¹⁴⁸ The Central Arizona Project, which supplies water to Phoenix and Tucson, is a junior appropriator¹⁴⁹ of water from the Colorado River, but hedges against future water shortages by storing excess water in its aquifers, in exchange for allowing neighboring Nevada to withdraw surface water belonging to Arizona.¹⁵⁰ Such massive water transfers, accomplishing large savings, are more complex than they should be, and are not readily undertaken by smaller entities, much less individual farmers seeking a broader

¹⁴⁴ Nir Becker, *Water Pricing in Israel: Various Waters, Various Neighbors*, in WATER PRICING EXPERIENCES AND INNOVATIONS 181–99 (A. Dinar, V. Pochat & J. Albiac-Murillo, eds., 2015).

¹⁴⁵ Prevalent in many water law regimes is a use-it-or-lose-it restriction that forces water rights holders to maintain inefficient uses, or risk losing them altogether. This creates a very strong incentive against conserving water, which might result in forfeiture. When coupled with common restrictions on transfer, water rights may be locked into wasteful uses indefinitely. See, e.g., Henry E. Smith, *Governing Water: The Semicommons of Fluid Property Rights*, 50 ARIZ. L. REV. 445, 453 (2008); CULP ET AL., *supra* note 116, at 20–21.

¹⁴⁶ CULP ET AL., *supra* note 116, at 7.

¹⁴⁷ Adler, *supra* note 79, at 3–4.

¹⁴⁸ Sharon B. Megdal et al., *Water Banks: Using Managed Aquifer Recharge to Meet Water Policy Objectives*, 6 WATER 1500, 1504 (2014), <https://perma.cc/V2T6-2PBS>.

¹⁴⁹ Surface water rights in Western states are acquired by diverting water from a natural watercourse, intending to put the water to a beneficial use, and actually putting it to a beneficial use within a reasonable time. See, e.g., JAN LAITOS, NATURAL RESOURCES LAW 396–97 (3d ed. 2019). In case of shortages, priority is determined by the date of diversion with application to a beneficial use. *Id.* at 409. A “junior appropriator” such as the Central Arizona Project would thus lose all of its water first in case of shortage to senior appropriators in Nevada.

¹⁵⁰ Megdal et al., *supra* note 148, at 1507.

array of options. But they represent a model for water conservation through trading.

While legal reform can be contentious,¹⁵¹ a Resources Trust with a government charter may be legislatively granted certain privileges, such as exemption from use-it-or-lose-it rules.¹⁵² Private nonprofit water trusts already acquire water rights for instream flows,¹⁵³ so the idea that a governmental Resources Trust could acquire water rights for dry years is not so radical a departure from current water law. Indeed, state and federal governments often transact water for environmental purposes.¹⁵⁴

Importantly, a Resources Trust need not always be acquiring permanent water rights, as private and governmental entities do when transacting for environmental purposes. Temporary water rights options are easier to negotiate, as they do not impinge upon the long-term access to water enjoyed by a water rights holder.¹⁵⁵ Nor must a Resources Trust necessarily acquire the complete usufructuary water right, but might acquire future water *options*,¹⁵⁶ which entitle the holder to acquire, at some future time, a stated quantity of water for a stated price.¹⁵⁷ In case of a climate-induced shortage, a Resources Trust would *exercise* an option to purchase water from a seller.

Neither options nor short-term water leases actually change the amount of water available. Financial instruments do not change the laws of physics. However, in the context of a Resources Trust they do what they do in the financial context: they manage risk. More importantly, since many of the inefficiencies of water usage stem from the absence of a market value for water, these instruments free up water from low-value uses that would not be sorely missed.

One more way to develop capacity to address a water shortage is to acquire tracts of land with appurtenant water rights. As noted above, Harvard University's investment instrument acquired vineyard land in California, enough to become one of the ten largest property owners in

¹⁵¹ CULP ET AL., *supra* note 116, at 14 (“Comprehensive reform of these doctrines would be controversial and could take decades to implement.”).

¹⁵² Smith, *supra* note 145, at 455.

¹⁵³ CULP ET AL., *supra* note 116, at 23.

¹⁵⁴ Jedidiah Brewer et al., *Transferring Water in the American West: 1987–2005*, 40 J.L. REFORM 1021, 1039 (2007) (“[Environmental] transactions generally are initiated by either the federal or state governments . . . [and] are aimed at wetlands restoration, fish and wildlife habitat preservation or protection, and augmenting stream flows. The most active parties are the U.S. Fish and Wildlife Service and state departments of fish and game.”).

¹⁵⁵ *Id.* at 1046 (“[L]egal impediments and political objections . . . have driven market participants to use short-term leases to transfer large quantities of water precisely because such leases avoid high transaction costs and finesse the controversial issue presented by a permanent reallocation of water from farmers to cities.”).

¹⁵⁶ Tomkins & Weber, *supra* note 8, at 110.

¹⁵⁷ An option is a financial contract that gives an investor the right, but not the obligation, to either buy or sell an asset at a pre-determined price by a specified date. *Option*, MERRIAM-WEBSTER, <https://perma.cc/A5W8-87UN> (accessed Feb. 8, 2019).

the state.¹⁵⁸ Harvard is not primarily interested in growing grapes; it is extremely interested in the excellent groundwater rights appurtenant to its properties.¹⁵⁹ The grape-growing and wine-making business does, however, provide a cash flow to offset the capital costs of acquiring the land, while preserving the option of using the groundwater for some other, more pressing purpose, should water shortages compel it.¹⁶⁰ Acquisitions like Harvard's are particularly fitting for a Resources Trust: those land assets represent a secure option on water (provided that other groundwater users don't deplete the aquifer) and, as a bonus, minimize the taxpayer burden by generating what amounts to a side income.

It is true that water must be delivered to users, which requires delivery infrastructure and monitoring systems nimble enough to adapt to changing water needs, including the possibility of large water trades.¹⁶¹ This would be especially true if water trading were to extend well beyond the border of familiar irrigation districts, or if a state-based Resources Trust sought to purchase water or water rights from outside its boundaries. The problem could be solved if, unlike current legal rigidities, water delivery capacity could be provided by private suppliers reaping delivery fees for use of its infrastructure.¹⁶² Oil and gas pipelines feed an extensive network and face higher hurdles in the form of regulatory requirements and safety and environmental concerns;¹⁶³ and yet, they get built in surprisingly large numbers.¹⁶⁴ Water aqueducts and other as-yet-unforeseen ways of delivering water may well get built if robust water trading is liberated from current constraints, which tend to bundle water distribution with the rights themselves.¹⁶⁵

While climate change may disrupt natural resource supplies, adaptation by making more efficient use of water does not require heroics or vivid imagination. At least in terms of providing for basic human needs, considerable scope exists for adaptation to climate change. One charge of a Resources Trust is to realize these efficiencies at scale.

¹⁵⁸ Gold, *supra* note 9.

¹⁵⁹ *Id.*

¹⁶⁰ *See id.*

¹⁶¹ CULP ET AL., *supra* note 116, at 10.

¹⁶² *See, e.g., id.* at 19, 21 (suggesting that one can manage the risk of water fluctuations through a private market mechanism for water right transference).

¹⁶³ *See, e.g.,* JOHN L. KENNEDY, OIL AND GAS PIPELINE FUNDAMENTALS 155 tbl.7-1 (1993) (showing list of environmental restrictions in permitting process).

¹⁶⁴ *Id.* at 12 ("Thousands of miles of new pipeline are built each year around the world.").

¹⁶⁵ CULP ET AL., *supra* note 116, at 21.

B. Food

It is a more complicated undertaking to secure a supply of food for an extended climate crisis. Water supply can be volatile,¹⁶⁶ but food supply is more volatile, as it is buffeted by variations in weather,¹⁶⁷ disease,¹⁶⁸ pestilence,¹⁶⁹ and water supply.¹⁷⁰ Also, while water could be stored indefinitely in reservoirs and aquifers, food has a limited shelf-life. It is more challenging for food than it is for water to imagine a Resources Trust waiting patiently and unobtrusively for a shortage to occur, and only then springing into action as a supplier of last resort. Were a Resources Trust able to quickly take up its role of supplier of last resort, it might already need to be in the business of supplying food already, which could interfere with private markets.

But as with water, a large job is made more tractable by the possibility of realizing efficiency improvements over existing methods of food production and consumption. Estimates of food waste range from 20–50%, more if wastes in the production process are included.¹⁷¹ Producing food requires too much land¹⁷² and water,¹⁷³ contributes to climate change instead of mitigating it,¹⁷⁴ and provides, despite a superficial abundance of choice, an unsatisfactory menu of food

¹⁶⁶ For example, California's average water supply through precipitation and imports is about 200 million acre-feet per year. Brad Plumer, *A Guide to California's Drought and Water Crisis*, VOX (Apr. 30, 2015), <https://perma.cc/82U8-MU54>. However, that can fluctuate by 40 million acre-feet in any given year. *Id.*

¹⁶⁷ Matthieu Stigler, *Commodity Prices: Theoretical and Empirical Properties*, in SAFEGUARDING FOOD SECURITY IN VOLATILE GLOBAL MARKETS 29, 35 (Prakash ed., 2011), <https://perma.cc/5JJW-DYU5> [hereinafter SAFEGUARDING FOOD SECURITY].

¹⁶⁸ Jim Greenfield & Abdolreza Abbassian, *Strengthening Global Food Market Monitoring*, in SAFEGUARDING FOOD SECURITY, *supra* note 167, at 471.

¹⁶⁹ *Id.*

¹⁷⁰ Glob. Perspectives Unit & Nat. Res. Dep't, United Nations Food & Agric. Org., *Rising Vulnerability in the Global Food System: Environmental Pressures and Climate Change*, in SAFEGUARDING FOOD SECURITY, *supra* note 167, at 83.

¹⁷¹ See, e.g., Jean C. Buzby et al., U.S. Dep't of Agric., *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*, in ECONOMIC INFORMATION BULLETIN 121, 12 (2014), <https://perma.cc/TPG9-UWGN> (about 133 billion out of 430 billion pounds of post-harvest food wasted in the United States, or 31%); UNITED NATIONS FOOD & AGRIC. ORG., FOOD WASTAGE FOOTPRINT: IMPACTS ON NATURAL RESOURCES SUMMARY REPORT 6 (2013), <https://perma.cc/CS9S-TP3F> (about one-third of all agricultural production wasted globally); TOM QUESTED ET AL., WASTE & RES. ACTION PROGRAMME, HOUSEHOLD FOOD AND DRINK WASTE IN THE UNITED KINGDOM 2012, at 3 (2013), <https://perma.cc/ZMF5-UJPG> (22% of all retail purchases wasted in United Kingdom); Betsy Fink & Jesse Fink, *Foreword* to RETHINKING FOOD WASTE THROUGH ECONOMICS AND DATA, A ROADMAP TO REDUCE U.S. FOOD WASTE BY 20 PERCENT 1 (2016), <https://perma.cc/6DC6-NHSG>.

¹⁷² TIM SEARCHINGER ET AL., WORLD RES. INST., CREATING A SUSTAINABLE FOOD FUTURE: SYNTHESIS REPORT 1 (2018), <https://perma.cc/9MNR-PTD8>.

¹⁷³ *Id.* at 10.

¹⁷⁴ Since growing crops is centered upon the fixation of carbon dioxide in plant life, agriculture in its simplest form should be, on net, a carbon sink, not a source of emissions. Agricultural practices and land use practices in support of agriculture, however, greatly complicate the picture. *Id.* at 1.

choices.¹⁷⁵ Moreover, food production in the United States has, in the interests of maximizing output and profits, emphasized production of food with shockingly low nutritional values and alarmingly high in health risks.¹⁷⁶ To be sure, inexpensive calories possess a market attraction; it is just that the food supplied is so astronomically far from ecological, economic, and public health optima that constructing a basic food provision system from the ground-up stands a very realistic chance of accomplishing much more with much less.

To avoid disrupting markets, a Resources Trust must enter the agricultural marketplace as a marginal market participant. At the same time, it must maintain a capacity to step in as a food supplier of last resort. To do this, a Resources Trust requires some capacity for cultivation, but not so much as to set up a parallel, competing system of production. Dispensing with prevailing inefficient agricultural practices, a Resources Trust must be able to produce food with less water and land,¹⁷⁷ should capture carbon dioxide instead of releasing greenhouse gases,¹⁷⁸ and should provide better nutritional and health benefits than currently prevailing in the United States.¹⁷⁹ Producing food under those constraints increases social welfare, but comes at a higher cost.¹⁸⁰

¹⁷⁵ The scholarly literature is voluminous and sprawling, but in the popular literature the compelling case has been made in MICHAEL POLLAN, *THE OMNIVORE'S DILEMMA: A NATURAL HISTORY OF FOUR MEALS* 18–19 (2006), in which Pollan traces back a number of unhealthy foods to the subsidization of corn, which has found its way into many foods in many forms. See also, Alston et al., *supra* note 123, at 473.

¹⁷⁶ See, e.g., POLLAN, *supra* note 175, at 117 (a thorough investigation of American food production systems and nutritional consequences); Alston et al., *supra* note 123, at 475 (discussing how agricultural subsidies contributing to obesity epidemic).

¹⁷⁷ See Brad Plumer, *Can We Grow More Food on Less Land? We'll Have to, a New Study Finds*, N.Y. TIMES (Dec. 5, 2018), <https://perma.cc/5W3X-SY8V> (surveying needs for efficiency in agriculture).

¹⁷⁸ Although crop cultivation generally fixes ambient carbon dioxide, methane and nitrous oxide are also emitted. The way agriculture is commonly practiced, by plowing and ripping apart soil, accounts for the majority of emissions of these two powerful greenhouse gases. Mitigation is possible through different soil practices. See, e.g., Pete Smith et al., *Greenhouse Gas Mitigation in Agriculture*, 363 PHIL. TRANSACTIONS ROYAL SOC'Y B. 789, 793 (2008).

¹⁷⁹ See, e.g., POLLAN, *supra* note 175, at 103–04.

¹⁸⁰ For example, traditional crop irrigation might spray fields with water, resulting in loss through evaporation. Drip irrigation is more efficient with water, but costs more. Margriet Caswell & David Zilberman, *The Choices of Irrigation Techniques in California*, 67 AM. J. AGRIC. ECON. 224, 227 (1985). Traditional crop cultivation plows fields for sowing, which releases greenhouse gases. No-till cultivation avoids ripping the soil by plowing, using more subtle methods of planting seeds, but equipment costs more. David R. Huggins & John P. Reganold, *No-Till: The Quiet Revolution*, 299 SCI. AM. 70, 73 (2008). Livestock occupy about 30% of all ice-free (for now) land on Earth and produce emissions of methane. Livestock production could reduce methane emissions and occupy less land and use less water, but at greater cost. Philip K. Thornton, *Livestock Production: Recent Trends, Future Prospects*, 365 PHIL. TRANS. ROYAL SOC. B. 2853, 2853, 2858, 2860 (2010). Methane emissions from livestock account for about 5% of all greenhouse gas emissions. HENSON, *supra* note 2, at 47.

But that is exactly what a governmentally-chartered Resources Trust should do! A higher cost of production and a concomitantly higher retail cost would avoid interfering too much with markets but could, in a climate crisis, fill in gaps in supply until markets return to normal. In the meantime, production need not be carried out at scale, while markets remain calm.

One mechanism that could help build out some food supply capacity without interfering with market operation is the use of commodities futures contracts.¹⁸¹ A Resources Trust could secure a number of contracts to acquire agricultural commodities, for delivery of soybeans, wheat, oats, corn, rice, sugar, or livestock¹⁸² at some series of future dates at which there might be a shortage. Most commodities futures contracts are “liquidated” before the delivery date, meaning that the mutual obligations to buy and sell are voided for some negotiated price.¹⁸³ A Resources Trust could enter into contracts to buy agricultural commodities at a given price, and then liquidate them once it becomes clear that a shortage will not materialize. Better still, a Resources Trust might also acquire agricultural trade *options*¹⁸⁴ to acquire certain vital foods, dispensing with the need to liquidate unneeded contracts.¹⁸⁵

As with short-term water leases and water options, these instruments do not fundamentally change production, and do not significantly expand supply. Commodities futures and options can mitigate risk and, to the extent that they subtly shift some production to certain vital foods,¹⁸⁶ they can reduce the overall societal risk of food shortage from climate change. But bridging a food gap brought on by climate change may require additional measures that can significantly add to food supply.

Fortunately, models for efficient, enlightened agriculture exist, in the form of a backstop technology. As noted above, the tiny country of the Netherlands, with its 17 million people crowded onto 13,000 square miles,¹⁸⁷ is the second largest food exporter in the world, behind only the

¹⁸¹ A commodity futures contract is an agreement to buy or sell a particular commodity at a future date at a fixed price and quantity. *Futures Markets Basics*, U.S. COMMODITIES FUTURES TRADING COMM'N, <https://perma.cc/7VVZ-LML3> (last visited Jan. 25, 2020).

¹⁸² For a list of commonly traded agricultural commodities, see Frank J. Fabozzi, et al., *A Primer on Commodity Investing*, in *THE HANDBOOK OF COMMODITY INVESTING* 3, 8 (F. Fabozzi, R. Füss & D.G. Kaiser eds., 2008).

¹⁸³ *Id.* at 16.

¹⁸⁴ Similar to water options, agricultural trade options entitle the holder to buy or sell some fixed quantity of an agricultural commodity at a fixed price at some future date. *Agricultural Trade Options*, U.S. COMMODITIES FUTURES TRADING COMM'N, <https://perma.cc/J7JU-FWJD> (last visited Jan. 25, 2020).

¹⁸⁵ If it becomes clear that a crisis in food supply will not materialize, a Resources Trust could just decline to exercise its option, without the need for liquidation.

¹⁸⁶ If a Resources Trust were to purchase options for say, basic cereals or produce to supply in a shortage situation, production would likely shift towards these commodities, and away from other, less useful crops that might be grown for other reasons.

¹⁸⁷ *The World Factbook, Europe: Netherlands*, U.S. CENT. INTELLIGENCE AGENCY (Oct. 2, 2019), <https://perma.cc/8JLU-QLYY>.

United States.¹⁸⁸ Large, sprawling complexes of technologically sophisticated greenhouses as large as 175 acres¹⁸⁹ grow massive amounts of produce using a fraction of the amount of water and pesticides as conventional crop agriculture. Greenhouse cultivation is less agriculture than it is manufacturing; but doing more with less is fundamentally about efficiency gains, a conscious break from romanticized notions of farming.

Continuing with the theme of efficiency in food production, aquaculture also provides untapped potential to supply food. The artificial cultivation of seafood poses a number of environmental and economic issues,¹⁹⁰ but also presents the same logic of scale as greenhouse production, deploying technology to do more with less resources.¹⁹¹ Capture fisheries are notoriously unsustainable, with one-third of all fisheries globally now considered overfished, up from 10% in 1974.¹⁹² In part because of overfishing, catches worldwide have stagnated since the 1980s, but aquaculture has increased dramatically to keep up with steadily rising fish consumption, growing from 3 million tons in 1970¹⁹³ to 80 million tons worldwide in 2016.¹⁹⁴ To be sure, aquaculture has often attracted the wrong kind of attention: a broken fish pen in Washington State allowed thousands of farmed Atlantic salmon to escape, creating unwanted competition for the endangered native Pacific salmon.¹⁹⁵ Aquaculture also generates water pollution from the simple fact that fish defecate, and fish farms concentrate fish.¹⁹⁶ But when compared with commercial fishing and livestock farming, aquaculture poses fewer environmental and ecological

¹⁸⁸ *Agriculture and Horticulture*, GOV'T OF THE NETH., <https://perma.cc/DC3W-EX9M> (last visited Jan. 25, 2020).

¹⁸⁹ Viviano, *supra* note 54, at 82, 92.

¹⁹⁰ FOOD & AGRIC. ORG. OF THE U.N., THE STATE OF WORLD FISHERIES AND AQUACULTURE 2018 144–45 (2018), <https://perma.cc/XCM4-9XYG> (“Common space-related problems that limit aquaculture development include: introduction and spread of aquatic animal diseases, environmental concerns, limited production, social conflicts, restricted access to post-harvesting services . . .”).

¹⁹¹ NAT'L SCI. & TECH. COUNCIL, COMM. ON SCI., INTERAGENCY WORKING GRP. ON AQUACULTURE, NATIONAL STRATEGIC PLAN FOR FEDERAL AQUACULTURE RESEARCH (2014–2019) 1 (2014) (“Aquaculture yields public benefits that extend beyond producers to directly impact consumers, and provides diverse ecosystem services. A sector of agriculture, aquaculture offers alternative farming in a variety of aquatic environments, from inland freshwater ponds to marine coastal and offshore waters. Aquaculture also provides an important tool used to enhance commercial and recreational fisheries, and to restore threatened and endangered species and habitats.”).

¹⁹² FOOD & AGRIC. ORG. OF THE U.N., *supra* note 190, at 40 fig.14.

¹⁹³ *Aquaculture*, FOOD & AGRIC. ORG. OF THE U.N. (2019), <https://perma.cc/2CRV-6KJD> (“In the 1970s, aquaculture produced about 3 million tonnes of fish.”).

¹⁹⁴ FOOD & AGRIC. ORG. OF THE U.N., *supra*, note 190, at 4 tbl.1.

¹⁹⁵ Courtney Flatt & John Ryan, *Environmental Nightmare' After Thousands of Atlantic Salmon Escape Fish Farm*, NPR.ORG (Aug. 24, 2017), <https://perma.cc/X46H-42T4>.

¹⁹⁶ *See, e.g.*, PATRICK WHITE, AQUACULTURE POLLUTION: AN OVERVIEW OF ISSUES WITH A FOCUS ON CHINA, VIETNAM, AND THE PHILIPPINES (Emilie Cassou et al. eds., 2017).

problems.¹⁹⁷ If properly regulated, aquaculture represents an important alternative to commercial fishing, and one that might relieve the relentless pressure on overfished fisheries.

As a food supplier of last resort, a Resources Trust must walk a fine line. On the one hand, it is counterproductive to interfere significantly with private markets, as they are needed to carry on food production in the absence of shortage, and still much of the food production in times of shortage. On the other hand, a Resources Trust must have the capacity to carry on in case of a collapse in private food suppliers. There could be many reasons that private markets might fail,¹⁹⁸ and a Resources Trust must allow them to thrive when healthy, but be resilient enough to step in if not.

C. Energy

A Resources Trust must also be able to supply energy to enable people to do more than merely survive. Preserving a quality of life comparable to that predating climate crises would require the preservation of business and commerce, which would also be important to restoring and maintaining supplies of food and water. This would require a steady supply of energy, for both transportation and electricity generation (which for electric vehicles, also provides transportation).

Being an energy provider of last resort raises some of the same issues as in the agricultural context: it must ordinarily be a marginal market participant in order to avoid disrupting markets, but have the capacity to step in to bridge climate-induced energy shortfalls. Fortunately, a discussion about energy resilience is already well underway in academia, government, and energy industries.¹⁹⁹ The provision of energy depends on large, sprawling, built systems, which face multiple threats of disruption from climate change,²⁰⁰ so the chore list is long.²⁰¹

¹⁹⁷ Michael Conathan, *Dealing With the Aquaculture Dilemma*, CTR. FOR AM. PROGRESS (June 17, 2011), <https://perma.cc/9DTL-UEUG> (“According to a report released last week by Conservation International and the WorldFish Center, fish are more efficient than either cows or pigs at converting feed to protein, and have dramatically lower potential to cause eutrophication from runoff of animal waste and pesticides and fertilizers used to grow the crops that feed the livestock.”); see, e.g., Hsu, *supra* note 27, at 26–47 (discussing the environmental impacts of hog farming).

¹⁹⁸ See, e.g., *supra* notes 100–105 and accompanying text.

¹⁹⁹ See, e.g., USGCRP, *supra* note 22, at 187; Paul E. Roege et al., *Metrics for Energy Resilience*, 72 ENERGY POL’Y 249, 249 (2014), <https://perma.cc/W48H-C3TG>; HENRY H. WILLIS & KATHLEEN LOA, MEASURING THE RESILIENCE OF ENERGY DISTRIBUTION SYSTEMS 1 (2015), <https://perma.cc/9ZZQ-Z5UF>; Dan T. Ton & W-T. Paul Wang, *A More Resilient Grid: The U.S. Department of Energy Joins with Stakeholders in an R&D Plan*, IEEE POWER & ENERGY, May/June 2015, at 26, 27, <https://perma.cc/6UP8-5TBL>; Aleh Cherp & Jessica Jewell, *The Concept of Energy Security: Beyond the Four As*, 75 ENERGY POL’Y 415, 415 (2014).

²⁰⁰ Hotter temperatures make electricity generation and transmission of electricity less efficient. Droughts threaten the water supply of hydroelectric dams, and also the cooling

But the notion of reserves is more prominent in the energy sector. Already built into the electricity sector is the idea of safety margins: in almost all states electricity generators are required to demonstrate that they have sufficient capacity and adequate resources to satisfy unexpected or sharp demand spikes.²⁰² One sensible step, not requiring the intervention of a Resources Trust, would be for these “resource adequacy” requirements to be augmented to account for longer-term disruptions caused by climate change.

Rather than duplicate or compete with extant rules, a Resources Trust might fruitfully focus on the task of providing standby power for an intermediate-term shortage. For example, prolonged drought may threaten hydropower electricity supplies.²⁰³ A Resources Trust for a state highly dependent upon hydropower might fruitfully develop some standby capacity. Or, cascading failures or mishaps may introduce long shortages of transportation or other electricity generating fuels. Again, acquiring some insurance might be prudent.

As in the case of water and food, option contracts can contribute to the capacity to supply energy in case of shortage. Options for oil, natural gas, coal, and electric power are traded in North America and Europe.²⁰⁴ Of course, an option is only as good as the promisor, which could be

processes of fuel refining and fossil-fueled power plants. Severe weather damages drive greater energy demands and stress capacities, for both heating and cooling. Flooding and extreme weather events damage all stages of energy generation and delivery. USGCRP, *supra* note 22, at 177.

²⁰¹ For example, protecting electricity transmission grids would involve possibly burying power lines underground, and upgrading utility poles; protecting against wildfires from electricity transmission lines might involve more careful vegetation practices. Power plants, transmission lines and transmission infrastructure such as substations and compressor stations in flood-prone areas need some hardening and flood protection. Energy storage and microgrids—the networking of a small number of users and small-scale electricity generators—are targeted for research and development to enhance longer-term resilience. For a longer list, see *id.* at 187.

²⁰² For example, under its Resource Adequacy Program, CAL. PUB. UTIL. CODE § 380 (2019), California requires that each electricity generator annually demonstrate adequate resource capacity to satisfy three different types of contingencies. Electricity generators are required to maintain sufficient electric “flexible capacity” to service sharp daily increases when solar generation decreases and when evening demand increases, and to ensure supply locally in case of grid emergencies. CAL. PUB. UTIL. COMM’N, TRACK 1 DECISION ADOPTING LOCAL PROCUREMENT AND FLEXIBLE CAPACITY OBLIGATIONS FOR 2017, AND FURTHER REFINING THE RESOURCE ADEQUACY PROGRAM, RULEMAKING 14-10-010 (2014), <https://perma.cc/9GLP-YF9K>. Generators are further required to demonstrate that they have the capacity to serve their forecast retail load plus 15–17%; CAL. PUB. UTIL. COMM’N, ORDER INSTITUTING RULEMAKING TO PROMOTE POLICY AND PROGRAM COORDINATION AND INTEGRATION IN ELECTRIC UTILITY RESOURCE PLANNING, RULEMAKING 04-04-003 (2004), <https://perma.cc/HV8N-EJKM>.

²⁰³ USGCRP, *supra* note 22, at 27 (“Changes in the relative amounts and timing of snow and rainfall are leading to mismatches between water availability and needs in some regions, posing threats to, for example, the future reliability of hydropower production in the Southwest and the Northwest.”).

²⁰⁴ *Energy*, INTERCONTINENTAL EXCH., <https://perma.cc/QCJ2-E3RR> (last visited Jan. 25, 2020).

suffering through the same climate-induced energy crisis as the one that springs a Resources Trust into action. The often vast scale of climate change means that, like earthquakes and floods, climate change introduces correlated risks, foiling attempts to insure.²⁰⁵ If broad enough, financial instruments for energy resources can still help manage risk, but can only play a supporting role in avoiding climate disruption.

As in the case of water, some energy storage is possible. One energy reserve already exists: the Strategic Petroleum Reserve, created to provide an emergency supply of crude oil in case of a disruption of supply, lasting several months.²⁰⁶ Although the mandate of a Resources Trust would be to supply energy, not reduce greenhouse gases, it still seems ironic to rely upon a reserve of petroleum to deal with the effects of climate change. That said, the supply of transportation fuels could be disrupted for significant periods of time by climate events, so the maintenance of a petroleum reserve for climate emergencies would seem prudent, especially given the historical precedent for gasoline hoarding.²⁰⁷

A less incongruous energy reserve might consist of natural gas, which contributes less to climate change than oil, and about half that of coal.²⁰⁸ Natural gas is already the most common fuel for electricity generation in the United States,²⁰⁹ and is currently at historically low prices,²¹⁰ making it a natural and immediately available option for a Resources Trust. Natural gas can also be compressed for storage, and can be stored underground in the many depleted oil and gas reservoirs, and in the same underground caverns used to store petroleum.²¹¹

²⁰⁵ Correlated risk is imposed by the threat of hurricanes, floods, earthquakes and other natural disasters in which the losses are suffered by many all at once, threatening the solvency of an insurer. HOWARD KUNREUTHER, NAT'L BUREAU OF ECON. RESEARCH, REFLECTIONS ON U.S. DISASTER INSURANCE POLICY FOR THE 21ST CENTURY 2–3 (2006), <https://perma.cc/R7AY-4NST>. Climate change creates correlated risks in the form of more severe hurricanes and floods, W.J.W. Botzen & J.C.J.M. van den Bergh, *Insurance Against Climate Change and Flooding in the Netherlands: Present, Future, and Comparison with Other Countries*, 28 RISK ANALYSIS 413, 413 (2008).

²⁰⁶ The Strategic Petroleum Reserve is an emergency supply of crude oil, stored in underground salt caverns totaling a capacity to hold 727 million barrels, good for a supply of 143 days. *SPR Quick Facts and FAQs*, U.S. DEP'T OF ENERGY, <https://perma.cc/6NXY-CBME> (last visited Jan. 25, 2020).

²⁰⁷ See Weitzman, *supra* note 6, at 401; Hansman et al., *supra* note 70, at 1; Friedman, *supra* note 11, at 1; Harris, *supra* note 71, at A1.

²⁰⁸ Natural gas emits 117 lbs. of CO₂ per mmBtu, as opposed to 157.2 for gasoline, and 210 for coal. *Carbon Dioxide Emissions Coefficients by Fuel*, U.S. ENERGY INFO. ADMIN. (Feb. 2, 2016), <https://perma.cc/C4JS-VGE4>.

²⁰⁹ U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2019, at 21 (2019), <https://perma.cc/J6B9-N86Y> (showing a table that displays Electricity Generation from Selected Fuels).

²¹⁰ *Id.* at 22 (“The continuing decline in natural gas prices . . . have resulted in lower wholesale electricity prices . . .”).

²¹¹ *The Basics of Underground Natural Gas Storage*, U.S. ENERGY INFO. ADMIN. (Nov. 16, 2015), <https://perma.cc/F86W-NQ43>.

Importantly, depending on how energy and transportation systems evolve, natural gas could be a fuel for both electricity generation and transportation, as more and more fleet vehicles are powered by natural gas, rather than gasoline.²¹²

Beyond these relatively simple measures, a Resources Trust must, as in the case of water and food, get creative and seek a way to fill gaps in existing energy systems. One way to ensure sufficient standby capacity that interferes minimally with existing markets is to develop renewable energy sources and pairing them with energy storage systems.²¹³ This would not generally be the most cost-effective way of generating electricity, at least with current technologies and prevailing fossil fuel prices, so interference with existing private markets would be minimized.²¹⁴ It is, however, a mode of electricity generation that is currently accepted as reliable enough to serve as reserve power, making it a prime asset for a Resources Trust. Under its Resource Adequacy Program, the California Public Utilities Commission requires electricity generators supplying the California Independent Systems Operator to maintain sufficient electricity generation capacity to handle three different types of supply or demand disruptions.²¹⁵ Electricity generators may satisfy Resource Adequacy requirements—and are even required to under California’s greenhouse gas laws²¹⁶—by using renewable energy sources, and deploying storage technologies to store excess electricity produced by renewable sources.²¹⁷

To be an electricity supplier of last resort, a Resources Trust should do one better. To ensure that the electricity generated by renewable energy sources is reliable, significant storage capacity needs to accompany generation facilities to even out the intermittency of renewable sources.²¹⁸ This is not fanciful: new storage technologies exploit salt caverns to store not just petroleum and natural gas, but

²¹² See, e.g., Sonia Yeh, *An Empirical Analysis on the Adoption of Alternative Fuel Vehicles: The Case of Natural Gas Vehicles*, 35 ENERGY POLY 5865, 5866 (2007) (“As a result of the Energy Policy Act (EPACT) of 1992, the market share of NGVs has grown significantly, as they are primarily adopted by government light-duty vehicle fleets.”).

²¹³ MARK G. SPECHT & LAURA M. WISLAND, TURNING DOWN THE GAS IN CALIFORNIA: THE ROLE OF NATURAL GAS IN THE STATE’S CLEAN ELECTRICITY FUTURE 9 (2018), <https://perma.cc/DNH2-CHQ3>.

²¹⁴ *Id.* at 20–21. (showing partial retirement of fossil fuel plants if new resources, including renewable energy and battery storage, are brought online).

²¹⁵ CAL. PUB. UTIL. CODE § 380 (2019); see *supra* note 202 and accompanying text.

²¹⁶ CAL. PUB. UTIL. CODE § 399.11(a) (2019).

²¹⁷ CAL. PUB. UTIL. CODE § 380(e) (1996); CAL. PUB. UTIL. CODE § 399.11(b)(7) (2002).

²¹⁸ Renewable energy sources such as wind and solar have no fuel costs, but are intermittent, posing a problem for electricity supply, which consumers expect to be reliable, any time of day and regardless of weather conditions. A solution to solving the intermittency problem is to use energy storage systems on-site near renewable energy facilities to capture excess energy when conditions are favorable—when winds are blowing and the sun is shining—and release it when conditions are unfavorable. See, e.g., John P. Barton & David G. Infield, *Energy Storage and its Use with Intermittent Renewable Energy*, 19 IEEE TRANSACTIONS ON ENERGY CONVERSION 441, 441, 446, 448 (2004).

hydrogen and compressed air that can be tapped to provide energy when wind or solar resources do not.²¹⁹

A Resources Trust would depend upon more existing energy infrastructure than for food and water. There are many ways to make energy supply more resilient, such as the institution of microgrids, local energy networks that can disconnect from the larger, traditional electricity grid, and work autonomously with only local electricity sources.²²⁰ But altering the means of energy supply and distribution is beyond the scope of a Resources Trust. It is not as if existing energy infrastructure is robust; it is just that the larger job of systemic energy resiliency is not the job of a Resources Trust. The job of a Resources Trust would be to help prepare for climate-induced energy shortfalls at a cost that is not prohibitive to the taxpayer. Towards that end, a Resources Trust should implement a series of relatively modest contributions to standby energy.

VI. IMPLEMENTATION OF A RESOURCES TRUST

While a Resources Trust might seem like a radical step, it is not conceptually new. Government provision of vital life resources, even amidst predominantly private provision, is nothing new, as the Tennessee Valley Authority is a federally-chartered corporation,²²¹ while the Bonneville Power Administration is part of the U.S. Department of Energy.²²² The Central Valley Project is a complex, 400-mile network of dams, reservoirs, canals, and hydroelectric facilities that deliver water and power to the water-poor, but agriculturally productive, California Central Valley.²²³ As noted above, anti-hoarding institutions such as the Federal Deposit Insurance Corporation have been around for nearly a century to prevent bank runs.²²⁴

Moreover, organizations chartered to buffer against future adversity are nothing new. For example, sovereign wealth funds are state-owned investment vehicles that serve forward-looking objectives,

²¹⁹ See, e.g., Philip Athey, *World's Largest Renewable Storage Project Planned in Utah*, ENERGYWIRE (June 3, 2019), <https://perma.cc/4S8T-DA6S>.

²²⁰ Allison Lantero, *How Microgrids Work*, U.S. DEPT OF ENERGY (June 17, 2014), <https://perma.cc/9XHX-86VS>.

²²¹ *About TVA*, TENN. VALLEY AUTH., <https://perma.cc/VUV5-4B83> (last visited Jan. 25, 2020) (“The Tennessee Valley Authority is a corporate agency of the United States . . . [and] receives no taxpayer funding . . .”).

²²² *About Us*, BONNEVILLE POWER ADMIN., <https://perma.cc/GYL5-R9NU> (last visited Jan. 25, 2020).

²²³ *Central Valley Project (CVP)*, U.S. BUREAU OF RECLAMATION, <https://perma.cc/KR46-U2SV> (last updated Dec. 12, 2017).

²²⁴ *Managing the Crisis: The FDIC and RTC Experience — Chronological Overview*, FED. DEPOSIT INS. CORP. (FDIC), <https://perma.cc/CH2K-KQYU> (last updated Jan. 2, 2018) (“Sudden withdrawal demands in certain parts of the country started a panic of massive proportions President Roosevelt signed the Banking Act of 1933 on June 16 of that year. Section 8 of that legislation amended the Federal Reserve Act to create the Federal Deposit Insurance Corporation.”).

such as economic stabilization, diversification, and increasing savings for future generations.²²⁵ Oil-rich jurisdictions in particular have instituted trusts for a variety of long-term purposes,²²⁶ including planning for a future of low oil revenues.²²⁷ Alaska, through its Permanent Fund Corporation, takes the added step of distributing some proceeds to its residents.²²⁸ Total holdings for all sovereign wealth funds worldwide were estimated to be over \$8 trillion for 2018.²²⁹ Norway's massive Government Pension Fund Global (GPFG) alone accounts for \$1 trillion in assets.²³⁰

As conceived in this Article, a Resources Trust is different in scope but not in concept from traditional sovereign wealth funds. For both sovereign wealth funds and Resources Trusts, the focus would be on future welfare, coupled with a desire to impose minimal impact on the present. Most sovereign wealth funds seek to avoid engaging in macroeconomic policy-making.²³¹ Some sovereign wealth funds, including Norway's GPFG have some social policies embedded in their investment principles, such as "sustainable development in economic, environmental, and social terms."²³² But GPFG's focus remains fiscal probity, and excluding companies for social or environmental reasons is subject to a transparent and rigorous process.²³³ This is a governance model that might be adopted by Resources Trusts, as they try to avoid interfering with private markets that supply water, food, and energy.

²²⁵ *What is a Sovereign Wealth Fund?* SOVEREIGN WEALTH FUND INST., <https://perma.cc/57G6-Z587> (last visited Jan. 25, 2020).

²²⁶ Texas has used royalties from oil and gas extraction within the state to fund public primary, secondary, and university education. Royalties from oil and gas leases are invested in the Texas Permanent School Fund to be distributed to public primary and secondary schools throughout the state. Michael E. McClellan, *Permanent School Fund*, TEX. ST. HIST. ASS'N: HANDBOOK OF TEX. ONLINE, <https://perma.cc/ZRW4-U2TE> (last visited Jan. 25, 2020). Another portion of the same pool of royalties is invested in the Permanent University Fund (PUF), which supports the University of Texas and Texas A&M University. *The Permanent University Fund (PUF)*, UNIV. OF TEX. SYS., <https://perma.cc/LK5H-EDE2> (last visited Jan. 25, 2020).

²²⁷ Mehmet Caner & Thomas Grennes, *Sovereign Wealth Funds: The Norwegian Experience*, 33 *WORLD ECON.* 597, 599 (2010) ("The Norwegian government has acknowledged the transitory nature of oil revenue. Crude-oil production in the North Sea has been declining steadily since 2001, and oil prices have been extremely erratic. One purpose of the Fund is to allow Norwegians to smooth the pattern of their spending relative to the volatile pattern of the nation's oil revenue.").

²²⁸ ALASKA STAT. § 43.23.005-.295 (2018).

²²⁹ *Top 83 Largest Sovereign Wealth Fund Rankings by Total Assets*, SOVEREIGN WEALTH FUND INST., <https://perma.cc/5A8E-B8GY> (last visited Jan. 25, 2020).

²³⁰ *Id.*

²³¹ *What is a Sovereign Wealth Fund?*, SOVEREIGN WEALTH FUND INST., <https://perma.cc/5W6Q-37QE> (last visited Jan. 25, 2020).

²³² The Act on the Government Petroleum Fund (Act No. 36/1990) (Nor.); *as amended*, The Government Pension Fund Act (Act No. 123/2005) (Nor.), § 1-3(3).

²³³ Larry Catá Backer, *Sovereign Wealth Funds as Regulatory Chameleons: The Norwegian Sovereign Wealth Funds and Public Global Governance Through Private Global Investment*, 41 *GEO. J. INT'L L.* 425, 459-62 (2010).

The key difference between a sovereign wealth fund and a Resources Trust is that the latter has a much broader and more complicated mandate. A Resources Trust is a more ambitious undertaking than an investment vehicle, and one with more potential for mishap. While an investment trust (even a dividend-paying one) entails only the purchase and sale of mostly liquid financial instruments, a Resources Trust would require the acquisition of physical assets, many of them illiquid, and which would require a larger and more varied staff to manage it.

It is unfortunately well beyond the scope of this Article to set forth a detailed blueprint for a Resources Trust. The contribution of this Article is to provide the justification for a Resources Trust, and to lay out a skeletal proof of concept. I leave for future work a more detailed examination of the implementation issues inherent in a Resources Trust. In the meantime, this Article can define some of the contours of a Resources Trust to not only place limits on its operations, but also make explicit its objectives. This section explores three key parameters of a Resources Trust: the level of the chartering jurisdiction, governance, and the conditions under which a Resources Trust would enter and exit markets as a supplier of last resort.

A. What Government: State, Federal, or Regional?

A Resources Trust could be chartered at several different levels of government, and by several different types of government. For purposes of this Article, the most likely candidates are states, nations, and some collection of like-minded states or nations contracting to collectively constitute, fund, and operate a Resources Trust. To put it mildly, the political economy and political cultures of different jurisdictions vary widely, making the idea of a Resources Trust a nonstarter in one place and a no-brainer in another. But the realpolitik of climate change, and more prosaically, climate resilience, also undergoes rapid, unforeseeable changes,²³⁴ making it difficult to predict where the idea of a Resources Trust might catch on.

²³⁴ It would have been difficult, for example, to even imagine a high-cost “Green New Deal” emerging in the U.S. House of Representative before the 2018 elections. *See, e.g.,* Lisa Friedman, *Dianne Feinstein Lectures Children Who Want Green New Deal, Portraying It as Untenable*, N.Y. TIMES (Feb. 22, 2019), <https://perma.cc/U86C-WNYY> (noting twelve Democratic Senators support the Green New Deal). Florida Congressman Francis Rooney, one of the most conservative members of the Republican Party, has seen fit to co-sponsor a carbon tax bill with his Democratic colleague from Florida, Ted Deutch, one of the most liberal members of Congress. Nick Sobczyk, *Lawmakers Roll Out Landmark Bipartisan Carbon Bill*, E&E DAILY (Nov. 28, 2018), <https://perma.cc/HK2P-DA2S>.

1. *Federal Resources Trust*

Crucially relevant to this question of chartering government, of course, is the consideration of funding a Resources Trust, both as a start-up expenditure and as an ongoing expense of maintaining a standby source of water, food, and energy. Political flux notwithstanding, a congressional appropriation for a Resources Trust would still seem to be an implausibly heavy lift at this time.²³⁵ However, it is worth emphasizing that a core function of a Resources Trust is to head off potential violence associated with hoarding, so this kind of a project could interest officials in the Departments of Defense or Homeland Security, both of which enjoy deference in terms of congressional appropriations.²³⁶ Certainly, the Department of Defense, with its frequent exposure to violence from mass migrations, has a fairly long history of concern about climate change.²³⁷ And the Department of Homeland Security, which has been forced into the center of a contentious debate about migration,²³⁸ certainly has a mandate to monitor internal security risks, such as those posed by shortages and hoarding. So, it might not be fanciful to imagine finding a home for a Resources Trust within the Pentagon's \$700 billion budget,²³⁹ or in Homeland Security's \$47.5 billion budget.²⁴⁰

Other non-fiscal considerations point to the federal government as a good locus for a Resources Trust. The logistical challenges of actually distributing vital life staples to large populations is exactly what the

²³⁵ See, e.g., Dina Titus, *Is Congress the "Broken Branch" of Government?*, 49 POL. SCI. & POL. 490, 490 (2016), <https://perma.cc/68YB-AWVM> ("As a political scientist and a member of the House of Representatives, I have often lamented and been frustrated by the growing irrelevance of Congress.")

²³⁶ See, e.g., MARSHALL C. ERWIN & AMY BELASCO, CONG. RESEARCH SERV., INTELLIGENCE SPENDING AND APPROPRIATIONS: ISSUES FOR CONGRESS 4 (2013), <https://perma.cc/JV2Y-PBSQ> (noting that intelligence spending has doubled in real dollars since 2001); Veronique de Rugy, *What Does Homeland Security Spending Buy?* 2 (Am. Enter. Inst., Working Paper No. 107, 2005), <https://perma.cc/87RN-XHV5> (noting that the federal government spends \$50 billion on homeland security and only \$38 million on automobile safety, vehicles being the cause of many, many more deaths).

²³⁷ See, e.g., U.S. DEP'T OF DEF., NATIONAL DEFENSE STRATEGY 4–5 (2008), <https://perma.cc/B5JD-RHPG> ("Over the next twenty years physical pressures—population, resource, energy, climatic and environmental—could combine with rapid social, cultural, technological and geopolitical change to create greater uncertainty The interaction of these changes with existing and future resource, environmental, and climate pressures may generate new security challenges These risks will require managing the divergent needs of massively increasing energy demand to maintain economic development and the need to tackle climate change."). Given the secrecy of the Departments of Defense and Homeland Security, the concern almost certainly dates back much further.

²³⁸ Zolan Kanno-Youngs, *Homeland Security Chief Cites Top Threat to U.S. (It's Not the Border)*, N.Y. TIMES (Mar. 18, 2019), <https://perma.cc/DVM5-PWQ5>.

²³⁹ Christine Negroni, *Military Spending is Up but Aerospace and Defense Workers Are Scarce*, N.Y. TIMES (July 16, 2018), <https://perma.cc/WS4X-2E95>.

²⁴⁰ WILLIAM L. PAINTER, CONG. RESEARCH SERV., TRENDS IN THE TIMING AND SIZE OF DHS APPROPRIATIONS: IN BRIEF 7 (2019), <https://perma.cc/6MCF-M3BF>.

Department of Defense does so well when it administers humanitarian assistance.²⁴¹ Also, identifying its beneficiaries is a central task of a Resources Trust, and political units have the advantage of a tax base and an ascertainable population of beneficiaries. Few organizations are more effective at identifying its constituents than the Internal Revenue Service and the United States Census Bureau. Finally, constituting a Resources Trust at the federal level would take advantage of scale economies and of the diverse resources of the entire country, potentially shifting surplus resources in one part of the country to another in need.²⁴²

2. State Resources Trust

Although a Resources Trust at the federal level doubtless presents a number of advantages, it seems more politically realistic to consider the possibility of an individual state or group of states chartering a Resources Trust. Oversimplifying a bit, it is a contested but broadly-held view that Americans are more likely to prefer their state governments to the federal government for certain policy realms, including environmental policy.²⁴³ A state-level Resources Trust would at least avoid some of the obstacles of partisanship currently so dominant in Congress.

As noted above, sovereign wealth funds exist at the state level. Ten states, all mineral-producing, have used mineral severance taxes to fund sovereign wealth funds.²⁴⁴ Management of these funds can be contentious,²⁴⁵ but have avoided major controversies.²⁴⁶ The Alaska

²⁴¹ (NAME REDACTED), CONG. RESEARCH SERV., THE DEPARTMENT OF DEFENSE ROLE IN FOREIGN ASSISTANCE: BACKGROUND, MAJOR ISSUES, AND OPTIONS FOR CONGRESS 1 (2008), <https://perma.cc/QW62-JWKX> (“Since at least the 19th century, U.S. military forces have provided urgent assistance to foreign populations in time of disasters, such as earthquakes and floods. More recently, U.S. military forces have also provided aid in humanitarian crises such as famines and forced population movements. DOD aids foreign populations under authorities to conduct humanitarian assistance in a variety of other circumstances”).

²⁴² Inter-basin water transfers have often been proposed to move water from where it is abundant to where it is scarce. However, not only do these projects tend to be expensive, they also raise ecological concerns. See, e.g., Bryan R. Davies et al., *An Assessment of the Ecological Impacts of Inter-basin Water Transfers, and Their Threats to River Basin Integrity and Conservation*, 2 AQUATIC CONSERVATION: MARINE & FRESHWATER ECOSYSTEMS 325, 327 (1992) (“Any transfer of water within or between basins will have physical, chemical, hydrological and biological implications for both donor and recipient systems, as well as for their estuaries and local marine environments.”).

²⁴³ See, e.g., Cindy D. Kam & Robert A. Mikos, *Do Citizens Care About Federalism? An Experimental Test*, 4 J. EMPIRICAL LEGAL STUD. 589, 593 (2007); Robert A. Mikos, *The Populist Safeguards of Federalism?* 68 OHIO ST. L.J. 1669, 1700 (2007).

²⁴⁴ The states are Alaska, Texas, New Mexico, Wyoming, North Dakota, Alabama, Utah, Idaho, Louisiana, and West Virginia. SOVEREIGN WEALTH FUND INSTITUTE, *supra* note 229.

²⁴⁵ See, e.g., Nathaniel Herz, *Alaska House Votes to More Than Double PFDs, Splintering Majority and Threatening Budget Progress*, ANCHORAGE DAILY NEWS, (Mar.

Permanent Fund makes an annual distribution to every eligible resident of Alaska²⁴⁷ that is statutorily determined,²⁴⁸ but the amount available is itself sometimes a political matter.²⁴⁹ But this model of ministerial administration with occasional political oversight seems to have kept the Alaska Permanent Fund out of trouble.

The sovereign wealth fund phenomenon at the state level also suggests a possible funding source. It could be controversial, especially in the mineral-producing states, to redirect severance revenues towards a Resources Trust. But given that the purpose would still be to provide resources for its own citizens, it might not be prohibitively controversial, especially if a Resources Trust could avoid attaching itself to the politics of climate change.²⁵⁰ For that matter, states likely enjoy more freedom to increase existing taxes and create new ones, such as marijuana taxes.²⁵¹ While the idea of federal income tax increases remain politically noxious,²⁵² a number of states have enacted tax increases, some very red ones at that.²⁵³ Were a Resources Trust to draw upon a new or increased tax, states would seem to be a less contentious place to start.

Of course, chartering a Resources Trust at the state level would have concomitant drawbacks. A state Resources Trust may struggle to provide one or more life staples. In a drier era for Southwestern states,²⁵⁴ it could be a challenge for states such as Arizona and New

26, 2018), <https://perma.cc/L4AY-HMNA>. Some conservatives have argued that the dividend, on the order of \$1,000–\$2,000, provides a disincentive for work. Researchers have found no such employment effect of the dividend. Damon Jones & Ioana Elena Mariescu, *The Labor Market Impacts of Universal and Permanent Cash Transfers: Evidence from the Alaska Permanent Fund* 15 (Nat'l Bureau of Econ. Research Working Paper 24312, 2018), <https://perma.cc/QD4M-KSEA>.

²⁴⁶ See, e.g., EDWIN M. TRUMAN, PETERSON INST. FOR INT'L ECON., A BLUEPRINT FOR SOVEREIGN WEALTH FUND BEST PRACTICES 3 (2008), <https://perma.cc/ESQ5-DREE> (describing tensions raised by sovereign investing as “hypothetical.”).

²⁴⁷ ALASKA STAT. § 43.23.005 (2017).

²⁴⁸ *Id.* § 43.23.025.

²⁴⁹ Anchorage Daily News Editorial Bd., *5 Things You Might Not Know About the Alaska Permanent Fund Dividend*, ANCHORAGE DAILY NEWS (Oct. 2, 2018), <https://perma.cc/WZ5Q-7SFH>.

²⁵⁰ For example, Republican Florida Governor Ron DeSantis has created an Office of Resilience and Coastal Protection, which has the stated goal of helping “prepare Florida’s coastal communities and habitats for impacts from sea level rise” This is all done, however, without acknowledging the science of climate change. Jackie Flynn Mogensen, *The New Governor of Florida is Not the Environmental Disaster Everyone Thought He’d Be*, MOTHER JONES (Apr. 8, 2019), <https://perma.cc/XR28-HPRX>.

²⁵¹ Katharine Loughead & Morgan Scarboro, *How High Are Recreational Marijuana Taxes in Your State?*, TAX FOUND. (Apr. 26, 2018), <https://perma.cc/976G-MKKBG>.

²⁵² See, e.g., Monica Prasad, *Actually, It Was Democrats Who Killed the 70 Percent Tax*, POLITICO (Feb. 5, 2019) <https://perma.cc/V24E-HT2A>.

²⁵³ Six states raised income or other taxes in 2018: Hawai’i, Illinois, Kansas, Tennessee, South Carolina, and Oregon. Sean Williams, *6 States Raising Taxes in 2018*, MOTLEY FOOL (Dec. 12 2017), <https://perma.cc/N674-XZ35>.

²⁵⁴ Benjamin I. Cook et al., *Unprecedented 21st Century Drought Risk in the American Southwest and Central Plains*, 1 SCI. ADV. 1, 1 (2015), <https://perma.cc/HP4K-QKFM>.

Mexico to find ways to supply food or water. As noted above, efficiencies are possible, and some Resources Trusts may be well-advised to try and emulate the Netherlands in food-growing.²⁵⁵ But even some forward-thinking early adopters may have to look well beyond their borders for life staples. That in itself would be unremarkable. State sovereign wealth funds and state retirement pensions own a broad portfolio of assets spread across the globe.²⁵⁶ The Alaska Permanent Fund holds a variety of real estate assets, including shopping malls in Portugal, a Sam's Club in Houston, and 299 Park Avenue in New York City.²⁵⁷ And as noted above, water transfers involve exchanges that may place water rights claimed by one state in the aquifers or reservoirs of another.²⁵⁸ However, in a climate-changed future, markets could be less hospitable to out-of-state Resources Trusts.

Given the potential for state competition for resources, a state-level Resources Trust may give rise to migration or leakage problems. If shortages of life staples become a realistic possibility, the existence of a Resources Trust in some states but not others may spur one of two things: migration into states with Resources Trusts, or markets for life staples crossing state lines. If a Resources Trust is truly just another supplier in otherwise functional markets, then injecting supply into one state will inevitably result in some supply leaking into another state.

One response to the twin problems of migration and leakage is to simply accept them as inevitable but nonfatal problems of a state-level Resources Trust. As with the federal government, a state can ascertain its residents using federal income tax information. To the extent people actually uproot and change state residences to avail themselves of the safety net of a Resources Trust, it may just be considered the product of a healthy competition among states to attract residents. To discourage free-riding, funding for a state-level Resources Trust could be tied to state income, property, consumption taxes or any other creative new options, such as marijuana taxes. If a Resources Trust is truly just a supplemental source of supply, then it is possible that leakage could drive some life staples beyond state borders. That would be the logical consequence of allowing beneficiaries to re-sell their allotted resources.²⁵⁹ But if the objective is to guarantee state residents with needed resources, then leakage through re-selling would not pose a significant problem.

²⁵⁵ See *supra* notes 187–189 and accompanying text.

²⁵⁶ See, e.g., CAL. PUB. EMPS. RET. SYS., CALPERS FOR CALIFORNIA 2017, at 29 (2017), <https://perma.cc/9ND6-CLG4> (showing global equity investments).

²⁵⁷ *Real Estate Portfolio*, ALASKA PERMANENT FUND CORP., <https://perma.cc/L29X-RZL7> (last visited Jan. 25, 2020).

²⁵⁸ See *supra* notes 148–150 and accompanying text.

²⁵⁹ See *supra* Part V.

3. Regional Resources Trust

One way to both take advantage of economies of scale and to avoid dysfunctional federal politics is to establish a Resources Trust at a regional level. States contracting to pool resources and jointly operate a Resources Trust are effectively diversifying a resource base and pooling risk. Both enhance resilience. Examples of regional agreements abound. The Regional Greenhouse Gas Initiative (RGGI) is a common market of nine Mid-Atlantic and New England states to cap greenhouse gas emissions from their respective power sectors and allow the trading of emissions credits among electricity generators in those states.²⁶⁰

It is true that defection will always be a live possibility for a regional-level Resources Trust. The State of New Jersey withdrew from RGGI in 2011,²⁶¹ and now seeks to re-join.²⁶² Sudden changes in composition of member states of a regional Resources Trust could be disruptive. However, disruption costs can be contained, as they were in the case of New Jersey's withdrawal, and they may be less of a problem than the political obstacles at the federal level and the problems of small scale at the state level. A regional Resources Trust provides an alternative to a state or federal Resources Trust.

B. Sunrise, Sunset: When Resource Trusts Step In and Step Out

As conceived in this Article, a Resources Trust is a safety measure, not a pretense for a government-funded entity to usurp markets and assume control of food, water, and energy provision. State-owned enterprises, even in the United States, have sometimes crowded out private investment,²⁶³ sometimes wasted mind-boggling amounts of money,²⁶⁴ and sometimes both.²⁶⁵ That said, in order to possess the

²⁶⁰ *Elements of RGGI*, REG'L GREENHOUSE GAS INITIATIVE, <https://perma.cc/C52B-AGJ3> (last visited Jan. 25, 2020).

²⁶¹ BOB MARTIN, N.J. DEP'T OF ENVTL. PROT., NOTICE OF WITHDRAWAL OF AGREEMENT TO THE RGGI MEMORANDUM OF UNDERSTANDING (2011), <https://perma.cc/L4WX-KQDK>.

²⁶² *News Release: Governor Murphy Notifies RGGI Governors of New Jersey's Commitment to Rejoining Climate-Change Compact*, N.J. DEP'T OF ENVTL. PROT. (Feb. 26, 2018), <https://perma.cc/P74C-KFEF>.

²⁶³ Finance firms have long complained about competing with government-backed mortgage finance companies Fannie Mae and Freddie Mac, which take advantage of lower interest rates available to the U.S. government. *See, e.g.*, VIRAL V. ACHARYA ET AL., GUARANTEED TO FAIL: FANNIE MAE, FREDDIE MAC, AND THE DEBACLE OF MORTGAGE FINANCE 85 (2011).

²⁶⁴ The Federal Emergency Management Agency, or FEMA, is the frequent target of complaints about wasteful rebuilding of structures damaged by flooding, only to be rebuilt repeatedly in the same flood-prone places. *See, e.g.*, Kevin Sack & John Schwartz, *As Storms Keep Coming, FEMA Spends Billions in 'Cycle' of Damage and Repair*, N.Y. TIMES (Oct. 8, 2018), <https://perma.cc/5KF7-M23W> (describing numerous instances of wasteful rebuilding).

²⁶⁵ FEMA is wasteful, but it has also been asserted the FEMA also crowds out private insurance. Carolyn Kousky et al., *Does Federal Disaster Assistance Crowd Out Private Demand for Insurance?* 7 (Wharton Sch. of Bus., Working Paper No. 2013-10, 2013),

capacity to be a supplier of last resort, it must participate to some extent in the routine market provision of water, food and energy. Having the capacity to supply water, food, and energy requires a working infrastructure, and it would be wasteful for a Resources Trust to remain completely idle while it awaits a climate-induced shortage. Also, financially sustaining a Resources Trust and minimizing the cost to taxpayers would require that it defray costs by actually selling some goods, in preparation for the day that it must quickly ramp up production.

Oversimplifying a bit, a Resources Trust would operate in one of two modes: 1) in a shortage of one or more life staples, in which it will actively participate as a supplier of last resort, or what I will call “ON” mode; or 2) in the absence of a shortage, in standby mode, participating only marginally in markets but maintaining capacity to supply in much greater amounts, or what I will call “OFF” mode. A critical parameter is the definition of *triggers* that would require a Resources Trust should switch from OFF mode to ON mode, stepping in to supply and ease shortages. The equally important complement to that would be to define the trigger of when a Resources Trust should switch back to OFF mode, after the shortage abates.

What would those triggers look like? And with respect to which goods? Considering just food, would food hoarding target an individual crop? Or should a Resources Trust concern itself with a representative basket of important foods, as if it were the basis for a consumer price index for foods? What if shortages only existed for one food, or only a subset of foods in the basket? It is beyond the scope of this Article to provide specific answers, much less numeric criteria for switching to ON mode. However, it is worth laying out some principles that could form the basis of a charter for intervention by a Resources Trust.

First, the underlying motivation for a Resources Trust is to ensure reasonable access for beneficiaries, so that the touchstone for intervention ought to be the ability of individuals to obtain their needed food, water, and energy. While it is difficult to demarcate “access,” there are some ways to spot a *lack* of access. Long queues are a red flag. If time that might otherwise be spent productively is diverted to waiting in line for food, water, or gasoline, then a serious market failure has occurred. For energy, electricity outages are another sign of something amiss. Like queuing, outages affect productivity, and are serious enough to signal that access has been reduced too quickly for adjustments to take place.

Second, one of the most problematic aspects of hoarding is the phenomenon individuals or groups stocking up more than is needed for any reasonable time period of consumption. Not only is this costly and

<https://perma.cc/9WWR-F9NW>. States also offer disaster insurance against wind damage, which suffer from the same pathologies of wastefulness and crowding out private insurance. Carolyn Kousky, *Managing Natural Catastrophic Risk: State Insurance Programs in the United States*, 5 REV. ENVTL. ECON. & POL'Y 153, 153 (2011).

inconvenient for the hoarder, it is a concentration of resources when deconcentration is most needed. For vital life staples, the most efficient distribution of resources is an equitable one, and hoarding moves in exactly the opposite direction. The avoidance or reversal of hoarding is, after all, the *raison d'être* of a Resources Trust.

Finally, because the Resources Trust is conceived as a mechanism for augmenting supply, it follows that the criteria for shifting into ON mode should incorporate some market signals. One unmistakable signal that markets are amiss is a *rapid* increase in prices. The larger the increase and the shorter the time period, the more likely that an unexpected shortage has taken hold, leaving most with insufficient time to adapt. A rapid price increase would be a sign that hoarding has started or is imminent.

It is important to emphasize that it is the *rapidity* of a price increase, not just the magnitude of the price increase (although that is relevant), that raises the red flag of hoarding. Prices change in response to changing conditions, and climate change will certainly change conditions, so of course prices in a climate-changed future would be higher, reflecting greater scarcity and new supply challenges. Over time, consumers and producers will no doubt find ways to adjust, even if they fail to restore markets to the pre-climate-changed levels. But *rapid* price increases pose a threat to the stability of civil society.

How rapid is too rapid of a price increase, signaling the onset of hoarding? While again avoiding specifics, there are two aspects that signal trouble: 1) the magnitude of the price increase; and 2) the rapidity of the price increase. A quick and sudden but small change in prices need not concern the administrators of a Resources Trust. Also, a large price increase that evolves over a period of time may allow adjustments to take place and may, as noted above, simply reflect the physical realities of a climate-changed future. In neither case is intervention *necessarily* warranted. But if both are present, then intervention may be warranted. Taken together, these two considerations provide guidance for a Resources Trust in gauging the extent of shortfall, and whether or not to enter ON mode.

Conversely, a trigger for a Resources Trust switching back from ON mode to OFF mode would look like some sort of a return to normalcy for water, food, or energy markets. While a return to normalcy need *not* be a return to pre-crisis price levels, markets for life staples should be robust and stable. Ideally, prices should decline gradually, reflecting gains in efficiencies, healthy adjustments to climate-induced shortages and most importantly, restored access to vital life staples. At the very least, the three factors signaling trouble should be absent: there should be no queuing for any vital life staple, there should not be any concentration of possession of any vital life staples, and prices should be stable. These conditions might indicate that it is time for the Resources Trust to wind down.

Importantly, neither ON or OFF mode need be extreme modes of hyper-production or total dormancy. The job of a Resources Trust is to ensure broad access, but within the confines of markets. In order to minimize the cost, a Resources Trust should recoup the costs of acquisition and operation when and where it can. And even in ON mode, some demand must be met by private provision; even in OFF mode, a Resources Trust should be a market participant, even if marginally.

C. Governance and Oversight

Organizational governance is the subject of a dense and sprawling literature, in law and in other fields. At the risk of sounding repetitive and evasive, this Article will not attempt a comprehensive discussion of the myriad of governance issues arising in a Resources Trust. Nor would it be fruitful to dictate a governance structure for Resources Trusts; indeed, different jurisdictions may have different needs and different ideas about governance of a Resources Trust. Political variation may well give rise to different preferences regarding governance structure and oversight. Rather than lay out a list of possibilities, this section identifies several governance issues and some potential governance and oversight examples that might be applied to a Resources Trust.

To begin with, provision of water, food, and energy would likely necessitate the creation of three separate divisions, each with domain over one resource. While there would be overlap and hopefully cooperation between the three divisions, each division should have its own management objectives to provide guidance to the resource. In fact, a Resources Trust could actually be three separate trusts, one each for water, food, and energy.

The core duties of a Resources Trust are bound to be contentious and political, so governance is of vital importance. To consider possible governance structures for a Resources Trust, it is worth reviewing its duties. As conceived in this Article, a Resources Trust must carry out the following two fundamental tasks:

1) Acquire and manage the assets necessary to serve as a standby provider of last resort. It is no simple feat to consider how to hedge against a prevailing mode of provision of food, water, and energy. Deciding what assets to acquire—water options, land with surface water rights, or land with groundwater rights—how such assets would be put to use in the event of a climate-induced shortage, and how production could be stayed indefinitely while awaiting the inevitable shortage, are very demanding and complicated organizational mandates of a Resources Trust. It must do so while minimizing interference with existing markets. That is not to say that a Resources Trust must leave existing methods of provision *completely undisturbed*. Part of adaptation to climate change must include the wringing out some of the most blatant inefficiencies, such as growing alfalfa in the California Central Valley, and water policies that reward the most profligate water users with more water. But the mandate of a Resources Trust is not to remake existing systems of provision; existing

methods and private suppliers are still needed to supply life staples in a climate crisis. The mandate of a Resources Trust is to *underwrite* supply, undertaking those non-market tasks that existing suppliers eschew, for a lack of incentives. And because revenues for all kinds of government functions will be both more scarce and more important in the future, a Resources Trust must carry out its large mandate while minimizing taxpayer expense.

2) Decide when to supply in ON mode, and when to refrain in OFF mode.

As conceived in this Article, a Resources Trust is only a contingent supplier, so deciding when to switch to ON or OFF mode is a fundamental decision. Those two decisions define the boundaries of a Resources Trust: overbroad criteria for switching to ON mode would render a Resources Trust an industry behemoth; too narrow a set of criteria would render it feckless.

In addition to these weighty tasks, a Resources Trust must also carry out some more ministerial duties, such as identifying appropriate beneficiaries, keeping an accurate and transparent accounting, and distributing life staples in a shortage situation in an orderly fashion. Governance precedents for these less weighty matters are readily available. In addition, the best of these examples also provides a foundation for governing a Resources Trust. Several types of governance models are discussed below.

1. Sovereign Wealth Funds

Nothing quite like a Resources Trust has ever been proposed before outside of the context of centrally-planned economies, which have not generally turned out well. The closest non-Marxist analogues are sovereign wealth funds. Within that class, it is worth having a first look at the largest and probably the most lauded fund, Norway's \$1 trillion Government Pension Fund Global,²⁶⁶ which offers some lessons for both governance and oversight.

The fund is managed by Norway's central bank, Norges Bank, under the oversight of the Ministry of Finance.²⁶⁷ The management objective for the Norges Bank is to "seek to achieve the highest possible return after management costs measured in the [investment portfolio's] currency basket . . ." ²⁶⁸ and adds that a "good long-term return is considered dependent on sustainable development in economic, environmental and social terms, as well as well-functioning, legitimate and efficient markets."²⁶⁹ There are other, more detailed restrictions

²⁶⁶ See, e.g., Gordon L. Clark & Ashby Monk, *The Norwegian Government Pension Fund: Ethics Over Efficiency*, 3 ROTMAN INT'L J. PENSION MGMT. 14, 14 (2010) ("The fund . . . is widely recognized as transparent and well governed.")

²⁶⁷ The Act on the Government Petroleum Fund (Act No. 36/1990) (Nor.); *amended*, The Government Pension Fund Act (Act No. 123/2005) (Nor.), <https://perma.cc/RP87-ATMQ>.

²⁶⁸ *Id.* § 1-1(1).

²⁶⁹ *Id.* § 2-1.

such as benchmark indices,²⁷⁰ but otherwise, the actual operational decisions of the fund are left to a fairly familiar corporate structure of an executive board overseeing executives and a collection of committees and bank staff.²⁷¹

A Norwegian central bank was never going to be rife with corruption, but even by Scandinavian standards, the fund has been uncannily free of controversy.²⁷² Two features of the fund that receive praise are its transparency and accountability.²⁷³ Reports are frequent and detailed, with explanations of changes in investment strategies.²⁷⁴ The Fund explains to the Finance Minister reasons for significant changes to investment strategy.²⁷⁵ The same plaudits of transparency and efficiency are also frequently given to the Alaska Permanent Fund, which also adopts a similar level of legislative oversight.²⁷⁶

Sovereign wealth funds offer one template for governance of a Resources Trust. A similarly transparent and cautious approach to oversight would seem to be warranted for a Resources Trust. But more is required, as a Resources Trust requires not just investment expertise, but expertise in the provision and distribution of water, food, and energy. Moreover, the expertise must expand beyond financial matters but also technical, legal and policy aspects. A Resources Trust likely requires an organizational form capable of undertaking more complicated and more politically sensitive actions than just maximizing investment wealth.

2. Publicly-Chartered Corporations

Incorporated government entities are thought to be sometimes more efficient than administrative agencies for delivering certain public goods.²⁷⁷ This is especially true if carrying out some public function requires a large amount of private transacting, such as lending, borrowing, or insuring. Carrying out transactions that are considered routine in the private sector could be onerous if subject to federal or

²⁷⁰ Investments in European markets (including Norway) must be weighted 2.5 times that of investments in the United States and Canada. *Id.* § 3-3(2). The ratio of government bonds to private bonds must be 70:30. *Id.* § 3-2(1). Equities must constitute 50–80% of the portfolio. *Id.* § 3-4(1).

²⁷¹ *Governance Model*, NORGES BANK, <https://perma.cc/BD8F-AYH7> (last updated Apr. 26, 2019).

²⁷² See, e.g., Clark & Monk, *supra* note 266, at 18 (“In the case of GPF, it is apparent that public and political legitimacy currently trumps functional legitimacy. As such, the fund still enjoys widespread support.”); Backer, *supra* note 233, at 452 (“One of the most distinguishing, and lauded, features of the GPF is its transparency.”).

²⁷³ Clark & Monk, *supra* note 266, at 17.

²⁷⁴ Backer, *supra* note 233, at 452.

²⁷⁵ The Government Pension Fund Act § 2-2(3).

²⁷⁶ Landry Signé, *Africa’s Natural Resource Revenue for All: The Alaska Fund Dividend Model*, BROOKINGS INST.: AFRICA IN FOCUS (June 26, 2018), <https://perma.cc/6J43-U2PL>.

²⁷⁷ A. Michael Froomkin, *Reinventing the Government Corporation*, 3 U. ILL. L. REV. 543, 557–58 (1995).

state administrative law. Incorporation matches up with the concept of a Resources Trust because while the objective is one of public policy—being a supplier of last resort—the means for being able to do so involves a considerable amount of commercial activity that is best freed from most restrictions of administrative law.

Federal government corporations, or “FGCs,” have been part of United States legal landscape for over 200 years.²⁷⁸ Over that time, federal corporations have assumed a wide variety of forms with a wide variety of governance structures. Some are wholly-owned by the federal government, and are thus subject to most Administrative Procedure Act requirements.²⁷⁹ Some are under private ownership, usually with publicly traded shares, but still generally permit some federal officials to appoint some of the directors.²⁸⁰ These include some of most controversial corporations, such as Fannie Mae and Freddie Mac, which played a large role in the 2008 Financial Crisis that nearly brought down a global economy.²⁸¹

Federal government corporations such as Fannie Mae and Freddie Mac, sometimes called “Government Sponsored Enterprises,” or “GSEs,”²⁸² often have special lending powers and borrowing advantages that give it a competitive advantage over private firms. GSEs benefit from an implicit guarantee that if the GSE were ever in danger of default on its obligations, the federal government would inject money to keep it solvent.²⁸³ Because of this implicit guarantee, GSEs like Fannie Mae and Freddie Mac could borrow on terms much more favorable than private finance firms, significantly reducing its borrowing costs.²⁸⁴ However, if the objective is to ensure a robust market in home mortgages (with the ultimate objective of making home ownership available to as many Americans as possible),²⁸⁵ then the “crowding out”

²⁷⁸ *Id.* at 547.

²⁷⁹ *Id.* at 554–55.

²⁸⁰ *Id.* at 555.

²⁸¹ The multitude of causes of the Financial Crisis are still hotly debated, and the extent to which malfeasance by Fannie Mae and Freddie Mac contributed is still contested. However, even the most benign accounts place significant blame at the feet of Fannie Mae and Freddie Mac. *See, e.g.*, Brett McDonnell, *Don't Panic! Defending Cowardly Interventions During and After a Financial Crisis*, 116 PA. ST. L. REV. 1, 65 (2011).

²⁸² *See id.* at 12.

²⁸³ Richard A. Epstein, *The Government Takeover of Fannie Mae and Freddie Mac: Upending Capital Markets with Lax Business and Constitutional Standards*, 10 N.Y.U. J.L. & BUS. 379, 385 (2014).

²⁸⁴ Fromkin, *supra* note 277, at 600.

²⁸⁵ *See, e.g.*, Christopher L. Peterson, *Fannie Mae, Freddie Mac, and the Home Mortgage Foreclosure Crisis*, 10 LOY. J. PUB. INT. L. 149, 163 (2009) (“Although purchasing risky securities had never been the mission of the two special companies, management justified this significant shift in their method of and standards for acquiring mortgage loans by explaining that the investments were profitable and furthered their mission of providing support for home ownership.”).

of some private activity²⁸⁶ might be deemed preferable to having it be undersupplied by a purely private market.²⁸⁷

GSEs such as Fannie Mae and Freddie Mac offer a functional analog to a Resources Trust, because of the potential for the crowding out of private activity. Economic analyses seem to indicate that as a pure crowding-out matter (not taking into account the role of the GSEs in the Financial Crisis), the “substitution cost” of having government-sponsored lending is fairly low.²⁸⁸ At least before the financial crisis, tolerating this cost as a tradeoff for broadening home ownership was deemed to be worthwhile, if still controversial.²⁸⁹ A Resources Trust could well be conceived to be more efficient for providing water, food, and energy, but this Article is very consciously *not* proceeding from the premise that private provision should be supplanted.

For that reason, Fannie Mae and Freddie Mac, and GSEs generally, offer at best an incomplete template for governance of a Resources Trust. The critical decisions made by a Resources Trust—how to accumulate assets, and when to enter and exit markets—are potentially contentious decisions that should have a political component. As conceived in this Article, minimizing interference with private markets is core precept of a Resources Trust. At the same time, the purpose of a Resources Trust is to be able to act as a supplier of last resort, so it must be able to carry out the numerous and sometimes complicated transactions to acquire the needed assets.

3. A Synthetic GSE, and More Cautionary Tales

Much work is to be done in terms of acquiring and managing assets, and much work would need to be done once a Resources Trust enters ON mode to quell any climate-induced shortages. It seems unrealistic to expect the sovereign wealth fund model alone to serve as a template, as the business of a Resources Trust is more complicated and more contentious than that of even a \$1 trillion sovereign wealth fund. At the same time, a Resources Trust cannot be the given free reign that some GSEs have been given to do business and compete as if they were just another market participant. As should be clear by now, a Resources Trust is not just another market participant. The answer is to combine some form of a public corporation with the oversight commonly associated with sovereign wealth funds.

Along with Fannie Mae and Freddie Mac, other GSEs are tasked with more complicated mandates, and may therefore provide more

²⁸⁶ Zachary J. Gubler, *Public Choice Theory and the Private Securities Market*, 91 N.C. L. REV. 745, 799–802 (2013).

²⁸⁷ Andrea J. Boyack, *Laudable Goals and Unintended Consequences: The Role and Control of Fannie Mae and Freddie Mac*, 60 AM. U. L. REV. 1489, 1526 (2013).

²⁸⁸ CONG. BUDGET OFFICE, CONTROLLING THE RISKS OF GOVERNMENT-SPONSORED ENTERPRISES 18–19 (1991), <https://perma.cc/FN2S-HXY7>.

²⁸⁹ See, e.g., McDonnell, *supra* note 281, at 65.

nuanced exemplars. The Tennessee Valley Authority (TVA) is one illustrative example, as it was charged with no less than “improv[ing] the navigability and to provide for the flood control of the Tennessee River . . . provid[ing] for reforestation and the proper use of marginal lands in the Tennessee Valley . . . [and] provid[ing] for the agricultural and industrial development of said valley”²⁹⁰ The TVA has not only carried out these mandates but parlayed its mandate to provide for “industrial development” into the largest public utility and one of the largest electricity generators in the United States, with twenty-nine hydroelectric dams, six coal-fired power plants, seventeen natural gas-fired power plants, and some nuclear and renewable capacity.²⁹¹ At its formation and for years afterwards, the TVA was controversial, as private electricity generation companies chafed at the low electricity prices offered by TVA.²⁹² It was common for politicians to inveigh against the TVA as “socialist.”²⁹³ This criticism was not baseless: for sixty years following the Tennessee Valley Authority Act, Congress appropriated billions of dollars for the TVA, and the TVA enjoys continuing subsidies in the form of state and federal tax exemptions.²⁹⁴ Nevertheless, as the Tennessee Valley Authority Act vested the TVA with a corporate form, with the capacity to sue and be sued, conflicts were reduced to a commercial or competitive context.²⁹⁵ The constitutionality of the TVA was upheld in *Ashwander v. Tennessee Valley Authority*,²⁹⁶ putting to rest any doubt about the capacity of Congress to create the TVA.²⁹⁷

The TVA offers illustrative lessons for a Resources Trust. First, where the political will exists to undertake a large project—in the case of the TVA, rural development, and in the case of a Resources Trust, emergency provisions of water, food, and energy—a public corporation serves as a suitable vehicle for carrying out the project. In the TVA, Congress accomplished its objective of rural electrification and development.²⁹⁸ Again, that is not to say that it did so without controversy, or even effectively;²⁹⁹ this Article most emphatically does

²⁹⁰ Tennessee Valley Authority Act, 16 U.S.C. § 831–831cc (1933).

²⁹¹ *Our Power System*, TENN. VALLEY AUTH., <https://perma.cc/4PC7-RYEK> (last updated June 10, 2019).

²⁹² *TVA, HISTORY* (Aug. 3, 2017), <https://perma.cc/MC5M-DTDS> (last visited Jan. 25, 2020).

²⁹³ *Id.*; President Dwight D. Eisenhower, even while striking a compromise to extend the Tennessee Valley Authority Act, lamented the TVA as an example of “creeping socialism.” *The Great Compromise*, TENN. VALLEY AUTH., <https://perma.cc/R3DH-D8KJ> (last visited Jan. 25, 2020).

²⁹⁴ Jim Powell, *How Big Government Infrastructure Projects Go Wrong*, REASON (Mar. 2, 2009), <https://perma.cc/2EWV-E8E9>.

²⁹⁵ David E. Lilienthal & Robert H. Marquis, *The Conduct of Business Enterprises by the Federal Government*, 54 HARV. L. REV. 545, 567–68 (1941).

²⁹⁶ 297 U.S. 288, 339 (1936).

²⁹⁷ *Id.* at 338–39.

²⁹⁸ *TVA*, *supra* note 292.

²⁹⁹ *Id.*

not take the position that the TVA was a success, however that might be measured. But as a matter of legislative delegation, the TVA carried out its Congressional mandates even while severely ruffling feathers by stepping into private markets as a GSE with numerous competitive advantages. The corporate form had a way of normalizing conflicts within the framework of business-to-business litigation, not odious administrative law litigation.

Second, the TVA, along with Fannie Mae and Freddie Mac, holds a cautionary note about the potential for a GSE to grow beyond its original mandate. In retrospect, it might have seemed wise for Congress to have inserted some words of limitation in their organic acts, placing some bounds on exactly how and how much a GSE might grow. In the case of Fannie Mae and Freddie Mac, the promotion of home ownership was judged to be a great enough public good to tolerate the market distortions; even before the Financial Crisis, that judgment appeared tenuous.³⁰⁰ The TVA, too, was vested with broad powers with few limitations to build and operate dams for the purposes of developing the Tennessee Valley for navigation, flood control, and electricity generation,³⁰¹ which were judged to be worth the economic inefficiencies.³⁰² There have been prominent detractors, too, of that judgment.³⁰³

GSEs often allow the executive or legislative branches to appoint members of its board of directors,³⁰⁴ but the Norwegian example suggests that oversight might fruitfully be more proactive. Significant deviations or changes in strategy of a Resources Trust can and should be explained to either a legislative body or an executive official, the way that Norges Bank must explain to the Norwegian Finance Minister any changes to its investment strategy.³⁰⁵ Routinizing communication between a Resources Trust and its political overseers would not only provide some guardrails for excessively adventurous measures, but also

³⁰⁰ See, e.g., Froomkin, *supra* note 277, at 584 (noting that Fannie Mae was implicated in the Savings and Loan crisis of the early 1990s); McDonnell, *supra* note 281, at 65 (“I say eliminate Fannie Mae and Freddie Mac. They once served a purpose, helping to make mortgages cheaper and develop the securitization market. But now private institutions and markets are well developed and capable of handling the mortgage market. Continued government involvement simply creates moral hazard due to the implicit guarantee of bailouts and leads to too many resources going into the housing market.”).

³⁰¹ Tennessee Valley Authority Act of 1933, 16 U.S.C. § 831 (2012).

³⁰² Deborah Groban Olson, *Fair Exchange: Providing Citizens with Equity Managed by a Community Trust, in Return for Government Subsidies or Tax Breaks to Business*, 15 CORNELL J.L. & PUB. POL’Y 231, 259 (2006).

³⁰³ JANE JACOBS, *CITIES AND THE WEALTH OF NATIONS* 110–23 (1984); Powell, *supra* note 294.

³⁰⁴ Froomkin, *supra* note 277, at 573 (noting that the President appoints a number of Fannie Mae’s directors); FLA. STAT. § 627.351(6)(c)4.a. (2018) (setting forth the Florida officers powers to appoint directors of the Citizens Property Insurance Corp.).

³⁰⁵ The Act on the Government Petroleum Fund (Act No. 36/1990) (Nor.); *amended*, The Government Pension Fund Act (Act No. 123/2005) (Nor.), at § 1-5(1)–(2) <https://perma.cc/ZM4K-V4FY>.

provide the measure of transparency that has kept many sovereign wealth funds out of trouble.

Because operation of a Resources Trust is apt to be more controversial than that of a sovereign wealth fund, oversight might be made even more robust. Under the Federal Reserve Act,³⁰⁶ the twelve independent Federal Reserve Banks are governed by a nine-member board of directors, three of which are appointed by the Board of Governors of the Federal Reserve System,³⁰⁷ and six of which are selected by the regulated commercial banks themselves.³⁰⁸ While this has the interesting feature of regulated parties controlling their regulators, the lesson might be useful: a diversification of overseers might usefully constrain a Resources Trust from trampling on private markets. Representation on the board of directors of a Resources Trust might include stakeholders from energy providers (public and private electricity providers, for example), water providers (irrigation districts and other public water districts), and agriculture (state and county farm bureaus and university extension specialists).

In addition, the complexity of mandate for a Resources Trust demands that the organic statute contain some additional words of limitation. It is insufficient to allow a Resources Trust to run free like many GSEs have done in the past.³⁰⁹ In particular, the sensitive decisions to ramp up into ON mode or wind down into OFF mode are likely to be fraught ones. Even vague standards would make clear that a Resources Trust is to do two things: 1) assemble the capacity to be a supplier of water, food, and energy, and 2) do so while minimizing interference with private markets. At the very least, words of limitation could provide standards by which courts can adjudicate questions of whether a Resources Trust has exceeded its bounds, in the process building up a body of law that could further guide operation.

Deference is surely called for; a Resources Trust requires not just investment expertise, but expertise in the provision and distribution of water, food, and energy. Moreover, the expertise must expand beyond technical matters but also legal and policy aspects. But because of the potential for interference with markets for water, food, and energy, robust oversight must be ever-present, if infrequently to micro-manage.

VII. CONCLUSION

A benign adaptation may involve prices for life staples that rise gradually, in which case adjustment would be possible. But the multifaceted way that climate change can strike, and the suddenness of events, pose the distinct risk that access to life staples, even in a

³⁰⁶ Federal Reserve Act, Pub. L. No. 63–43, 38 Stat. 251 (1913).

³⁰⁷ 12 U.S.C. § 302 (2012).

³⁰⁸ *Directors of the Federal Reserve Banks and Branches*, FED. RESERVE, <https://perma.cc/L6AJ-BYKU> (last visited Jan. 25, 2020).

³⁰⁹ See Powell, *supra* note 294.

wealthy country such as the United States, can dry up quickly. Water, food, and energy shortages occur, even in the United States, and markets are no guarantee that rising prices can provide early warnings. Climate change threatens to make shortages more frequent, more severe, and longer, and overwhelm the ability of markets to assimilate information. A Resources Trust can head off these shortages and fend off unrest by becoming a supplier of last resort. By providing a credible assurance that every person within a chartering jurisdiction can lay claim to an adequate amount of vital life staples, the impetus to hoard can be greatly reduced.

The Resources Trust proposed in this Article is an ambitious undertaking. Except in centrally-planned economies, which in this author's view have mostly ended dramatically in failure,³¹⁰ it has never before been proposed that a democratic government take preparatory steps to be a supplier of last resort for vital life staples. Considerable precautions must be taken to avoid repeating the miseries of Bolshevism and Moaism. But a Resources Trust itself is a necessary precaution against a climate dystopia that could well be even worse than the ravages of extreme socialism.

³¹⁰ A debate about the merits of socialist, centrally-planned economies is well beyond the scope of this Article, but the curious reader might start with David Lipton & Jeffrey Sachs, *Creating a Market Economy in Eastern Europe: The Case of Poland*, in BROOKINGS PAPERS ECONOMIC ACTIVITY 75 (William C. Brainard & George L. Perry eds., 1990).