Our Children's Trust
P.O. Box 5181
Eugene, OR 97405

April 14, 2021

Chairman Pallone and Ranking Member McMorris Rodgers, House Committee on Energy and Commerce

Re: Materials for April 15, 2021 Hearing on "The CLEAN Future Act and Environmental Justice: Protecting Frontline Communities"

Chairman Pallone and Ranking Member McMorris Rodgers,

On behalf of Our Children's Trust ("OCT"), a nonprofit organization dedicated to securing the legal right to a stable climate for youth and future generations, please find enclosed herewith materials for your consideration relevant to the Subcommittee's April 15, 2021 hearing on "The CLEAN Future Act and Environmental Justice: Protecting Frontline Communities."

Through youth-led constitutional legal actions, including *Juliana v. United States* – the landmark federal constitutional climate case – OCT supports youth seeking to hold their governments accountable for policies and actions that have caused, and continue to cause, the climate crisis. Through these actions, youth seek science-based remedies to reduce greenhouse gas emissions at rates necessary to protect their fundamental human rights. We write in the interest of our Nation's youth and posterity to advise the Committee to align its legislation with protecting the fundamental constitutional rights of children, such as children within environmental justice communities, including communities of color, low-income communities, and indigenous communities. The social and physical scientific experts are clear that if you focus your efforts on protecting children within environmental justice communities, the entire community reaps the benefits.

It is OCT's understanding that the materials and testimony submitted for the April 15 hearing will inform the Committee's proposed legislation for a transition to a clean energy economy while protecting frontline communities. Given our mission and our work representing youth in frontline communities, OCT has a substantial interest in ensuring that any such legislation is consistent with what the best available science dictates is necessary to stabilize the climate system and protect the fundamental rights of youth and future generations. We invite you to consult the materials enclosed herewith, which demonstrate that climate change is already

affecting the fundamental rights of young people in the United States and that a transition to a 100 percent clean energy economy across all sectors by no later than 2050 is necessary to protect the fundamental rights of youth and future generations.

Children are uniquely vulnerable to human-caused climate change and other forms of environmental pollution because of their developing bodies, higher exposure to air, food, and water per unit body weight, unique behavior patterns, dependence on caregivers, and longevity on the planet.[1] Young people are often on the frontlines of human rights abuses, experiencing the most severe impacts of bigotry, oppression, and violence, sometimes in their own homes and often at the hands of adults in positions of power who do not act in the best interest of children. They are also inevitably at the forefront of the movements that emerge to address these issues, as we saw in the Child Labor Law Movement or the Civil Rights Movement. As such, children's rights and well-being must dictate the environmental justice strategies in the proposed legislation that the Committee considers.

Enclosed as **Exhibit A** you will find a document entitled "Government Climate and Energy Actions, Plans, and Policies Must Be Based on a Maximum Target of 350 ppm Atmospheric CO_2 and 1°C by 2100 to Protect Young People and Future Generations." This document details the scientific basis underlying, and prescription for, stabilization of the climate system as necessary to protect the fundamental human rights of youth and future generations relative to the climate crisis, particularly youth in frontline communities. Enclosed as **Exhibit B.1** is an executive summary entitled "350 PPM Pathways for the United States," which demonstrates multiple technologically and economically feasible pathways for transitioning to a 100 percent clean energy economy consistent with the science-based prescription for stabilizing the atmosphere and securing the fundamental rights of youth and future generations. Enclosed as **Exhibit B.2** is an executive summary entitled "350 PPM Pathways for Florida" that mirrors the national study's target. Updated national data is included in the full report as the U.S. model was upgraded to reflect the newer and even lower costs for renewable technologies. The U.S. data from the Technical Supplement (starting on page 71) is also included under this Exhibit. Enclosed as **Exhibit C** is the Congressional testimony of *Juliana* plaintiff Aji Piper when he testified at the first hearing of the House's Climate Crisis Select Committee. Enclosed as **Exhibit D** is the Congressional testimony of *Juliana* plaintiff Vic Barrett.

[1] Samantha Ahdoot, Susan Pacheco & Council on Environmental Health, *Global Climate Change and Children's Health*, 136 Pediatrics e1468 (2015); RP Philipsborn & K Chan, *Climate Change and Global Child Health*, 141 Pediatrics e20173774 (2018); PE Sheffield & PJ Landrigan, *Global Climate Change and Children's Health: Threats and Strategies for Prevention*, 119 Envtl. Health Persp. 291 (2011).

A transition off of our national fossil fuel energy system to a 100 percent clean economy is urgently needed to protect the fundamental rights of young people living in frontline communities. Any legislation providing for such a transition must ensure emissions reductions and sequestration of excess CO_2 consistent with what the best available science dictates is necessary for the protection of such fundamental rights. The information in these Exhibits are additionally relevant to a forthcoming reintroduction of a House concurrent resolution, Children's Fundamental Rights and Climate Recovery (H.Con.Res.119), sponsored by Representatives Schakowsky, Rush and Jayapal, supporting the Juliana youth plaintiffs. It recognizes the disproportionate effects of the climate crisis on children and their fundamental rights which demands U.S. leadership and development of a national science-based climate recovery plan.

Should you have any questions regarding the enclosed materials, please feel free to contact Liz Lee, OCT's government affairs staff attorney at liz@ourchildrenstrust.org.

Sincerely,

/s Julia Olson
Julia Olson
Executive Director
Our Children's Trust

Enclosures:
Exhibit A: Government Climate and Energy Policies Must Target <350 ppm Atmospheric CO2 by 2100 to Protect Children and Future Generations (March 2021)
Exhibit B.1: 350 PPM Pathways for the United States, Executive Summary
Exhibit B.2: 350 PPM Pathways for Florida (2020), Executive Summary and U.S. data from the Technical Supplement, Evolved Energy Research
Exhibit C: Congressional Testimony of Aji Piper
Exhibit D: Congressional Testimony of Vic Barrett

Exhibit A:

Government Climate and Energy Policies Must Target <350 ppm Atmospheric CO_2 by 2100 to Protect Children and Future Generations (March 2021)

Government Climate and Energy Policies Must Target <350 ppm Atmospheric CO_2 by 2100 to Protect Children and Future Generations (March 2021)

INTRODUCTION

Human laws can adapt to nature's laws, but the laws of nature will not bend for human laws. Government climate and energy policies **must** be based on the best available science to protect our climate system and vital natural resources on which human survival and welfare depend, and to ensure the fundamental rights of young people and future generations are protected.

Because carbon dioxide (CO_2) is the primary driver of Earth energy imbalance (EEI), climate destabilization, and ocean warming and acidification, all government policies regarding CO_2 emissions and CO_2 sequestration should be aimed at reducing global CO_2 concentrations **below 350 parts per million (ppm) by 2100**. Global mean atmospheric CO_2 levels, as of 2020, are approximately 412 ppm and rising.[1] With timely action, an emission reductions and sequestration pathway back to <350 ppm could limit peak warming to approximately 1.3°C this century and stabilize long-term heating this century at ~1°C above pre-industrial temperatures with further reductions next century. The temperature of the Earth, much like sea level rise, is a measurable indicator of the CO_2 problem, but it is not a good metric for solving it. EEI and CO_2 levels provide measurable standards, with CO_2 emission reductions and sequestration the measurable means to meet those standards.

As explained in more detail below, there are numerous scientific bases and lines of evidence supporting setting <350 ppm by 2100 as the uppermost safe limit for atmospheric CO_2 concentrations and global warming. Beyond 2100, atmospheric CO_2 may need to return to well below 350 ppm and closer to the preindustrial level of ~280 ppm to prevent the complete melting of Earth's ice sheets and protect coastal cities from sea level rise. Fortunately, it is still not only technically and economically feasible to return to <350 ppm by 2100, but transitioning to clean energy sources will provide significant economic and public health benefits and improve quality-of-life.

WHY GOVERNMENTS MUST AIM FOR <350 PPM AND RESTORING EARTH ENERGY BALANCE

Three lines of robust and conclusive scientific evidence, based on the paleo-climate record and real-world observations, show that above an atmospheric CO_2 concentration of 350 ppm there is: 1) significant Earth energy imbalance; 2) massive ice sheet destabilization and sea level rise; and 3) ocean warming and acidification resulting in the bleaching death of coral reefs and other marine life.

[1] Ed Dlugokencky & Pieter Tans, NOAA/GML, www.esrl.noaa.gov/gmd/ccgg/trends/.

1) Earth Energy Imbalance

Scientists say the "Earth energy imbalance (EEI) is the most critical number defining the prospects for continued global warming and climate change."[2] "Stabilization of climate, the goal of the universally agreed United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and the Paris Agreement in 2015, requires that EEI be reduced to approximately zero to achieve Earth's system quasi-equilibrium."[3] Earth's energy flow is significantly out of balance. Because of a buildup of CO_2 (and to a lesser extent other greenhouse gases) in our atmosphere, due to human activities, primarily the burning of fossil fuels and deforestation,[4] more solar energy is retained in our atmosphere and less energy is released back into space.[5] (Figure 1.)[6] The measured imbalance from 2010-2018 (0.87±0.12 Wm^{-2}) was approximately double the imbalance from 1971-2018.[7]

Returning CO_2 concentrations to below 350 ppm would restore the energy balance of Earth by allowing as much heat to escape into space as Earth retains, an important historic balance that has kept our planet in the sweet spot for the past 10,000 years, supporting stable sea levels and coastlines, enabling productive agriculture, and allowing humans and other species to thrive.[8] The paleo-climate record shows that CO_2 levels, temperature, and sea level all move together (see Figure 2). Humans have caused CO_2 levels to shoot off the chart (circled in red), rising to levels unprecedented over the past 3 million years, and causing the Earth energy imbalance.[9]

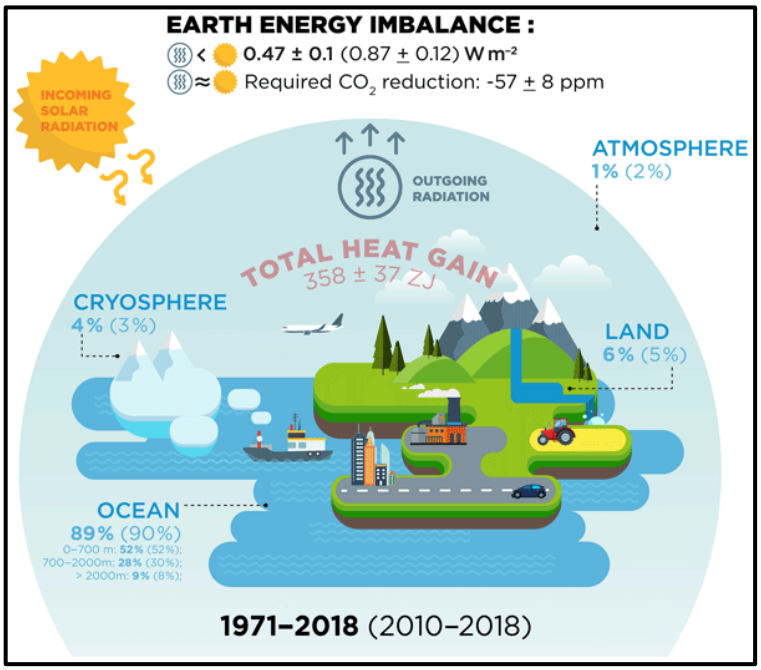

Figure 1: Earth heat inventory for Earth energy imbalance at the top of the atmosphere.

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[2] Karina von Schuckmann et al., *Heat Stored in the Earth System: Where Does the Energy Go?*, 12 Earth Syst. Sci. Data. 2013 (2020) [hereinafter *Heat Stored in the Earth System*] (written by 38 international experts, including lead IPCC authors).
[3] *Id.*
[4] IPCC, *Summary for Policymakers, in* Climate Change 2014: Synthesis Report (2014).
[5] James Hansen et al., *Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, 8 PLOS ONE e81648 (2013) [hereinafter *Assessing "Dangerous Climate Change"*].
[6] von Schuckmann, *Heat Stored in the Earth System.*
[7] *Id.*
[8] James Hansen, *Storms of My Grandchildren* 166 (2009).
[9] M. Willeit et al., *Mid-Pleistocene Transition in Glacial Cycles Explained by Declining CO_2 and Regolith Removal*, 5 Science Advances eaav7337 (2019).

2) Ice Sheets and Sea Level Rise

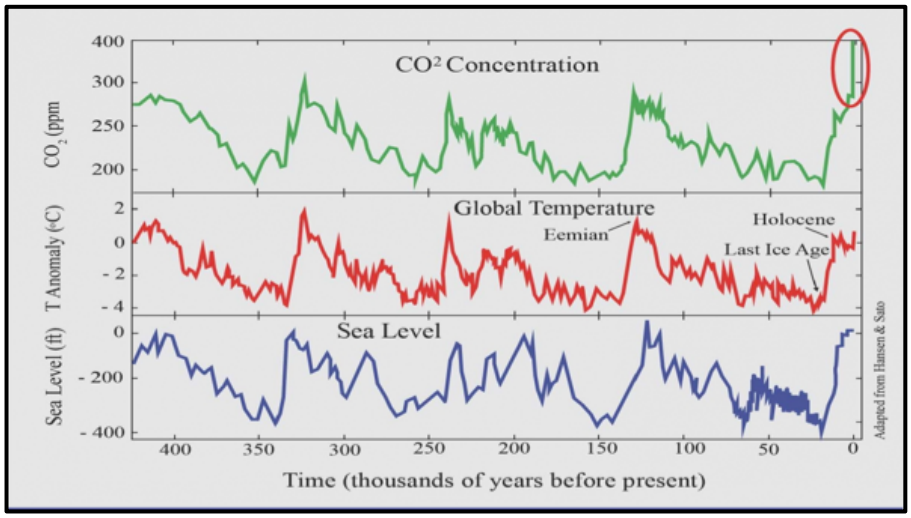

Figure 2: Evidence from the paleo-climate record showing the relationship between CO_2 concentration, global temperature, and sea level.

The last time the ice sheets appeared stable in the modern era was in the 1980s when the atmospheric CO_2 concentration was below 350 ppm. The consequences of >350 ppm and >1°C of warming are already visible, significant, and dangerous for humanity. With just over a global average 1°C of warming, glaciers in all regions of the world are shrinking, and the rate at which they are melting is accelerating.[10] Large parts of the Greenland and Antarctic ice sheets, which required millennia to grow, are teetering on the edge of irreversible disintegration, a point that, if reached, would lock-in major ice sheet mass loss, sea level rise of many meters, and worldwide loss of coastal cities – a consequence that would be irreversible on any timescale relevant to humanity (see Figure 3).[11] Greenland's ice sheet melt is currently occurring faster than anytime during the last three and a half centuries, with a 33% increase alone since the 20th century.[12] From 1994 to 2017, the Earth lost 28 trillion tonnes of ice, with the rate of ice loss increasing by 57% compared to the 1990s.[13] The paleo-climate record shows the last time atmospheric CO_2 levels were over 400 ppm, the seas were **70 feet higher** than they are today and heating consistent with CO_2 concentrations as low as 450 ppm may have been enough to melt almost all of Antarctica.[14] While many experts are predicting multi-meter sea level rise this century, even NOAA's modest estimate of 5-8.2 feet (1.5-2.5 m) global mean rise by 2100[15] would impact millions of Americans (see Figure 4).[16]

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[10] M. Zemp et al., *Global Glacier Mass Changes and their Contributions to Sea-Level Rise from 1961-2016*, 568 Nature 382 (2019); B. Menounos et al., *Heterogeneous Changes in Western North American Glaciers Linked to Decadal Variability in Zonal Wind Strength*, 46 Geophysical Research Letters 200 (2019).

[11] Hansen, *Assessing "Dangerous Climate Change*," at 13; *see also* James Hansen et al., *Ice Melt, Sea Level Rise and Superstorms; Evidence from Paleoclimate Data, Climate Modeling, and Modern Observations that 2 °C Global Warming Could be Dangerous*, 16 Atmos. Chem. & Phys. 3761 (2016) [hereinafter *Ice Melt, Sea Level Rise and Superstorms*].

[12] L.D. Trusel et al., *Nonlinear Rise in Greenland Runoff in Response to Post-industrial Arctic Warming*, 562 Nature 105 (2018).

[13] T. Slater et al., *Earth's Ice Imbalance*, 15 The Cryosphere 233 (2021).

[14] James E. Hansen, *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 6:15-cv-01517-TC, 14 (D. Or. Aug. 12, 2015); IPCC, *Chapter 6.3.2, What Does the Record of the Mid-Pliocene Show?, in* Climate Change 2007: The Physical Science Basis (2007); Dowsett & Cronin, *High Eustatic Sea Level During the Middle Pliocene: Evidence from the Southeastern U.S. Atlantic Coastal Plain*, 18 Geology 435 (1990); N.J. Shackleton et al., *Pliocene Stable Isotope Stratigraphy of Site 846*, 138 Proceedings of the Ocean Drilling Program, Scientific Results 337 (1995).

[15] NOAA, *Global and Regional Sea Level Rise Scenarios for the United States* (2017) (intermediate-high to extreme global mean sea level rise scenarios).

[16] NOAA, Examining Sea Level Rise Exposure for Future Populations, https://coast.noaa.gov/digitalcoast/stories/population-risk.html.

Figure 3: Antarctic melt water from the Nansen ice shelf.

Many climate models represent sea level rise as a gradual linear response to melting ice sheets, but the historic climate record shows something very different. In reality, seas do not rise slowly and predictably but rather in pulses as ice sheets destabilize.[17] Scientists believe we still have a chance to preserve the large ice sheets of Greenland and Antarctica and most of our shorelines and ecosystems if we restore Earth's energy balance and return to below 350 ppm, thereby limiting longer-term warming by the end of the century to no more than 1°C above pre-industrial levels (short-term warming will inevitably exceed 1°C but must not exceed 1°C for more than a short span of years rather than multiple decades or centuries).

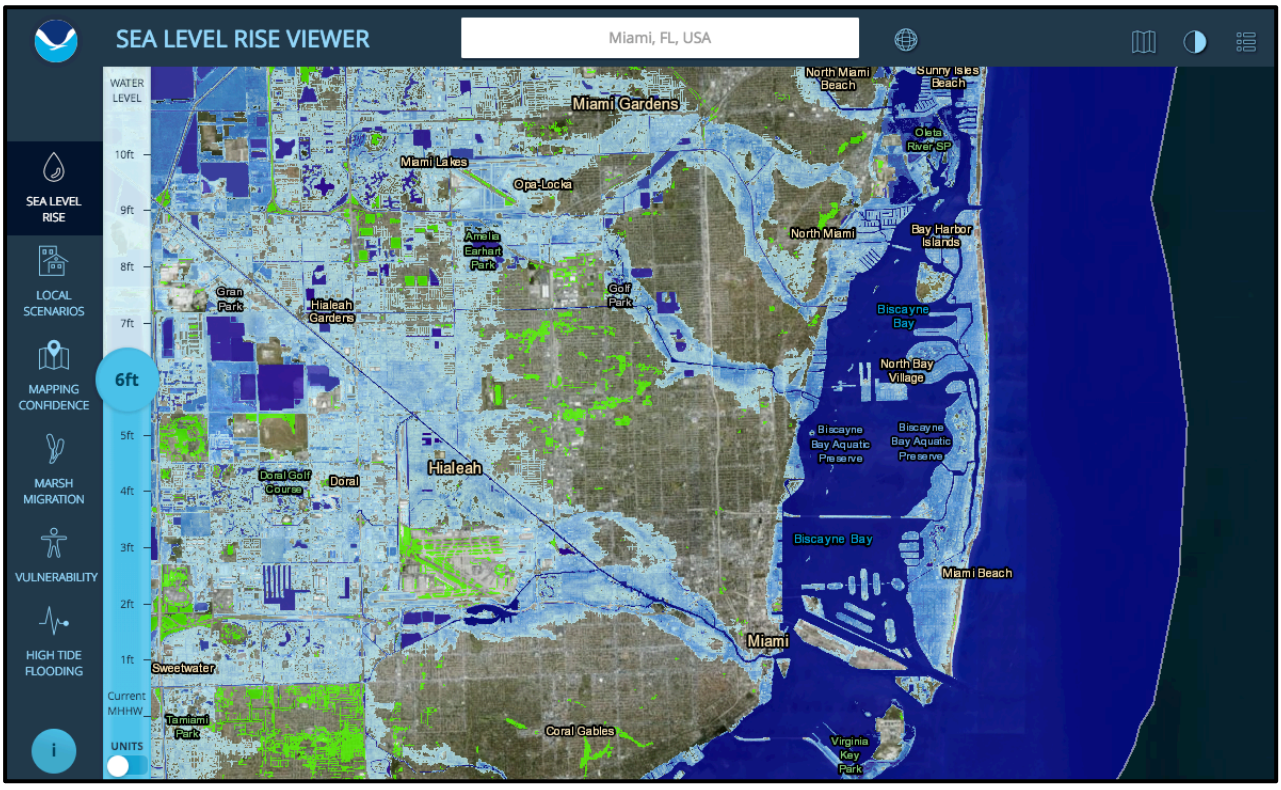

Figure 4: South Florida, including Miami, will face significant inundation with 6 feet of sea level rise.

[17] H.R. Wanless, et al., *Dynamics and Historical Evolution of the Mangrove/Marsh Fringe Belt of Southwest Florida, in Response to Sea-level History, Biogenic Processes, Storm Influences and Climatic Fluctuations*. Semi-annual Research Report (June 1993 to February 1994); Hansen, *Ice Melt, Sea Level Rise and Superstorms*, at 3761; Hansen, *Assessing "Dangerous Climate Change,"* at 20.

3) Ocean Warming and Acidification

Less than 350 ppm is the best scientific standard to protect oceans and marine life. Our oceans have absorbed about 90% of the excess heat in the atmosphere trapped by greenhouse gases (see Figure 5) as well as approximately 30% of CO_2 emitted into the atmosphere, causing ocean temperatures to surge and the ocean to become more acidic.[18] Indeed, our oceans are warming much more rapidly than previously-thought.[19] In 2020, the oceans absorbed 20 sextillion joules of heat due to climate change and warmed to record levels. The quantity of warming, 20,000,000,000,000,000,000,000 joules, is equivalent to the amount of energy from 10 Hiroshima atomic bombs being released every second of the year or to heat 1.3 billion kettles of water.[20] Many marine ecosystems, and particularly coral reef ecosystems, cannot tolerate the increased warming and acidity of ocean waters that result from increased CO_2 levels.[21] At today's global mean CO_2 concentration, around 412 ppm, critically important ocean ecosystems, such as coral reefs, are rapidly declining and will be irreversibly damaged from high ocean temperatures and repeated mass bleaching events if we do not quickly curtail emissions (see Figures 6 and 7).[22] According to the Intergovernmental Panel on Climate Change (IPCC), bleaching events are occurring more frequently than the IPCC previously projected and 70-90% of the world's coral reefs could disappear as soon as 2030 (the IPCC also predicts >99% of coral reefs will die with 2°C warming).[23] The 2018 National Climate Assessment acknowledged that coral reefs in Florida, Hawaii, Puerto Rico, and the

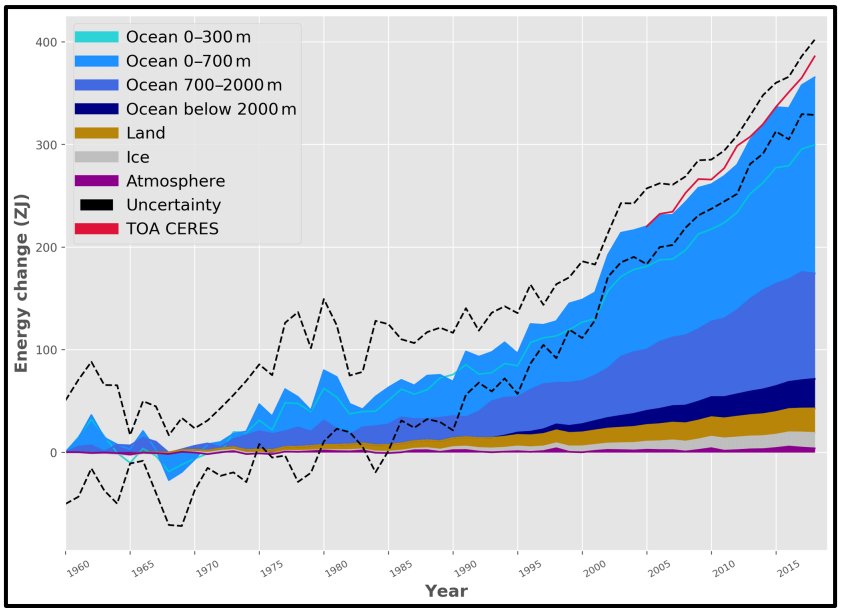

Figure 5 . Earth energy accumulation relative to 1960.

[18] von Schuckmann, *Heat Stored in the Earth System*; Hansen, *Assessing "Dangerous Climate Change*," at 1; IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, 2013); L. Cheng et al., *How Fast are the Oceans Warming?* 363 Science 128 (2019) (as of 2019, about 93% of the energy balance accumulates in the ocean); NOAA, *What is Ocean Acidification?,* https://oceanservice.noaa.gov/facts/acidification.html.

[19] L. Cheng et al., *How Fast are the Oceans Warming?*, 363 Science 128 (2019).

[20] https://www.abc.net.au/news/2021-01-18/ocean-temperatures-reached-record-high-in-2020-study-finds/13062628; https://www.cambridgenetwork.co.uk/news/world-continued-warm-2020.

[21] T. P. Hughes et al., *Global Warming Impairs Stock-Recruitment Dynamics of Corals*, 568 Nature 387 (2019).

[22] K. Frieler et al., *Limiting Global Warming to 2 ℃ is Unlikely to Save Most Coral Reefs*, 3 Nature Climate Change 165 (2013); J. Veron et al; *The Coral Reef Crisis: The Critical Importance of <350ppm CO_2*, 58 Marine Pollution Bulletin 1428 (2009); T. P. Hughes et al., *Spatial and Temporal Patterns of Mass Bleaching of Corals in the Anthropocene*, 359 Science 80 (2018); T. P. Hughes et al., *Global Warming Impairs Stock–Recruitment Dynamics of Corals*, 568 Nature 387 (2019).

[23] Ove Hoegh-Guldberg et al., *Impacts of 1.5℃ Global Warming on Natural and Human Systems, in* Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, at 225-226 (2018); IPCC, *Summary for Policymakers, in* Global Warming of 1.5°C (2018).

U.S. Virgin Islands have been harmed by mass bleaching and coral diseases and could disappear by mid-century as a result of warming waters.[24] Scientists believe we can protect marine life and prevent massive bleaching and die-off of coral reefs only by rapidly returning CO_2 levels to below 350 ppm.[25]

No scientific institution, including the IPCC, has ever concluded that the Earth energy imbalance, which exists with >350 ppm, and 1.5-2°C warming would be safe for ocean life. According to Dr. Ove Hoegh-Guldberg, one of the world's leading experts on ocean warming and acidification, and a Coordinating Lead Author on the "The Ocean" chapter of the IPCC's Fifth Assessment Report and on the "Impacts of 1.5ºC Global Warming on Natural and Human Systems" of the IPCC's Special Report on Global Warming of 1.5°C:

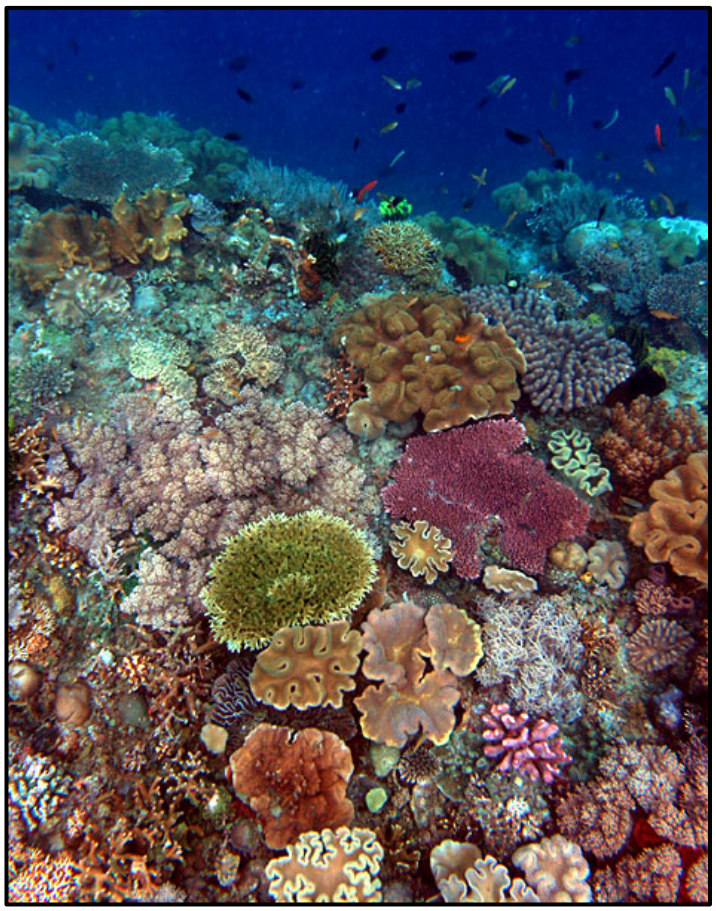

Figure 6: Healthy coral like this are already gravely threatened and will likely die with warming of 1.5°C.

"Allowing a temperature rise of up to 2°C would seriously jeopardize ocean life, and the income and livelihoods of those who depend on healthy marine ecosystems. Indeed, the best science available suggests that coral dominated reefs will completely disappear if carbon dioxide concentrations exceed much more than today's concentrations. Failing to restrict further increases in atmospheric carbon dioxide will eliminate coral reefs as we know them and will deny future generations of children from enjoying these wonderful ecosystems."[26]

Figure 7: Bleached coral from warmer ocean temperatures.

IPCC's Special Report on Global Warming of 1.5° states that "[w]arming of 1.5ºC is not considered 'safe' for most nations, communities, ecosystems, and sectors and poses significant risks to natural and human systems as compared to current warming of 1°C (*high confidence*)."[27]

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[24] A.J. Pershing et al., *Oceans and Marine Resources, in* Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II (USGCRP, 2018).
[25] J. Veron et al., *The Coral Reef Crisis: The Critical Importance of <350 ppm CO_2*, 58 Marine Pollution Bulletin 1428 (2009).
[26] Ove Hoegh-Guldberg, *Declaration in Support of Petitioners, Foster v. Wash. Dep't of Ecology*, No. 14-2-25295-1 SEA (Wash. Super. Ct. Aug. 24, 2015).
[27] J. Roy et al., *Sustainable Development, Poverty Eradication and Reducing Inequalities, in* Global Warming of 1.5°C,

ADDITIONAL OBSERVATIONS ILLUSTRATE THE DANGERS OF INCREASED WARMING

In addition to the evidence discussed above which illustrates the necessity of ensuring that the atmospheric CO_2 concentration returns to no more than 350 ppm, based on present day observations about climate impacts occurring **now**, it is clear that the present level of 412 ppm and resulting heating of 1.1°C (as of 2020) is already causing significant climate impacts and additional warming will exacerbate these already dangerous impacts. Climate impacts that are already being experienced today include:

- Declining snowpack and rising temperatures are increasing the length and severity of drought conditions, especially in the western United States and Southwest, causing problems for agriculture users, forcing some people to relocate, and leading to water restrictions.[28]
- In the western United States, the wildfire season is now almost three months longer (87 days) than it was in the 1980s.[29] 10.3 million acres burned in 2020, well above the 2011-2020 average of 7.5 million acres.[30]
- Extreme weather events, such as intense rainfall events that cause flooding, are increasing in frequency and severity because a warmer atmosphere holds more moisture.[31] What are supposedly 1-in-1000-year rainfall events are now occurring with alarming frequency – in 2018 there were at least five such events.[32]
- Tropical storms and hurricanes are increasing in frequency and intensity, both in terms of rainfall and windspeed, as warmer oceans provide more energy for the storms (as seen with Hurricanes Harvey, Irma, and Maria in 2017) [33] (Figure 8).
- Terrestrial ecosystems are experiencing compositional and structural changes, with major adverse consequences for ecosystem services.[34]

Figure 8: Flooding in Port Arthur, Texas on August 13, 2018 after Hurricane Harvey.

at 447 (2018).

[28] Steven W. Running, *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 18-36082, Doc. 21-12 (9th Cir. Feb. 7, 2019).

[29] *Id.*; A. L. Westerling, *Increasing Western US Forest Wildfire Activity: Sensitivity to Changes in the Timing of Spring*, 371 Phil. Trans. R. Soc. B 20150178 (2016).

[30] Congressional Research Service, *Wildfire Statistics* (updated Jan. 4, 2021).

[31] Kevin E. Trenberth, *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 18-36082, Doc. 21-3 (9th Cir. Feb. 7, 2019).

[32] F. Belles, *America's 'One-in-1,000-Year' Rainfall Events in 2018*, The Weather Channel (Sept. 27, 2018).

[33] Kevin E. Trenberth, *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 18-36082, Doc. 21-3 (9th Cir. Feb. 7, 2019).

[34] C. Nolan et al., *Past and Future Global Transformation of Terrestrial Ecosystems Under Climate Change*, 361 Science

- Terrestrial, freshwater, and marine species are experiencing a significant decrease in population size and geographic range, with some going extinct and others are facing the very real prospect of extinction – the rapid rate of extinctions has been called the sixth mass extinction.[35]
- Human health and well-being are already being affected by heat waves, floods, droughts, and extreme events; infectious diseases; and quality of air, food, and water.[36] Doctors and leading medical institutions are calling climate change a "health emergency."[37] Children are uniquely vulnerable to climate change health effects due to their higher respiratory rate, lung growth and development, immature immune system, higher metabolic demands, and immature central nervous system.[38]
- In addition to physical harm, climate change is causing mental health impacts, ranging from stress to clinical disorders such as anxiety, depression, and suicidality, due to exposure to climate events, displacement, loss of income, chronic stress, and other impacts of climate change.[39]

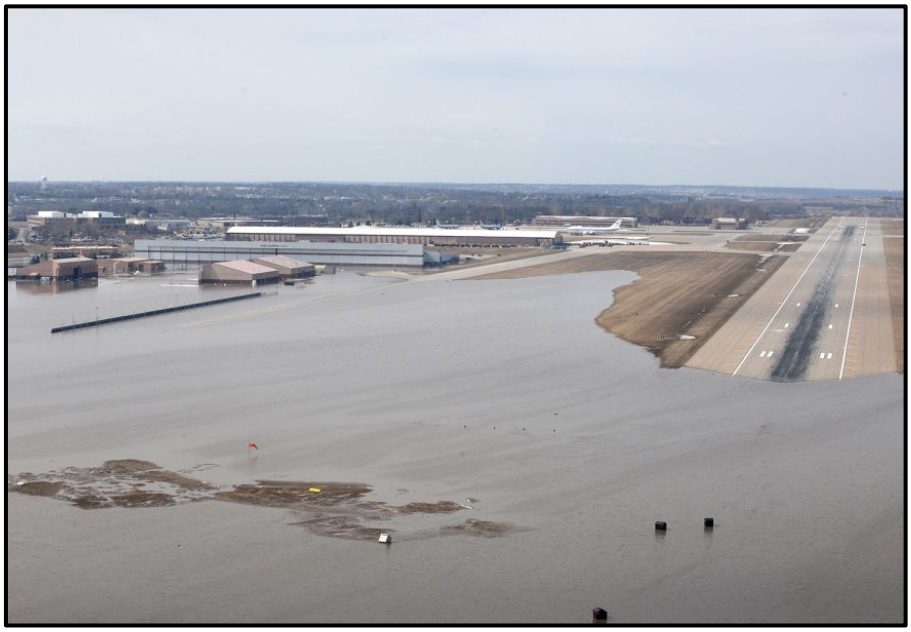

Figure 9: Offutt Air Force Base was impacted by flood waters during flooding in Nebraska during spring 2019.

- As Congress has recognized, "climate change is a direct threat to the national security of the United States and is impacting stability in areas of the world both where the United States Armed Forces are operating today, and where strategic implications for future conflict exist."[40] Senior military leaders have called climate change "*the* most serious national security threat facing our Nation

920 (2018).

[35] G. Ceballos et al., *Accelerated Modern Human–Induced Species Losses: Entering the Sixth Mass Extinction*, 1 Science Advances e1400253 (2015); Steven W. Running, *Expert Report, Juliana v. United States*, No. 6:15-cv-01517-TC, Doc. 264-1 (D. Or. June 28, 2018).

[36] K.L. Ebi et al., *Human Health, in* Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II (USGCRP, 2018).

[37] C.G. Solomon & R.C. LaRocque, *Climate Change – A Health Emergency*, 380 N. Engl. J. Med. 209 (2019).

[38] S. Pacheco, *Catastrophic Effects of Climate Change on Children's Health Start before Birth*, 130 Journal of Clinical Investigation 562 (2020); C. May et al., *Northwest, in* Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II (USGCRP, 2018); N. Watts et al., *The 2019 Report of The Lancet Countdown on Health and Climate Change: Ensuring that the Health of a Child Born Today is not Defined by a Changing Climate*, 394 The Lancet 1836 (2019); *Brief of Amici Curiae Public Health Experts, Public Health Organizations, and Doctors in Support of Plaintiffs*, No. 18-36082, Doc. 47 (9th Cir. Mar. 1, 2019).

[39] Lise Van Susteren, *Expert Report, Juliana v. United States*, No. 6:15-cv-01517-TC, Doc. 271-1 (D. Or. June 28, 2018). K.L. Ebi et al., *Human Health, in* Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II (USGCRP, 2018).

[40] *National Defense Authorization Act for Fiscal Year 2018*, Pub. L. No. 115-91, 131 Stat. 1358.

today,"[41] a conclusion similarly recognized by our Nation's intelligence community.[42] Climate change is increasing food and water shortages, pandemic disease, conflicts over refugees and resources, and destruction to homes, land, infrastructure, and military assets, directly threatening our military personnel and the "Department of Defense's ability to defend the Nation" (see Figure 9).[43]

- Climate change is already causing vast economic harm in the United States. Since 1980 the United States has experienced 285 climate and weather disasters that each caused damages in excess of $1 billion, for a total cost of $1.875 trillion.[44] In 2018 alone, Congress appropriated more than $130 billion for weather and climate related disasters.[45]

These already serious impacts will grow in severity and will impact increasingly large numbers of people and parts of the world if CO_2 concentrations continue to rise. If we want our children and grandchildren to have a safe planet to live on, full of health and biodiversity rather than chaos and conflict, we must follow the best scientific prescription to restore Earth's energy balance and avoid the destruction of our planet's atmosphere, climate, and oceans.

INTERNATIONAL POLITICAL TARGETS OF 1.5°C OR 2°C ARE NOT SCIENCE-BASED AND ARE NOT SAFE

International treaties require the stabilization of the climate system to avoid dangerous anthropogenic climate change. As described above, EEI and CO_2 concentrations should be the measurable scientific metrics, adopted as legal standards, for setting emission reduction and sequestration targets to stabilize our climate, avoid danger, and protect children and future generations. Temperature targets, set higher than today's already-too-hot planet, which would mean an even greater and more dangerous EEI and greater instability, are incompatible with fundamental human rights. International, politically-established temperature targets like 1.5°C or "well below" 2°C – which are commonly associated with long-term atmospheric CO_2 concentrations of 425 and 450 ppm, respectively – have not been and are not presently considered safe or scientifically-sound targets for present or future generations.

Legalizing heating of 1.5°C-2°C legalizes greater dangers than we have already witnessed. It is a death sentence for young people. In fact, Sir David King, former Special Envoy for Climate Change and Chief Scientific Advisor for the United Kingdom, elaborated on the importance of 350 ppm and limiting global heating to 1°C:

> *As a key negotiator for the United Kingdom government during discussions leading up to the Paris Agreement, I advocated that 1.5°C was an acceptable level of global warming. However, I was wrong. In 2020, our planet experienced an average of 1.1°C*

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[41] Vice Admiral Lee Gunn, USN (Ret.), *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 18-36082, Doc. 21-17 (9th Cir. Feb. 7, 2019) (emphasis in original); *see also* CNA Military Advisory Board, *National Security and the Accelerating Risks of Climate Change* (2014).
[42] National Intelligence Council, *Implications for US National Security of Anticipated Climate Change* (Sept. 2016).
[43] U.S. Dep't of Defense, *2014 Climate Change Adaptation Roadmap* (2014).
[44] NOAA, *Billion Dollar U.S. Weather/Climate Disasters 1980-2020* (2020), https://www.ncdc.noaa.gov/billions/events.pdf.
[45] U.S. House of Representatives Committee on the Budget, *The Budgetary Impact of Climate Change* 2 (Nov. 27, 2018).

> *of warming — much higher in some places like the Arctic -- and we experienced catastrophic weather events and climate-related disasters. These will only become more frequent, and more severe, as our emissions continue to rise. We cannot afford to negotiate what we now know is the safest level for stabilizing our climate systems: We must limit warming to less than 1.0°C as fast as possible. The 350 ppm pathways findings in studies by Jim Williams and Evolved Energy Research successfully demonstrate that the United States has clear pathways available to significantly reduce emissions, protecting the health and livelihood of their citizens while also boosting their national economies. This will crucially enable the USA to join leading nations in managing this severe challenge to humanity*.[46]

Importantly, the IPCC has never established nor endorsed a target of 1.5°C or 2°C warming as a limit below which the climate system will be stable and the energy balance restored. It is beyond the IPCC's declared mandate to endorse a particular threshold of warming as "safe" or "dangerous." As the IPCC makes clear, "each major IPCC assessment has examined the impacts of [a] multiplicity of temperature changes but has left [it to the] political processes to make decisions on which thresholds may be appropriate."[47]

Neither 1.5°C nor 2°C warming above pre-industrial levels has ever been considered "safe" from either a political or scientific point of view. The 2°C figure was originally adopted in the political arena "from a set of heuristics," and it has retained predominantly political character ever since.[48] The 2°C figure has recently been all-but-abandoned as a credible policy goal, in light of the findings in IPCC's 1.5°C Special Report, and the mounting evidence leading up to its publication, that 2°C would be catastrophic relative to lower, still-achievable levels of warming.[49]

On the other hand, the idea of a 1.5°C target was first raised by the Alliance of Small Island States (AOSIS) in the negotiations leading up to the ill-fated 2009 UNFCCC Conference of Parties in Copenhagen.[50] AOSIS, however, was explicitly advocating a *well below* 1.5°C and *well below* 350 ppm target, on the basis of the research of Dr. James Hansen and his colleagues.[51] Political compromise, including pressure from the fossil fuel industry, on this target then led to the adoption of a goal of "pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" in Article 2 of the Paris Agreement. Yet the 2018 IPCC Special Report on 1.5°C has made clear that allowing a temperature rise of 1.5°C:

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[46] Correspondence from Sir David King to Julia Olson (Jan. 2021) (notes on file with Julia Olson); The Do One Better! Podcast, Interview with Sir David King, https://www.lidji.org/sir-david-king.

[47] IPCC, *Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report* 125 (Cambridge University Press, 2014).

[48] S. Randalls, *History of the 2°C Temperature Target*, 1 WIREs Climate Change 598, 603 (2010); C. Jaeger & J. Jaeger, *Three Views of Two Degrees*, 11 (Suppl 1) Reg. Environ. Change S15 (2011).

[49] IPCC, *Summary for Policymakers, in* Climate Change 2014: Impacts, Adaptation, and Vulnerability, 13-14 (2014); UNFCCC, *Report on the Structured Expert Dialogue on the 2013–2015 Review*, 18 (2015), http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf; Petra Tschakert, *1.5°C or 2°C: A Conduit's View from the Science-Policy Interface at COP20 in Lima, Peru*, 2 Climate Change Responses 8 (2015); IPCC, *Global Warming of 1.5°C* (2018).

[50] *See* R. Webster, *A Brief History of the 1.5C Target*. Climate Change News (Dec. 10, 2015), http://www.climatechangenews.com/2015/12/10/a-brief-history-of-the-1-5c-target/.

[51] *Submission from Grenada on behalf of AOISIS to the Ad Hoc Working Group on Further Commitments for Annex I Parties Under the Kyoto Protocol*, U.N. Doc. FCCC/KP/AWG/2009/MISC.1/Add.1 (25 March 2009), https://unfccc.int/sites/default/files/resource/docs/2009/awg7/eng/misc01a01.pdf, citing James Hansen et al. *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 The Open Atmospheric Science Journal 217 (2008).

> is **not considered 'safe'** for most nations, communities, ecosystems, and sectors and poses significant risks to natural and human systems as compared to current warming of 1°C (*high confidence*).[52]

Dr. James Hansen warns that "distinctions between pathways aimed at ~1°C and 2°C warming are much greater and more fundamental than the numbers 1°C and 2°C themselves might suggest. These fundamental distinctions make scenarios with 2°C or more global warming far more dangerous; so dangerous, we [James Hansen et al.] suggest, that aiming for the 2°C pathway would be foolhardy."[53] This target is at best the equivalent of "flip[ping] a coin in the hopes that future generations are not left with few choices beyond mere survival. This is not risk management, it is recklessness and we must do better."[54]

Tellingly, more than 80 eminent scientists from over 50 different institutions have been co-authors on publications in peer-reviewed journals finding that the maximum level of atmospheric CO_2 consistent with restoring the EEI, protecting humanity and other species is 350 ppm, and no one, including the IPCC, has published any scientific evidence to counter that 350 ppm is the maximum safe concentration of CO_2.[55]

A 1.5° OR 2°C TARGET RISKS LOCKING-IN DANGEROUS FEEDBACKS

The longer the length of time atmospheric CO_2 concentrations remain at dangerous levels (i.e., above 350 ppm) and there is an Earth energy imbalance, the risk of triggering, and locking-in, dangerous warming-driven feedback loops increases. The 1.5°C or 2°C target (linked to 425-450 ppm) reduces the likelihood that the biosphere will be able to sequester CO_2 due to carbon cycle feedbacks and shifting climate zones.[56] As Earth surface temperatures increase, forests burn and soils warm, releasing their carbon. These natural carbon "sinks" become carbon "sources" and a portion of the natural carbon sequestration necessary to drawdown excess CO_2 simply disappear. Another dangerous feedback includes the release of methane, a potent greenhouse gas, as the global tundra thaws.[57] These feedbacks might show little change in the short-term, but can hit a point of no return, even at a 1.5°C or 2°C temperature increase, which will trigger accelerated heating and sudden *and irreversible* catastrophic impacts. Moreover, an emission reduction target aimed at 2°C would "yield

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[52] J. Roy et al., *Sustainable Development, Poverty Eradication and Reducing Inequalities, in* Global Warming of 1.5°C, at 447 (2018) (emphasis added).
[53] Hansen, *Assessing "Dangerous Climate Change*," at 15.
[54] Matt Vespa, *Why 350? Climate Policy Must Aim to Stabilize Greenhouse Gases at the Level Necessary to Minimize the Risk of Catastrophic Outcomes*, 36 Ecology Law Currents 185, 186 (2009).
[55] James Hansen, et al., *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 The Open Atmospheric Science Journal 217 (2008); Hansen, *Assessing "Dangerous Climate Change"*; Hansen, *Ice Melt, Sea Level Rise and Superstorms*; James Hansen, et al., *Young People's Burden: Requirement of Negative CO_2 Emissions*, 8 Earth Syst. Dynamics 577 (2017); J. Veron, et al., *The Coral Reef Crisis: The Critical Importance of <350 ppm CO_2* 58 Marine Pollution Bulletin 1428 (2009); K. Frieler, et al., *Limiting Global Warming to 2 ℃ is Unlikely to Save Most Coral Reefs* 3 Nature Climate Change 165 (2013); von Schuckmann, *Heat Stored in the Earth System*; Communication from James Hansen, Karina von Shuckmann to Julia Olson (2021) (notes on file with Julia Olson).
[56] Hansen, *Assessing "Dangerous Climate Change,"* at 15, 20.
[57] *Id*.

a larger eventual warming because of slow feedbacks, probably at least 3°C."[58] Once a temperature increase of 2°C is reached, there will already be "additional climate change 'in the pipeline' even without further change of atmospheric composition."[59]

THE BEST AVAILABLE SCIENCE REQUIRES US TO REDUCE CO_2 LEVELS TO <350 PPM BY 2100

There are two steps to reducing CO_2 levels to <350 ppm by the end of the century: 1) reducing CO_2 emissions; and separately 2) sequestering excess CO_2 already in the atmosphere (carbon drawdown). Carbon dioxide emission reductions of approximately 80% by 2030 and close to 100% by 2050 (in addition to the requisite CO_2 sequestration) are necessary to be on track to an atmospheric CO_2 concentration to 350 ppm, restoring energy balance, and keeping long-term warming to below 1°C above preindustrial temperatures. Politically-motivated emission reduction targets that seek to reduce CO_2 emissions by only 80% by 2050 are consistent with an atmospheric CO_2 concentration of 450 ppm and long-term warming of 2°C, which, as described above, would result in catastrophic and irreversible impacts for the climate system and oceans.

IT IS TECHNOLOGICALLY AND ECONOMICALLY FEASIBLE TO REDUCE EMISSIONS IN LINE WITH 350 PPM BY 2100

Importantly, it is economically and technologically feasible to transition the entire U.S. energy system to a zero-CO_2 energy system by 2050 and to drawdown the excess CO_2 in the atmosphere through reforestation and carbon sequestration in soils.[60]

Deep Decarbonization Pathways Project and Evolved Energy Research recently completed research and very sophisticated modeling describing a nearly complete phase out of fossil fuels in the U.S. by 2050.[61] They describe six different technologically feasible pathways to drastically, and quickly, cut our reliance on fossil fuels and achieve the requisite level of emissions reductions in the U.S. while meeting our nation's forecasted energy needs. All of the 350 ppm pathways rely on four pillars of action: a) investment in energy efficiency; b) electrification of everything that can be electrified; c) shifting to very low-carbon and primarily renewable electricity generation; and d) carbon dioxide capture as fossil fuels are phased out. The six scenarios are used to evaluate the ability to meet the targets even absent one key technology. For example, one scenario describes a route to 350 ppm absent construction of new nuclear facilities; another illustrates getting to 350 ppm with extremely limited biomass technology; still another describes a way to 350 ppm without any carbon capture and storage. Even absent a key technology, each of these six routes are viable and cost effective.

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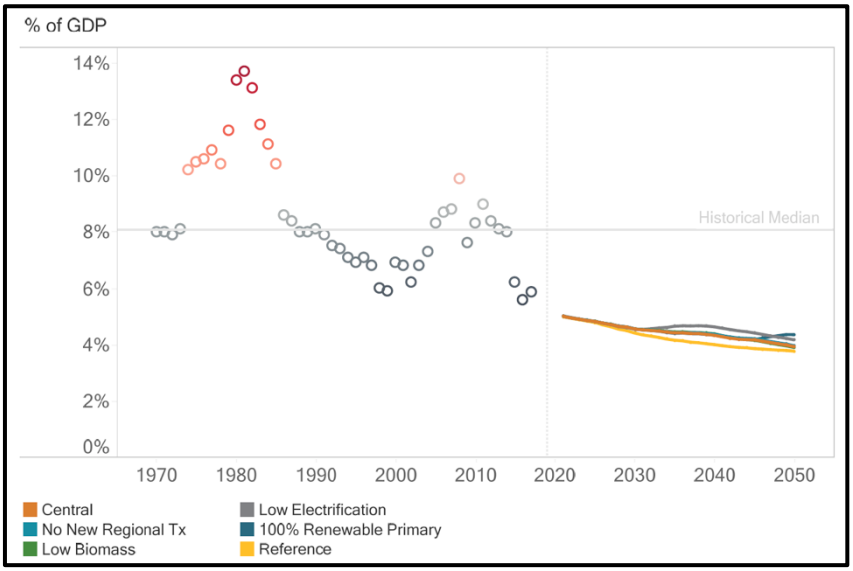
[58] *Id*. at 15.
[59] *Id*. at 19.
[60] *See* Mark Z. Jacobson et al., *100% Clean and Renewable Wind, Water, and Sunlight (WWS) All-Sector Energy Roadmaps for the 50 United States,* 8 Energy & Envtl. Sci. 2093 (2015) (for plans on how the United States and over 100 other countries can transition to a 100% renewable energy economy see www.thesolutionsproject.org); *see also* Arjun Makhijani, *Carbon-Free, Nuclear-Free: A Roadmap for U.S. Energy Policy* (2007); B. Haley et al., *350 ppm Pathways for the United States* (2019); James Williams et al., *Carbon-Neutral Pathways for the United States*, 2 AGU Advances e2020AV000284 (2021).
[61] B. Haley et al., *350 ppm Pathways for the United States* (2019).

A related 2021 study concludes that emissions reductions consistent with a 350 ppm trajectory by 2100 can be done at low net cost, substantially lower than estimates for less ambitious 80% by 2050 scenarios a few years ago due to recent declines in solar, wind, and vehicle battery prices.[62] The cost would be well below the 9.5% of GDP spent on the energy system in 2009 (not to mention well below the harm to the economy caused by climate change). (Figure 10)[63] Once the transition is complete, the cost of energy will remain low and stable because we will no longer be dependent on volatile global fossil fuel markets for our energy supplies. As Nobel Laureate Economist Dr. Joseph Stiglitz has stated: "[t]he benefits of making choices today that limit the economic costs of climate change far outweigh any economic costs associated with limiting our use of fossil fuels."[64]



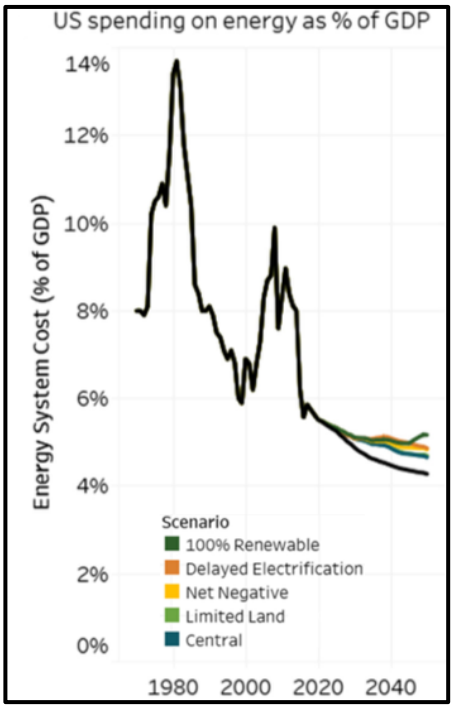


Figure 10: Historic and projected costs of energy in the U.S. as percentage of GDP.

Other experts have already prepared plans for all 50 U.S. states as well as for over 139 countries that demonstrate the technological and economic feasibility of transitioning off of fossil fuels toward 100% of energy, for all energy sectors, from clean and renewable energy sources: wind, water, and sunlight by 2050 (with 80% reductions in fossil fuels by 2030).[65]

Products already exist that enable new construction or retrofits that result in zero greenhouse gas buildings. We have the technology to meet all electricity needs with zero-emission electric generation. We know how to achieve zero-emission transportation, including aviation. These actions result in other benefits, such as improved health, job creation, and savings on energy costs.

The amount of natural carbon sequestration required is also proven to be feasible. Researchers have evaluated the potential to drawdown excess carbon dioxide in the atmosphere by increasing the carbon

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[62] James Williams et al., *Carbon-Neutral Pathways for the United States*, 2 AGU Advances e2020AV000284 (2021).
[63] *Id*., Ben Haley et al., *350 ppm Pathways for Florida, Technical Supplement* (2020).
[64] Joseph E. Stiglitz, Ph.D., *Declaration in Support of Plaintiffs, Juliana v. United States*, No. 18-36082, Doc. 21-14 (9th Cir. Feb. 7, 2019).
[65] Mark Z. Jacobson et al., *100% Clean and Renewable Wind, Water, and Sunlight (WWS) All-Sector Energy Roadmaps for the 50 United States,* 8 Energy & Envtl. Sci. 2093 (2015). For a graphic depicting the overview of the plan for the United States see: https://thesolutionsproject.org/why-clean-energy/#/map/countries/location/USA.

stored in forests, soils, and wetlands, and have found significant potential for these natural systems to support a return to 350 ppm by the end of the century.[66] We know the agricultural, rangeland, wetland, and forest management practices that decrease greenhouse gas emissions and increase sequestration.

There is no scientific, technological, or economic reason to *not* adopt a <350 ppm and 1°C by 2100 target. There are abundant reasons for doing so, not the least of which is to do our best through human laws to respect the laws of nature and create a safe and healthy world for children and future generations.

A NOTE ON "NET ZERO"

The politically popular concept of "net zero" allows governments to zero out a percentage of ongoing fossil fuel emissions by counting them as "sequestered" through removal processes, such as biogenic or natural sequestration in carbon sinks, leaving a smaller amount of source "net emissions" to be reduced. However, in order to align emissions and sequestration with a <350 ppm standard, carbon removed through natural sequestration in sinks must be used to draw down the excess CO_2 already in the atmosphere from cumulative historic emissions, not to provide a negative credit or offset for ongoing emissions. Emissions and sequestration must be accounted and inventoried separately with separate standards for each category.[67] A "net zero" emissions target is a shell game with little accountability, detached from a precise standard for protection of fundamental rights and restoration of Earth's energy balance.

[66] Benson W. Griscom et al., *Natural Climate Solutions,* 114 Proceedings of the National Academies of Sciences 11645 (2017); Joseph E. Fargione et al., *Natural Climate Solutions for the United States,* 4 Science Advances eaat1869 (2018).
[67] D. McLaren et al., *Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions*, Front. Clim. (2019).

Exhibit B.1:

350 PPM Pathways for the United States (2019)
Executive Summary
Evolved Energy Research

EXECUTIVE SUMMARY

350 PPM PATHWAYS FOR THE UNITED STATES

May 8, 2019

EVOLVED ENERGY RESEARCH

Prepared by

Ben Haley, Ryan Jones, Gabe Kwok, Jeremy Hargreaves & Jamil Farbes

Evolved Energy Research

James H. Williams

University of San Francisco

Sustainable Development Solutions Network

DEEP DECARBONIZATION PATHWAYS PROJECT

DDPP

Executive Summary

This report describes the changes in the U.S. energy system required to reduce carbon dioxide (CO_2) emissions to a level consistent with returning atmospheric concentrations to 350 parts per million (350 ppm) in 2100, achieving net negative CO_2 emissions by mid-century, and limiting end-of-century global warming to 1°C above pre-industrial levels. The main finding is that 350 ppm pathways that meet all current and forecast U.S. energy needs are technically feasible using existing technology, and that multiple alternative pathways can meet these objectives in the case of limits on some key decarbonization strategies. These pathways are economically viable, with a net increase in the cost of supplying and using energy equivalent to about 2% of GDP, up to a maximum of 3% of GDP, relative to the cost of a business-as-usual baseline. These figures are for energy costs only and do not count the economic benefits of avoided climate change and other energy-related environmental and public health impacts, which have been described elsewhere.[1]

This study builds on previous work, *Pathways to Deep Decarbonization in the United States* (2014) and *Policy Implications of Deep Decarbonization in the United States* (2015), which examined the requirements for reducing GHG emissions by 80% below 1990 levels by 2050 ("80 x 50").[2] These studies found that an 80% reduction by mid-century is technically feasible and economically affordable, and attainable using different technological approaches. The main requirement of the transition is the construction of a low carbon infrastructure characterized by high energy efficiency, low-carbon electricity, and replacement of fossil fuel combustion with decarbonized electricity and other fuels, along with the policies needed to achieve this transformation. The findings of the present study are similar but reflect both a more stringent emissions limit and the consequences of five intervening years without aggressive emissions reductions in the U.S. or globally.

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[1] See e.g. *Risky Business: The Bottom Line on Climate Change,* available at https://riskybusiness.org/
[2] Available at http://usddpp.org/.

The 80 x 50 analysis was developed in concert with similar studies for other high-emitting countries by the country research teams of the Deep Decarbonization Pathways Project, with an agreed objective of limiting global warming to 2°C above pre-industrial levels.[3] However, new studies of climate change have led to a growing consensus that even a 2°C increase may be too high to avoid dangerous impacts. Some scientists assert that staying well below 1.5°C, with a return to 1°C or less by the end of the century, will be necessary to avoid irreversible feedbacks to the climate system.[4] A recent report by the IPCC indicates that keeping warming below 1.5°C will likely require reaching net-zero emissions of CO_2 globally by mid-century or earlier.[5] A number of jurisdictions around the world have accordingly announced more aggressive emissions targets, for example California's recent executive order calling for the state to achieve carbon neutrality by 2045 and net negative emissions thereafter.[6]

In this study we have modeled the pathways – the sequence of technology and infrastructure changes – consistent with net negative CO_2 emissions before mid-century and with keeping peak warming below 1.5°C. We model these pathways for the U.S. for each year from 2020 to 2050, following a global emissions trajectory that would return atmospheric CO_2 to 350 ppm by 2100, causing warming to peak well below 1.5°C and not exceed 1.0°C by century's end.[7] The cases modeled are a 6% per year and a 12% per year reduction in net fossil fuel CO_2 emissions after 2020. These equate to a cumulative emissions limit for the U.S. during the 2020 to 2050 period of 74 billion metric tons of CO_2 in the 6% case and 47 billion metric tons in the 12% case. (For comparison, current U.S. CO_2 emissions are about 5 billion metric tons per year.) The emissions in both cases must be accompanied by increased extraction of CO_2 from the atmosphere using land-based negative emissions technologies ("land NETs"), such as reforestation, with greater extraction required in the 6% case.

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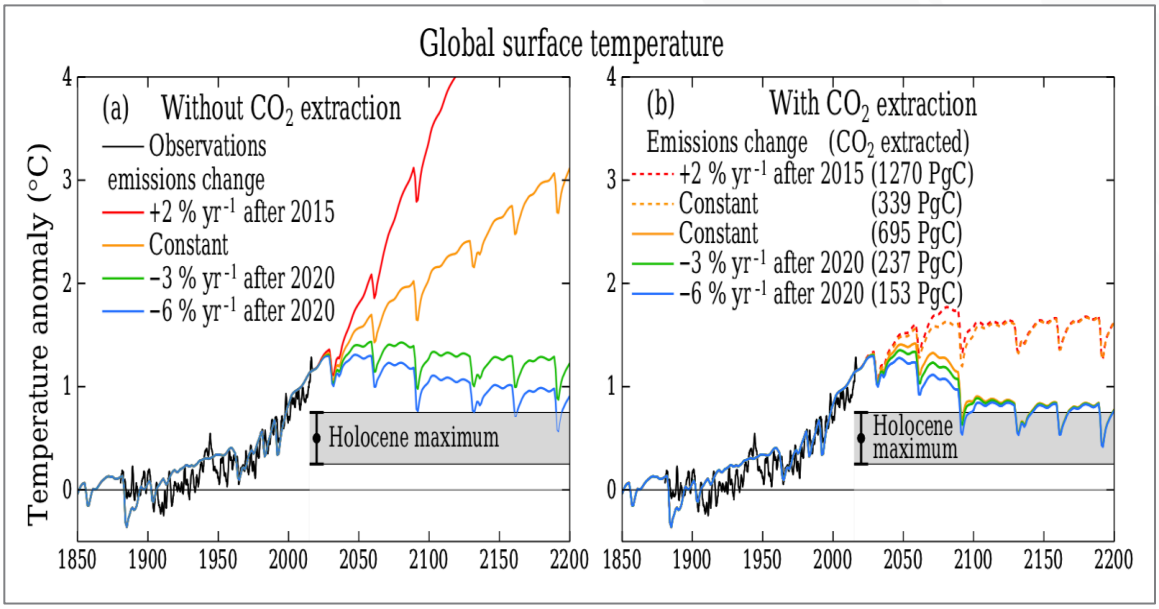
[3] Available at http://deepdecarbonization.org/countries/.
[4] James Hansen, et al. (2017) "Young people's burden: requirement of negative CO2 emissions," *Earth System Dynamics*, https://www.earth-syst-dynam.net/8/577/2017/esd-8-577-2017.html.
[5] Available at https://www.ipcc.ch/sr15/.
[6] Available at https://www.gov.ca.gov/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.
[7] Hansen et al. (2017).

Figure ES1 Global surface temperature and CO2 emissions trajectories. Hansen et al, 2017.



We studied six different scenarios: five that follow the 6% per year reduction path and one that follows the 12% path. All reach net negative CO_2 by mid-century while providing the same energy services for daily life and industrial production as the *Annual Energy Outlook (AEO)*, the Department of Energy's long-term forecast. The scenarios explore the effects of limits on key decarbonization strategies: bioenergy, nuclear power, electrification, land NETs, and technological negative emissions technologies ("tech NETs"), such as carbon capture and storage (CCS) and direct air capture (DAC).

Table ES1. Scenarios developed in this study

Scenario	Average annual rate of CO_2 emission reduction	2020-2050 maximum cumulative fossil fuel CO_2 (million metric tons)	Year 2050 maximum net fossil fuel CO_2 (million metric tons)	Year 2050 maximum net CO_2 with 50% increase in land sink (million metric tons)
Base	6%	73,900	830	-250
Low Biomass	6%	73,900	830	-250
Low Electrification	6%	73,900	830	-250
No New Nuclear	6%	73,900	830	-250
No Tech NETS	6%	73,900	830	-250
Low Land NETS	12%	57,000	-200	-450

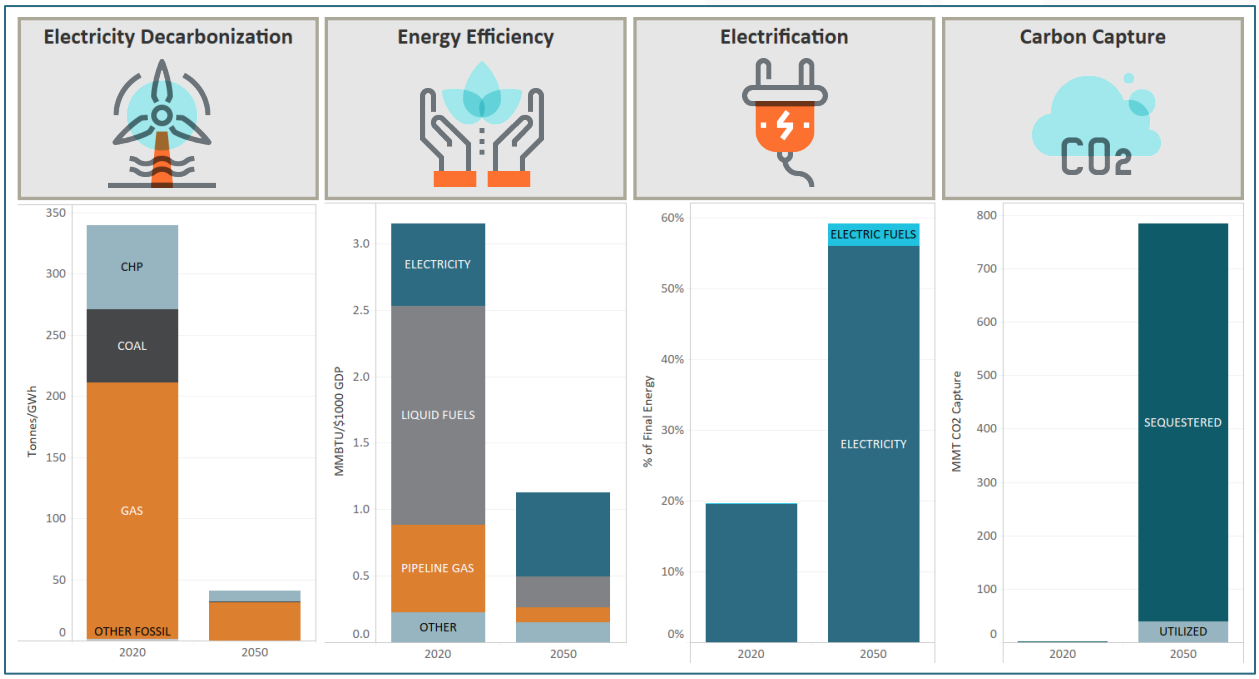
The scenarios were modeled using two new analysis tools developed for this purpose, EnergyPATHWAYS and RIO. As extensively described in the Appendix, these are sophisticated models with a high level of sectoral, temporal, and geographic detail, which ensure that the scenarios account for such things as the inertia of infrastructure stocks and the hour-to-hour dynamics of the electricity system, separately in each of fourteen electric grid regions of the U.S. The changes in energy mix, emissions, and costs for the six scenarios were calculated relative to a high-carbon baseline also drawn from the *AEO*.

Relative to 80 x 50 trajectories, a 350 ppm trajectory that achieves net negative CO_2 by mid-century requires more rapid decarbonization of energy plus more rapid removal of CO_2 from the atmosphere. For this analysis, an enhanced land sink 50% larger than the current annual sink of approximately 700 million metric tons was assumed.[8] This would require additional sequestration of 25-30 billion metric tons of CO_2 from 2020 to 2100. The present study does not address the cost or technical feasibility of this assumption but stipulates it as a plausible value for calculating an overall CO_2 budget, based on consideration of the scientific literature in this area.[9]

[8] U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016,* available at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016

[9] Griscom, Bronson W., et al. (2017) "Natural climate solutions." *Proceedings of the National Academy of Sciences* 114.44 (2017): 11645-11650; Fargione, Joseph E., et al. (2018) "Natural climate solutions for the United States." *Science Advances* 4.11: eaat1869.

Figure ES2 Four pillars of deep decarbonization - Base case



Energy decarbonization rests on the four principal strategies ("four pillars") shown in Figure ES2: (1) electricity decarbonization, the reduction in emissions intensity of electricity generation by about 90% below today's level by 2050; (2) energy efficiency, the reduction in energy required to provide energy services such as heating and transportation, by about 60% below today's level; (3) electrification, converting end-uses like transportation and heating from fossils fuels to low-carbon electricity, so that electricity triples its share from 20% of current end uses to 60% in 2050; and (4) carbon capture, the capture of otherwise CO_2 that would otherwise be emitted from power plants and industrial facilities, plus direct air capture, rising from nearly zero today to as much as 800 million metric tons in 2050 in some scenarios. The captured carbon may be sequestered or may be utilized in making synthetic renewable fuels.

Achieving this transformation by mid-century requires an aggressive deployment of low-carbon technologies. Key actions include retiring all existing coal power generation, approximately doubling electricity generation primarily with solar and wind power and electrifying virtually all passenger vehicles and natural gas uses in buildings. It also includes creating new types of infrastructure, namely large-scale industrial facilities for carbon capture and storage, direct air capture of CO_2, the production of gaseous and liquid biofuels with zero net lifecycle CO_2, and

the production of hydrogen from water electrolysis using excess renewable electricity. The scale of the infrastructure buildout by region is indicated in Figure ES3.

Figure ES3 Regional infrastructure requirements (Low Land NETS scenario)

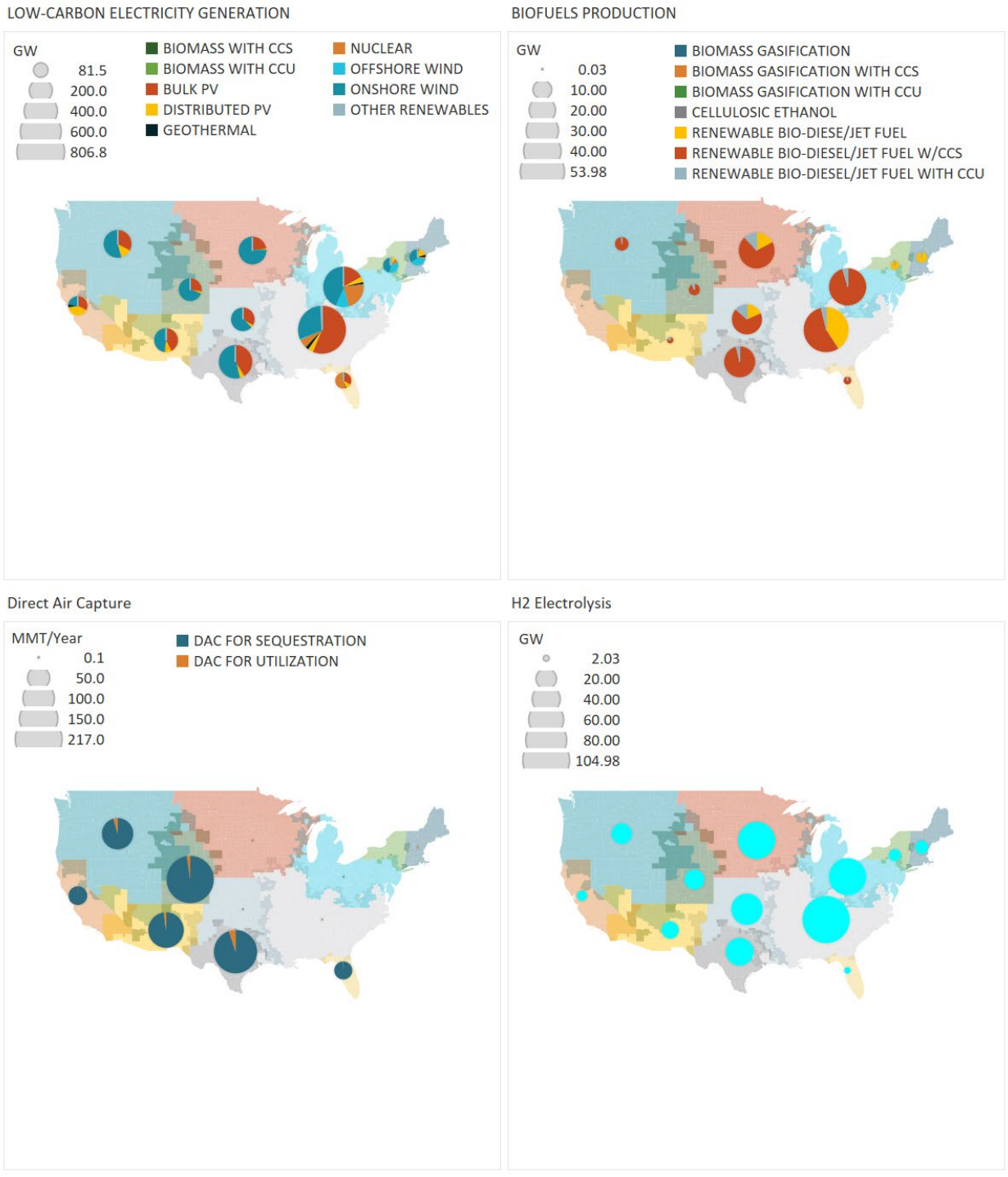


Figure ES4 shows that all scenarios achieve the steep reductions in net fossil fuel CO_2 emissions to reach net negative emissions by the 2040s, given a 50% increase in the land sink, including five that are limited in one key area. This indicates that the feasibility of reaching the emissions goals is robust due to the ability to substitute strategies. At same time, the more limited scenarios are, the more difficult and/or costly they are relative to the base case with all options available. Severe limits in two or more areas were not studied here but would make the emissions goals more difficult to achieve in the mid-century time frame.

Figure ES4 2020-2050 CO_2 emissions for the scenarios in this study

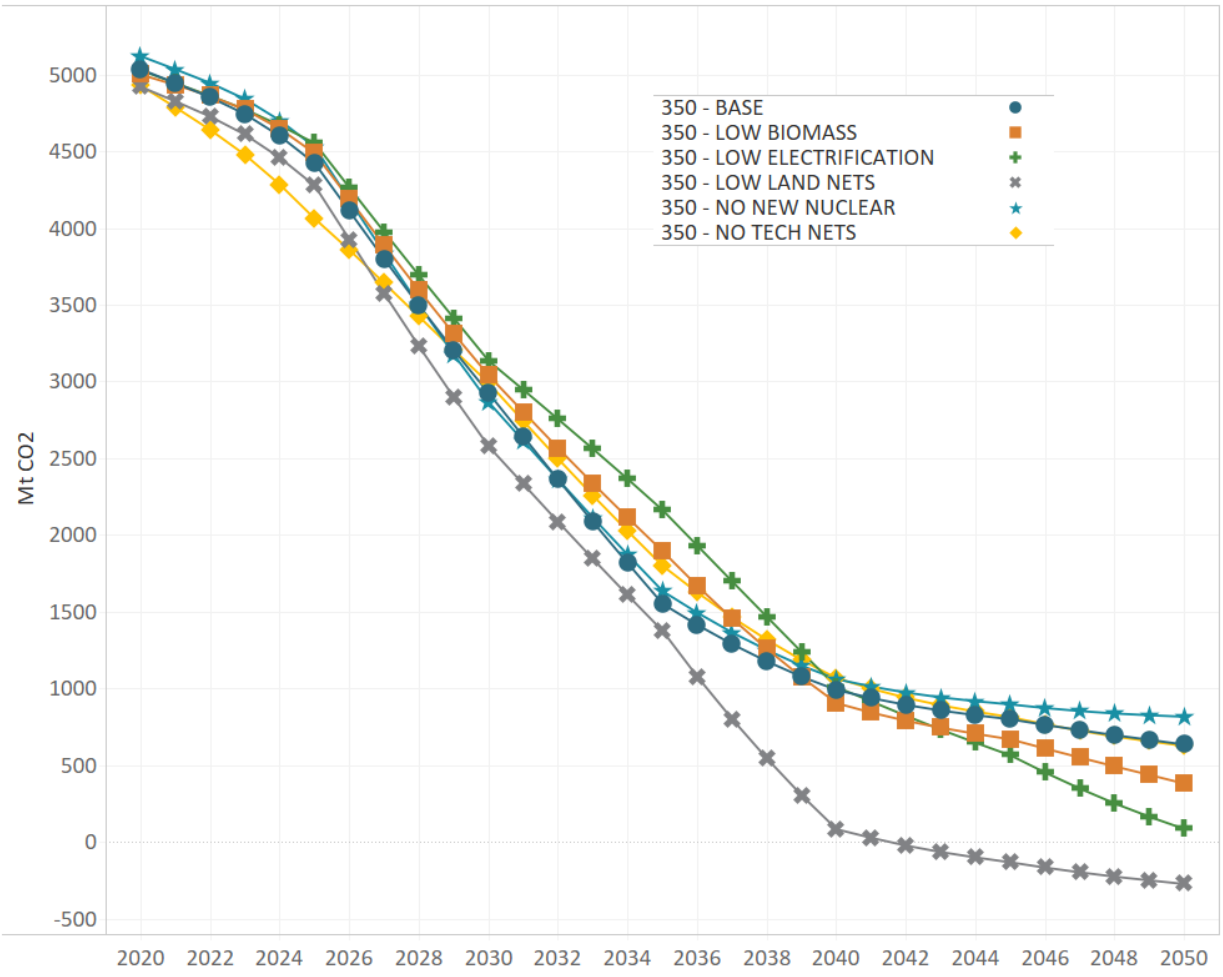
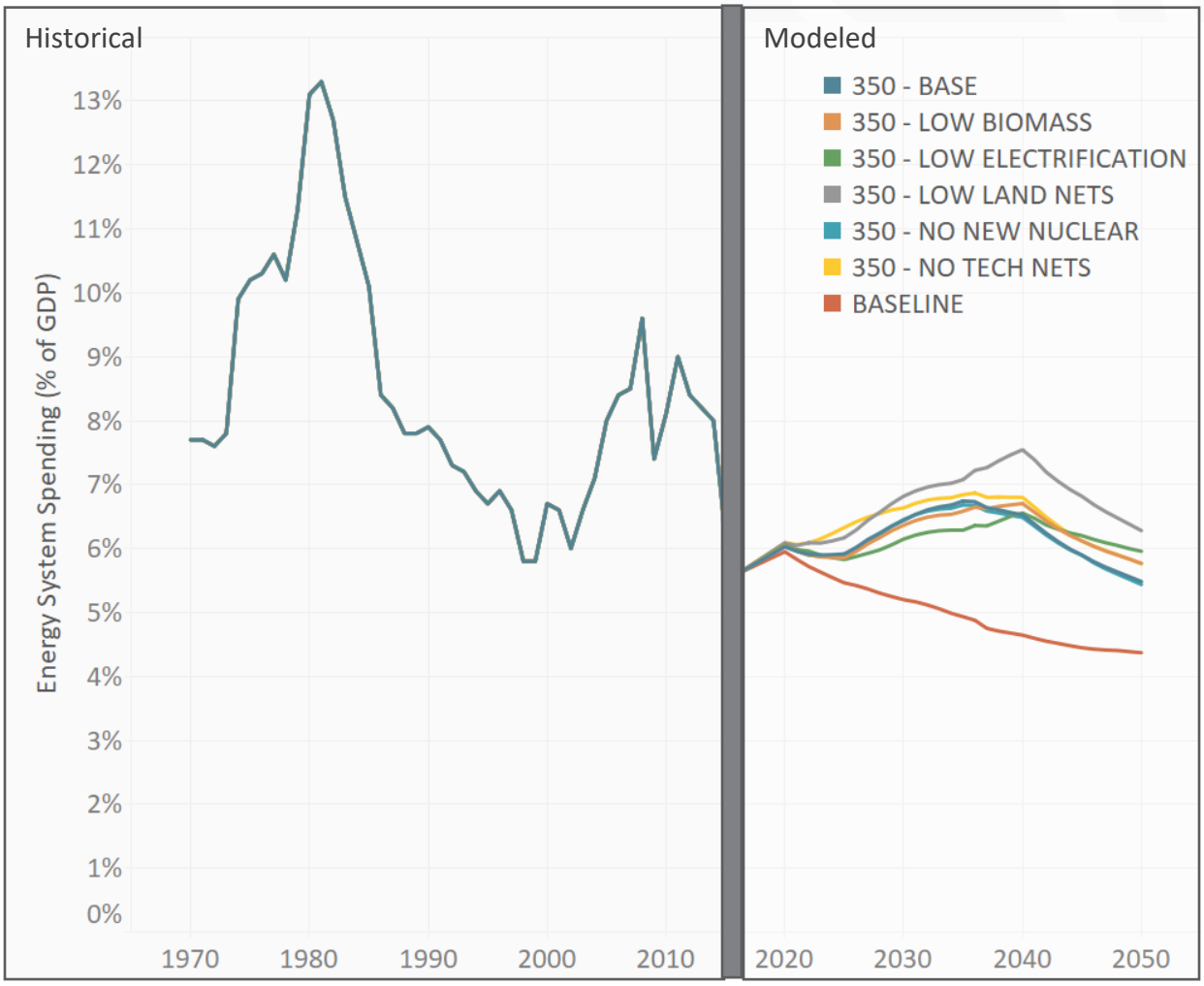


Figure ES5 shows U.S. energy system costs as a share of GDP for the baseline case and six 350 ppm scenarios in comparison to historical energy system costs. While the 350 ppm scenarios have a net cost of 2-3% of GDP more than the business as usual baseline, these costs are not out of line with historical energy costs in the U.S. The highest cost case is the Low Land NETs

scenario, which requires a 12% per year reduction in net fossil fuel CO_2 emissions. By comparison, the 6% per year reduction cases are more closely clustered. The lowest increase is the Base scenario, which incorporates all the key decarbonization strategies. These costs do not include any potential economic benefits of avoided climate change or pollution, which could equal or exceed the net costs shown here.

Figure ES5. Total energy system costs as percentage of GDP, modeled (R.) and historical (L.)



A key finding of this study is the potentially important future role of "the circular carbon economy." This refers to the economic complementarity of hydrogen production, direct air capture of CO_2, and fuel synthesis, in combination with an electricity system with very high levels of intermittent renewable generation. If these facilities operate flexibly to take advantage of periods of excess generation, the production of hydrogen and CO_2 feedstocks can provide an economic use for otherwise curtailed energy that is difficult to utilize with electric energy

storage technologies of limited duration. These hydrogen and CO_2 feedstocks can be combined as alternatives for gaseous and liquid fuel end-uses that are difficult to electrify directly like freight applications and air travel. While the CO_2 is eventually emitted to the atmosphere, the overall process is carbon neutral as it was extracted from the air and not emitted from fossil reserves. A related finding of this work is that bioenergy with carbon capture and storage (BECCS) for power plants appears uneconomic, while BECCS for bio-refineries appears highly economic and can be used as an alternative source of CO_2 feedstocks in a low-carbon economy.

There are several areas outside the scope of this study that are important to provide a full picture of a low greenhouse gas transition. One important area is better understanding of the potential and cost of land-based NETs, both globally and in the U.S. Another is the potential and cost of reductions in non-CO_2 climate pollutants such as methane, nitrous oxide, and black carbon. Finally, there is the question of the prospects for significant reductions in energy service demand, due to lifestyle choices such as bicycling over cars, structural changes such as increased transit and use of ride-sharing, or the development of less-energy intensive industry, perhaps based on new types of materials.

“Key Actions by Decade” below provides a blueprint for the physical transformation of the energy system. From a policy perspective, this provides a list of the things that policy needs to accomplish, for example the deployment of large amounts of low carbon generation, rapid electrification of vehicles, buildings, and industry, and building extensive carbon capture, biofuel, hydrogen, and synthetic fuel synthesis capacity.

Some of the policy challenges that must be managed include: land use tradeoffs related to carbon storage in ecosystems and siting of low carbon generation and transmission; electricity market designs that maintain natural gas generation capacity for reliability while running it very infrequently; electricity market designs that reward demand side flexibility in high-renewables electricity system and encourage the development of complementary carbon capture and fuel synthesis industries; coordination of planning and policy across sectors that previously had little interaction but will require much more in a low carbon future, such as transportation and electricity; coordination of planning and policy across jurisdictions, both vertically from local to state to federal levels, and horizontally across neighbors and trading partners at the same level;

mobilizing investment for a rapid low carbon transition, while ensuring that new investments in long-lived infrastructure are made with full awareness of what they imply for long-term carbon commitment; and investing in ongoing modeling, analysis, and data collection that informs both public and private decision-making. These topics are discussed in more detail in *Policy Implications of Deep Decarbonization in the United States.*

Key Actions by Decade

This study identifies key actions that are required in each decade from now to mid-century in order to achieve net negative CO_2 emissions by mid-century, at least cost, while delivering the energy services projected in the *Annual Energy Outlook*. Such a list inherently relies on current knowledge and forecasts of unknowable future costs, capabilities, and events, yet a long-term blueprint remains essential because of the long lifetimes of infrastructure in the energy system and the carbon consequences of investment decisions made today. As events unfold, technology improves, energy service projections change, and understanding of climate science evolves, energy system analysis and blueprints of this type must be frequently updated.

2020s

- Begin large-scale electrification in transportation and buildings
- Switch from coal to gas in electricity system dispatch
- Ramp up construction of renewable generation and reinforce transmission
- Allow new natural gas power plants to be built to replace retiring plants
- Start electricity market reforms to prepare for a changing load and resource mix
- Maintain existing nuclear fleet
- Pilot new technologies that will need to be deployed at scale after 2030
- Stop developing new infrastructure to transport fossil fuels
- Begin building carbon capture for large industrial facilities

2030s

- Maximum build-out of renewable generation
- Attain near 100% sales share for key electrified technologies (e.g. EVs)
- Begin large-scale production of bio-diesel and bio-jet fuel
- Large scale carbon capture on industrial facilities
- Build out of electrical energy storage
- Deploy fossil power plants capable of 100% carbon capture if they exist

Maintain existing nuclear fleet

2040s

- Complete electrification process for key technologies, achieve 100% stock penetration
- Deploy circular carbon economy using DAC and hydrogen to produce synthetic fuels
- Use synthetic fuel production to balance and expand renewable generation
- Replace nuclear at the end of existing plant lifetime with new generation technologies
- Fully deploy biofuel production with carbon capture

Exhibit B.2:

350 PPM Pathways for Florida (2020)
Executive Summary and
U.S. Data from the Technical Supplement
Evolved Energy Research

EVOLVED ENERGY RESEARCH

350 PPM Pathways for Florida

Prepared by

Ben Haley, Gabe Kwok, and Ryan Jones

Evolved Energy Research

October 6, 2020

Executive Summary

This study evaluates multiple scenarios to radically reduce the greenhouse gas emissions that result from Florida's energy system, and can serve as a tool to inform statewide energy system decisions.

We detail five technically and economically feasible pathways to reduce carbon dioxide emissions and remain within a small enough "carbon budget" to enable a return to 350 parts per million of carbon dioxide in the atmosphere by 2100, a level identified by scientists as a safe limit necessary to preserve a stable climate. These scenarios limit emissions while providing the same energy services for daily life and industrial production as the Department of Energy's long-term forecast.

This study builds upon the research conducted by Evolved Energy Research and the Sustainability Development Solutions Network (SDSN) and published on May 8, 2019, titled *350 PPM Pathways for the United States.*

Scenarios

This study evaluates five energy decarbonization[1] scenarios for the energy system of Florida:

Central: The least constrained scenario, this uses all options to decarbonize the energy system.

Low Biomass: This scenario reduces the development of new biomass feedstocks[2] by 50%.

Low Electrification: This scenario assesses the impact of a delayed adoption of electric vehicles and heat pumps.

[1] "Decarbonization" is the process of removing sources of carbon dioxide (and other greenhouse gases) from a system – in this case, removing fossil fuel emissions from Florida's energy system.

[2] Biomass feedstocks are plant-based and animal-based sources of fuel, like trees, grasses, or animal fats, for example.

100% Renewable Primary: This scenario describes an energy system based solely on biomass, wind, solar, hydro, and geothermal sources by 2050.

No New Regional Transmission (TX): This scenario limits the development of new electricity transmission lines between regions within the U.S.

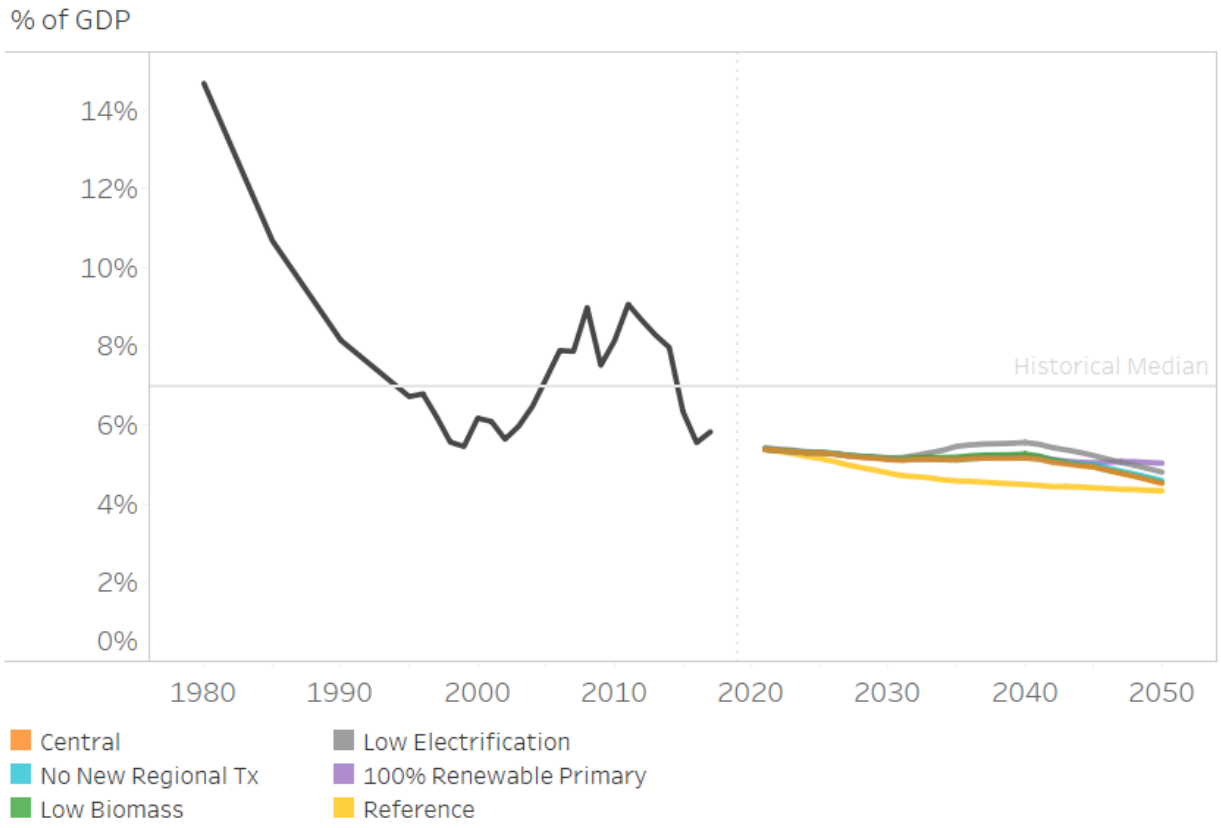
Florida Energy System Results

Energy decarbonization in Florida relies on four principal strategies: (1) **Electricity decarbonization** requires reducing the amount of fossil fuels used for electricity generation, thereby reducing the amount of greenhouse gas emissions from every unit of electricity delivered by about 95% by 2050; (2) **Energy efficiency** is the reduction in energy required to provide energy services such as heating and transportation, and energy use per unit GDP is reduced by about 50% below today's level; (3) **Electrification** involves switching energy uses including transportation and building heating off of fossils fuels and onto low-carbon electricity, and (4) **Capturing carbon** that would otherwise be emitted from power plants and industrial facilities – with the captured carbon either stored permanently (sequestered) or used to create fuels like synthetic natural gas or synthetic diesel, by combining the carbon with renewably-generated hydrogen.

Figure 1 shows historical and projected energy system costs as a share of State Gross Domestic Product (GDP). All scenarios evaluated in this study are in line with historical energy costs in Florida and, even with decarbonization, energy system costs are anticipated to decline as a share of GDP. The highest cost scenario is the 100% Renewable Primary pathway due to the emphasis on displacing *all* fossil fuels by 2050, rather than continuing to use some small amount of the lowest-cost fossil fuels and capturing and storing the associated carbon. The lowest cost scenario is the Central scenario, which allows for the most flexibility in terms of key decarbonization strategies.

Note that the costs within this chart do not reflect any of the macroeconomic benefits of transitioning off of fossil fuels, including improved air quality, avoided climate impacts (like avoided sea level rise), reduced energy price volatility, and energy independence, which could equal or exceed the net costs shown here.

Figure 1. Total energy system costs as percentage of GDP, historical and projected for Florida



Key Actions by Decade

Achieving the transition described above is not expensive but requires significant changes in public policy. Some of the **key policy challenges** that must be managed in all scenarios include: a) managing tradeoffs between using land for low carbon electricity generation (like wind farms and solar arrays) and improving natural carbon storage in forests and soils ; b) electricity market designs that maintain natural gas generation capacity for reliability while using gas generators very infrequently; c) developing electricity rates that incentivize customers to flex their energy use to better match periods of electricity surplus and shortage that come with intermittent renewables like wind and solar; d) encourage the development of carbon capture industries that can leverage periods of excess electricity generation ; e) coordination of planning and policy across sectors that previously had little interaction, such as transportation and electricity; f) coordination of planning and policy across jurisdictions; g) mobilizing investment for a rapid

low carbon transition; and e) investing in ongoing modeling, analysis, and data collection that informs both public and private decision-making. These topics are discussed in more detail in *Policy Implications of Deep Decarbonization in the United States.*

Achieving this transformation in Florida by mid-century at lowest cost requires an **aggressive deployment of low-carbon technologies**, including:

2020s

- Begin large-scale transition to electric technologies in key sectors; moving to electric light duty vehicles and electric heat pumps.
- Use coal fired power plants only when absolutely necessary, prioritizing all other sources of electricity generation first. Begin retiring coal assets.
- Ramp up construction of renewable electricity generation and upgrade electricity transmission where needed.
- Allow strategic replacement of natural gas power plants to support rapid deployment of low-carbon generation. These power plants must be financed with the understanding that they will run very infrequently to provide capacity, not as they are operated today.
- Maintain existing nuclear power plants.
- Pilot new technologies that will need to be deployed at scale after 2030.
- Stop developing new infrastructure to transport and process fossil fuels.
- Begin building carbon capture for large industrial facilities.

2030s

- Maximum build-out of renewable electricity generation.
- Nearly 100% of new vehicle sales and new building heating systems using electric technologies.
- Begin large-scale production of biodiesel and bio-jet fuel.
- Large scale carbon capture on industrial facilities.
- Build out electrical energy storage.
- Deploy new natural gas power plants capable of 100% carbon capture if they exist.
- Maintain existing nuclear power plants.
- Continue to reduce generation from gas-fired power plants.

2040s

- Complete the transition to electric technologies for key sectors; virtually 100% of light duty vehicles and building heating systems run on electricity.
- Produce large volumes of hydrogen for use in freight trucks and fuel production.
- Use synthetic fuel production to balance and expand renewable generation.
- Fully deploy biofuel production with carbon capture.
- Further limit gas generation to infrequent periods when needed for system reliability.

Technical Supplement

The following technical supplement shows results for the U.S. as a whole as well as scenario figures not shown in the body of the main report for Florida.

U.S. Results

Figure 30 E&I CO2 emissions trajectories – U.S.

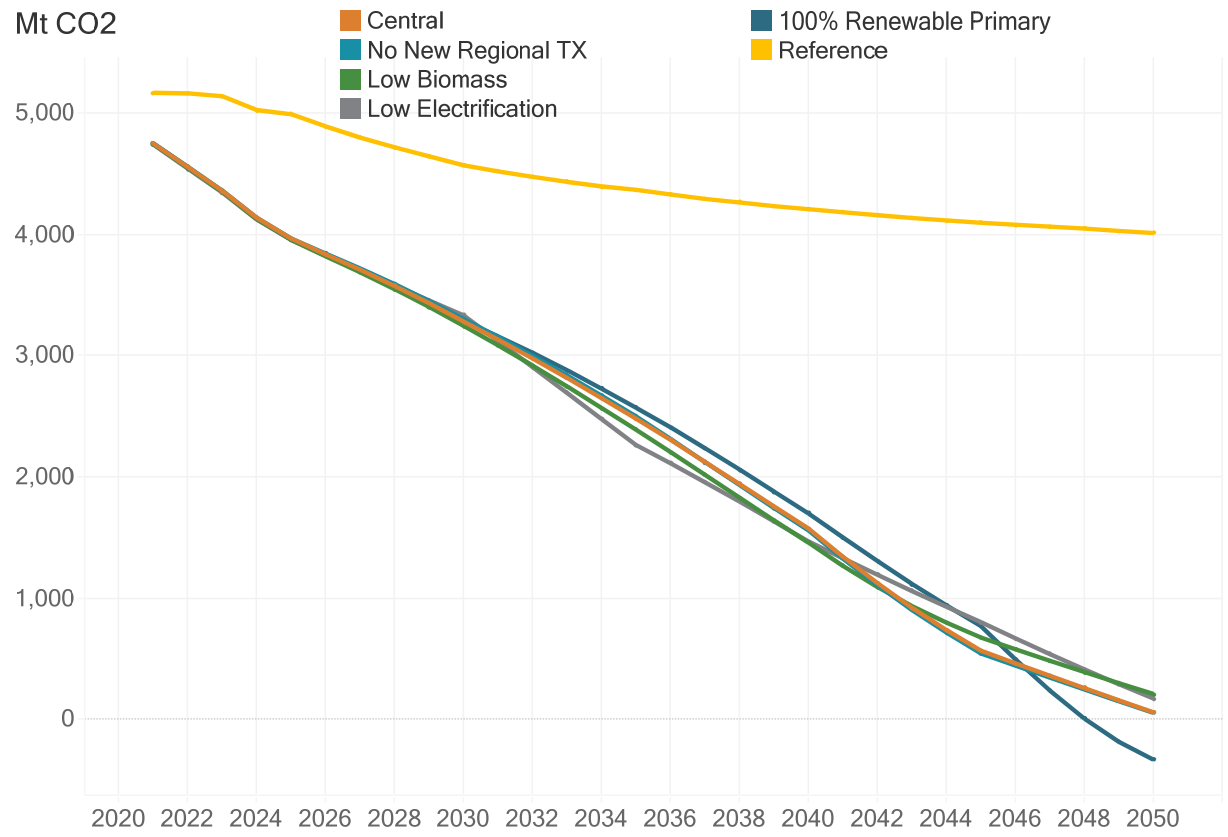


Figure 31 CO2 emissions by final energy/emissions category

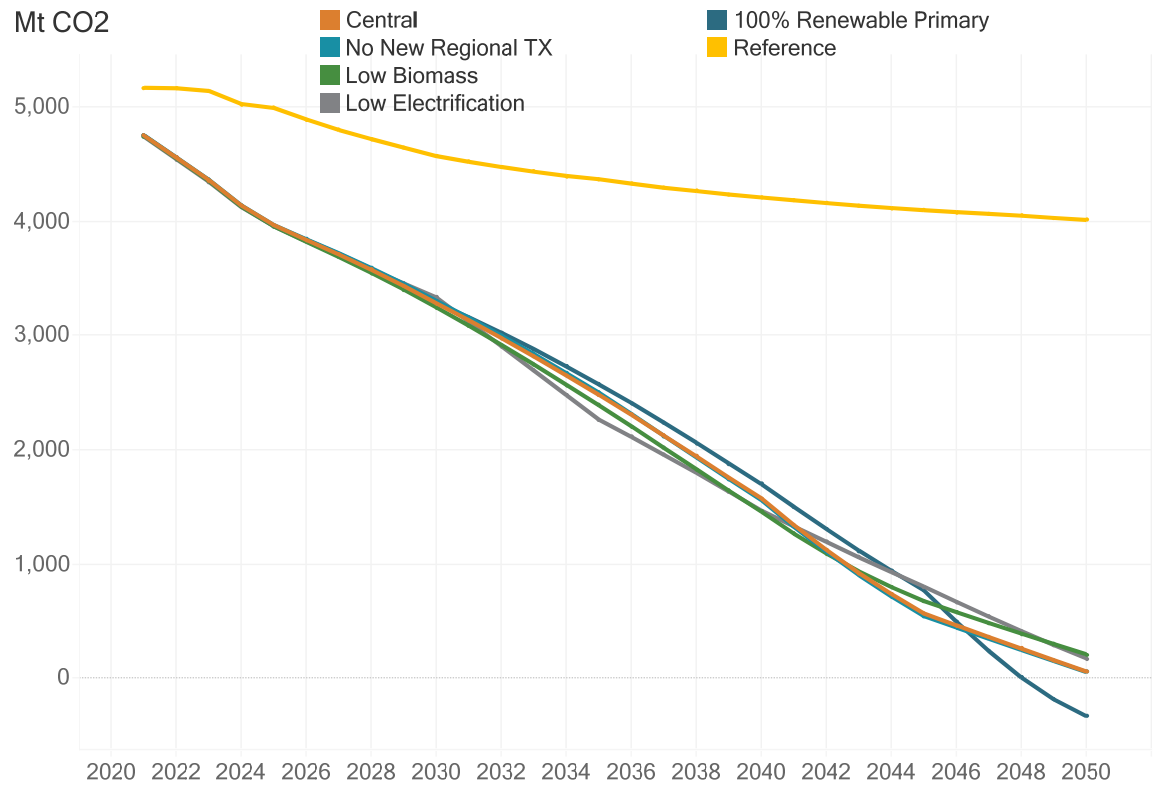


Figure 32 Cumulative E&I CO2 emissions trajectories

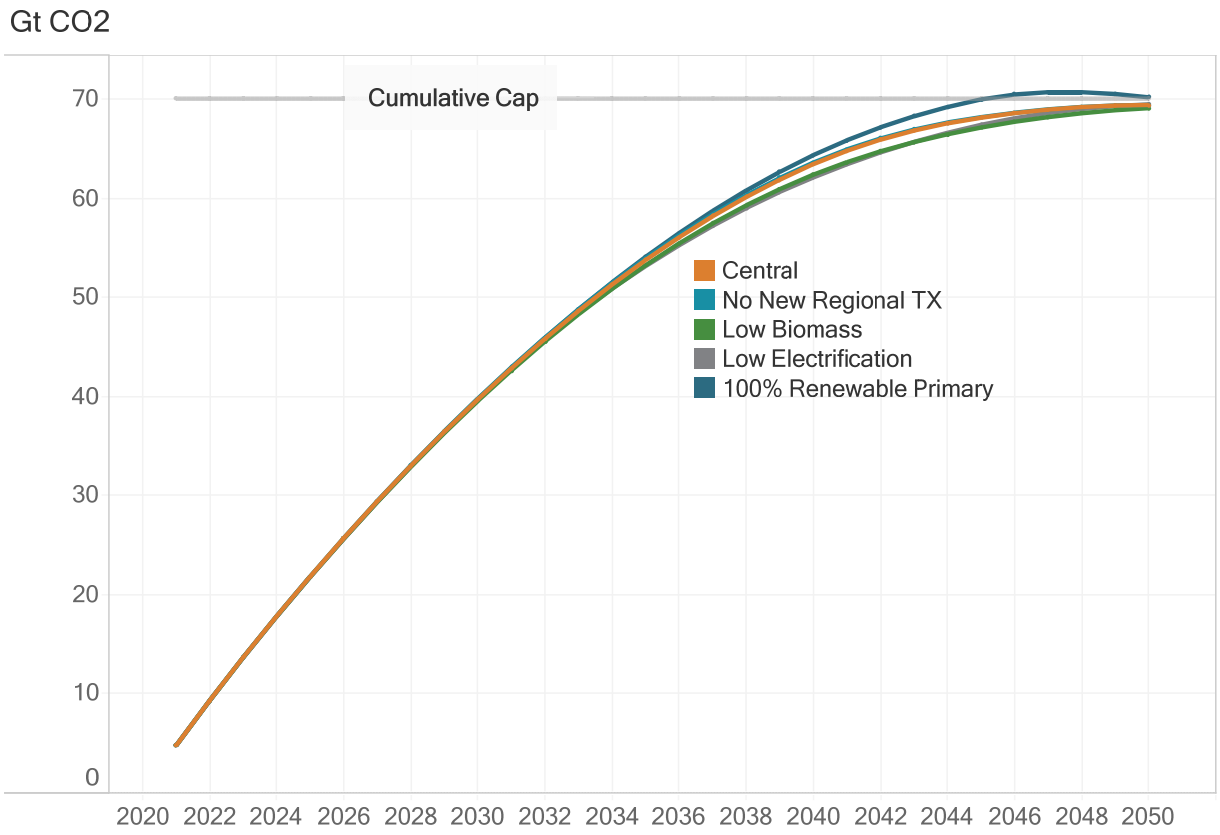


Figure 33 Four pillars of deep decarbonization – U.S.

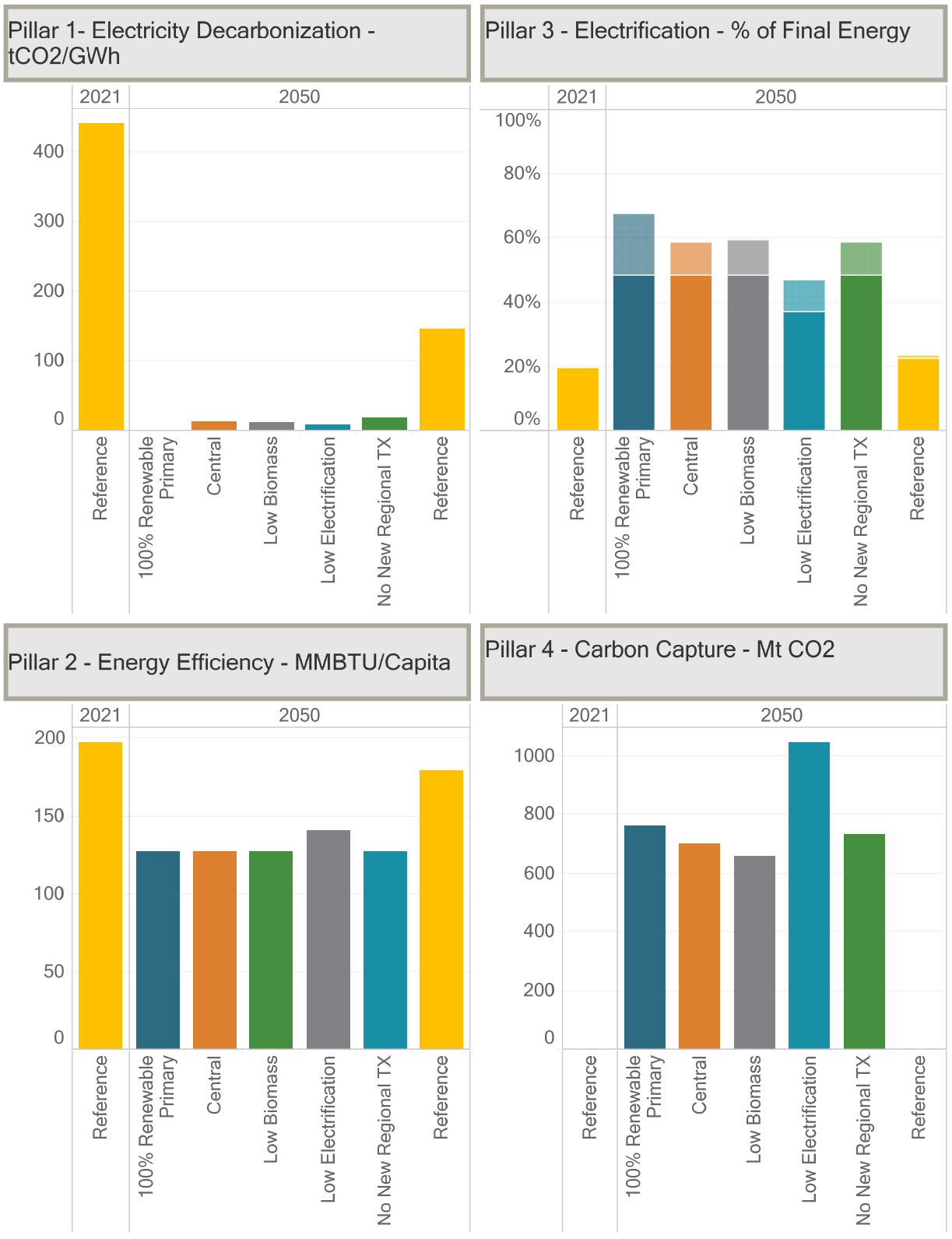


Figure 34 Final and primary energy demand for all scenarios from 2021 – 2050 – U.S.

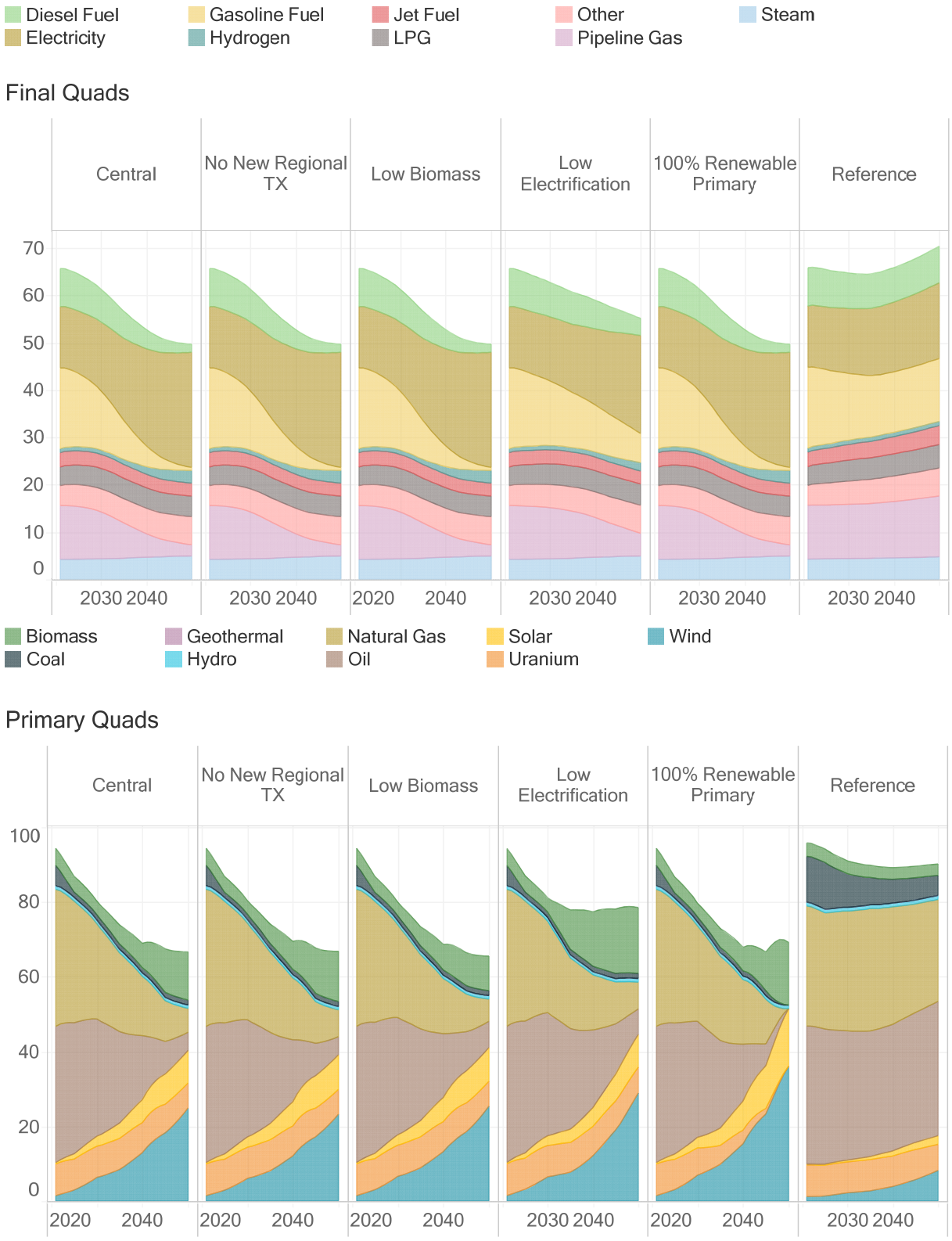


Figure 35 Components of emissions reductions in the Central scenario – U.S.

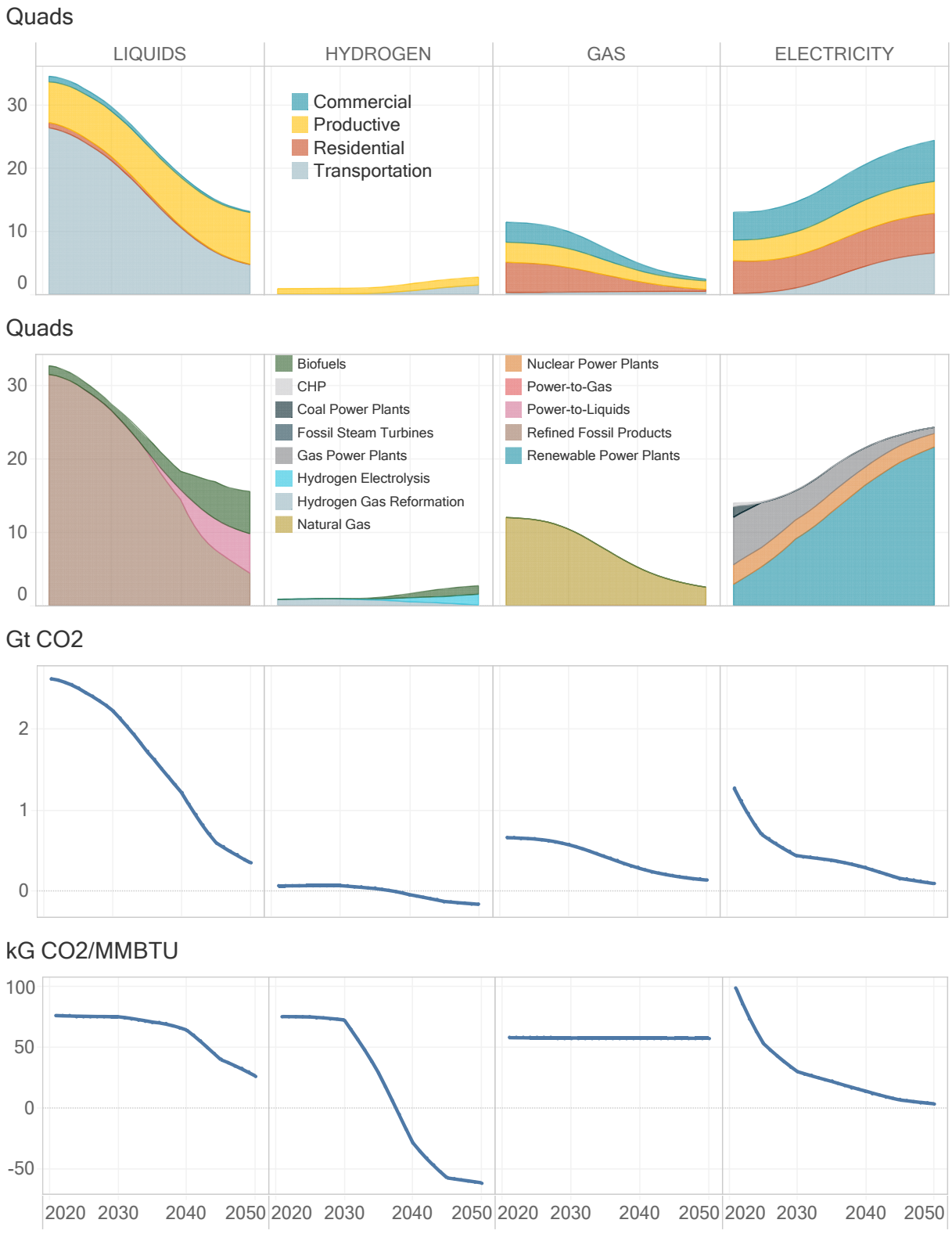


Figure 36 Components of emissions reductions in the Low Biomass scenario – U.S.

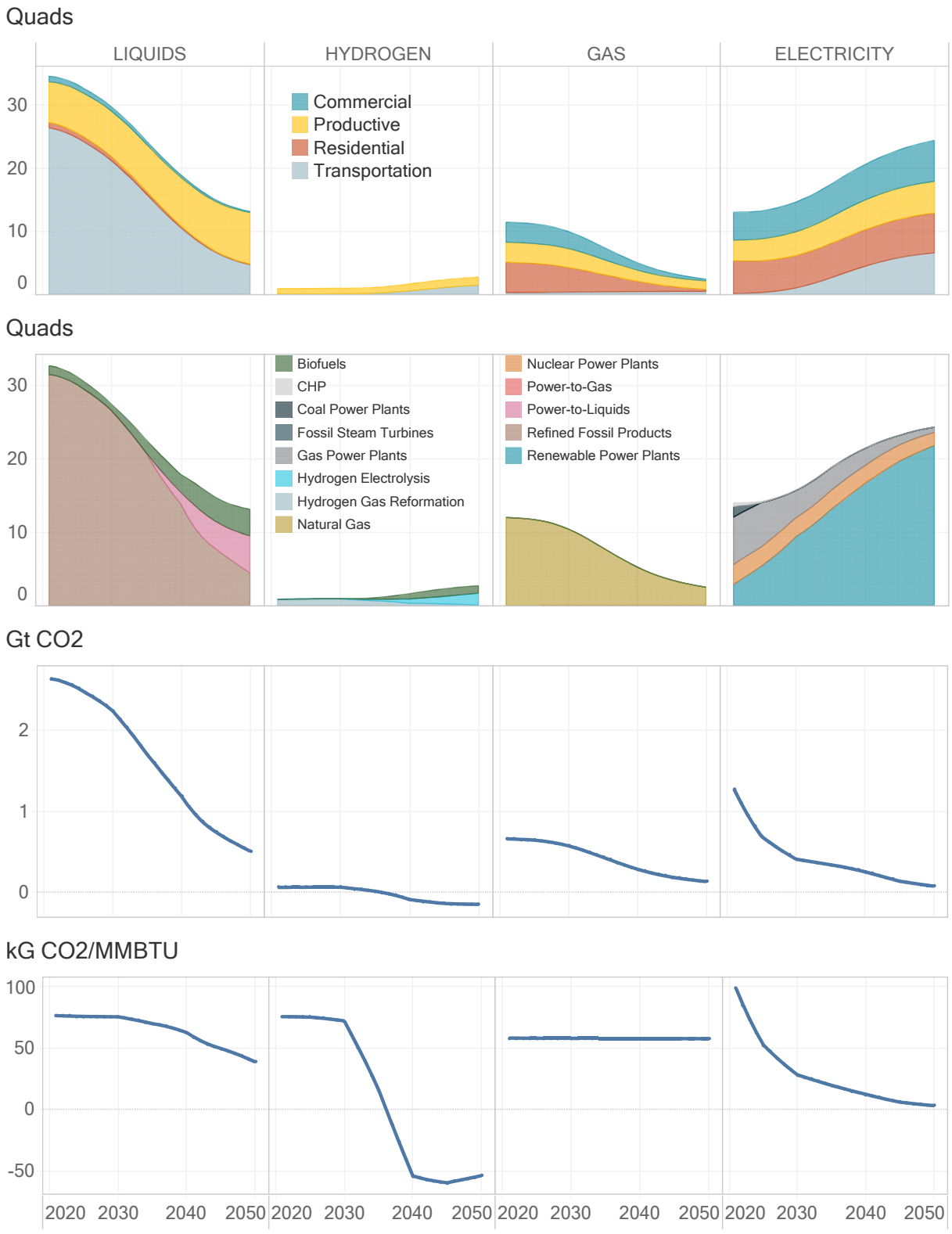


Figure 37 Components of emissions reductions in the Low Electrification scenario – U.S.

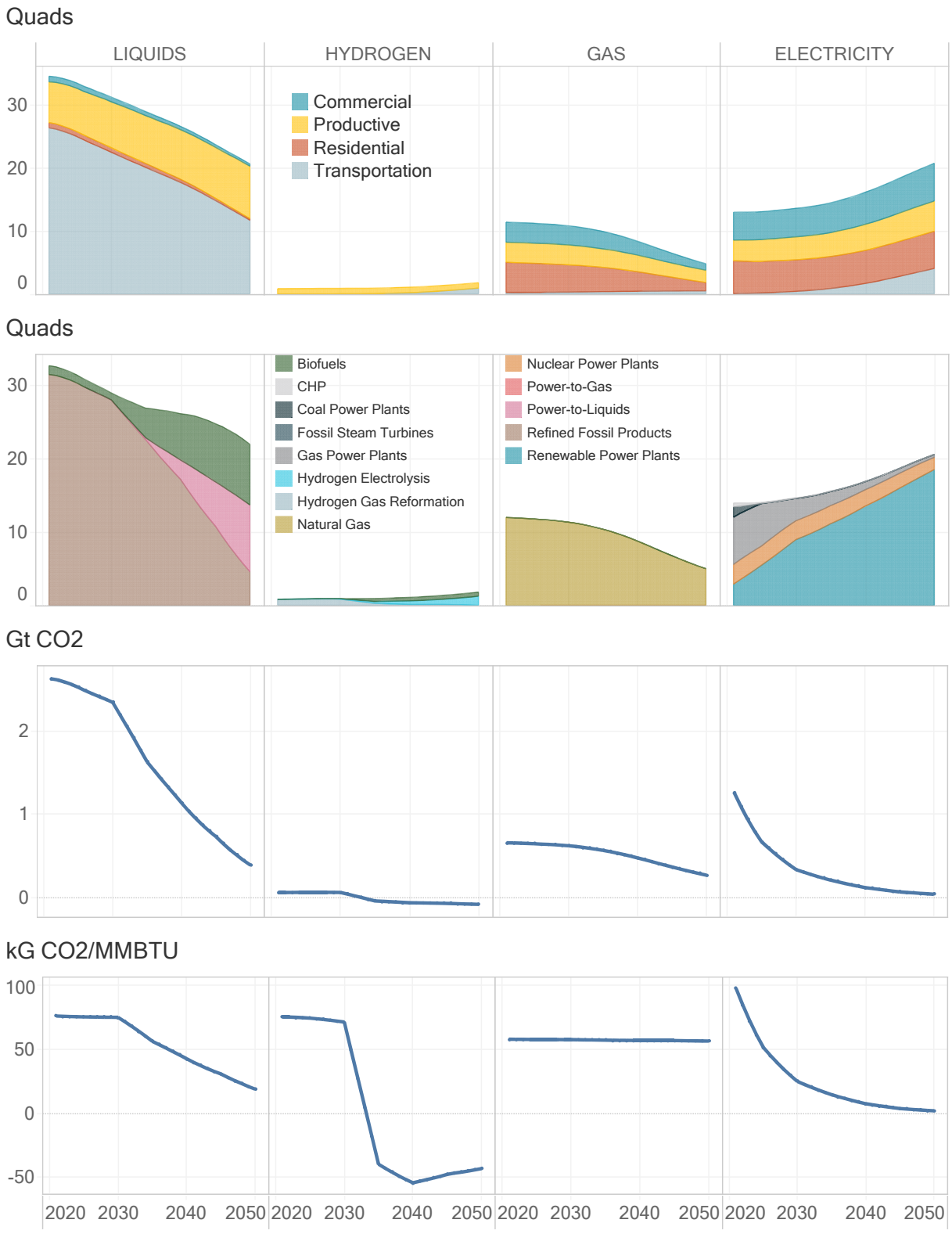


Figure 38 Components of emissions reductions in the No New Regional TX scenario – U.S.

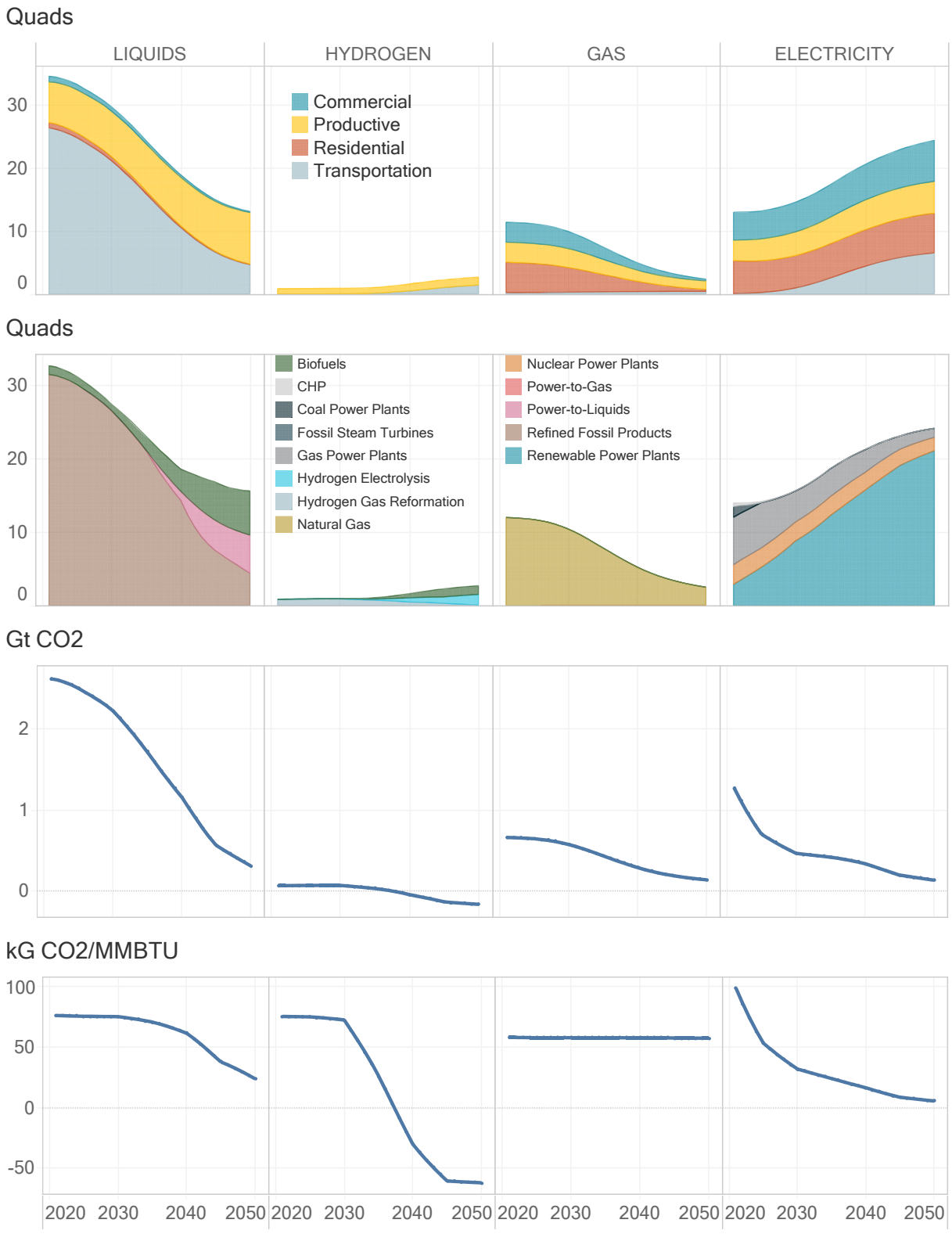


Figure 39 Components of emissions reductions in the 100% Renewable Primary scenario – U.S.

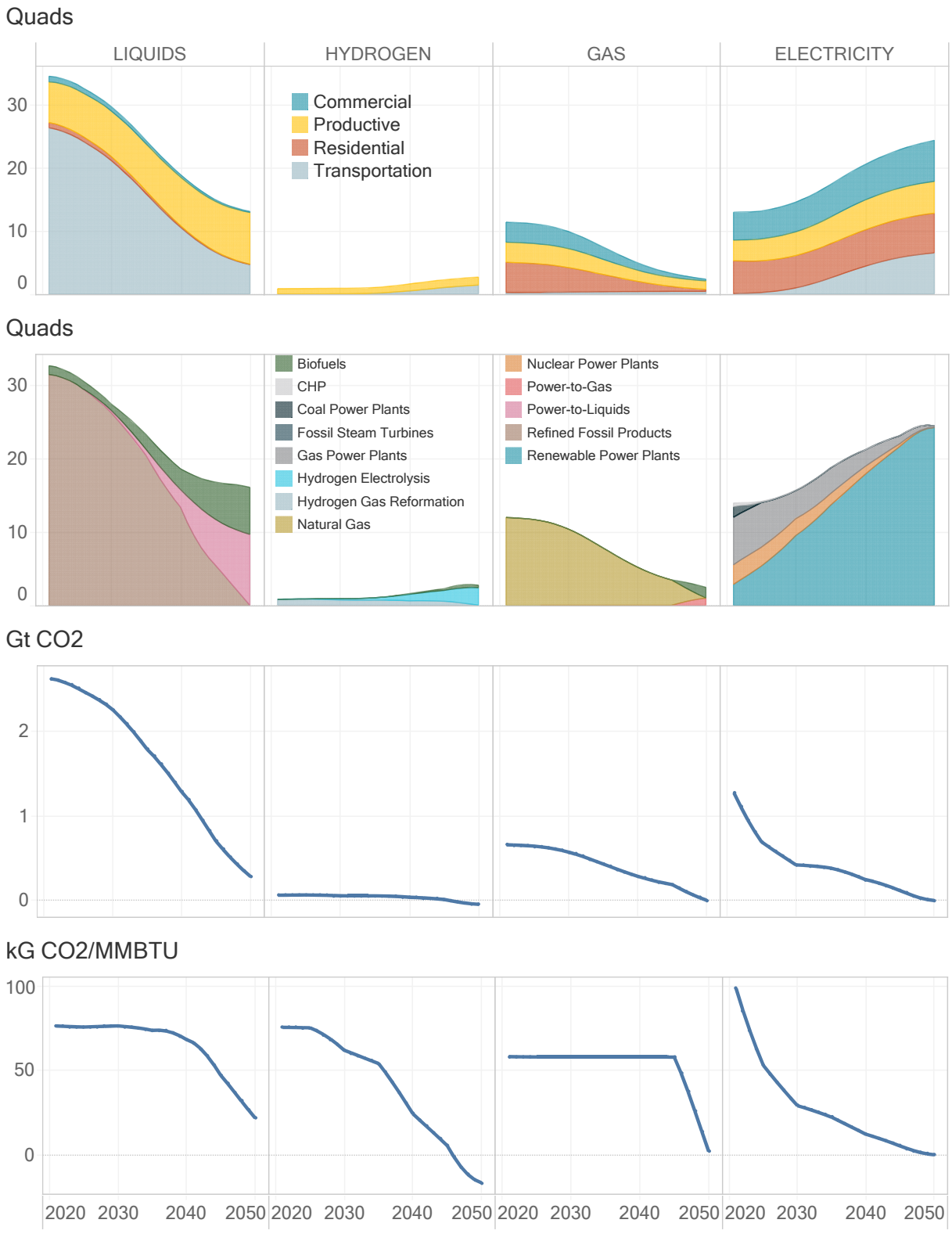


Figure 40 Annual net system cost premium above baseline in $2018 and as % of GDP – U.S.

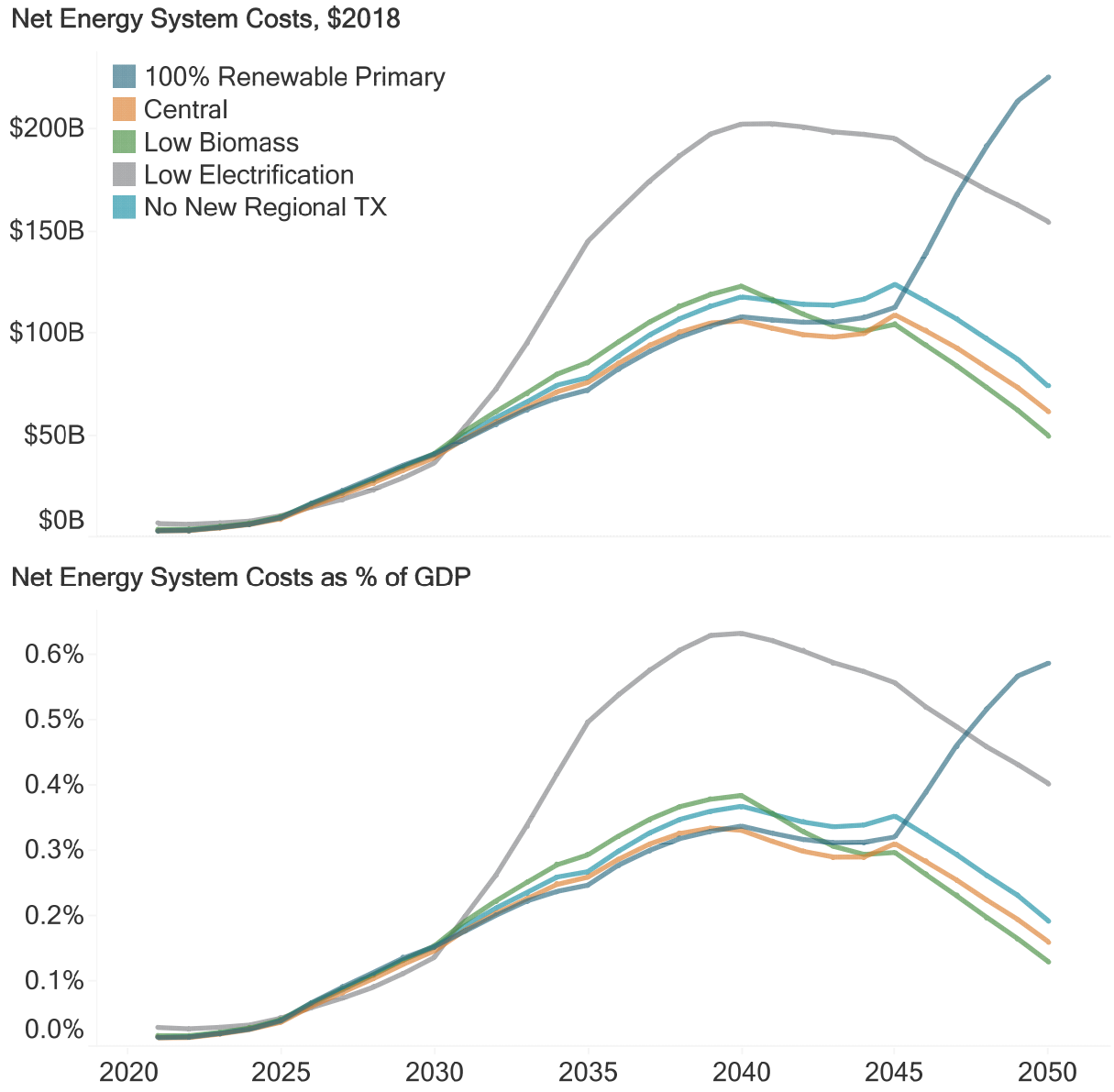


Figure 41 Net Change in E&I System Spending – U.S.

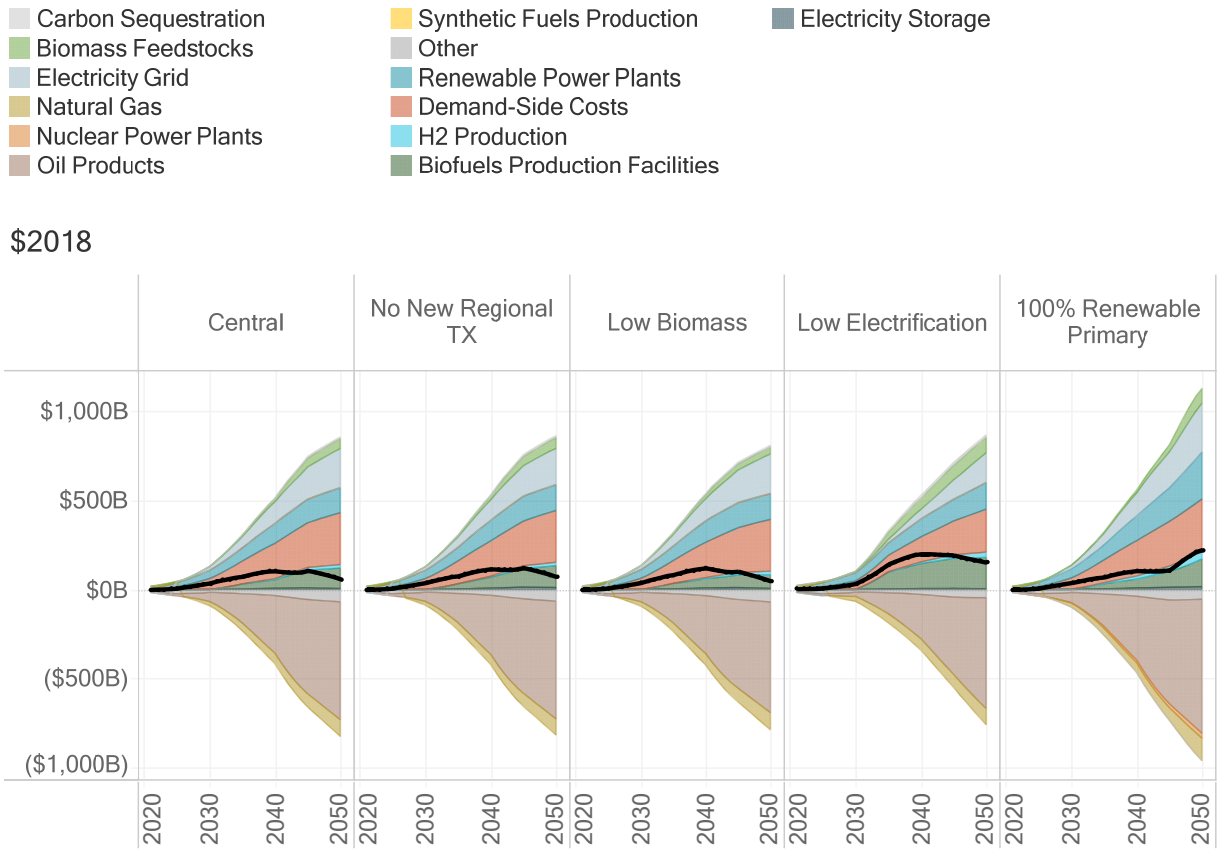


Figure 42 Total energy system costs as % of GDP –historical and projected – U.S.

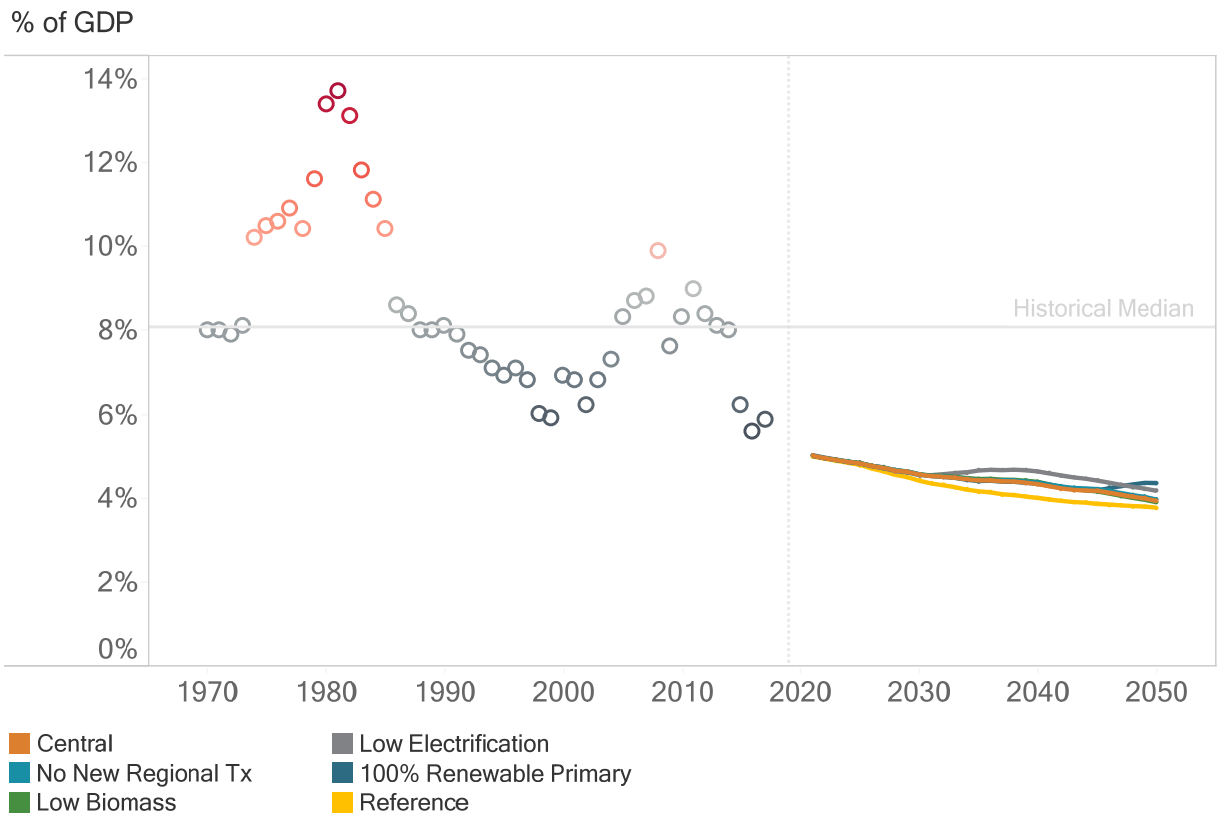


Exhibit C:

Congressional Testimony of Aji Piper

Written Testimony before the U.S. House of Representatives,
Select Committee on the Climate Crisis
Hearing Entitled
"Generation Climate: Young Leaders Urge Climate Action Now"
Aji Piper, Climate Activist and Youth Plaintiff, *Juliana v. United States*
April 4, 2019

Chair Castor, Ranking Member Graves, and distinguished Members of this Select Committee,

Thank you for inviting me to provide testimony to your Select Committee on the Climate Crisis. My name is Aji Piper. I'm 18-years-old. I love vanilla bean ice cream, snowboarding, and writing songs on my ukulele. I love my family and my friends and my home near the Puget Sound in Seattle. And I am suing the United States government for knowingly causing climate change as the largest historic contributor to the problem and for continuing, even now, to make a dangerous situation worse.

I have been reading climate science literature since I was 13-years-old. I have also been studying what my governments have done about the climate crisis during my lifetime, and even before I was born. For much of my life, I saw climate change as a problem that would be solved by adults in nice suits in a faraway Capitol. But as I grew up, and the coal and oil trains kept rolling through my hometown of Seattle, and the oil tankers kept sailing in and out of Puget Sound, I became apprehensive.

The late summer skies over Seattle now regularly fill with wildfire smoke, people walk around in gas masks, our ocean waters around my hometown are acidifying and rising, and yet there are still politicians in Washington, D.C. talking about climate change as if it is an issue to debate and still talking about promoting fossil fuel energy as if the pollution from that energy source is not dangerously destroying the one planet we've got, and the lives and futures of children along with it. I got to a point where I felt like I could no longer wait for the solutions to come from the Capitol or the adults that are responsible to protect young people like myself.

I am one of the 21 Youth Plaintiffs in the constitutional climate lawsuit, *Juliana v. United States*. Our complaint asserts that, through the federal government's affirmative actions in causing climate change, it has violated my constitutional rights, and those of my generation, to life, liberty, property, and equal protection under the law, as well as failed to protect vital public trust resources.[1] While I am not a legal expert, nor a climate scientist, and I only recently came of voting age, the goal of my testimony is to explain my perspective on the most consequential and

[1] First Amended Complaint, *Juliana et al. v. United States et al.*, No. 6:15-cv-01517-AA (D. Or. Sept. 10, 2015) (Exhibit DD).

far-reaching issues of our time, an issue that all three branches of this government are duty bound to address.

The Juliana Plaintiffs

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As a young black man, I have grown up with the long-lasting consequences of unconstitutional discrimination from government-sanctioned and engineered segregation. My childhood was shadowed by trauma from an abusive father. The trajectory of his life was formed in part by generational trauma of unlawful discrimination. Generations of black families have lived with the lasting legacy of government-sponsored racial discrimination, not just in the South, but in places like Seattle, where white suburbs formed out of federal government policies with restrictive covenants on housing developments and federally-guaranteed loans to homeowners that only whites could take advantage of. Cities across the country are segregated because of these federal policies that were finally declared unconstitutional after World War II by the Supreme Court, and that this branch of government attempted to redress decades later in the Fair Housing Act of 1968.[2] But the damage had been done and the legacy of that unconstitutional government conduct remains today in the color and shape of our communities, the makeup of our schools, the voting districts, and the disparity in those who were able to acquire home equity and wealth and those who were not. Unconstitutional systemic government actions have long-lasting social consequences. Innocent children inherit those legacies.

[2] *The Color of Law: A Forgotten History of How Our Government Segregated America*, Richard Rothstein (2017)

In response to decades of unconstitutional discrimination, in May of 1963, thousands of children led marches through Birmingham, Alabama to demand the desegregation of the city in a movement now known as the Birmingham Children's Crusade. On the first day of the protest, hundreds of children were arrested. By the second day, police officers tried to stop the marches by using fire hoses and police dogs to attack the children. On May 10, 1963, within one week of the first march, the city acquiesced to the children's demands, agreeing to desegregate businesses and to free all who had been jailed during the demonstrations. These youth stood at the forefront of one of the most pivotal moments in civil rights reform in the United States, using non-violent protest as a means to advance human rights.

Young people are often on the frontlines of human rights abuses, experiencing the most severe impacts of bigotry, oppression, and violence, sometimes in their own homes and often at the hands of adults in positions of power who do not act in the best interest of children. They are also inevitably at the forefront of the movements that emerge to address these issues, as we saw in the Child Labor Law Movement or the Civil Rights Movement.

Climate change is no different. My generation, and generations to come, have the most to lose from the sweeping impacts of climate change. As a result, youth throughout the world have taken the lead in the movement to address this existential threat. Just last month, over a million students the world over walked out of class to demand urgent and sane climate action from the adults in charge.

The entrenched federal government policies of orchestrating, promoting, supporting, subsidizing, sanctioning, and permitting a fossil fuel energy system will perpetrate as long-lasting harm on generations of innocent children as did this body's legal sanctioning and promotion of segregation. When government sanctions and controls a system that unconstitutionally deprives children of their basic fundamental rights to life, liberty and property, that system must be dismantled, and it is up to all three branches of this federal government to act now while there is still time to uphold the rights of my generation, to stop the perpetuation of intergenerational injustice.

Our case, Juliana v. United States

I, along with 20 other youth plaintiffs, Dr. James Hansen as guardian for future generations, and a youth-led organization called Earth Guardians, filed the landmark *Juliana v. United States* lawsuit in August 2015. Since the time our case was filed, when President Obama was in the White House, the federal defendants[3] have done everything in their power to stop *Juliana* from

[3] The United States Of America; The Office Of The President Of The United States; Council On Environmental Quality; Office Of Management And Budget; Office Of Science And Technology Policy; The United States Department Of Energy; The United States Department Of The Interior;

going to trial. They have made unprecedented and drastic efforts to have it thrown out before we get our day in court. Nonetheless, we have won every step of the way. In November 2016, we received a historic opinion from U.S. District Court Judge Ann Aiken, who aptly began her decision by referring to *Juliana* as "no ordinary lawsuit."[4]

Judge Aiken's opinion stated that:

> Exercising my 'reasoned judgment,' . . . I have no doubt that the right to a climate system capable of sustaining human life is fundamental to a free and ordered society. Just as marriage is the 'foundation of the family,' a stable climate system is quite literally the foundation 'of society, without which there would be neither civilization nor progress.'[5]

As part of her decision, the district court properly found the right "to a climate system capable of sustaining human life" is both fundamental to ordered liberty and deeply rooted in our Nation's history and traditions. The district court also found we should have an opportunity to present evidence to show that my federal government has knowingly violated this fundamental right.[6] In response, the Executive Branch defendants say that: "Plaintiffs' purported right to a 'climate system capable of sustaining human life' has no basis whatsoever in this Nation's history or tradition and is therefore not a fundamental right."[7] My government leaders are denying that the very foundation of life on Earth, our climate system, is one of my unalienable rights as a human living in this Nation. They say it is not one of the rights that I was endowed with when I was born. They say that my government can deprive me and all human civilization of the climate foundation of life, and discriminate against me, other children and all future generations in favor of supporting a fossil fuel-based economy and the narrow interests fossil fuels support, over policies that power clean energy and don't threaten my life and my security.

Our lawsuit makes a number of other claims, including that the United States government has a fiduciary responsibility to protect our public trust resources, such as the air, fresh water, the sea and the shores of the sea, not just for my generation, but for future generations as well. My co-plaintiffs and I are beneficiaries of rights under the public trust doctrine, unalienable rights that are secured by the substantive due process clause of the Fifth Amendment and the Posterity

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The United States Department Of Transportation; The United States Department Of Agriculture; The United States Department Of Commerce; The United States Department Of Defense; The United States Department Of State; The United States Environmental Protection Agency

[4] *Juliana v. United States,* 217 F. Supp. 3d 124 (D. Or. 2016) (Exhibit S).

[5] Exhibit S.

[6] *See also* District Court order granting in part and denying in part Defendants Motion for Summary Judgment and Motion for Judgment on the Pleadings (Exhibit T).

[7] Defendants' Reply Brief on Interlocutory Appeal (Exhibit EE).

Clause of the Constitution. Defendants have failed in their duty of care to safeguard the interests of my generation as the present and future beneficiaries of the public trust.

We have a tremendous amount of evidence, mostly from government documents, showing that the U.S. government has knowingly endangered our health and welfare by creating and promoting a national fossil fuel-based energy system, through controlling (1) Energy planning and policies; (2) fossil fuel extraction and production; (3) subsidies, financial and R&D support; (4) imports and exports; (5) interstate fossil fuel infrastructure and transport; (6) power plants and refineries; (7) energy standards for appliances, equipment, and buildings; (8) road, rail, freight, and air transportation; (9) government operations.[8] All of these deliberate orchestrated actions by the United States have cumulatively resulted in dangerous levels of atmospheric CO_2, which deprive us of our fundamental rights to life, liberty, and property. Importantly, the Defendants have admitted many of the allegations in our complaint, including that greenhouse gases "pose risks to human health and welfare" and "threaten the public health and welfare of current and future generations;" that the U.S. has emitted 25 percent of cumulative global CO_2 emissions from 1850 to 2012; and current CO_2 concentrations are "unprecedented for at least 2.6 million years."[9]

While the Defendants have been unsuccessful at stopping our case, they have certainly delayed it, and time is not on our side. Just weeks before we were set to begin what would have been, and certainly will be, the most important trial of the century for my generation, the Supreme Court issued a temporary stay of our trial in order to consider whether to stay our case and review it before a final decision.[10] While the Supreme Court ultimately denied the defendants' request and lifted the stay, the case has bounced up and down between the U.S. Supreme Court, the Ninth Circuit Court of Appeals and the District Court, while fossil fuels continue to be extracted and burned.[11] As our planet drifts ever-closer to the point of no return, we knew we had to do something.

Our request for a Preliminary Injunction during the Delay on Appeal

In February, we filed a motion to the Ninth Circuit Court of Appeals seeking an injunction to stop the actions by the U.S. government that are continuing to put me and other young people in danger by worsening climate change. Specifically, we asked:

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[8] Expert Report of James Gustave ("Gus") Speth (Exhibit U); Declaration of Peter A. Erickson (Exhibit E).
[9] Defendants Answer ¶¶ 5, 151, 208-09; 213 (Exhibit FF); Exhibit R.
[10] *In re United States*, 139 S. Ct. 16, *vacated*, 139 S. Ct. 452 (2018).
[11] For the briefing before the Ninth Circuit Court of Appeals on the government's interlocutory appeal see Exhibit P (Defendants' Opening Brief); Exhibit Q (Plaintiffs' Answer Brief); Exhibit EE (Defendants' Reply Brief); *see also* Exhibit O (*Amicus* brief submitted by 80 law professors in support of Plaintiffs)

> This Court should preliminarily enjoin, for the pendency of this interlocutory appeal, Defendants from authorizing through leases, permits, or other federal approvals: (1) mining or extraction of coal on Federal Public Lands; (2) offshore oil and gas exploration, development, or extraction on the Outer Continental Shelf; and (3) development of new fossil fuel infrastructure, in the absence of a national plan that ensures the above-denoted authorizations are consistent with preventing further danger to these young Plaintiffs.[12]

This injunction is urgently needed because, despite long-standing knowledge of the resulting destruction to our Nation and the profound harm to myself and my co-plaintiffs, the federal government's ongoing development of the fossil fuel-based energy system is actively harming us and making it more difficult for us to ever solve this crisis. While a complete halt on these actions may seem like a radical request to some of you, scientists tell us that nothing short of stopping these kinds of additional fossil fuel development can avert the worst effects of climate change, and prevent us from entering a period of irreversible baked-in, or runaway, heating. I wish incremental actions were enough, but the government's long-standing actions perpetuating a fossil fuel energy system have put us in this situation. But here's the upshot, our top experts say that neither the injunction we seek, nor our ultimate remedy in the case will hurt the economy. In fact, they say that it will *help* the economy and create new jobs, and is our only real shot at preventing our economy from tanking from the increasing costs of climate disasters, the enormous economic threats that climate change poses, and the lost opportunity to lead the market transition away from fossil fuels that other nations are outpacing us on.[13]

Please listen to the experts; The harm is real and is happening to us now

In *Juliana v. United States*, my co-plaintiffs and I are very fortunate to be supported by some of the world's top climate change science and solution experts. I've included some of their written expert testimony as attachments to my testimony and I encourage you to read them.

According to Dr. Jerome Paulson, Professor Emeritus at George Washington University who submitted a declaration in support of our preliminary injunction filing: "Each month that passes by without action by the federal government to reduce fossil fuel extraction and GHG emissions exacerbates this already grave public health emergency facing our nation's most vulnerable population — our children."[14]

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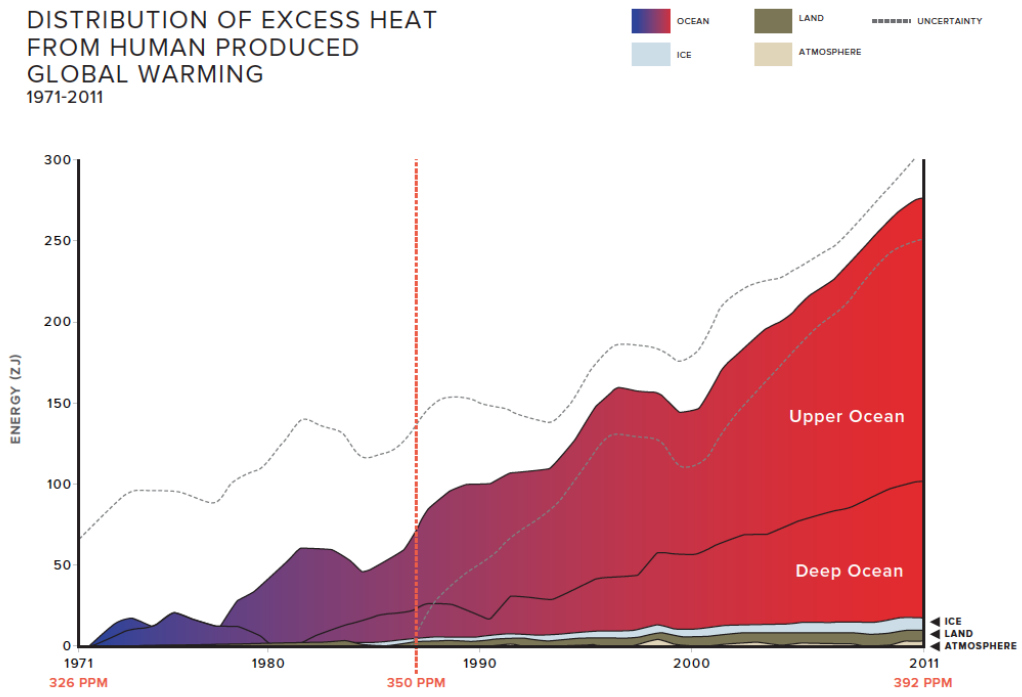
[12] Exhibit A.
[13] Declaration of Joseph E. Stiglitz (Exhibit I).
[14] Exhibit D, p. 7.

Nobel Prize-winning economist Joseph Stiglitz testified: "There is no urgency to promote more fossil fuels. There is no urgency for energy supply. There is no urgency for employment or economic growth. There is, however, real urgency to stop the climate crisis and the already-dangerous status quo from worsening, and to protect these young people's constitutional rights. There are very real and substantial societal costs and risks of moving forward with these fossil fuel enterprises while this lawsuit is pending."[15]

Dr. Steve Running, Professor Emeritus at the University of Montana and Nobel prize winner testified: "The Federal Government has for many years had knowledge, information, and scientific recommendations that it needed to transition the Nation off of fossil fuels in order to first prevent against, and now try to stop, catastrophic climate change. We are well beyond the maxim: 'If you find yourself in a hole, quit digging.'"[16]

Dr. Ove Hoegh-Guldberg, Professor of Marine Studies and the Director of the Global Change Institute at The University of Queensland stated in his declaration: "Th[e] absolute amount of excess heat absorbed by our oceans is tremendous: the equivalent of energy from approximately 1.5 Hiroshima-sized atomic bombs per second over the past 150 years, at-present the equivalent of approximately 3-6 Hiroshima-sized bombs every second" (see Figure 1).[17]



[15] Exhibit I, p. 15.
[16] Exhibit G, p. 26.
[17] Exhibit F, p. 4.

Figure 1: Distribution of global-warming energy accumulation (heat) relative to 1971 and from 1971 to 2011. Half of the human-produced global warming heat has entered the ocean since 1997.[18]

Over the past month, we have heard stories on the news of entire towns in the midwest wiped off of the map by massive flooding events triggered by a historic 'bomb cyclone.' Hurricane Florence, which hit North Carolina last fall and brought historic flooding, Hurricane Michael, which flattened the community of Mexico Beach, Florida in 2018, and Hurricane Maria that decimated Puerto Rico in 2017, have become our new normal. These storms will only get worse unless we take urgent action.[19]

My fellow plaintiff Jayden experienced one of these climate change-driven super storms first hand in 2016, when she woke up to find feet of standing water in her bedroom. Her house in Rayne, Louisiana had been flooded in a 'thousand-year storm', yet these storms seem to be coming year after year. Her family is still making repairs on their home after three years.[20]

Wildfire

It's not just storms that we have to worry about. I have experienced firsthand how wildfire seasons extended by two and a half months throughout the west are shrouding our communities with smoke for months on end, causing innumerable respiratory health issues, and taxing our emergency response funds (see Figure 2). It is not just rural communities that are experiencing this smoke, it is urban areas as well. I never thought that living in the United States would come with air quality warnings advising me to stay inside and school and youth sports activities being canceled so we aren't harmed by breathing the air. I can't tell you how scary it is to see people walking down the street in gas masks in August in Seattle, which used to be the most beautiful time to be outside in the Pacific Northwest.[21]

[18] Chart is a modified version of a chart found in Nuccitelli, D. et al., *Comment on Ocean heat content and Earth's radiation imbalance*. *II. Relation to climate shifts*, Physics Letters A, Vol. 376, Issue 14 (2012).
[19] Declaration of Kevin E. Trenberth (Exhibit B).
[20] Exhibit W.
[21] Declaration of Steven W. Running (Exhibit G); Declaration of Aji. P (Exhibit X).

Figure 2: Wildfire smoke shrouds Seattle.[22]

Sea Level Rise

If we don't make serious change now, in just a few decades some the largest cities in the United States will first become uninhabitable and then be entirely submerged, as well a vast majority of the state of Florida. My fellow plaintiff, Levi, will watch his family home and the entire island that he grew up on go underwater with just a few feet of sea level rise, which could hit by mid-century. He will become a climate refugee long before then (see Figures 3 and 4).[23]

[22] Agueda Pacheco-Flores, *Puget Sound air-quality warnings: Beware of smoke from British Columbia fires*, The Seattle Times (Aug. 13, 2018); available at: https://www.seattletimes.com/seattle-news/british-columbia-wildfire-smoke-is-impacting-air-quality-warnings-issued-for-vulnerable-groups/.

[23] Declaration of Levi D. (Exhibit Y); Declaration of Dr. James Hansen (Exhibit L); *see also* Hansen, J., et al., (2016). *Ice melt, sea level rise and superstorms: Evidence from paleoclimate data, climate modeling, and modern observations that 2°C global warming could be dangerous.* Atmos. Chem. Phys., 16, 3761-3812, doi:10.5194/acp-16-3761-2016.

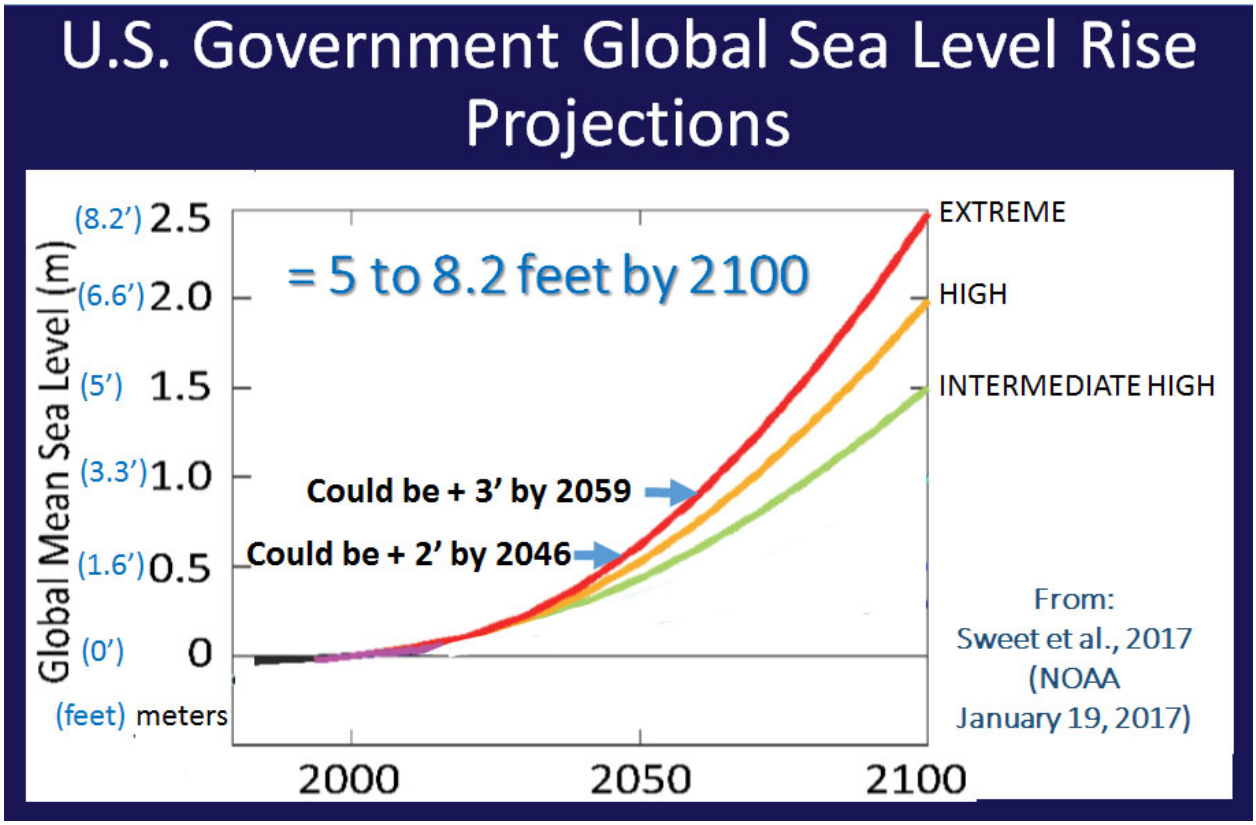


Figure 3: U.S. government sea level rise projections through 2100.[24]

[24] Exhibit Z.

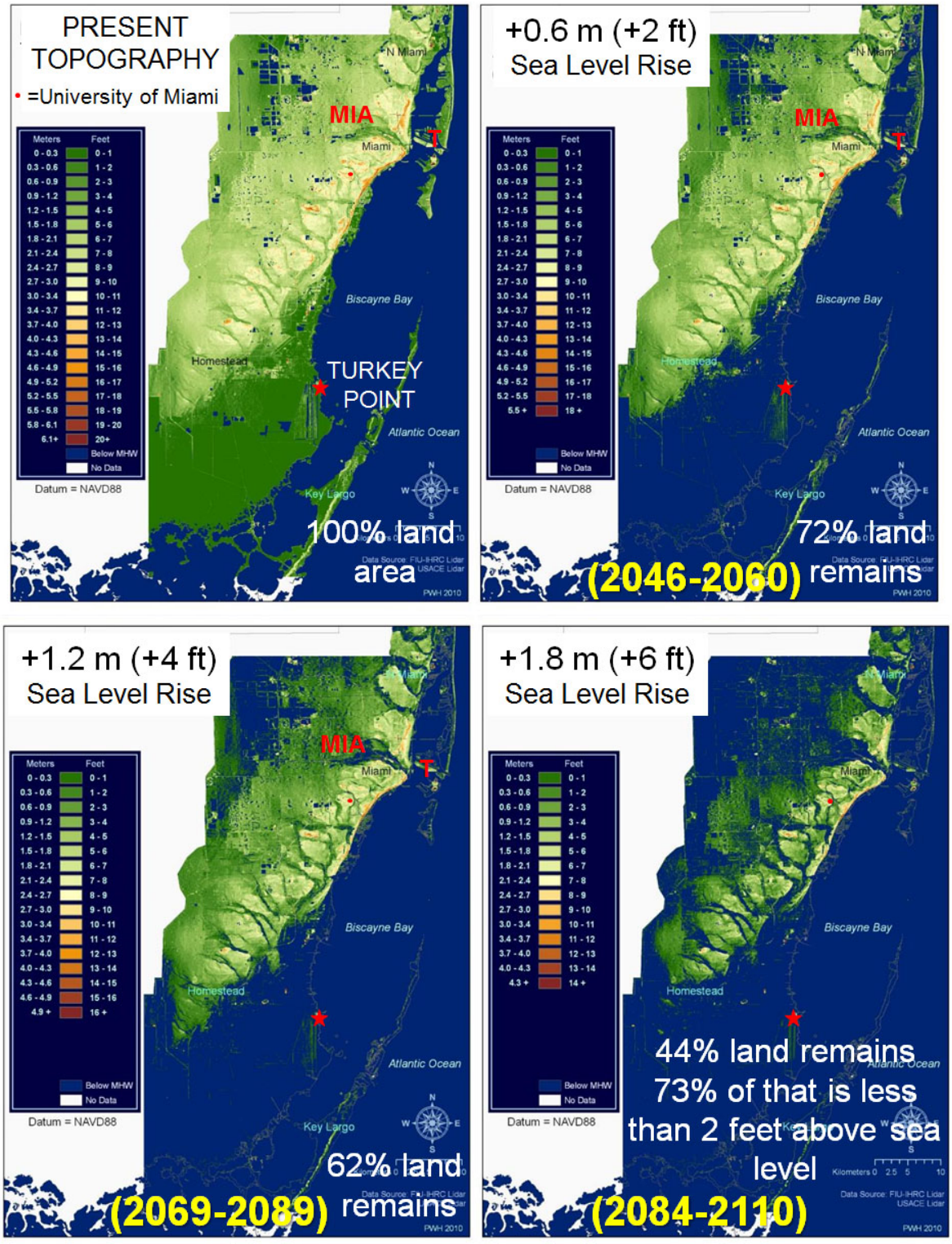


Figure 4: Sea level rise projections for southern Florida.[25]

[25] Exhibit Z.

The economic impacts of sea level rise to our country will be astronomical. Just 25 years from now, coastal properties in the U.S. worth some $136 billion will be at risk of chronic flooding. By the end of the century, that rises to $1 trillion in properties at risk of chronic flooding - not to mention the billions of dollars that would be lost in other sectors.[26]

National Security Threat

Many people in communities throughout the United States, including some along the Washington coast, are already being forced from their homes because of flooding and sea level rise. All of these people, and many more, will be displaced permanently if we do not act now. This displacement would in turn lead to massive geo-political destabilization. An expert declaration provided by retired Vice Admiral and Former Inspector General of the United States Department of the Navy, Lee Gunn, states:

> Climate change is the most serious national security threat facing our Nation today. Climate change contributes to increased extreme weather events, rapidly changing coastlines, and conflicts over basic resources like food and water, which lead to humanitarian crises with increased migration and refugee flows. Climate change is a "threat multiplier" and "catalyst for conflict" and directly threatens our military and the "Department of Defense's ability to defend the Nation." Climate change poses unprecedented risks to our Nation's economic prosperity, public health and safety, and international stability.

Vice Admiral Gunn goes on:

> The great danger for young people, is that they are being handed a situation that is out of their control, a situation made more egregious due to the fact that the Defendants have a complete understanding of precisely how dangerous the situation is that they are handing down to these Plaintiffs.[27]

Public Health

The medical community across the country is sounding alarm bells about the public health emergency that climate change is causing. As an *amicus brief* filed in support of my case in the Ninth Circuit, on behalf of 78 doctors and medical professional and 14 medical organizations,[28] stated:

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[26] Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implication for US Coastal Real Estate* (2018), available at: https://www.ucsusa.org/global-warming/global-warming-impacts/sea-level-rise-chronic-floods-and-us-coastal-real-estate-implications.

[27] Exhibit K.

[28] The organization are: American Academy of Allergy, Asthma and Immunology; American Academy of Pediatrics; American Association of Community Psychiatrists; American Heart

> The medical community widely considers the health effects of human-induced climate change, GHG emissions, and the other air pollutants that are emitted when fossil fuels are combusted to be significant public health threats, representing an unacceptably high level of risk for the current and future health of the U.S. population.[29]

The Targets You Set Will Matter

What is clear now is that climate change is already dangerously affecting people within the United States with 1 degree of warming. It is not just scientists who have come to that conclusion. My co-plaintiffs and I, along with other communities and individuals that are experiencing the devastating impacts I have just described, understand the perils of living in this climate system. The situation is only going to get worse if the planet becomes 1.5°C warmer than pre-industrial levels. This is the temperature target that is called for by the Paris Climate Accord. It is the target called for in the Green New Deal, and by the countless cities, states, and climate advocacy groups around the country that have endorsed it. To be clear, 1.5°C of warming, or approximately 425 parts per million (ppm) of carbon dioxide in the atmosphere, is genocide, and a death sentence for human civilization as we know it. Even the 2018 IPCC report on the impacts of 1.5°C concluded that allowing the globe to warm to 1.5°C will involve devastating impacts. Chapter 5 of the report states plainly that 1.5°C is not safe:

> Warming of 1.5°C is not considered 'safe' for most nations, communities, ecosystems, and sectors and poses significant risks to natural and human systems as compared to current warming of 1°C (*high confidence*) (see Chapter 3, Section 3.4, Box 3.4, Box 3.5, Cross-Chapter Box 6 in Chapter 3).

This body should never endorse a target that destroys Levi's island and much of Florida or my Puget Sound, damages the lungs of children in the West, decimates the rich croplands of the midwest, or floods homes across the country from fossil fuel-fed unprecedented storms.

The now-pervasive 1.5°C target first appeared in the lead up to the 2009 UNFCCC Conference of Parties in Copenhagen, Denmark (COP 15), as a result of the advocacy of the Alliance of Small Island States (AOSIS). At a time where international political negotiations still revolved around 2°C, AOSIS advocated for "*well below* 1.5°C," and relied on the work of Dr. James Hansen, one of our experts, and his colleagues' research arguing that a 350 ppm CO_2 target was

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Association; American Lung Association; American Pediatric Society; American Thoracic Society; Infectious Diseases Society of America; International Society for Children's Health and the Environment; Medical Society Consortium on Climate and Health; National Association of County and City Health Officials; National Environmental Health Association; National Medical Association; and Society for Academic Emergency Medicine.

[29] Exhibit N, p. 8.

necessary to preserve a habitable climate.[30] In later research, Hansen and his colleagues determined that 350 ppm would only lead to 1°C of long-term warming, which was an important target to aim for by 2100.[31] Yet as time went on and contentious climate negotiations ran their course, the "well below" portion of AOSIS's "well below 1.5°C" position was lost, and the world's governments settled on 1.5°C as a compromise goal. But they did so without any scientific support for the notion that we would be safe with 1.5 degrees of warming.

We have to ask ourselves: Are we willing to 'compromise' on our safety and our future?

In the long term, 1.5°C warming means melting most of the ice sheets on the planet and more than 70 feet of sea level rise (see Figure 5).[32] The reason we know this is because this is what sea levels were the last time carbon dioxide levels were as high as they are today. According to a study by McGranahan et. al., over 600 million people live within 30 feet above sea level.[33] The Fourth National Climate Assessment, using modest estimates of sea level rise, found that "[s]ea level rise might reshape the U.S. population distribution, with 13.1 million people potentially at risk of needing to migrate due to a SLR of 6 feet (about 2 feet less than the Extreme scenario) by the year 2100."[34]

[30] Hansen, J., et al., (2008). *Target atmospheric CO2: Where should humanity aim?* Open Atmos. Sci. J., 2, 217-231, doi:10.2174/1874282300802010217.
[31] Hansen, J., et al., (2013). *Assessing "dangerous climate change": Required reduction of carbon emissions to protect young people, future generations and nature*. PLOS ONE, 8, e81648, doi:10.1371/journal.pone.0081648.
[32] Expert Report of Dr. Harold R. Wanless, p. 6-7 (Exhibit Z); Declaration of Eric Rignot (Exhibit H).
[33] McGranahan, G., Balk, D., & Anderson, B. (2007). *The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones*. Environment and urbanization, 19(1), 17-37.7
[34] U.S. Global Change Research Program, "Ch. 8 Coastal Effects", *Fourth National Climate Assessment, Volume II, Impacts, Risks, and Adaptation in the United States* 335 (2018), https://nca2018.globalchange.gov.

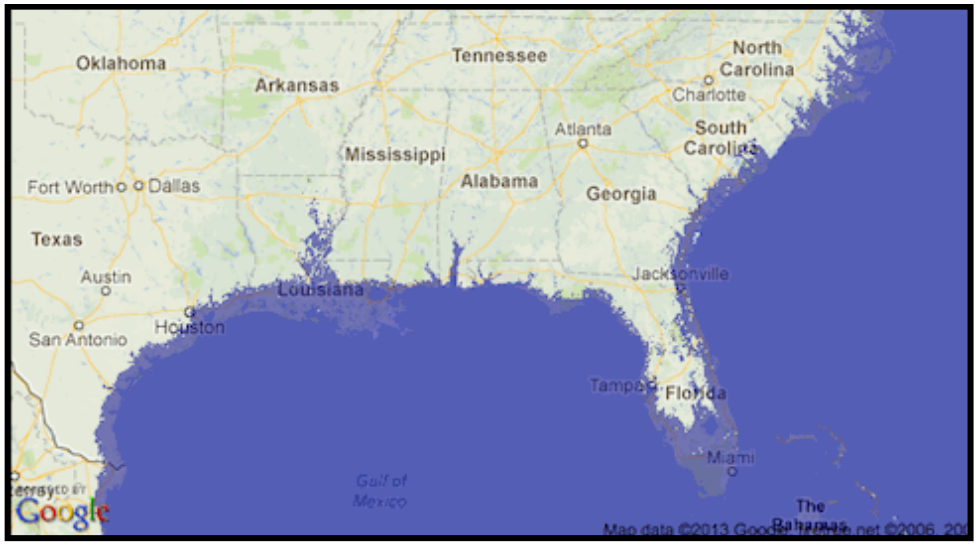

Figure 5: Map of the south Atlantic and Gulf coasts showing the inundation that would occur with 70 feet of sea level rise.[35]

All of these people, and more, will be displaced if we allow the 1.5°C target to remain in place. Even the 2018 IPCC report plainly states that 1.5°C warming is not safe, but governments and groups continue to push us towards this disaster. At 1.5°C we also lose the worlds coral reefs and ocean life becomes threatened, meaning our food sources disappear and the rich biodiversity of our planet crashes.

The writing is on the wall: this body needs to look beyond the arbitrary 1.5°C target for one that is based in the best available science, and that will allow us to avoid the most grievous impacts of climate change. Scientists tell us that 1°C (350 ppm CO_2) is the maximum level of long-term warming that our civilization can survive this century. And we likely need to return even closer to preindustrial CO_2 levels of 280 ppm over the longer term. So why aren't we acting like it?

Is it radical to seek integration of all schools instead of just some? Is it radical to stand up for the rights of children and future generations? Is it radical to want to stop the danger we face? Is it radical to want to save what you love?

A Remedy is Still Possible but the Window is Closing

We have the technology to follow the path of emissions reductions the experts say we need to in order to have a chance at health and survival for us and our planet. It is within reach to transition to a decarbonized energy system by 2050, and to increase natural carbon sequestration through

[35] Exhibit Z.

reforestation and sustainable agriculture to bring us back to 350 ppm by the end of the century.[36] The U.S. needs to do its part in the world to make that happen. It will not happen without us.

While many critics often cite the expense of a transition to renewable energy, experts expect a transition off of fossil fuels would have a minimal increase on national energy costs, and the costs would be well below the historic spikes in energy costs due to volatile fossil energy prices (see Figure 6).[37] This temporary increase in energy system costs is trivial compared to the oppressive costs we can expect if we continue to stumble our way into an unmitigated climate catastrophe.

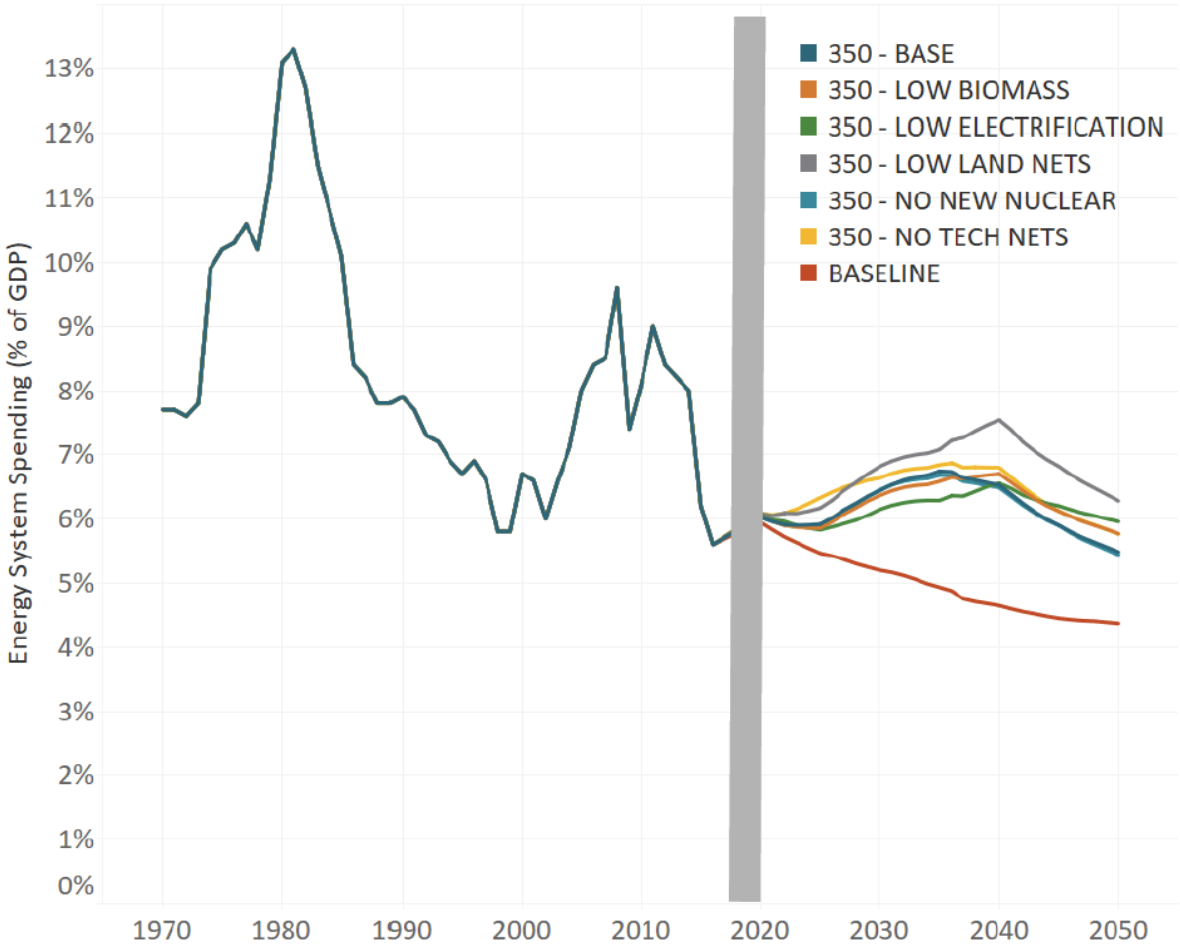

Figure 6: Total spending on the U.S. energy system represented as a percentage of GDP. Historical spikes from the 1970s oil crisis and high oil prices in 2006-2010. Modeled variations

[36] Declaration of Mark Z. Jacobson (Exhibit C); Declaration of James H. Williams (Exhibit J); Exhibit V.
[37] Exhibit V.

on the right illustrate the cost of multiple scenarios that transition the U.S. off of fossil fuels by 2050.[38]

Because CO_2 is the primary driver of climate destabilization, all government policies regarding CO_2 pollution and CO_2 sequestration should be aimed at reducing global CO_2 concentrations below 350 ppm by 2100. Other greenhouse gases should also be reduced as much as possible and as rapidly as possible. Time is running out. We can no longer afford to base greenhouse gas reduction targets, with tangible consequences for life and death, on politics rather than science.

We are at a critical juncture — never in my life have I seen so much momentum to address the climate challenge. We must not waste this energy, and as such, we must reevaluate our goals and where they are coming from. We can't truly succeed if we're relying on targets based on political compromise instead of the best available science.

We have a fundamental right to a liveable future, and that future requires us to limit global warming to 1°C by the end of the century.

Long-Standing Government Knowledge

My involvement in the *Juliana* lawsuit has given me insight into the injustices of climate change, and a better understanding of the United States Government's responsibility for it.[39] In preparing our case, we uncovered documents that show us that the Government has known about the threats of carbon dioxide for more than half a century. One of my co-plaintiffs, Alex, uncovered a 1961 letter to President Kennedy, where U.S. Senator Clinton Anderson voices the predictions of scientists about catastrophic climate change and sea level rise due to fossil fuel CO_2 emissions.[40] Just a few years later, President Lyndon B. Johnson received a more pointed warning in a report from noted climate scholar Charles David Keeling, and dozens of university researchers, that "man is unwittingly conducting a vast geophysical experiment," by burning fossil fuels.[41] This 1965 White House report clearly outlined the connection between the burning of fossil fuels and climate change (see Figure 7).

[38] Williams, J. et al. *Assessing the feasibility of 350 PPM CO_2 targets in the United States.* 2019.
[39] Expert Report of James Gustave ("Gus") Speth (Exhibit U).
[40] Exhibit BB.
[41] Report of the Environmental Pollution Panel President's Science Advisory Committee, *Restoring the Quality of our Environment* (1965); available at: https://babel.hathitrust.org/cgi/pt?id=uc1.b4116127;view=1up;seq=11.

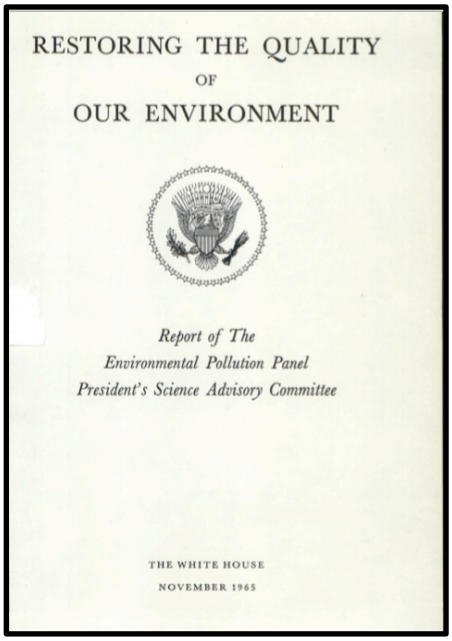

Figure 7: Cover of 1965 Restoring the Quality of our Environment report.

Back in September 1969, Daniel Patrick Moynihan, Urban Affairs Adviser to President Nixon, wrote White House counsel John Ehrlichman stating that CO2 emissions resulting from burning fossil fuels was a problem perhaps on the scale of "apocalyptic change," threatening the loss of cities like New York and Washington D.C. from sea level rise. The 1969 Moynihan Letter urged the Federal Government to immediately address this threat. Moynihan wrote that it was "pretty clearly agreed" that carbon dioxide content would rise 25 percent by 2000. "This could increase the average temperature near the earth's surface by 7 degrees Fahrenheit. This in turn could raise the level of the sea by 10 feet. Goodbye New York. Goodbye Washington, for that matter."[42]

Despite these warnings, and the many more that followed, our nation's leaders actively perpetuated climate change by permitting fossil fuel extraction on public lands and subsidizing fossil fuel extraction (see Figure 8).

[42] Exhibit CC.

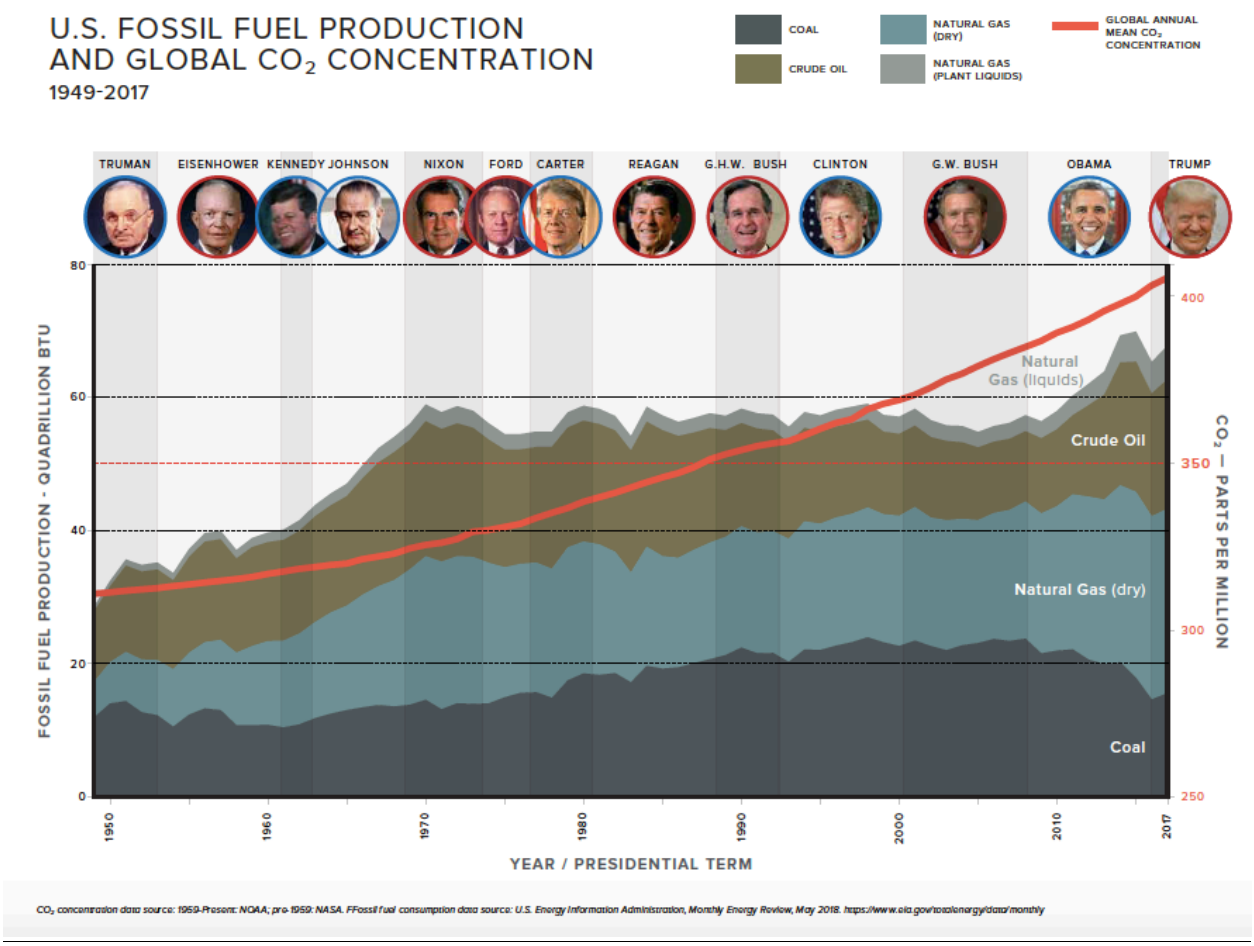

Figure 8: U.S. fossil fuel production and CO_2 concentration for every presidential administration since President Truman.[43]

Historical Precedent for Our Case and Our Unalienable Rights

The *Juliana v. United States* lawsuit is not without precedent. In fact, it has ample support in the historic record, and even in the words of the Framers of the U.S. Constitution. According to expert historian Andrea Wulf, there are deep roots to the constitutional right to a stable climate. In her expert report, she discusses how the Founders believed that "Nature is the domain of liberty," linking national "happiness, dignity, and independence" to the quality of the lands. She goes on the discuss how James Madison's speech of 1818 was "emblematic of how deeply rooted the importance of nature in balance was to the Framers and to the young nation":

> Madison was the first American politician to write that 'the atmosphere is the breath of life. Deprived of it, they all equally perish,' referencing animals, man

[43] Exhibit U.

> and plants. He spoke of the balanced composition of the atmosphere and the give and take of animals and plants, which allowed the atmosphere the aptitude to function so as to support life and the health of beings, according to nature's laws.[44]

The Framers adopted John Locke's philosophy ("laws human must be made according to the general laws of Nature… otherwise they are ill made") that human laws must conform to nature's laws for the preservation of humankind. As such, Thomas Jefferson wrote extensively about this concept, stating "that our Creator made the earth for the use of the living and not of the dead … that one generation men cannot foreclose or burthen its use to another."[45]

All of these examples clearly demonstrate the fact that, while the Founding Fathers were unable to foresee the grave threat of human-caused climate change hundreds of years ago, they nevertheless intended to enshrine the protection of the public trust into our nation's constitution, and to ensure the fundamental right of present and future generations to access to the natural resources that previous generations benefitted from, and on which human survival depends.

Wulf goes on to reference other American presidents who have voiced the Government's responsibility to preserve the natural world for future generations, such as Theodore Roosevelt, who said:

> The function of our Government is to insure to all its citizens, now and hereafter, their rights to life, liberty and the pursuit of happiness. If we of this generation destroy the resources from which our children otherwise derive their livelihood, we reduce the capacity of our land to support a population, and so either degrade the standard of living or deprive the coming generations of their right to life on this continent.[46]

In Conclusion

Growing up with the looming threat of climate change has had lasting impacts on my mental health. Thinking about the future has been a constant source of anxiety and depression for me. I have felt as if there is a pressure cooker boiling over inside of me. I can hardly focus at times because I am overwhelmed with existential horror about the fate of planet.

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[44] Exhibit AA.
[45] Thomas Jefferson to Thomas Earle, Sept. 24 1823, *The Writings of Thomas Jefferson* vol. VII, 310-11 (H.A. Washington ed. 1854).
[46] Exhibit AA.

I am a child of abuse. I know the feel of it on my skin and deep in my psyche. And what my government is doing to perpetuate indefinitely fossil fuel energy, and not take urgent comprehensive action to try to stop climate change, is a form of abuse on young people, who don't have the votes or the lobbying money to stop it. But we cannot just sit back and take it. Not anymore. Government actions that ramp up the danger, hurt our health, destroy our homes, endanger our communities, and scar our emotional wellbeing must stop.

My climate change-induced state of panic is not uncommon amongst my peers. According to Dr. Lise Van Susteren, another expert on our case and an Advisor for the Harvard Medical School Center for Health and the Global Environment, "it is the emotional toll of climate change that is even more catastrophic, especially for our children. It has the capacity to destroy children psychologically."[47]

In Judge Aiken's 2016 opinion, she cites the Supreme Court when it wrote in *Obergefell v. Hodges*:

> The nature of injustice is that we may not always see it in our own times. The generations that wrote and ratified the Bill of Rights . . . did not presume to know the extent of freedom in all its dimensions, and so they entrusted to future generations a charter protecting the right of all persons to enjoy liberty as we learn its meaning. When new insight reveals discord between the Constitution's central protections and a received legal stricture, a claim to liberty must be addressed.[48]

Today I am telling you, Judge Aiken was right: "the right to a climate system capable of sustaining human life is fundamental to a free and ordered society."

I didn't become a climate activist because I like shouting outside of Government buildings or because I want to put my body on the line to block a tar sands pipeline.[49] I became a climate activist because I know that it is my moral responsibility to do everything in my power to stop catastrophic climate change. Your generation and the ones before you, sitting in your seats in positions of power, have decimated our planet. My words stand before you, representing the voices of millions of children, youth and future generations, who are trying to clean up the mess of our forebears. For years, the federal government and the same adults who created the disaster

[47] Exhibit M, p. 4.
[48] Exhibit S.
[49] Today, April 2, 2019, Judge Mary Ann Driscoll of Boston, MA just found that 13 people acting in civil disobedience to protect our climate from more fossil fuel projects were found not responsible in light of their necessity defense that their actions were necessary to protect life. http://www.climatedisobedience.org/raw_audio_westrox_climatetrial_27march2018.

have marginalized us. No more. Climate change is here now. Waiting for the future is already too late.

It is clear: Without youth leadership and a constitutional guidepost, legislative efforts won't save us in time. The Executive Branch won't even fully admit climate change is real, and its leaders do the bidding of the fossil fuel industry. Half measures and incrementalism will only modestly delay the worst impacts of climate change. If we want a future worth living, all three branches of our federal government must recognize our unalienable rights are at stake and work with the youth at the forefront of this movement, to guarantee that the constitutional right to a stable climate is recognized and protected in the United State of America.

Forget about being on the right side of history. If there even *are* history books, it will be because of the efforts that we are taking today. Be on the side of young people right now. Act as if our fundamental rights to life, liberty, property and equal protection under the law are as important as yours, those who came before us, and those who will come after us. We are all connected, and the work you do during your terms in this powerful office, should be on the right side of the youth who sit before you and we ask you to stand with us.

That is why I am asking all of you and this entire House to endorse the fundamental rights and the remedy sought in *Juliana v. United States* on the record, and to sign on to amicus curiae briefs in support of me and my co-plaintiffs, as your other colleagues have, including Senators Ron Wyden, Jeff Merkley, and Sheldon Whitehouse, and Representatives Debra Haaland, Peter DeFazio, Earl Blumenauer, and Rashida Tlaib.

We all have a moral imperative. And you have a constitutional one. If not us, then who? If not now, then when? If not for me, do it for your children, and your children's children, and for all life as we know it. Do it because when you took office, you made an oath "to uphold our Constitution and "secure the blessings of liberty to ourselves and Our Posterity."

I will do my best to address any questions that you may have.

Thank you,

Aji Piper
Seattle, Washington
Plaintiff, *Juliana v. United States*
Beneficiary of the Public Trust and the U.S. Constitution

Exhibit D:

Congressional Testimony of Vic Barrett

Written Testimony before the U.S. House of Representatives,
House Committee on Foreign Affairs and House Select Committee on the Climate Crisis
Hearing Entitled
"Voices Leading the Next Generation on the Global Climate Crisis"
Vic Barrett, Fellow, Alliance for Climate Education and
Youth Plaintiff, *Juliana v. United States*
September 18, 2019

Chairman Keating, Ranking Member Kinzinger, Chairwoman Castor, Ranking Member Graves, Members of the House Committee on Foreign Affairs Subcommittee on Europe, Eurasia, Energy, and the Environment, and the House Select Committee on the Climate Crisis - thank you for inviting me to provide testimony. My name is Vic Barrett, I am 20-years-old and one of the 21 youth plaintiffs in the *Juliana v. United States* constitutional lawsuit, suing the executive branch of the federal government for knowingly causing climate change.

I am a first-generation Garifuna-American. My people are an afro-indigenous community originally from the island of St. Vincent in the Caribbean. In the 18th and 19th centuries, we were pushed from our homeland on St. Vincent by British colonial power, settling on the eastern coast of Central America in Honduras and Belize. Despite overwhelming adversity, we organized our community and emancipated ourselves to protect our future as a people.

However, the struggle continues for me and my people. As temperatures increase, sea levels rise, storms become more intense and frequent, and the coral reefs and fisheries upon which we depend disappear, our future is uncertain. Once again, we are being pushed from the lands we call home. The ocean-front land that my family has inhabited for generations and that I am supposed to inherit, will be underwater if the U.S. federal government continues to promote a fossil fuel-based energy system.

It is not just me and my people in Honduras being harmed by climate change. Frontline communities around the country and around the world are already feeling the effects of the climate crisis - from the dispossession of land to the grave public health threats that are disproportionately affecting myself and other young people.

These frontline communities are made up of people who look like me: young, black and brown, LGBTQ, indigenous... identities which place them at a significantly higher risk to experience the impacts of climate change than the general populace due to their marginalized status in our society.

I myself have felt the consequences of climate change directly. Growing up in New York, I was impacted by the climate change-fueled Hurricane Sandy, which left my family and my school without power for days. I still experience grave anxiety about experiencing another climate-driven disaster like Superstorm Sandy, and the harm that these storms will have on myself and my family.

As someone who already struggles with anxiety and depression from my understanding of climate change and what I experience, watching our government knowingly perpetuate the climate crisis is often overwhelming. I wrestle with this anxiety every day, from the moment that I wake up in the morning to the moment I fall asleep at night: If we keep going on with business as usual, both Honduras and New York, the places where my family and I are from, will forever be lost to the sea. That is one of my greatest fears: that climate change is going to take these places away from us.

My co-plaintiffs also experience both the mental and physical health impacts of climate change. For example, my co-plaintiff Jayden became very ill when her home in Rayne, Louisiana was flooded and she was exposed to mold and water contaminated with raw sewage and toxic chemicals. My co-plaintiffs with asthma and allergies have suffered from the prolonged wildfire and allergy seasons in the West, limiting their ability to participate in certain activities or even go outside. Many of them, like me, are also struggling with psychological harms from climate change.

The medical community now recognizes climate change as a grave public health threat. One of our experts, the esteemed Dr. Jerome A. Paulson, describes climate change as a public health emergency, which is disproportionately impacting children and youth in a myriad of ways. He goes on to list specific health risks exacerbated by climate change, including but not limited to: heat stress, extreme weather events, wildfires, decreased air quality, and infectious disease; all of which pose a disproportionate threat to children and youth.

Another one of our experts, Dr. Lise Van Susteren, a psychiatrist known nationally for her work on climate change, explains that ***quote*** "with continued government actions that exacerbate the climate crisis, the Plaintiffs, and those they represent, will suffer catastrophic emotional injuries." She goes on to state that the federal government's ***quote*** "sanctioning of climate change as lawful in federal law and policy makes the psychological injuries suffered by individuals, including the Plaintiffs, particularly harmful and insidious." She warns that without immediate action by the federal government to address climate change the mental health impacts will worsen and be life-long.

The ways in which climate change disproportionately impacts youth was also detailed in an amicus brief filed by the Harvard Law School Environmental Law and Policy Clinic in support of my case with the Court of Appeals. Fourteen of the nation's top medical organizations signed onto the brief, including the American Heart Association, the American Lung Association, and the American Academy of Pediatrics, along with over 70 preeminent experts in pediatrics, psychiatry, and public health.

Just as my federal government sanctioned discrimination in schools and housing until the middle of the last century, a policy that harmed children, my federal government has also orchestrated and sanctioned a system of fossil fuel energy that is harming children in another way, irreversibly threatening our health, our personal security, our homes and our communities by creating a dangerous climate system.

Like youth who have come before us in the civil rights movement and other social justice movements, it is often the youth that must shine a light on systems of injustice.

So…. In 2015, 21 young people, myself included, filed a lawsuit against the United States and agencies of the executive branch, to safeguard our constitutional right to life, liberty and property, including our rights to personal security, bodily integrity and a stable climate system that sustains our lives and liberties.

Because climate change is a systemic issue, it will require systemic change and all three branches of government to fix it. The burdens of the system's problems cannot be placed on the shoulders of an individual, especially not a young person like myself and my co-plaintiffs. To combat the system-wide government actions that have led to the climate crisis, we need system-wide reform at a governmental level to address this emergency before it's too late.

The Juliana Plaintiffs

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