AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

VOICES LEADING THE NEXT GENERATION ON THE GLOBAL CLIMATE CRISIS

HEARING

BEFORE THE

SUBCOMMITTEE ON EUROPE, EURASIA, ENERGY, AND THE ENVIRONMENT

OF THE

COMMITTEE ON FOREIGN AFFAIRS
HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

September 18, 2019

Serial No. 116–62

Printed for the use of the Committee on Foreign Affairs

Available: http://www.foreignaffairs.house.gov/, http://docs.house.gov, or http://www.govinfo.gov

U.S. GOVERNMENT PUBLISHING OFFICE
37–705PDF WASHINGTON : 2019

COMMITTEE ON FOREIGN AFFAIRS

ELIOT L. ENGEL, New York, *Chairman*

BRAD SHERMAN, California
GREGORY W. MEEKS, New York
ALBIO SIRES, New Jersey
GERALD E. CONNOLLY, Virginia
THEODORE E. DEUTCH, Florida
KAREN BASS, California
WILLIAM KEATING, Massachusetts
DAVID CICILLINE, Rhode Island
AMI BERA, California
JOAQUIN CASTRO, Texas
DINA TITUS, Nevada
ADRIANO ESPAILLAT, New York
TED LIEU, California
SUSAN WILD, Pennsylvania
DEAN PHILLIPS, Minnesota
ILHAN OMAR, Minnesota
COLIN ALLRED, Texas
ANDY LEVIN, Michigan
ABIGAIL SPANBERGER, Virginia
CHRISSY HOULAHAN, Pennsylvania
TOM MALINOWSKI, New Jersey
DAVID TRONE, Maryland
JIM COSTA, California
JUAN VARGAS, California
VICENTE GONZALEZ, Texas

MICHAEL T. MCCAUL, Texas, *Ranking Member*
CHRISTOPHER H. SMITH, New Jersey
STEVE CHABOT, Ohio
JOE WILSON, South Carolina
SCOTT PERRY, Pennsylvania
TED S. YOHO, Florida
ADAM KINZINGER, Illinois
LEE ZELDIN, New York
JIM SENSENBRENNER, Wisconsin
ANN WAGNER, Missouri
BRIAN MAST, Florida
FRANCIS ROONEY, Florida
BRIAN FITZPATRICK, Pennsylvania
JOHN CURTIS, Utah
KEN BUCK, Colorado
RON WRIGHT, Texas
GUY RESCHENTHALER, Pennsylvania
TIM BURCHETT, Tennessee
GREG PENCE, Indiana
STEVE WATKINS, Kansas
MIKE GUEST, Mississippi

JASON STEINBAUM, *Staff Director*
BRENDAN SHIELDS, *Republican Staff Director*

SUBCOMMITTEE ON EUROPE, EURASIA, ENERGY, AND THE ENVIRONMENT

WILLIAM KEATING, Massachusetts, *Chairman*

ABIGAIL SPANBERGER, Virginia
GREGORY MEEKS, New York
ALBIO SIRES, New Jersey
THEODORE DEUTCH, Florida
DAVID CICILLINE, Rhode Island
JOAQUIN CASTRO, Texas
DINA TITUS, Nevada
SUSAN WILD, Pennsylvania
DAVID TRONE, Maryland
JIM COSTA, California
VICENTE GONZALEZ, Texas

ADAM KINZINGER, Illinois, *Ranking Member*
JOE WILSON, South Carolina
ANN WAGNER, Missouri
JIM SENSENBRENNER, Wisconsin
FRANCIS ROONEY, Florida
BRIAN FITZPATRICK, Pennsylvania
GREG PENCE, Indiana
RON WRIGHT, Texas
MIKE GUEST, Mississippi
TIM BURCHETT, Tennessee

GABRIELLE GOULD, *Staff Director*

INFORMATION REFERRED TO FOR THE RECORD

Information referred from Mr. Graves 8

WITNESSES

Thunberg, Ms. Greta, Founder, Fridays for Future 11
Margolin, Ms. Jamie, Co-Founder, This is Zero Hour, Plaintiff, Piper v. State of Washington 14
Barrett, Mr. Vic, Fellow, Alliance for Climate Education, Plaintiff, Juliana v. United States 20
Backer, Mr. Benji, President, American Conservation Coalition 47

APPENDIX

Hearing Notice 65
Hearing Minutes 66
Hearing Attendance 67

STATEMENTS FOR THE RECORD SUBMITTED FROM COMMITTEE MEMBERS

Statement submitted for the record from Representative Costa 68

ADDITIONAL MATERIALS SUBMITTED FOR THE RECORD

Summary of Policymakers 69
Court case 92
Submission for the record from Representative Carter 100

VOICES LEADING THE NEXT GENERATION ON THE GLOBAL CLIMATE CRISIS

Wednesday, September 18, 2019

House of Representatives,

Subcommittee on Europe, Eurasia,

Energy, and the Environment,

Committee on Foreign Affairs, Joint With the

Select Committee on the Climate Crisis,

Washington, DC

The committees met, pursuant to notice, at 10:11 a.m., in room 2172, Rayburn House Office Building, Hon. William R. Keating (chairman of the subcommittee) presiding.

Mr. KEATING. The hearing will come to order. Chairman Engel is joining us. We are here joined by the Select Committee on Climate Crisis and an esteemed panel of witnesses for this hearing on "The Voices Leading the Next Generation on the Global Climate Crisis."

I know a few of our witnesses have a hard stop at 11:30 in order to get to their next event advocating on these issues, so I will just ask that all the members keep their questioning to 5 minutes or less so we can fit in as many members as possible.

Without objection, all the members may have 5 days to submit statements, questions, extraneous materials for the record, subject to the length limitation in the rules.

And I would just like to call on the chairman of the full committee, who has a few words to offer.

Chairman ENGEL.

Mr. ENGEL. Good morning, everyone. I just wanted to invite everyone to come to the Foreign Affairs Committee, and by the looks of it, you are all here. I want to welcome everybody.

Climate change is certainly something that is so important, and the aggravating thing about it is that there are so many who still deny it. So I look forward to listening to what our young people are saying today because the world is really their future, and we owe it to them to do what we can now to make sure that the world is saved.

And climate change is certainly something that is happening, and if we do not do anything about it, it will certainly imperil future generations.

And I am just happy to welcome everybody to the Foreign Affairs Committee room. Thank you.

Mr. KEATING. I would like to thank the chairman.

I would just like to recognize myself for 5 minutes for an opening statement.

Our panel represents the next generation of leaders, and so naturally, we are speaking to the future. However, let us be clear, we are also speaking to the present. We are witnessing the effects of climate change daily, whether it is storms, forest fires, floods, and other disasters occurring with increasing intensity and frequency, increased migration due to sea level rise, threats to food and water safety. This is the reality we are facing right now because of climate change.

Regardless of where we live, we all see it when we go home. I see it every time I go home. My district is in southeastern Massachusetts and has one of the longest coastlines in the country and includes island communities. On Cape Cod, we are anticipating a sea level rise of 1 to 2 meters by 2100 and 3 to 12 meters in the next few hundred years. Erosion and storm damage cost families and businesses trying to live with more than they can afford as every storm approaches, and with each storm we are also worried about the cost to lives as well.

Our historic fishing and lobster industries are threatened by increasing ocean acidification and rising ocean temperatures. Our State and local governments are under immense pressure to address not only sea level rise but air quality issues. And in spite of having some of the best scientists and researchers right in that area, in UMass and Woods Hole, it is an incredible challenge.

There have been efforts spanning generations now in my district to diversify our energy supply, offshore wind, solar power that will bring in new jobs, yet there are still major gaps in access for our communities and a real struggle to overcome the political and bureaucratic obstacles that go with making necessary changes to how things are currently.

There must be leadership in addressing climate change because we, and especially your generation, cannot afford for things not to change. This is a global issue, and the biggest polluters are going to be needed to make big changes to do their part.

But we need to be honest with ourselves as leaders. So far, our generation has failed to adequately address our climate crisis. This failure is not fatal, yet our failure to change will be.

Change happens through leadership. We would not be in this situation right now, our witnesses would be safely and happily in school pursuing their dreams and not protesting and pushing their government to act if everyone was doing their part.

America knows how to lead in a crisis, and it is high time we pick ourselves up and get back to this fight to bring the rest of the world with us, because waiting for other countries to do the right thing is making a bad bet on our future.

There is so much we could and should do right now in our country. We have bright minds to engineer solutions to the future. America has shaped revolutions in industry time and time again, and it has made our country better off every time.

Now the stakes are so much higher, and in spite of all our resources and ingenuity, the one thing we do not have is time. The IPCC report warns us that without cuts in carbon emissions, the world could see an average sea level rise of 62 centimeters over the course of a lifetime of people born today. That is over 2 feet. And scientists are gravely concerned that sea level rise in the next 100

years could be even faster than in the hundreds of years that preceded it.

I would like to thank our witnesses, extraordinary young leaders fortified with scientific research, for being here. It is regrettable they have to be. The Paris agreement should have been reached decades ago, and we should have been well on our way by now toward far more aggressive targets, giving communities and industries the time to adapt and giving you a much more hopeful outlook on the future.

But here we are, and I hope your testimony today will galvanize us to act now before we are truly out of time.

Ranking Member Adam Kinzinger for his opening statement.

Mr. KINZINGER. Thank you, Mr. Chairman.

Thank you all for being here. We appreciate it.

Given the high level of interest in this hearing, the late start, and the many people that have questions, I will be brief.

Climate change is real, and the best way to combat it is by reducing not only our Nation's carbon emission, but that of the rest of the world.

The changes we are seeing in the climate pose both short-and long-term challenges, and I believe they can addressed in two major ways.

First, we need diversity in our energy sources. Energy diversity is energy security. Similar to one's own personal investment strategies, this Nation cannot afford to put all its eggs in one basket. If you are looking to invest, you do not put all your savings into one stock and let it ride. You diversify your investments in mutual funds, bonds, real estate, et cetera.

Second, we need to support market-driven innovations to develop new clean energy technologies that will put the United States at the forefront of environmental technology.

Illinois' 16th congressional District is a great example of what this market-driven strategy would look like. My district is home to four nuclear reactors which serve—actually, it is eight reactors, four plants—which serve as the most abundant, clean, and stable energy source on the planet, as well as hundreds of wind turbines, solar panels, and geothermal sources. These diverse sources not only provide year-round reliable clean energy, but also have produced high-paying jobs for my constituents.

Around the world, many nations are implementing strategies to combat climate change, and nuclear must be part of that strategy. Unfortunately, some of our closest allies are taking their nuclear reactors offline at a time when we need low carbon energy sources.

Meanwhile, as the West looks at options to combat climate change, we all know that China's global emissions continue to rise. For every ton of carbon dioxide reduced by the United States, China adds nearly four times as much. Today, the Chinese account for 30 percent of global emissions.

While some may say that the United States needs to be the leader of combating climate change, I would say that we already are. Since 2005, global emissions have increased by 20 percent, but the United States' emissions have decreased by more than the next 12 emission-reducing countries combined.

While reducing global emissions is vital, it is also important to note that there are over one billion people living without access to electricity. That is one billion people burning coal and wood for heat, one billion people living with increased risk for food-borne pathogens, one billion people living without access to basic sources of information like the radio.

From a foreign policy standpoint, this should not be overlooked. The next global health crisis or conflict could easily come from these communities living in poverty. We must encourage other developed nations to reduce emissions while understanding that for economies just getting off the ground it is not entirely possible, at least not without substantial help from the United States and our allies.

It is going to take major innovation and breakthroughs to not only reduce our emissions here at home, but also provide clean reliable power to those currently living without it.

All Americans want to be good stewards of their environment. Tesla does not sell cars because of the sound system, and people do not put solar panels on their roof because they look good. Consumers, especially young people like we have today on our panel, want to know that policymakers share their values. I believe we do and that we will continue to see market-driven solutions that combat climate change and provide clean energy to the world.

With that, I yield back the balance of my time.

Mr. KEATING. I thank the gentleman for his comments.

The chair now recognizes the chair of the Select Committee on the Climate Crisis, Ms. Castor.

Ms. CASTOR. Well, thank you, Chairman Keating, for hosting this hearing today. Thank you for including the members of the House Select Committee on the Climate Crisis. We are thrilled to be here.

The youth climate movement has grabbed the attention of the world, and it is due to the hard work of many of the students in this room and many young people all across the planet.

Did you all know that Congress' first major hearing on the climate crisis was in 1988? Congress has had plenty of opportunity to understand that burning fossil fuels warms the planet and alters the Earth's climate. Yet, scientists tell us that more than half of the carbon pollution that has been emitted into the atmosphere has occurred since that hearing in 1988.

I have been in Congress since 2007, and we have done some good things since then. We have raised auto efficiency standards. We have supported the dramatic expansion of wind and solar power. We have started to fund the kind of climate resilience to protect the places that we know and love. But it is not enough, not by a long shot.

This year, under Speaker Pelosi's leadership, we passed our first major piece of climate legislation in 10 years. A bipartisan vote sent H.R. 9, Climate Action Now, to the Senate, where it awaits action. That Bill takes a commonsense approach of keeping the United States in the Paris climate agreement, because the U.S., we should not back down, we should not surrender, not in the face of the climate crisis. We need to take bold action now.

Seventy percent of young people in America say they worry about climate change. I do not blame them. They are doing more than

paying attention in science class. This generation is the most well-informed and connected generation in history, and everything they are learning has driven them to a new level of engagement.

And students are asking policymakers a very powerful question: What is the point of going to school to learn about the climate crisis when your elected officials are not doing enough to act on it?

The climate strike movement has united young people in all countries, all across the globe. They are cooperating to demand climate action, and they are asking us to cooperate with allies to cut carbon pollution and protect our communities.

It is not lost on us that the United States is responsible for the biggest share of carbon pollution accumulated in the atmosphere to date, so we have a very serious responsibility to lead.

But we are also the world's greatest engine of innovation, and we can do this. We have the solutions. Local communities and States have acted boldly, but a strong national climate action plan has been missing.

We have heard from scientists in the select committee hearings, as we will hear from these young people today, that we must do more and that we do not have time to waste. Our answer has to be more than a promise to do better. Our solutions must equal the challenge before us.

And I bet that 10 or 20 years from now, young people marching and striking today will be serving in the Congress, and we need to take bold action now because we cannot leave it up to them to clean up the mess that Congress has made.

People say this next generation gives us hope, but that is not quite right, is it? This generation is giving us a job to do. The job is addressing the climate crisis. If we do our job, then we will be worthy of their hope because that means we will have started to create the future that they are fighting for.

The select committee has a mandate to come up with an action plan for Congress, and we need your ideas. We want the ideas to come from all corners of this country and beyond. You can go to climatecrisis.house.gov/inforequest and tell us what your ideas are to solve the climate crisis. Not all good ideas emanate from Washington, DC. I think you know that.

But it is only through cooperation, through coming together in our democracy that we can address the climate crisis. These young people are rising to the challenge, and we need to rise with them.

Thank you, and I yield back.

Mr. KEATING. Thank you.

The chair now recognizes the ranking member of the select committee, Mr. Graves.

Mr. GRAVES. Thank you, Mr. Chairman.

And I want to thank you all for being here today. Most importantly, I want to thank you for engaging in your government. Most young folks choose to not do that until many years later.

I have three kids, and we often talk about some of the impacts that we have seen from climate change and sea rise in my home State of Louisiana where some of the sea rise impacts have exacerbated the loss of 2,000 square miles of our coast—2,000 square miles. To put that in perspective, if that were the State of Rhode

Island, we would have 49 States today in the United States, meaning the size of an entire State would be gone.

I agree that we need to take aggressive action. I agree that we need to ensure that we move forward in a sustainable, rational manner. But I think it is also important that we ensure that we are moving forward based on facts.

As Mr. Kinzinger said a few minutes ago, contrary to popular belief, the United States—the United States—is the country that has led the world in greenhouse gas reductions. As stated, we have reduced greenhouse gases more than the next 12 countries combined. We have reduced them more than the next 12 countries combined.

Just last year, we stepped in and made more progress on adaptation and mitigation strategies than I believe any other year in this Nation's history, committing more dollars, moving toward establishing a resiliency standard, ensuring as we are rebuilding after disasters that we are building to a newer, higher standard, truly thinking about the future, ensuring that we are putting record dollars toward proactive efforts to ensure that our coastal communities and our river-based communities can be resilient, and continuing to move in this direction of greenhouse gas reductions.

But I also think that we have got to stop this ridiculousness of operating myopically or operating as though the United States is in a vacuum. It is important to keep in mind that the Energy Information Administration projects that by 2030, 80 percent of global energy demands—80 percent—are going to be addressed using fossil fuels. This is the Energy Information Administration, not some type of partisan hack group. Eighty percent.

Yet, just last week we had three bills designed to stop energy production in the United States. Over the weekend, we had attacks in Saudi Arabia. All that does is increase our reliance upon energy sources from other countries that have a lower safety standard and have a lower environmental standard.

Records show, it is crystal clear, that when we import energy from other places, we actually increase the risk to the environment, increase the risk of spills, than when we have domestic energy production.

I hear people talking about how we need to stop all fossil fuel utilization and stop all these emissions. Right now, as was stated, for every one ton of carbon emissions we produce in the United States, China has increased by four tons, more than offsetting all the reductions that we have had in the United States.

Moving forward, even under the Paris Accords that folks are sitting here giving accolades to and saying is a great idea—and I want to be clear, I support the U.S.' target in the Paris Accord—I think that signing onto an agreement and agreeing to something that allows for China to come in and have a 50 percent increase, adding another 5 gigatons of greenhouse gas emissions annually by 2030, is inappropriate. It is moving in the wrong direction, not in the right direction.

I also remain confounded reading letters like this one that says that we need to pressure the Organization of Petroleum Exporting Countries and cooperating countries to increase world oil supplies in order to lower prices at the pump. The impact of rising fuel

prices on our economy and on family budgets is significant and widespread.

This letter goes on to say the current run-up in world oil prices is effectively a tax on all American families' discretionary budget, except that the money goes to OPEC as opposed to the United States Treasury.

So let me say again, this letter is advocating for increased world oil production because prices are too high. Who do you think signed this letter? Who do you think signed this letter? Think about it just a minute. Put a name in your head. This letter was sent by Senator Cantwell, Senator Menendez, Senator Chuck Schumer, and Senator Ed Markey just last year.

I remain so confused by what it is that we are doing. What is our policy?

And, Mr. Chairman, I ask unanimous consent that this be included in the record.

Mr. KEATING. Any objection?

[The information referred to follows:]

United States Senate
WASHINGTON, DC 20510

May 23, 2018

The President
The White House
Washington, DC 20500

Dear Mr. President:

World crude oil prices increased over 75 percent in the past year, with some market analysts expecting prices to approach $100 per barrel in the coming months. Elevated fuel prices are a burden on every family, business, and farm and threaten our nation's continued economic growth and global competitiveness. Today, we call on you to use all of your authority to take timely action to pressure the Organization of the Petroleum Exporting Countries (OPEC) and cooperating countries to increase world oil supplies in order to lower prices at the pump during the upcoming summer driving season.

The U.S. Energy Information Administration (EIA) attributes current increases in crude oil prices to "falling global oil inventories, heightened market perceptions of geopolitical risks, and strong global economic growth signals." Indeed, global oil supplies have been relatively flat over the last two years, despite record U.S. crude oil production, because of an agreement between the OPEC and non-OPEC countries like Russia to decrease their oil production by around 1.7 million barrels per day starting in January 2017. Since the agreement has been in place, those countries have actually reduced production by over 2.4 million barrels per day.

Surging oil prices have made gas station fill-ups more expensive. According to the EIA, gasoline prices will average $2.95 per gallon this summer, 61 cents higher than last year. That means the average U.S. household will be forced to pay $167 more in fuel costs this summer driving season as compared to the same period last year. Diesel fuel, essential for transporting American goods to market, will average 64 cents more per gallon than last summer, and prices could top $4 per gallon in some states.

The impact of rising fuel prices on our economy and on family budgets is significant and widespread. According to a recent analysis by Goldman Sachs, the run up in oil prices will roughly cancel out the effects from tax reductions this year, with the greatest impact on households that can least afford it.

Last month, you said it was unacceptable for OPEC to artificially inflate oil prices. We agree and urge you to work with our international partners to take the following actions to make sure OPEC does not continue to suppress world crude oil supplies, and to protect domestic policies that help consumers:

- Leverage your personal relationship with Saudi Crown Prince Mohammad bin Salman to urge Saudi Arabia to use their swing capacity to increase world oil supplies.
- Send Energy Secretary Perry to the June 22, 2018, OPEC meeting in Vienna, Austria to personally communicate the importance of maintaining stable crude oil prices.
- Initiate World Trade Organization dispute proceedings against countries engaged in anticompetitive practices that artificially inflate world oil prices.
- Work with our European allies and China, which last year surpassed the United States as the world's largest oil importer, to put pressure on oil exporting nations.
- Direct the Federal Trade Commission, Commodities Futures Trading Commission, and the Department of Justice to exercise vigorous oversight over oil markets.
- Maximize the use of more environmentally friendly and domestically produced biofuel alternatives by protecting the Renewable Fuel Standard.
- Abandon your Administration's stated plan to roll back fuel economy standards that otherwise will save the average car owner more than $6,000 over the life of the car and cut the nation's oil consumption by over two million barrels per day by 2025.

The current run up in world oil prices is effectively a tax on every American family's discretionary budget, except that the money goes to the OPEC cartel rather than the U.S. Treasury. Adding to our constituents' pocketbook concerns is their understanding that our nation's continued dependence on oil is at the heart of many of our nation's greatest economic, environmental, and national security challenges.

Sincerely,

Maria Cantwell Robert Menendez

Charles Schumer Edward J. Markey

Mr. GRAVES. Look, my home State is at risk of its existence moving forward with sea rise, but we have got to make sure that we are moving forward in a rational manner that builds on successes and corrects failures rather than these confounding policies that make no sense.

Yield back.

Mr. KEATING. Thank you.

I will now introduce our witnesses.

Greta Thunberg is from Sweden. She is a climate activist who helped build the Fridays for Future movement, where she began going on strike from school outside the Swedish Parliament on Fridays. She has spoken on the climate crisis before the EU Parliament.

Welcome.

Ms. Jamie Margolin is from Seattle, Washington. She is co-founder and co-executive director of the Zero Hour, an international youth climate organization, founded in the summer of 2017. She is also a plaintiff in Piper *v.* State of Washington.

Mr. Vic Barrett is from White Plains, New York. He is a fellow with the Alliance for Climate Education and a plaintiff in Juliana *v.* United States.

Welcome.

Mr. Benji Backer is from Appleton, Wisconsin. He is the president of the American Conservation Coalition, a nonprofit organization to educate and engage conservatives on climate change.

All of you are here. We welcome all of you. We appreciate your efforts. Please limit your testimony to 5 minutes. And without objection, your prepared written statements will be made part of the record.

I will now go to Ms. Thunberg for her statement.

STATEMENT OF GRETA THUNBERG, FOUNDER, FRIDAYS FOR FUTURE

Ms. THUNBERG. My name is Greta Thunberg. I have not come to offer any prepared remarks at this hearing. I am instead attaching my testimony. It is the IPCC Special Report on Global Warming of 1.5 degrees Celsius, the SR 1.5, which was released on October 8th, 2018.

I am submitting this report as my testimony because I do not want you to listen to me. I want you to listen to the scientists, and I want you to unite behind science, and then I want you to take real action.

Thank you.

[The prepared statement of Ms. Thunberg follows:]

Testimony of Greta Thunberg
Climate Activist
Before the United States House of Representatives
Foreign Affairs Committee Subcommittee on Europe, Eurasia, Energy, and the Environment,
with the House Select Committee on the Climate Crisis
"Voices Leading the Next Generation on the Global Climate Crisis"

My name is Greta Thunberg.

I have not come to offer prepared remarks at this hearing

I am instead attaching my testimony. It is the IPCC Special Report on Global Warming of 1.5°C [SR1.5] which was released on October 8, 2018.

I am submitting this report as my testimony because I don't want you to listen to me. I want you to listen to the scientists. And I want you to unite behind the science.

And then I want you to take action.

Mr. KEATING. Tack sa mycket.
Ms. MARGOLIN.

STATEMENT OF JAMIE MARGOLIN, CO-FOUNDER, THIS IS ZERO HOUR, PLAINTIFF, PIPER *V.* STATE OF WASHINGTON

Ms. MARGOLIN. My name is Jamie Margolin, and I am a 17-year-old climate justice activist from Seattle, Washington. I am missing a lot of school to be here. It is my senior year of high school. I have college applications deadlines looming over me, and to be honest, I have barely even started because I am too busy fighting to make sure that I am actually going to have the future I am applying to study for.

You are here spending a few moments with me. But that is nothing compared to the hours that Members of Congress have spent with lobbyists from corporations that make billions of dollars off of the destruction of my generation's future.

I want the entirety of Congress, in fact, the whole U.S. Government, to remember the fear and despair that my generation lives with every day, and I want you to hold on to it.

How do I even begin to convey to you what it feels like to know that within my lifetime the destruction that we have already seen from the climate crisis will only get worse?

What adds insult to injury is the fact that we keep getting promised what is not there. On college applications, I keep getting asked: What do you want to be when you grow up? The media, pop culture, businesses, and the whole world tells me that I and my whole generation will have something to look forward to that we just do not.

You are promising me lies. Everyone who will walk up to me after this testimony saying that I have such a bright future ahead of me will be lying to my face.

It does not matter how talented we are. It does not matter how much work we put in, how many dreams we have. The reality is my generation has been committed to a planet that is collapsing.

The fact that you are staring at a panel of young people testifying before you today pleading for a livable Earth should not fill you with pride. It should fill you with shame. Youth climate activism should not have to exist.

We are exhausted because we have tried everything. We have built organizations, organized marches, and worked on political campaigns. I sued my State government in a lawsuit called Piper *v.* The State of Washington, along with 12 other plaintiffs, for contributing to the climate crisis and denying my generation's constitutional rights to life, liberty, and property.

The lawsuit is also arguing that the natural resources of my State are protected as a right under the Washington State Constitution. The shellfish, salmon, orcas, and all of the beautiful wildlife of my Pacific Northwest home is dying due to ocean acidification caused by the climate crisis. And communities all over Seattle are suffering from the new fossil fuel infrastructure being built to lock in decades more of climate destruction into my State.

My friends and I were warned to stay inside the last two summers because our city was shrouded in a suffocating smoke from

wildfires that gave me such bad headaches for so long, and my friends with respiratory illnesses had to go to the ER.

Is this the future that we have to look forward to? Well, we youth are working as hard as we can to make sure that it is not.

On July 21 of 2018, after an entire year of nonstop organizing, despite being full-time high school students with a lot of homework to do, my organization, Zero Hour, marched on Washington, DC, in a pouring rainstorm and in 25 cities around the world demanding urgent climate action from you and all of our leaders. And that was only the beginning.

By 2030, we will know if we have created the political climate that will have allowed us to salvage life on Earth or if we acted too late. By then, we must be well on the path to climate recovery.

But this must start today. In fact, it should have started yesterday.

By 2030, I will be old enough to run for Congress and be seated right where you guys are sitting right now. By then, we need to have already achieved net zero greenhouse gas emissions and be rapidly on the path to climate recovery.

I cannot wait until I am sitting in your seats to change the climate crisis. You have to use the seats that you have now because by the time I get there, it is going to be way too late.

The good news is that experts agree that there are multiple pathways to decarbonize the United States energy system and that doing so is both technologically and economically viable and beneficial.

The most frustrating thing is that the U.S. Government cannot even begin to imagine the massive political shift that has to happen in order for us to solve this issue. The politics just has not been invented yet.

Solving the climate crisis goes against everything that our Country was, unfortunately, built on, colonialism, slavery, and natural resource extraction. This is why the youth are calling for a new era altogether.

As Greta mentioned, the Intergovernmental Panel on Climate Change report that we only have a few months left in order to create the massive political shift needed to transition our world to an entirely renewable energy economy. This needs to happen within the next 10 years, which is our deadline to save life as we know it.

People call my generation Generation Z as if we are the last generation. But we are not. We are refusing to be the last letter in the alphabet. I am here before the whole country today announcing that we are instead Generation GND, the Generation of the Green New Deal.

The only thing that will save us is a whole new era. The Green New Deal is not just about the specific plans laid out in resolutions, it is about a new chapter in American history and transforming our culture into one that celebrates, encourages, and enables radical climate action.

It is right here testifying before you that I am proud to announce that history is being made. You have heard of the Reagan era, the New Deal era. Well, the youth are bringing about the era of the Green New Deal.

[The prepared statement of Ms. Margolin follows:]

Jamie Margolin's 2019 Congressional Testimony

My name is Jamie Margolin, and I'm a 17-year-old climate justice activist from Seattle Washington. I am missing a lot of school to be here, it's my senior year of high school, college application deadlines are looming and to be honest, I've barely started because I'm too busy fighting to make sure I'm actually going to have the future I am applying to study for.

You're here spending a few moments with me, but that is nothing compared to the hours that members of congress have spent with lobbyists from corporations that make billions of dollars off of the destruction of my generation's future. I want the entirety of congress, in fact the whole US government, to remember the fear and despair that my generation lives with every day, and I want you to hold onto it. How do I even begin to convey to you what it feels like to know that within my lifetime the destruction that we have already seen from the climate crisis will only get worse?

What adds insult to injury is the fact that we keep getting promised what isn't there. On college applications I keep getting asked what I want to be when I grow up; the media, pop culture, politicians, businesses, and the whole world tells me that I and my whole generation will have something to look forward to that we just don't. You're promising me lies. Everyone who will walk up to me after this testimony saying I have such a bright future ahead of me, will be lying to my face. It doesn't matter how talented we are, how much work we put in, how many dreams we have, the reality is, my generation has been committed to a planet that is collapsing.

This is a foreign affairs committee, so I thought I'd tell you a story about the country my family is from. I am the daughter of a Colombian immigrant. My abuela grew up on a farm in Colombia, the kind of farm that actually replenishes the earth instead of ruthlessly extracting

from it. No pesticides were ever used, there were no monocrops, instead there were rotating crops and a diverse array of them too, that worked together to help each other grow. The soil was so rich and alive you could drop the seed of pretty much anything and it would grow. My abuela and her siblings could shimmy up a tree and pick their lunch, the river was clean enough to wash and drink from, and the land was well taken care of and respected.

I will never get to experience that harmony and paradise on earth that she did.
I know foreign affairs deals with international development, but this whole idea of development is backwards. We think that development means big cities and lots of money, but in reality places like where my abuela grew up are just as rich as any American metropolis.

The fact that you are staring at a panel of young people testifying before you today pleading for a livable earth should not fill you with pride, it should fill you with shame. We are exhausted because we have tried *everything.* We've built organizations, organized marches and worked on political campaigns. I sued my state government in a lawsuit called Piper vs.[1] The State of Washington along with 12 other youth plaintiffs, for contributing to the climate crisis and denying my generation's constitutional rights to life, liberty and property. The lawsuit is also arguing that the natural resources of my state are protected as our right under the Washington State Constitution.

The shellfish, salmon, orcas, and all of the beautiful wildlife of my Pacific Northwest home is dying due to ocean acidification caused by the climate crisis, and communities all over the Seattle area are suffering from the new fossil fuel infrastructure being built to lock in decades more of climate destruction into my state. My friends and I were warned to stay inside the last two summers because our city was shrouded in smoke from wildfires. Is this the future we have to look forward to?

We the youth are working to make sure it isn't. On July 21st of 2018, after an entire year of nonstop organizing, despite being full time high school students, my organization, Zero Hour marched on Washington D.C. in a pouring rainstorm and in 25 cities around the world, demanding urgent climate action from you and all our leaders.

And that was only the beginning. This past July of 2019, Zero Hour organized the Youth Climate Summit, in Miami Florida, where we educated and united roughly 350 young people from across the country on climate action. Throughout the entirety of 2019 we have implemented a campaign called *Getting To The Roots of Climate Change,* where we have trained over 600 youth climate justice ambassadors (and counting) to educate their communities on the root systems of oppression that caused the climate crisis. We are bringing a delegation of youth to the upcoming UN climate summit, where our voices will be heard by leaders from around the world.

By 2030 we will have known if we have created the political climate that will have allowed us to salvage life on earth, or if we acted too late. By then, we must be well down the path towards climate recovery, but this must start today. By 2030, I will be old enough to run for congress and be seated where you are right now. By then we need to have *already* achieved net zero greenhouse gas emissions and be rapidly on the path to climate recovery. The good news is that experts agree there are multiple pathways to decarbonize the U.S. energy system and that doing so is technologically and economically viable.

The most frustrating thing is that the US government can't even *begin* to imagine the massive political shift that has to happen in order for us to solve this issue. Solving the climate crisis, goes against what this country was unfortunately built on, colonialism, slavery and natural resource extraction. This is why youth are calling for a new era all together. The Intergovernmental Panel on Climate Change (IPCC) report that we have only a few months left

in order to create the massive political shift needed to transition our world to an entirely renewable energy economy. This needs to happen within the next 10 years, which is our deadline to save life as we know it.

People call my generation, Generation Z, as if we are the last generation. But we are not. We are refusing to be the last letter of the alphabet. I am here before the whole country today announcing that we are instead Generation GND –Generation Green New Deal. The only thing that will save us is a new era. It is right here, testifying before you that history is being made. You've heard of the Reagan Era, the New Deal Era, well the youth are bringing about the Era of the Green New Deal.

Mr. KEATING. Thank you.
Mr. BARRETT.

STATEMENT OF VIC BARRETT, FELLOW, ALLIANCE FOR CLIMATE EDUCATION, PLAINTIFF, JULIANA *V.* UNITED STATES

Mr. BARRETT. My name is Vic Barrett. I am 20 years old. And I am 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 would like to recognize my fellow co-plaintiffs in this room sitting behind me.

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, the ocean-front land that my family has inhabited for generations, that I am supposed to inherit, will be under water 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 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 struggles with depression from my understanding of climate change and what I experience, watching our government knowingly perpetuate the climate crisis is extremely 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. My co-plaintiffs with asthma and allergies have suffered from the prolonged wildfire and allergy sea-

sons 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 describes climate change as a public health emergency which is disproportionately impacting children and youth in a myriad of ways. He lists specific health threats exacerbated by climate change, including 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 policymakes 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 lifelong.

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.

I was born into a world in which my future and my past are uncertain, born into a world where my culture and inheritance are literally slipping into the sea, born into a world where my people are going extinct.

Show children everywhere that you care about our future and the future of all generations to come. Now is your time to stand in solidarity with me and my co-plaintiffs, America's youth, and communities around the world to fight for a just future, free from catastrophic climate change.

Thank you.

[The prepared statement of Mr. Barrett follows:]

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

—

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[1] have done everything in their power to stop *Juliana* from 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."[2]

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.'[3]

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.[4] 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."[5] 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

---

[1] 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; 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

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

[3] Exhibit S.

[4] *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).

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

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 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.[6] 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."[7]

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.[8] 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

---

[6] Expert Report of James Gustave ("Gus") Speth (Exhibit U); Declaration of Peter A. Erickson (Exhibit E).
[7] Defendants Answer ¶¶ 5, 151, 208-09; 213 (Exhibit FF); Exhibit R.
[8] *In re United States*, 139 S. Ct. 16, *vacated*, 139 S. Ct. 452 (2018).

burned.[9] 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:

> 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.[10]

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.[11]

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

---

[9] 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)

[10] Exhibit A.

[11] Declaration of Joseph E. Stiglitz (Exhibit I).

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."[12]

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."[13]

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.'"[14]

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).[15]

---

[12] Exhibit D, p. 7.
[13] Exhibit I, p. 15.
[14] Exhibit G, p. 26.
[15] Exhibit F, p. 4.

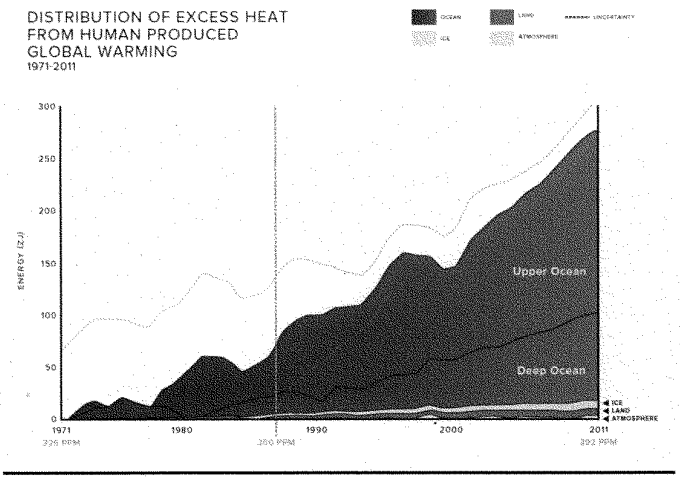


Figure 1: Distribution of global-warming energy accumulation (heat) relative to 1971 and from 1971 to 2011. Half of the human-produced global warming heat has entered the ocean since 1997.[16]

Over the past few months, 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. Most recently, Hurricane Dorian devastated the Bahamas and caused significant damage in the Southeastern United States. These storms will only get worse unless we take urgent action.[17]

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.[18]

---

[16] 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).
[17] Declaration of Kevin E. Trenberth (Exhibit B).
[18] Exhibit W.

Wildfire

It's not just storms that we have to worry about. For my co-plaintiffs living in the Western states, including Oregon and Washington, they are suffering from a wildfire season extended by two and a half months that is shrouding their communities with smoke for months on end, causing innumerable respiratory health issues, and taxing emergency response funds (see Figure 2). It is not just rural communities that are experiencing this smoke, it is urban areas as well. My co-plaintiff Aji has experienced air quality warnings advising him to stay inside and has had school and youth sports activities canceled so he was harmed by breathing the air. Aji has described how scary it is to see people walking down the street in gas masks in August in Seattle, where he lives, which used to be the most beautiful time to be outside in the Pacific Northwest.[19]

Figure 2: Wildfire smoke shrouds Seattle where my co-plaintiff Aji lives.[20]

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).[21]

---

[19] Declaration of Steven W. Running (Exhibit G); Declaration of Aji. P (Exhibit X).

[20] 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/.

[21] 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*

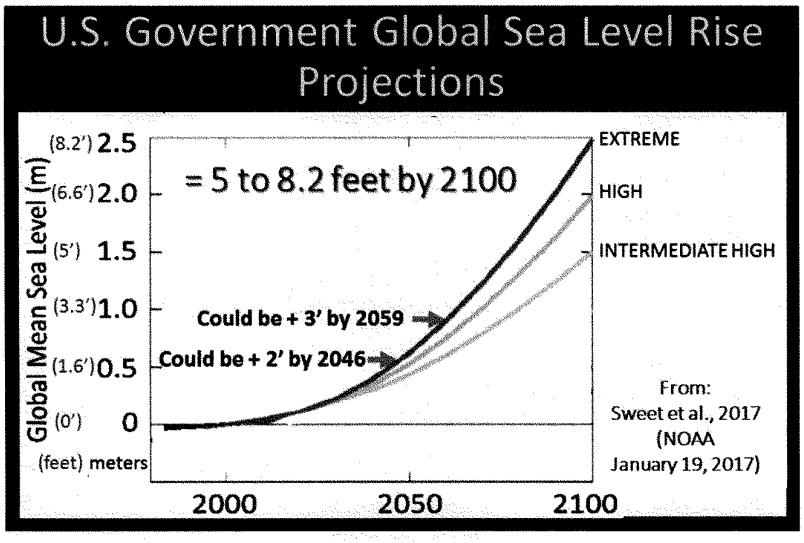


Figure 3: U.S. government sea level rise projections through 2100.[22]

---

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.

[22] Exhibit Z.

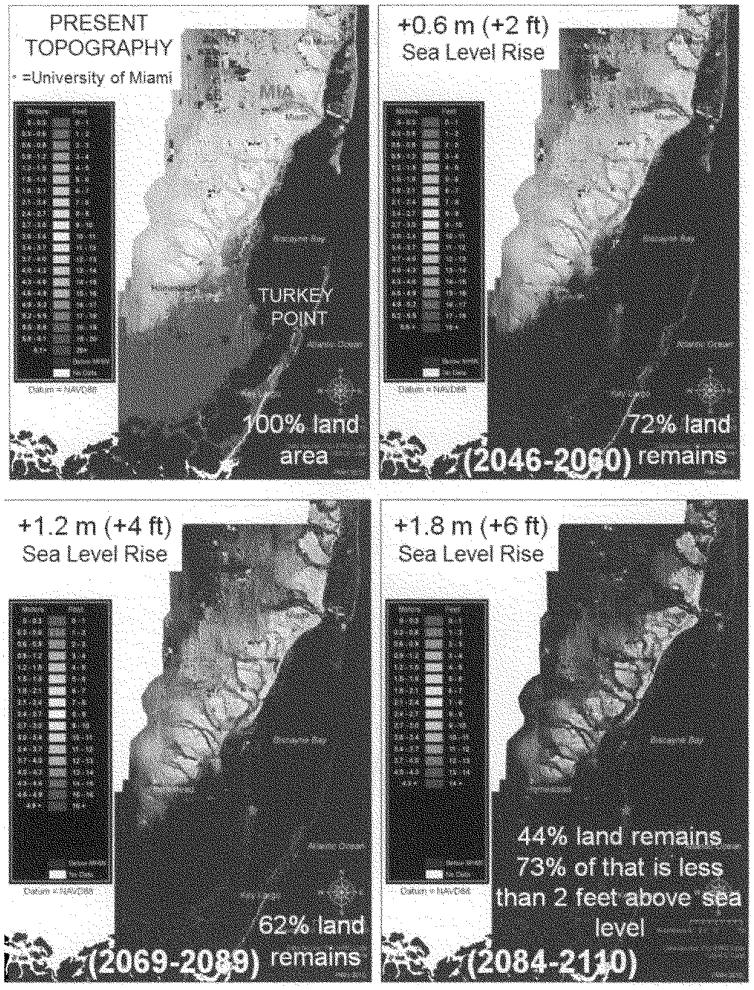


Figure 4: Sea level rise projections for southern Florida.[23]

[23] 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 $120 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.[24]

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.[25]

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,[26] stated:

---

[24] 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.

[25] Exhibit K.

[26] 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.[27]

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, will inundate New York City, where I grew up, 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

---

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.

[27] Exhibit N, p. 8.

necessary to preserve a habitable climate.[28] 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.[29] 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).[30] 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.[31] 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."[32]

---

[28] Hansen, J., et al., (2008). *Target atmospheric CO2: Where should humanity aim?* Open Atmos. Sci. J., 2, 217-231, doi:10.2174/1874282300802010217.

[29] 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.

[30] Expert Report of Dr. Harold R. Wanless, p. 6-7 (Exhibit Z); Declaration of Eric Rignot (Exhibit H).

[31] 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

[32] 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.

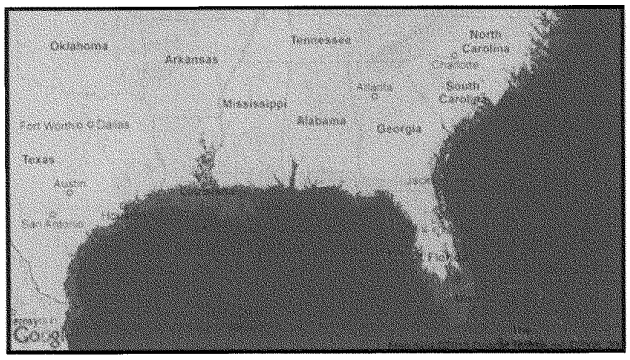


Figure 5: Map of the south Atlantic and Gulf coasts showing the inundation that would occur with 70 feet of sea level rise.[33]

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

[33] Exhibit Z.

reforestation and sustainable agriculture to bring us back to 350 ppm by the end of the century.[34] 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).[35] 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.

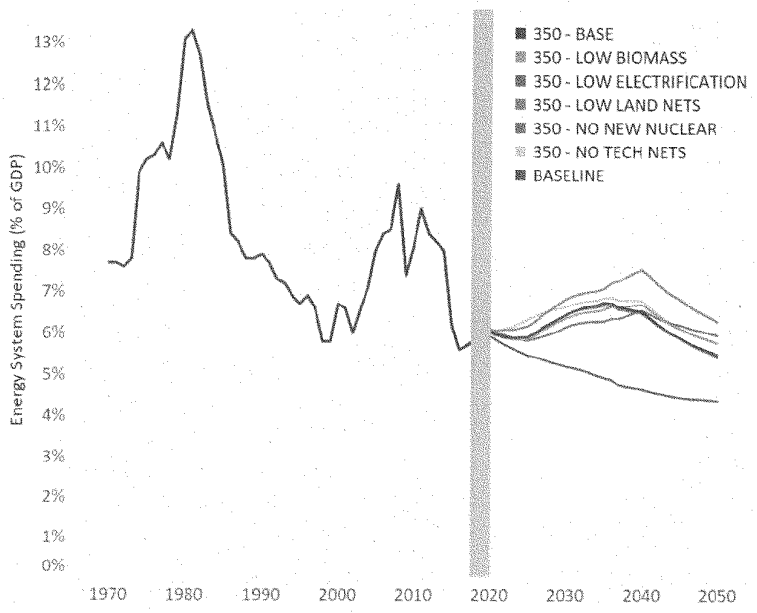


Figure 6: Total spending on the U.S. energy system represented as a percentage of GDP. Historical spikes from the 1970s oil crisis and high oil prices in 2006-2010. Modeled variations

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

on the right illustrate the cost of multiple scenarios that transition the U.S. off of fossil fuels by 2050.[36]

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.[37] 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.[38] 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.[39] This 1965 White House report clearly outlined the connection between the burning of fossil fuels and climate change (see Figure 7).

---

[36] Williams, J. et al. *Assessing the feasibility of 350 PPM CO_2 targets in the United States.* 2019.
[37] Expert Report of James Gustave ("Gus") Speth (Exhibit U).
[38] Exhibit BB.
[39] 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.

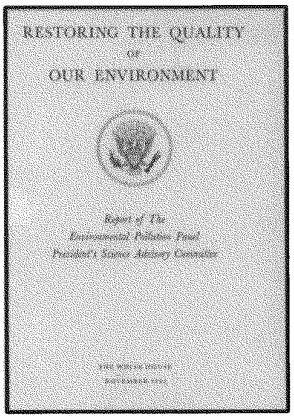


Figure 7: Cover of 1965 Restoring the Quality of our Environment report.

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."[40]

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).

[40] Exhibit CC.

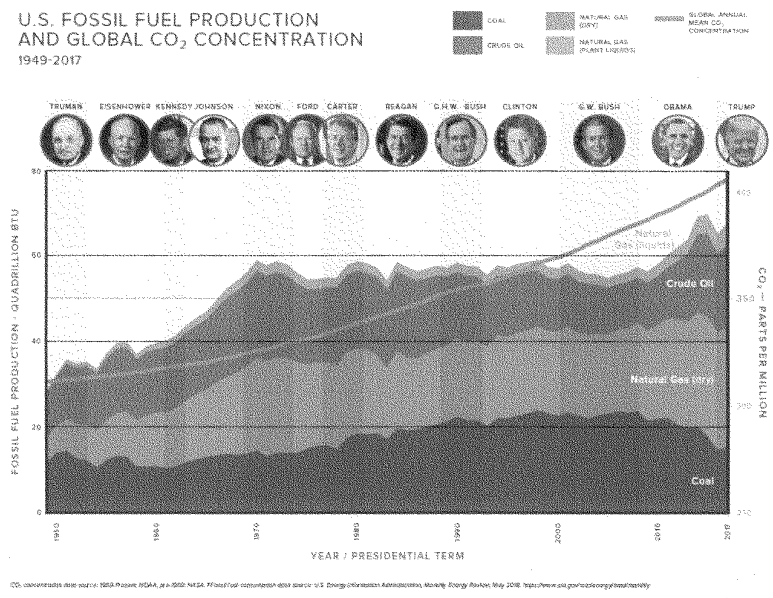


Figure 8: U.S. fossil fuel production and CO_2 concentration for every presidential administration since President Truman.[41]

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

[41] 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.[42]

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."[43]

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.[44]

In Conclusion

I was born into a world in which my future *and* my past are uncertain. Born into a world where my culture and inheritance are literally slipping into the sea. Born into a world where my people are going extinct. Growing up in this world, a world with an omnipresent threat of climate change has had lasting impacts on my mental health. Thinking about the future is a constant source of anxiety and depression for me, but I am not alone.

---

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

According to Dr. Lise Van Susteren, "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."[45]

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.[46]

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."

In order to begin to address the devastating impacts of climate change, including the physical and emotional toll that climate change is having on me and my peers, the federal government must halt its actions that promote fossil fuels and cause climate change – *now*. For years, the federal government and the same adults who created the disaster have marginalized us. No more. Climate change is here now. Waiting for the future is already too late.

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.

Now is your time to stand in solidarity with me and my co-plaintiffs, America's youth, and communities around the world to fight for a just future free from catastrophic climate change.

Thank you,

Vic Barrett
Madison, Wisconsin
Plaintiff, *Juliana v. United States*
Beneficiary of the Public Trust and the U.S. Constitution

---

[45] Exhibit M, p. 4.
[46] Exhibit S.

EXHIBITS

Exhibit A	Urgent Motion for Preliminary Injunction
Exhibit B	Declaration of Kevin E. Trenberth in Support of Urgent Motion for Preliminary Injunction
Exhibit C	Declaration of Mark Z. Jacobson in Support of Urgent Motion for Preliminary Injunction
Exhibit D	Declaration of Jerome A. Paulson in Support of Urgent Motion for Preliminary Injunction
Exhibit E	Declaration of Peter A. Erickson in Support of Urgent Motion for Preliminary Injunction
Exhibit F	Declaration of Ove Hoegh-Guldberg in Support of Urgent Motion for Preliminary Injunction
Exhibit G	Declaration of Steven W. Running in Support of Urgent Motion for Preliminary Injunction
Exhibit H	Declaration of Eric Rignot, Ph.D in Support of Urgent Motion for Preliminary Injunction
Exhibit I	Declaration of Joseph E. Stiglitz, Ph.D in Support of Urgent Motion for Preliminary Injunction
Exhibit J	Declaration of James H. Williams in Support of Urgent Motion for Preliminary Injunction
Exhibit K	Declaration of Vice Admiral Lee Gunn, USN (Ret.) in Support of Urgent Motion for Preliminary Injunction
Exhibit L	Declaration of Dr. James E. Hansen in Support of Urgent Motion for Preliminary Injunction

Exhibit M	Expert Report of Lise Van Susteren, M.D.
Exhibit N	Brief of *Amici Curiae* Public Health Experts, Public Health Organizations, and Doctors
Exhibit O	Brief of *Amicus Curiae* Law Professors
Exhibit P	Appellants' Opening Brief for Interlocutory Appeal
Exhibit Q	Plaintiffs-Appellees' Answering Brief for Interlocutory Appeal
Exhibit R	Findings & Recommendation, Thomas M. Coffin (May 1, 2017)
Exhibit S	Opinion and Order-MTD, Ann Aiken (November 10, 2016)
Exhibit T	Opinion and Order-MSJ, Ann Aiken (October 15, 2018)
Exhibit U	Corrected Expert Report of James Gustave ("Gus") Speth
Exhibit V	Executive Summary of EER Research
Exhibit W	Declaration of Jayden F. in Support of Plaintiffs' Opposition to Defendants' Motions Dismiss
Exhibit X	Declaration of Aji P. in Support of Plaintiffs' Urgent Motion for Preliminary Injunction
Exhibit Y	Declaration of Levi D. in Support of Plaintiffs' Urgent Motion for Preliminary Injunction
Exhibit Z	Expert Report of Dr. Harold R. Wanless
Exhibit AA	Expert Report of Andrea Wulf

Exhibit BB	Clinton P. Anderson letter to President Kennedy (February 14, 1961)
Exhibit CC	Daniel P. Moynihan memo to John Ehrlichman (September 17, 1969)
Exhibit DD	First Amended Complaint for Declaratory and Injunctive Relief
Exhibit EE	Appellants' Reply Brief for Interlocutory Appeal
Exhibit FF	Federal Defendants' Answer to First Amended Complaint for Declaratory and Injunctive Relief
Exhibit GG	Mark Jacobson et al., "100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World," Joule 1, 108-121 (2017)
Exhibit HH	Abstracts of 18 Peer-Reviewed Published Journal Articles from 2009-2018 by 96 Co-Authors Forming the Scientific Basis of "100% Clean, Renewable Wind-Water-Solar (WWS) All-Sector Energy Roadmaps for Town, Cities, States, Countries, and the World"
Exhibit II	Declaration of Victoria B. in Support of Plaintiffs' Opposition to Defendants' Motion for Summary Judgment (redacted version)
Exhibit JJ	Climate science summary explaining why 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

Mr. KEATING. Thank you.
Mr. BACKER.

STATEMENT OF BENJI BACKER, PRESIDENT, AMERICAN CONSERVATION COALITION

Mr. BACKER. Good morning. My name is Benji Backer, president and founder of the American Conservation Coalition, a nonprofit focused on bolstering conservative voices in environmental discussions.

I am also a 21-year old senior at the University of Washington in Seattle, and I would like to thank Chairman Keating, Ranking Member Kinzinger, Chairman Castor, and Ranking Member Graves for holding this very important hearing.

I am also honored to share this panel with Greta, Vic, and Jamie.

Each of you have played a critical role in generating worldwide awareness around this issue of climate change. So thank you.

I am a lifelong conservative activist, but like most of my generation, regardless of political affiliation, I believe climate change is real. I believe humans are making an impact. And with global emissions rising 1.7 percent last year, we are at a crossroads in history.

My generation does not care about the politics around climate change. We want productive discussions, realistic answers, and sound policies.

Most importantly, I believe America plays a vital role in solving this problem and that we must lead by example. Between 2005 and 2017, as already mentioned, we led the world in emissions reductions, more than the next 12 countries combined. However, while our contribution to greenhouse gas emissions is declining, we still contribute nearly 15 percent of global greenhouse gas emissions, which is second most in the world.

However, Americans have been told that one-size-fits-all approaches, such as the Green New Deal, are the only solution. Such policies advocate for an economic transformation that increases government control, spending, and regulation. These approaches inhibit innovation and are not an effective way to reduce emissions.

In fact, countries with highly restrictive and government-controlled economies, like Venezuela, have disastrous environmental records, and while on the other hand, countries leading in emissions reductions have some of the freest economic systems in the world.

We cannot ignore this reality, and the fact of the matter is we cannot regulate our way out of climate change. Markets and competition reduce emissions far more than heavy-handed regulation.

A truly effective climate plan will capitalize on America's strengths: technological advancements, empowered consumers, entrepreneurial businesses, effective government, and bold global leadership. We need to decarbonize fossil fuel emissions, increase the number of nuclear and hydropower plants, continue developing solar and wind, and encourage research and development into other clean energy technologies.

It is easier to export innovative American technologies than burdensome regulations to developing nations.

We must also understand the privilege Americans bring into this conversation. Across the globe, those who can most easily adapt to climate change are wealthy and live in developed countries. It is unfair to ask someone to make choices based on sustainability when they are struggling to survive.

As we transition to cleaner energy landscapes in the United States and abroad, we need to consider the most vulnerable in our world. There are still over one billion people without electricity worldwide. Transitioning to clean energy needs to happen, but it cannot happen overnight.

Climate change conversations are often dominated by hopelessness and despair. In reality, fighting climate change is an opportunity to improve human health, lift people up, and grow the economy.

And I see promising signs. Many bipartisan climate-related bills have been introduced and passed in the last 2 years. We are reducing emissions and creating remarkable new technologies. More Republicans are speaking up than ever before.

This innovation-based approach is not limited to the United States either. Just yesterday, the British Conservation Alliance, a group inspired by my organization, the ACC, was launched by students in the United Kingdom to advocate for market-based environmental reforms. We are making strides in the right direction, but we must do more.

Each of us play a critical role in tackling climate change.

To my fellow conservatives: The climate is changing. It is time to claim our seat at the table and develop smart, limited government policies to establish American leadership on this issue. There is a reasonable conservative approach to climate change, and we need to embrace it.

To those on the left: Without your leadership, this would not be receiving the attention that it deserves. But now it is time for solutions. Politicizing climate change has deepened the partisan divide and delayed real action. If you truly want to address climate change, work with conservatives who want to champion reforms.

To Congress: On climate change, it is not about Republicans or Democrats. It is about those who are taking effective action and those who are not. Our conversations on climate change should be about cutting global greenhouse gas emissions, not about political pandering.

To President Trump: Climate science is real. It is not a hoax. It is accepted that humans are having a negative impact on our climate. As a proud American, as a lifelong conservative, and as a young person, I urge you to accept climate change for the reality it is and respond accordingly. We need your leadership.

And last, to young people: You have remarkable power. The four of us testifying up here today are all under the age of 22. The world is listening with open ears and hearts to our voices and voices just like yours. Stand for what you believe in, uplift the world, and do not back down. Climate change is about our future, and people need to hear you and us.

In conclusion, I grew up on the shores of Lake Minocqua in northern Wisconsin where I connected with the outdoors early in life. Nature is where I find the most peace and calm within myself.

That is why I founded the American Conservation Coalition, to fight for wild places and stop climate change from destroying them.

The health of the environment affects all of us, regardless of where we live, our background, or our political affiliation. It is time for Americans to join together, find solutions on climate change, and protect our planet for generations to come.

Thank you.

[The prepared statement of Mr. Backer follows:]

Testimony of Benjamin Backer

President and Founder of the American Conservation Coalition

House Foreign Affairs Subcommittee on Europe, Eurasia, Energy, and the Environment

and the House Select Committee on the Climate Crisis

"Voices Leading the Next Generation on the Global Climate Crisis."

Wednesday, September 18th, 2019

Good morning, my name is Benji Backer, President and Founder of the American Conservation Coalition. I would like to thank Chairman Keating, Ranking Member Kinzinger, Chairwoman Castor, and Ranking Member Graves for holding this important hearing. I very much appreciate the opportunity to speak with you today on one of the greatest challenges facing humanity—global climate change.

Addressing an issue as daunting as climate change will take a bold, multidimensional, inventive approach at all levels of government. I look forward to providing a fresh perspective on this issue as a young conservative. During today's hearing, I will cover the importance of American leadership on climate change, as well as:

- Pragmatic solutions to lower emissions
- Privilege and equity
- A limited-government, market-based approach
- A call-to-action to important stakeholders

I'm a 21 year-old senior at the University of Washington in Seattle and a resident of Appleton, Wisconsin. I'm a lifelong conservative activist. Like most in my generation, regardless of political affiliation, I believe climate change is real. I believe humans are making an impact. Most importantly, I believe the United States leadership plays a vital role in helping solve this problem.

The American Conservation Coalition is a nonprofit organization focused on bolstering conservative voices in environmental discussions, ranging from conservation to climate change. We work on 180 college campuses nationwide. This summer, we were the first conservative organization to bring over 50 students to Washington, D.C. to advocate for common-sense action on climate change.

I'm honored to share this panel with such distinguished witnesses. Greta Thunberg, Vic Barrett, and Jamie Margolin have each played important roles in generating worldwide awareness around climate change. In the coming decades, our generation will be the ones tasked with finding solutions, and I'm grateful to be surrounded by young leaders who are transforming this conversation.

With global carbon emissions rising 1.7% last year, an important American election on the horizon, and more youth demanding action than ever before, we're at a crossroads in history.[1] Without bipartisan solutions on climate change, nothing can be accomplished. Most importantly, our conversations related to climate change should focus on cutting global greenhouse gas emissions, not pandering to a political base or scoring political points. This conversation needs to be about the most efficient and comprehensive ways to cut global emissions. My generation doesn't care about the politics around climate change. We just want productive discussions, realistic answers, and sound policy solutions. I urge every elected official listening to put partisan politics aside and collaborate on this pivotal issue. It is my belief that history will look kindly on those who worked across the aisle to find solutions.

That being said, there is no simple answer. There is no single plan that will solve the challenges we face. Fighting climate change will require many policies, diverse approaches, and efforts from governments, companies, and individuals working together. Just as citizens in Greenland and Louisiana feel the effects of climate change differently, we need diverse policies that are tailored to different nations' capabilities and challenges. Most importantly, we need innovative technologies that not only zero out emissions, but do so in a way that is affordable for all nations.

So, what does a serious approach to climate change look like?

First, the United States must continue to lead by example. Between 2005 and 2017, we led the world in emissions reductions—more than the next twelve countries combined.[2] While our contribution to global greenhouse gas emissions is declining, we still contribute nearly 15% of global emissions.[3] To put this into perspective, that 15% means we are the second highest-emitting country in the world. The United States has long served as an inspiration to people and nations around the globe. Our nation has an opportunity to inspire global action in the same way on climate change.

However, some Americans have been told that one-size-fits-all approaches, such as the Green New Deal or cap and trade, are the only solution. Such policies advocate for an economic transformation that will increase government control, spending, and regulation. These inhibit innovation—and are not the most effective way to reduce emissions on a global scale. More critically, developing nations are unwilling and unable to afford to implement policies like the Green New Deal. Adopting a policy that hampers the growth and global deployment of green technologies would be detrimental to the environment.

Importantly, we must also understand the privilege we, as Americans, bring to this conversation. Across the globe, those who can adapt to climate change most easily are wealthy and live in

---

[1] https://www.iea.org/geco/emissions/
[2] https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html
[3] https://www.earth-syst-sci-data.net/10/2141/2018/

first-world countries. That is true in regards to adaptation to extreme weather, but also in terms of affording a "green" lifestyle and technologies. It's unfair to ask someone to make choices based on sustainability when they are struggling to survive. Many proposed climate policies would have a disproportionate effect on low-income individuals and families, who are worried about putting food on the table and powering their homes.

We need to balance affordable energy access and climate mitigation goals. There are still over 1 billion people without electricity worldwide.[4] Even in the United States, millions of Americans are acutely sensitive to changes in energy prices. As we work to transition to a cleaner energy landscape in the United States and abroad, we need to consider the most vulnerable in our communities. It's our responsibility to lower the cost of clean energy and improve grid reliability so that developing countries can adopt them. American climate policy needs to lift up the rest of the world economically, be measured through emissions reduction (not just feel-good rhetoric), and focus on exporting cleaner, more efficient technologies.

If we're serious about curbing climate change before 2050, we must work to make each energy source cleaner and more affordable for all. Transitioning to clean energy will happen, and must happen, but it won't happen overnight. The reality is that most nations across the globe rely on fossil fuels to power their homes and businesses. Because countries will resist keeping their energy wealth in the ground, we need to focus on decarbonizing fossil fuels. That conversation will be far more productive than pushing a complete phase out of fossil fuels.

To actually reduce global emissions, America must work to enhance the technology around carbon capture for fossil fuel emissions, increase the amount of nuclear and hydropower in the world's energy portfolio, continue to develop and implement solar and wind, and encourage research and development for other clean energy technologies. It is easier and more productive to export new innovative technologies than burdensome regulations, such as the Green New Deal, especially to rapidly developing nations.

We must take quick, effective action on climate change, but we cannot regulate our way out of this problem. That's why we need to utilize innovation, technology, and markets to move forward. From innovation in the oil and natural gas space that reduced both emissions and energy costs, to improvements in wind and solar technology, and breakthrough products from companies like Tesla, the United States has led the world in emissions reductions. The private sector is often in a better position to make these changes. Many American companies, including 194 of the world's largest, have voluntarily pledged to shift to 100% clean energy. Innovation, technology, and market competition are non-partisan, and have reduced emissions regardless of whether a Republican or Democrat has sat in the White House. Countries leading in emissions reductions have some of the most free economic markets in the world. In contrast,

[4] https://www.weforum.org/agenda/2018/06/1-billion-people-lack-electricity-solution-mini-grid-iea/

countries with highly-restrictive and government-controlled economic systems, like Venezuela, have disastrous environmental records.[5] We can't ignore this reality.

The discussion of climate change is often dominated by voices spreading hopelessness and despair. While the gravity of climate change is clear, studies show that the "gloom and doom" approach has turned away a large number of people from the discussion, which, in turn, has limited engagement on this issue. I urge those of us who care about climate change to improve the conversation by showing our optimism. In reality, the challenge of climate change provides a beneficial opportunity to improve human health, save lives, support people who need it the most, and stimulate our economy through the creation of new jobs and technologies. Fortunately, there are promising signs on the horizon. Many bipartisan bills have been introduced—and passed—in the last two years. We're reducing emissions and creating remarkable new technologies every day. More Republicans are speaking up than ever before. Despite the mainstream narrative, we're making strides in the right direction—but we must do more.

Each of us play a crucial role in tackling climate change:

- To my fellow conservatives: The climate is changing. To whatever degree humans have impacted the changes we're seeing, we can chart a better course for the future. It's time to claim our seat at the table and develop smart, limited-government policies that establish American leadership on this issue. Climate change policies have become unappealing for conservatives because we've refused to lend our voice in the discussions. There is a reasonable, conservative response to climate change that we should embrace.

- To those on the left: Without your leadership, this issue would not be receiving the attention it deserves. But now, it's time for solutions. Politicizing climate change has deepened the partisan divide and delayed real action. Climate change should not be a wedge issue; rather, it should be one that is free of party labels. If you truly want to address climate change, work with conservatives who are ready to fight alongside you on implementing evidence-based policies.

- To the private sector: Sustainability and profit are no longer at odds. Young people like myself are supporting companies that share our values. Legislation moves slowly. You, however, have the power to make swift and meaningful changes to vastly reduce emissions. Take the opportunity to show that businesses are responsible members of the global community. The time to lead is now.

---

[5] https://www.heritage.org/international-economies/report/how-economic-freedom-promotes-better-health-care-education-and

- To Congress: On climate change, it's not about Republicans or Democrats, it's about those who are taking effective action, and those who are not. Ronald Reagan once said: "The person who agrees with you 80 percent of the time is a friend and an ally – not a 20 percent traitor." Your party labels won't matter if this challenge goes unanswered. Neither side will get everything they want in legislation that tackles climate change, but the issue is more important than that. Make your mark and show the rest of the nation—and the world—what true leadership looks like.

- To President Trump: Climate science is real...it's not a hoax. It's not only liberal activists who are pushing the science. It is accepted that humans are having a negative impact on our climate. As a proud American, as a lifelong conservative, and as a young person, I urge you to accept climate change for the reality it is and to respond accordingly. If you care about our national security, the health of our economy, our natural environment, or the future of the Republican Party—act now. We have an opportunity to show our nation's strength by leading on this issue. Americans are feeling the impacts of climate change today and your leadership on this would be a monumental step forward.

- To our partners around the world: we cannot address this problem alone. Fighting climate change is a global challenge and every nation has a stake in it. Each country will need to tackle this issue differently—and we must respect that. At the same time, we must unite across borders around meaningful responses.

- To young people: You have remarkable, unparalleled power. The four of us testifying here today are all under the age of 22. There has never been an easier time to make a difference as a young person than right now. The world is listening, with open ears and hearts, to young voices just like yours. Stand up for what you believe in, uplift the world, and don't back down. Become educated and make a difference on a local, state, national, and/or global scale. You're never too young to make your mark on this world. Climate change is about your future and people need to hear you.

In conclusion, a truly effective climate plan will capitalize on America's strengths: technological advancement, empowered consumers, entrepreneurial businesses, limited, but effective government, bold global leadership—and measure its success from emissions reductions.

I grew up on the shores of Lake Minocqua, a tranquil lake in northern Wisconsin, where I connected with the outdoors early in life. Nature is where I find the most peace and calm within myself. That's why I founded the American Conservation Coalition—to fight for wild places and to stop climate change from destroying them. The health of the environment affects all of us, regardless of where we live, our background, or political affiliation. It will take all of us to find solutions to climate change and protect our planet for generations to come.

Thank you.

Mr. KEATING. I thank all the witnesses for their testimony, and their urgency came through in all of your testimony.

And I now recognize myself for less than 5 minutes so that we can get as many people to ask questions as possible. I will start just with Ms. Thunberg.

You chose to submit the IPCC report in lieu of your written testimony. Could you expand on why it is so important to listen to the science?

Ms. THUNBERG. Well, I do not see a reason to not listen to the science. It is just such a thing that we should be taking for granted that we listen to the current best available united science. It is just something that everyone should do. This is not political opinions, political views, or my opinions, this is the science. So, yes.

Mr. KEATING. Thank you.

In all of your testimony, not just urgency came through when I was listening to what you had to say, but as someone from another generation listening, the last thing we would want for the generations to follow, for our children, grandchildren, and other people's children and grandchildren, is to hear in some of your remarks actual fear and anxiety being expressed.

Could you, each of you, you can jump right in as you see fit, comment on what that is like? I think that that message should be heard by all of us, not just urgency, but what are we doing to the next generation? How are their lives impacted by what we are not doing and what we are doing?

So if you could, I will let you just choose among yourselves. Each of you will have a chance to answer that question.

Ms. MARGOLIN. For me, it has really been affecting because, similar to Vic, I already have, underlying issues of, anxiety, and it is just really hard to grow up in a world full of "ifs."

You know, I do not think a lot of people in Congress understand the conversations that are happening in everyday American high schools, but we are constantly asked: Prepare for your future, study for your future, do this for your future. But our world is full of "ifs."

I will be talking to my best friend, and she will say, "Yes, you know, I really want to see this natural place sometime if it is going to still be around. I really want to study to be this if that is still going to be a possibility."

And it is just, this constant looming uncertainty. And it is a weird form of nihilism and weird just fear that has been existing in my generation where kids are joking, what is even, is the point? The world is ending. What are we studying for? What are we doing?

And it is this kind of depression, it is this fear that is not just among me or my panelists here but everyone, and that anxiety is something that no child should ever have to fear.

Because if you think about it, if you go back to what is the purpose of a parent down to just the biological purpose, it is to give their child the best future and the best life that they can possibly have and the supposed American Dream is to make sure that children have a better future than the adults.

But right now, it is, some members of government and some corporations are actively pointing a gun to children's futures and ac-

tively making it worse, actively going out of their way to support corporations and poison us and destroy our future.

And that is horrifying, and it feels like a betrayal, it is like a knife to the heart, to know that people who have kids, they will go around in these campaign ads and they will be, holding these babies, "Oh, you should vote for me, look at me interacting with a small child," while they actively poison and choose their wallets over their children.

So it is very devastating and scary, but also it feels like we have been betrayed.

Mr. KEATING. In less than a minute, would anyone else like to comment on that?

Mr. BARRETT. Young people are in the midst of their development. Adolescence is not characterized as being easy without also dealing with the greatest existential threat of our time.

Mr. BACKER. I definitely understand and agree with the panelists that this is something that a lot of young people stress about, and actually that is why I got into this movement to begin with in 2016. It was because I thought that it was something that Americans needed to tackle and the movement that I associated with, the conservative movement, needed to tackle as well.

But the more that I have gotten into this movement, the climate change movement, the more that I have seen that this is actually a positive, that there is actually a lot of opportunity here, that we have time. Science says so.

That does not mean we do not have to act, but we do have time. And we have an opportunity and a chance for people to come together on this issue and work across party lines and generate economic growth to solve this issue. So I feel hopeful.

Mr. KEATING. Great.

I now yield to the ranking member, Mr. Graves.

Mr. GRAVES. Thank you, Mr. Chairman.

And I want to thank you all for your testimony, all of you. It really was impressive, and I very much appreciate it.

Ms. Thunberg, you said let's unite behind the science. Could not agree with you more. Let's unite behind the science. And I think we actually need more science, not less.

Mr. Backer, you said that we need to stop this partisan fighting and actually work together to yield solutions that make sense.

So let me say it again. You have folks that proposed this Green New Deal, yet when it is brought up for a vote, nobody votes for it. No one.

You have efforts like last week to stop energy production, yet you have letters going out saying, hey, we want you to produce more oil in Middle Eastern countries and other nations that do not share American values and that have dirtier energy, that have higher emissions than in the United States.

This whole thing is a charade.

When you actually look at science, Ms. Thunberg, when you look at facts, the facts are it was not Waxman-Markey legislation here that was designed to require emissions reduction that yielded the United States leading the world in emissions reduction. It was actually folks doing the right thing, stepping in and actually reducing emissions through innovation, through energy efficiency, through

conservation, to where we are leading the world. And in fact, we have beat the projections under Waxman-Markey, the mandatory legislation, and we have done it with cheaper energy prices. Those are the facts.

Next, going to Mr. Backer. When you look at where we have actually made progress, once again, talking about last year, worked together, Mr. Sires and I and others on the Transportation Committee, where we developed the first resiliency standard, bipartisan unanimous bill passed out of the committee, where we dedicated record funding to resiliency and mitigation.

And in the United States today, we are spending more climate science, technology, and energy solutions than anywhere else in the world.

Those things have been done in a bipartisan manner and are actually yielding results, not the charades. These things are not yielding anything.

Ms. Thunberg, let me ask you a question. If you are sailing across the ocean and you are picking up trash along the way, and every one piece of trash that you pick up there is a boat right next to you dumping out five pieces, how would that make you feel?

Ms. THUNBERG. First of all, we were going so fast, we would not be able to pick up any trash.

Mr. GRAVES. All right. Well, if you were a slow sailor like me, how would that make you feel?

Ms. THUNBERG. Well, first of all, if you use that logic, then I am also dumping a lot of trash in the ocean. And then I would stop dumping my trash in the ocean and tell the other boat to stop dumping their trash in the ocean as well.

Mr. GRAVES. And that is the important point here. I think that what we need to be doing is we need to be focusing on the countries that are dumping trash in the ocean. Of course, that is a metaphor.

The fact that China is—here we are talking about reducing emissions, yet China, under the Paris Accords, are going to be increasing their emissions by nearly 50 percent, 5 gigatons annually.

So while in the United States we need to continue investing in innovative solutions and exporting clean energy technologies, it makes no sense for us to be doing it if we are simply watching for increases in China.

Mr. Backer, the IPCC report talks about numerous solutions moving forward, including clean energy and others. Under IPCC, does it contemplate only renewable energy sources moving forward?

Mr. BACKER. Thank you.

It actually does not, and I think that it shows a strong trend that we need to generate more clean energy going into the future, there is no doubt about that, and reduce emissions via clean energy technologies. But there is no statement in the IPCC report that says that we need to go 100 percent clean to reduce emissions at the level that we need to to fix this problem.

Mr. GRAVES. So moving on from there, if moving forward, even under IPCC, it does not contemplate not using any conventional fuels moving forward, for the next few decades anyway.

Do you think it makes sense to utilize the fuels from the Nation that has the cleanest energy? Or do you think that it makes more sense to, for example, use Russian gas that releases 13 percent

greater emissions as we move forward? Which makes more sense? Or do you think it makes sense to perhaps get fuels from Nigeria that just a few years ago had 2,000 ongoing spills?

Mr. BACKER. I think it is important for Americans to understand that we do generate fossil fuels cleaner than anywhere else in the world. And while the rest of the world still relies on fossil fuels, that is an important thing to note, I do think while we continue to generate power for the rest of the globe and uplift people, we as a Country also start transitioning more and more to clean technologies, which I think we are starting to do.

But I do believe that making sure that the rest of the world is generating fossil fuels safely is important because it is going to be a part of our future, especially today. And the United States does do it cleaner than anywhere else in the world. That is a fact, and it is something that we have to think about.

Mr. GRAVES. Thank you. I yield back.

Mr. KEATING. All right.

Chairwoman Castor.

Ms. CASTOR. Mr. Becker, in your testimony you point out that the United States must lead by example. And despite recent emissions reductions, the United States is currently the second highest emitting country in the world annually. And although we rank No. 2 now, the United States is responsible for the most carbon pollution accumulated in the atmosphere.

Some people say that the United States should not dramatically reduce our emissions because China and other countries are not doing enough. I would like to have your view on that and have each of the witnesses comment on that briefly.

Mr. BACKER. Yes. I think that is a false approach because we have never in history looked at a problem that we contribute in the United States and said, well, if it is happening somewhere else, then we should not fix it. So I do not think that that is a reasonable excuse.

But I also do think it is important to note that other countries are emitting and that we must hold them accountable as we hold ourselves accountable.

America has led on lots of initiatives in the past. You have people in Hong Kong waving their flags and singing the American National Anthem right now because we inspire them. We can do the same thing on climate change.

Mr. BARRETT. Yes. I would say what you said is totally correct. The United States contributes to 25 percent of historic emissions in the world. And if we are the country that we say we are, if we are the leaders that we say we are, we need to lead by example here and work on what we are doing here so that the rest of the world can follow our lead.

Ms. MARGOLIN. I have a question. When your children ask you, "Did you do absolutely everything in your power to stop the climate crisis, when the storms are getting worse and we are seeing all of the effects of the climate crisis?" when they ask you, "Did you do everything?" can you really look them in the eye and say, "No, sorry, I could not do anything because that country over there did not do anything, so if they are not going to do it, then I am not"?

That is shameful, and that is cowardly, and there is no excuse to not take action, to not improve as much as we can in the United States.

And how can we call ourselves the city on a hill or be an example for the world if we are going to be coward and hide behind waiting for other people, saying that, "I am not going to do this because they did not"?

I want you to think about this is all about being able to look your children in the eye and say, "I did absolutely everything I could for you. I know that we are up against a lot of pressure. I know that the time is running out, but, honey," however you call your kids, "I did everything I could."

And so I just do not understand as a parent how can you look your kid in the eye and say, "There is this impending crisis, everything is at stake, but I stood back and I did not really do anything. I did not take action. I did not act like it was an emergency because our neighbors over there weren't doing it, so I am just not going to." How can you tell your children that?

Ms. THUNBERG. I just—I think I do not need to add anything but just another perspective. I am from Sweden, a small country, and there it is the same argument: Why should we do anything? Just look at the U.S., they say.

So, just so you know, that is being used against you as well.

Mr. KEATING. The chair recognizes Representative Miller.

Mrs. MILLER. Thank you to Chairman Castor and Ranking Member Graves as well as to our Foreign Affairs counterparts, Chairman Keating and Ranking Member Kinzinger, for hosting us today, and I want to say a very special thank you to all of you for being here today and for caring so much about our Earth. Throughout our work on this committee, I have long said that any recommendations that the Select Committee on the Climate Crisis makes must ensure that we provide for innovation and not taxation. Solutions should work to reduce our carbon footprint but not come at the detriment of increased cost for consumers.

Mr. Backer, I want to thank you for your leadership and your candor. We all must do whatever we can and do our part to take care of our beautiful world. In your testimony, you discussed how we cannot regulate our way out of climate change. What are some of the ways that we can better utilize technology and increase innovation?

Mr. BACKER. Thank you. If we really want to focus on reducing emissions, which I think we all agree is the end goal that we are talking about here today, it needs to be about the results, and the results can come from innovation like you are alluding to. If you look at the technologies that we can have around carbon capture, taking carbon emissions out of the air from fossil-fuel-emitting plants and being able to put that into the Earth or reuse it for another type of product or you look at the shifts in the transportation sector to transition to cleaner cars and cleaner technologies, that is the example of things that we can do across the globe and continue innovating because innovation, like I mentioned in my testimony, is something that we can export to other countries very, very easily because it creates jobs, it is more efficient, and it ends up helping the economy. A great example of this is 194 of the world's

largest companies have pledged to go 100 percent renewable by 2030, 2040, or even sooner than that. They are doing that because it is more cheap, it is more efficient, and it helps their consumers. It has done that because of innovation. And if we put regulations on different industries, we are not going to be solving the problem. We need to work on decarbonizing fossil fuel and reducing emissions now, and we cannot do that with regulation. We can only do that through innovation. We need to innovate our way out of the climate change problem.

Mrs. MILLER. Thank you.

I yield back my time.

Mr. KEATING. Vice Chairwoman Spanberger.

Ms. SPANBERGER. Thank you very much. Thank you all for being here. I hold your commitment to fighting for the future generations of this planet in the highest esteem, and I am grateful for the attention you are bringing to these critical issues throughout your advocacy. Ms. Thunberg, in your speech to U.N. Secretary General Antonio Guterres on climate change, you said, we are facing an existential threat, and I agree.

The scientific consensus is clear, climate change is real. Its affects, including changes to rainfall and farmers' growing seasons, sea-level rise along our coasts, and exacerbation of conflicts abroad are a threat to us all. In fact, our intelligence community and two former Secretaries of Defense have cited climate change as a root cause and driver of instability and global threats, making it not just a moral imperative, but a national security imperative as well. I am curious, in your travels as an activist and as an advocate, have you heard stories, or have you engaged with those who are focused on the issues of how climate change and the instability it causes internationally are impacting security issues and how those might impact our future generations?

Ms. THUNBERG. I have, of course, met many people who have experienced environmental and climate-related disasters and who try to help people to come back from that, and I have not been meeting so much with people who have told me stories about it being a national security threat because I simply have not had enough time to do that. There are so many people to meet and so many stories to hear, so I cannot listen to them all. But I imagine maybe one of the others have.

It does not seem like they have either. So maybe then you should talk to someone who is an expert in that area.

Ms. SPANBERGER. And you mentioned, apart from the security aspect of things, that you have spoken with many who have faced disasters at home due to global climate change. Could you, perhaps, give a couple of examples just for the committee to hear, of the stories you have heard?

Ms. THUNBERG. Yes. I have met people whose communities were simply—whose neighborhoods were destroyed by natural disasters, who were amplified by the climate crisis. I have met people whose food and water supply is being threatened by environmental or climate-related catastrophes. And it is just—it is so sad that I—it is so incredibly many people, so incredibly many examples, that it is just horrible because so many who have experienced this and so many who are suffering from this today. And, I mean, we are al-

ready seeing the consequence—unacceptable consequences of this today, and it will only get worse the longer we delay action, unless we start to act now.

Ms. SPANBERGER. Thank you very much.

Ms. MARGOLIN. I would also look like to add, answering that question, I would like to acknowledge that we have some Amazon protectors in the room right now, who are fighting to protect the Amazon rainforest, and that is a place in the world where people are gravely suffering, not exactly from climate change itself, but from the causes of the climate crisis. The animal agriculture industry is behind—and the collusion of the animal agriculture industry with the governments of Brazil and other countries that would rather make a short-term profit than protect the lungs of our planet. The Amazon rainforest is the lungs of our planet, and that is why we are seeing these massive fires, and it is indigenous protectors like the ones here sitting, who have been fighting, literally putting their bodies on the line and suffering from these fires, and I want to speak for them, because I do not know their own stories, but I encourage you, talk to them later.

But I think it is also very important that, as we speak from an American perspective, we also realize that the climate crisis is global and that, even though maybe—you know, for me personally, I have Latin American roots in that my family is from Colombia, but even if you do not have those roots in Latin America, the Amazon rainforest is the lungs of our planet. And so it burning down, we must unite with Latin America, and we must unite with the indigenous activists and listen to them and give them a platform. And also not perpetuate the same systems of oppression that have been pushing them down because it is—and I do not want to speak for this, and I do not know if you have anything to add, but it is the same systems of oppression that are causing the climate crisis that are making people feel the worst effects.

To add to something that I heard earlier, I just want to say real quick—I realize my time is running out—but Albert Einstein defined insanity as trying to solve an issue with the same thinking that caused it. And right now something that has been disturbing me a lot is seeing the way that we are trying to colonize and buy and sell our way out of a problem caused by colonization and buying and selling.

Ms. SPANBERGER. Thank you, Mr. Chairman.

I am over time. I yield back.

Mr. KEATING. Representative Burchett.

Mr. BURCHETT. Thank you, Mr. Chairman.

I really do not have any prepared notes. I was sitting there just thinking, in 1977, I was confronted with a problem. I was—my father used to grow tomatoes—oh, Mr. Chairman, I appreciate you and the vice chairman and everybody for allowing us to be here. I meant to do the protocol first, I apologize, but—and I was—my father used to grow these tomatoes. He would get about a half a dozen tomatoes, and he would put about $20 in chemicals and all kinds of nasty stuff. And I thought to myself, you know, I am putting that stuff in my body. And I thought, there has got to be a better solution, and I stopped a—it is called KUB, Knoxville Utility Board. They used to cut all the trees that were growing on the

power lines, and they would grind them up, usually about 6 o'clock in the morning and wake us all up. And I stopped and asked one of those guys one time, I said: Hey, what do you you all do with that stuff?

And they said: Well, we take—you got to realize this is 1977, OK? I was in—I was in between my seventh and eighth grade years. And he said: We take it to the landfill.

And I said: Well, how much do they pay you for it?

And they said: We do not. We pay them to take it.

And so the wheels started turning in my head. And at that point, I became a capitalist. I realized that there was money to be made. You could save the environment. At that time, it saved about 25 percent of the landfill space in our community, and I got into that business. But I want—and I have realized now that, of our trash stream, about 85 percent of that is compostable. It does not have to go into a landfill. And when it goes into landfill, everybody just—a lot of people think it just goes away. It does not go away. It creates all kinds of bad things for the environment. The gases, one of the most feared gases is methane, is when something decomposes in an anaerobic, or in the absence of oxygen. So, if we could compost those things, 85 percent of that waste stream could be turned back into soil, which would be utilized, I think, in a capitalist manner.

And you wonder about capitalism. Well, I had the opportunity, I was sitting there with AOC, and I was pitching to her capitalism. I do not really know if it caught on with her or not, but my point was this. I said: You want to do away with airplanes—well, airplane engines that put out gases that are harmful to the environment. And I said: MIT right now has an airplane engine that has no moving parts and allegedly puts nothing harmful into the environment. No moving parts. And to me, that is just Buck Rogers, but I got on YouTube, and I watched the video, and I watched it—you all could probably understand it, but my 55-year-old brain just does not understand it. But it is fascinating to me. But, granted, all it did was fly a glider about the length of a football field. Well, I got to thinking, this little cell phone right here, 20 years ago, according to my friends at Oak Ridge National Laboratory, was a hundred million dollar computer. Twenty years ago. Capitalism brought this, now everybody basically has a television studio, can get to all the information in the world, can contact anybody in the world for about, I do not know, about a hundred bucks a month, and it is a pretty good deal, and that was through capitalism. And I would encourage you all to explore that, that realm of our economy. I have a piece of legislation, and I would encourage you all, I would like to hear from each one of you all, what you all think about it. It is called carbon capture. It is a capitalist view of capturing carbon and utilizing it. And it is House Resolution 3861, and I would encourage you all, not now, look it up, get on your little computers, you all know how to use them better than I do. Somebody will show me when I get your email, and I would encourage you all to read that and see what it is. And I applaud you all for being here, I applaud your enthusiasm and I am incredibly proud that you are this concerned about our environment and our world, and thank you all so much for being here.

Mr. Chairman, I yield back the remainder of my 55 seconds.

Mr. KEATING. Well, thank you.

Representative Lujan.

Mr. LUJAN. Thank you very much, Mr. Chairman, and to all of the chairs and ranking members for bringing us together today, to all of the panelists who are witnesses who are here with us today, I want to thank you as well. Before I begin my questions, though, I just want to remind my colleagues that those mobile phones that were once too big or a desktop that weighed thousands of pounds, they got smaller because of a Federal taxpayer investment by the United States of America, investing in the research. So I hope that there is an openness and a willingness that we take the same step. Let's put our money where our mouth is. Let's make sure that we are investing those dollars and we are answering this call.

And, Ms. Thunberg, I appreciate the power of your testimony. You laid it out in a document right in front of us, a document where experts and scientists have laid out the path in the road for the world to take policy action. It is simple. The work has been done for us. We just have to follow that path. So I want to thank you for that.

Now, I do not want to have to defend one of my colleagues as well, she can defend herself, as we all know. Congressman Cortez—or Congresswoman Alexandria Ocasio-Cortez has not said that she wants to stop air travel. Her policies have said: Let's do better. Let's act.

And I think that is what we are here to do. So I apologize; I took a little bit of my time to respond to some of the statements that were said earlier, but I thought it was important.

So, Ms. Thunberg, when I was your age, the concentration of CO2 in the atmosphere was 350 parts per million. This year, we eclipsed 415 parts per million. I am going to try to make some sense out of this. What many scientists have said is that we only can get to 430 parts per million to get to an increase of 1.5 degrees or to be able to even hold at 1.5 degrees increase. If we get to 450 parts per million, again we are at 415 already, that gets us to two degrees. Let me share what that means. With 1.5 degrees, 14 percent of the global population will face extreme heat. At 2 percent, it is 37 percent. At 1.5 degrees, we will see an ice-free Arctic once every hundred years. At two degrees, we see it every 10 years. At 1.5 degrees, our fisheries decline by 1.5 million tons, and our coral reefs decline by at least 70 percent. At 2 degrees, our fisheries will decline by twice that, and we will lose 99 percent of our coral reefs. We see the difference between what is devastating and what is even beyond what devastating can even be described as.

Ms. Thunberg, the science could not be more clear. If we wait, the climate crisis will only be more devastating. Just a year ago, you were protesting outside the Swedish Parliament. Now you are part of an international coalition of young people demanding action. I asked a few students that I had the honor of working with in New Mexico, and one of them responded. Her name is Marina Weber Stevens. She is one of the founding members of the Global Warming Express. Anyone that is interested can find them at theglobalwarmingexpress.org. And she asked a very important question, but one that I think you have an answer to, and it is this:

What is the best way to get the younger generations, teens and students, involved in advocacy to address the climate crisis? And I would add to that, adults. What can we be doing? How can we get more young people involved?

Ms. THUNBERG. How we can get more young people involved, I think to just tell them the truth, tell them how it is and—because when I found out how it actually was, that made me furious so I was—I wanted to do something about it. And that is the—at least I have spoken to many, and I think that is the experience many others have. Because as it is now, people in general do not seem to be very aware of the actual science and how severe this crisis actually is. So I just think we need to inform them and start treating this crisis like the existential emergency it is. Then I think people will understand and want to do something about it.

Mr. LUJAN. And that is powerful. Tell them the truth.

With that, I yield back.

Mr. KEATING. Mr. Carter.

Mr. CARTER. Thank you, Mr. Chairman.

And let me begin by thanking all four of you for being here. I cannot tell you how much this builds up my confidence in the younger generation, having you involved in this. It is extremely important that you be involved in the process, and I applaud you for being here, and I thank you for being here.

I am going to start with you, Mr. Backer. It is really good to see someone who is interested in such an important project, or such an important topic, I should say, and also who understands that we need to factor in the economy in this and the economic impact that something like this could have. Do you think that the state of our economy and the need to maintain a robust economy—because, after all, you are all going to be participating in our economy. In a way you already are, but in the future, you will be even more. It is important that we have a robust economy so that we will be able to provide jobs for young people and for all of our citizens. But do you think it is important to consider that when we are considering climate change?

Mr. BACKER. Thank you, Mr. Carter, and also thank you for being a member of the Roosevelt Conservation Caucus. It is a caucus started by Republicans focused on bringing Conservatives back to environmental discussions. It is a major step forward, so thank you.

So the economy definitely needs to be a part of this conversation because if we do not take the economy into consideration, we are leaving the people who are at the most risk at—we are keeping them at the most risk. We are allowing people who are in the lower poverty levels to be affected the most by our policies. There is an opportunity, a strong opportunity, to be economically sensible and environmentally sensible. Economic sustainability and environmental sustainability do go hand in hand. And I think a lot of people who are on this issue and believe that this is a topic that is of importance, believe that the agricultural industry, corporations, and fossil fuels, are a lot of times the enemy. But they are part of our society. And they are today, and they will be for the next—at least for the short-term. And so, if we want to lower emissions and we want to have a clean-air economy, we have to work with people,

instead of against people. Because the only way that we are going to truly reduce emissions is to do that. And that is true with the economy. Because we cannot have a strong environment without a strong economy, and the worldwide statistics show, as I mentioned earlier, that the most free economies are the cleanest in the world. Does that mean that they are done and that they do not have to do more? Not in the slightest, but economic success and environmental success go hand in hand.

Mr. CARTER. OK. If I could—and I will let you in just a second. I want to show you something on the screen, if we can get it up. It is a chart that the EPA has put out—are we going to be able to do it? Just hold it up. You want me to hold it up. OK. All right. Are you going to be able to get this? OK. Well, unfortunately, you cannot see it very well, but it is a chart that the EPA put out in 2018, and it shows the growth of our economy since 1970. And the United States has actually grown our economy. Our gross domestic product has grown almost 300 percent. Our vehicles miles traveled has grown almost 200 percent. Population has grown. Energy consumption has grown. But our carbon output has decreased over that period of time. So it is possible to do. We can grow our economy and decrease our carbon output. We have done that since 1970. In fact, if you look, we have actually decreased the six common pollutants almost a hundred percent since 1970, while growing our economy. So it can be done. One thing I want to make sure we understand is that, look, look, listen to me: This is not a Republican-Democratic issue. This is an American issue. This is a world issue. It is not United States versus China versus India. All of us have to work on this together.

I have always—I believe in climate change. I believe the climate's been changing since day one. I am old enough to remember—you are not—but I am old enough to remember the early 1970's when we thought we were headed for another Ice Age. Well, does man have an impact on that? Yes, we do have an impact. How much? That might be debatable. However, we should do something. And that is one of the things that I am so excited about.

And, Mr. Backer, you mentioned this about the opportunities that exist here because I have always said, we have got to have three things. We got to have innovation. We have got to have mitigation. And we have got to have adaptation. And that innovation, the greatest innovators, the greatest scientists in the world are right here in the United States of America. That is why I am excited about us leading the way. And I think we can lead the way. Yes, we have got much to be done; there is no question about that.

You also mentioned about agriculture. I represent a very rural area in south Georgia. The rural community is going to play a big part in this. We cannot leave them behind. That is going to be very important as well. We have to be very careful. My message is simple. And that is that, yes, this is something we have to deal with, but we cannot destroy our economy when we are dealing with it. We have to keep that in mind. We have to have affordable, reliable, clean energy.

Thank you, Mr. Chairman, and I yield back.

Mr. KEATING. Well, thank you. As we said before, we have a hard stop. So here is what I want to just do in closing—there will be no

closing statements, which will allow whatever time is limited. I do want to recognize Representative Brownley who has been here, paying great attention throughout the whole hearing; Representative Levin; Representative Titus; Representative Omar, in the case that we may not have the opportunity because you do have to leave. So I will now recognize Representative Meeks.

Mr. MEEKS. Thank you, Mr. Chairman. Thank you for this very, very timely and important hearing. Climate change is undoubtedly an economic threat—that is true; a national security threat—that is true; and, ultimately, and most importantly, an existential threat. It has battered our coasts and set our forests ablaze. In my home State, Mr. Barrett's home State of New York, Superstorm Sandy destroyed the property and uprooted the lives of thousands of New Yorkers, including many living in my district.

If left unabated, climate change will displace world populations. Islands, Mr. Barrett, you are correct, will be gone, where people currently live. And it will continue to wreak havoc on our own, costing billions in damage. That is economics if we are not prepared. It will be billions of dollars that will cause economic damage if we do not do something about climate change. It will also—climate change threatens to undue the last 50 years of progress in development, in global health, and poverty reduction. So we have got to do something, urgently.

If the world that we leave behind—and we all hold this world in trust for the next generation. So I look at it, the world that I leave behind for my new baby granddaughter, will look dramatically different if we do nothing today. Indeed, a drastic reduction in our carbon footprint will be one of, if not the most, important missions of our time.

I also want to say—and I heard Ms. Margolin say this a number of times—I just want to let you know that anxiety research, indeed, shows that young people have high levels of anxiety. It is not, though, just because of climate change. Everything from the economics to health disparities to student loans, et cetera. Of course, climate change is compounding that problem. But what you are doing by being here and leading does make a difference. And I just used the example of one of my colleagues who, at 16 years old, helped change and shape a Nation. His name was John Lewis. He put his life on the line. He had a lot of anxiety if you talk to him. But by doing this with that anxiety and turning that anxiety into something that you are going to lead, to change, it makes the world a better place for all of us. So I compliment you on how you are using your anxiety to make a difference in the world. That is something that is so important, and, indeed, yes, all young folks—I am old enough to remember the civil rights movement, when it was led by students, and high school students, who said, I am sick and tired of being sick and tired. And they changed things. So believe this: that each and every one of you—Mr. Backer, I have been listening to you. You are part of a change that is going to make us all better, make this Nation and this world better. One of the things—we will fight back and forth, but guess what, I still bet on America. We will go through some of the bad times, because Lord knows I have seen bad times, and I have seen us come through it.

So I want to say to each and every one of you: Do not give up on America because what America is all about is that, if we stand up and fight, if we stand up for what we believe in, we will change things. It does make a difference.

It is the reason why I can sit here, Mr. Barrett, because I have seen my father go through some terrible times as an African American, and then I saw Barack Obama become President of the United States. Not just for Black folks, but for all folks. Keep up your work; you will make this place we call Earth not only exist but thrive and be a better place, and I yield back.

Mr. KEATING. Well, thank you. Thank you for your extraordinary testimony. It makes a difference. It will make a difference, and, by the way, it is bipartisan and based on science. Thank you for being here.

We also want to thank Representative Costa who has been here, too, as well. So you stayed later than you agreed to. I know how hard pressed you are. So, if we could just ask those in the audience and the press, allow the witnesses to go to the anteroom, where we came in from, so that you can get to your next place more quickly. So, please, remain seated, allow the witnesses to go to the ante room so that they can have an expedited way back to their next meeting which they agreed to stay longer to hear our testimony.

With that, I adjourn this hearing. Thank you.

[Whereupon, at 11:37 a.m., the committees were adjourned.]

JOINT COMMITTEE HEARING NOTICE
COMMITTEE ON FOREIGN AFFAIRS
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515-6128

SUBCOMMITEE ON EUROPE, EURASIA, ENERGY, AND THE ENVIRONMENT

William R. Keating (D-MA), Chairman

SELECT COMMITTEE ON THE CLIMATE CRISIS

Kathy Castor (D-FL), Chair

September 18, 2019

TO: MEMBERS OF THE COMMITTEE ON FOREIGN AFFAIRS

You are respectfully requested to attend an OPEN hearing of the Committee on Foreign Affairs, to be held jointly by the Subcommittee on Europe, Eurasia, Energy, and the Environment and the Select Committee on the Climate Crisis in Room 2172 of the Rayburn House Office Building (and available live on the Committee website at https://foreignaffairs.house.gov/):

DATE: Wednesday, September 18, 2019

TIME: 10:00 am

SUBJECT: Voices Leading the Next Generation on the Global Climate Crisis

WITNESS:

Ms. Greta Thunberg
Founder
Fridays For Future

Ms. Jamie Margolin
Co-Founder, This Is Zero Hour
Plaintiff, Piper v. State of Washington

Mr. Vic Barrett
Fellow, Alliance for Climate Education
Plaintiff, Juliana v. United States

Mr. Benji Backer
President
American Conservation Coalition

By Direction of the Chairman

The Committee on Foreign Affairs seeks to make its facilities accessible to persons with disabilities. If you are in need of special accommodations, please call 202/225-5021 at least four business days in advance of the event, whenever practicable. Questions with regard to special accommodations in general (including availability of Committee materials in alternative formats and assistive listening devices) may be directed to the Committee.

COMMITTEE ON FOREIGN AFFAIRS

MINUTES OF SUBCOMMITTEE ON *Europe, Eurasia, Energy, and the Environment* HEARING

Day *Wednesday* **Date** *9/18/19* **Room** *2172*

Starting Time *10:10 AM* **Ending Time** *11:35 AM*

Recesses ____ (____to ____) (____to ____) (____to ____) (____to ____) (____to ____) (____to ____)

Presiding Member(s)

Keating

Check all of the following that apply:

Open Session ☑
Executive (closed) Session ☐
Televised ☑
Electronically Recorded (taped) ☑
Stenographic Record ☑

TITLE OF HEARING:

Voices Leading the Next Generation on the Global Climate Crisis

SUBCOMMITTEE MEMBERS PRESENT:

See Attached

NON-SUBCOMMITTEE MEMBERS PRESENT: *(Mark with an * if they are not members of full committee.)*

Chairman Eliot Engel, Representative Ilhan Omar

HEARING WITNESSES: Same as meeting notice attached? Yes ☑ **No** ☐
(If "no", please list below and include title, agency, department, or organization.)

STATEMENTS FOR THE RECORD: *(List any statements submitted for the record.)*

Ms. Greta Thunberg's Testimony
Ms. Greta Thunberg's Addition to the Record
Ms. Jamie Margolin's Testimony
Ms. Jamie Margolin's Addition to the Record
Mr. Vic Barrett's Testimony
Mr. Benji Backer's Testimony
Representative Jim Costa's Opening Statement
Representative Garret Graves' Addition to the Record
Representative Buddy Carter's Addition to the Record

TIME SCHEDULED TO RECONVENE _____
or
TIME ADJOURNED 11:35

Subcommittee Staff Associate

JOINT HEARING: HOUSE COMMITTEE ON FOREIGN AFFAIRS

EUROPE, EURASIA, ENERGY, AND THE ENVIRONMENT SUBCOMMITTEE

SELECT COMMITTEE ON THE CLIMATE CRISIS

PRESENT	*MEMBER*
X	**(E4)** William Keating, MA
X	**(SC)** Kathy Castor, FL
X	Eliot Engel, NY
X	**(E4)** Abigail Spanberger, VA
X	**(SC)** Ben Ray Luján, NM
X	**(E4)** Gregory W. Meeks, NY
	(SC) Suzanne Bonamici, OR
X	**(E4)** Albio Sires, NJ
X	**(SC)** Julia Brownley, CA
X	**(E4)** Theodore E. Deutch, FL
	(SC) Jared Huffman, CA
X	**(E4)** David Cicilline, RI
	(SC) A. Donald McEachin, VA
X	**(E4)** Joaquin Castro, TX
X	**(SC)** Mike Levin, CA
X	**(E4)** Dina Titus, NV
	(SC) Sean Casten, IL
	(E4) Susan Wild, PA
X	**(SC)** Joe Neguse, CO
	(E4) David Trone, MD
X	**(E4)** Jim Costa, CA
	(E4) Vicente Gonzalez, TX
X	Ilhan Omar, MN

PRESENT	*MEMBER*
X	**(E4)** Adam Kinzinger, IL
X	**(SC)** Garret Graves, LA
	(E4) Joe Wilson, SC
X	**(SC)** Morgan Griffith, VA
	(E4) Ann Wagner, MO
	(SC) Gary Palmer, AL
	(E4) James F. Sensenbrenner, Jr., WI
X	**(SC)** Buddy Carter, GA
	(E4) Francis Rooney, FL
X	**(SC)** Carol Miller, WV
	(E4) Brian K. Fitzpatrick, PA
	(SC) Kelly Armstrong, ND
	(E4) Greg Pence, IN
X	**(E4)** Ron Wright, TX
X	**(E4)** Michael Guest, MS
X	**(E4)** Tim Burchett, TN

STATMENTS FOR THE RRCORD SUBMITTED FROM COMMITTEE MEMBERS

Submission for the Record from Representative Jim Costa
Subcommittee on Europe, Eurasia, Energy, and the Environment
Voices Leading the Next Generation on the Global Climate Crisis
September 18, 2019

I'd like to thank the Chairman and Ranking Member for holding this hearing to bring attention to the reality we are facing as we continue to witness the impacts of climate change in our nation, and around the world. I also want to especially thank our panel for being here today. It is inspiring to see the faces leading the next generation.

Mr. Chairman, climate change is having devasting effects all over the world. Just in the last few weeks, we have witnessed the most intense hurricane to hit the Bahamas while the Amazon continues to burn.

There is no excuse for anyone to deny our climate is changing as it continues to pose a threat to our existence. In my state of California, we have continuously seen a pattern of more intense, longer fires topped with drought that reduces and limits access to water.

This is a vicious cycle that puts our environment in danger, but ultimately puts our communities and families directly in harm's way. We must work together, across the aisle, to confront the challenges that will be faced now and by the next generations, and our time is running out.

The San Joaquin Valley, my home and district I represent, has witnessed these devastating effects for far too long. Agriculture is a way of life in the Central Valley of California, which means so much more than just a farmer relying on water. There are multiple factors that rarely get mentioned such as monitoring the weather on a constant to better predict soil conditions for planting, watering, and ultimately harvesting a crop.

My district, California's 16th District, produces half of the nation's fruits and vegetables. The other half is exported across the world, helping feed the world, sustaining California's economy, and ultimately providing income for a family.

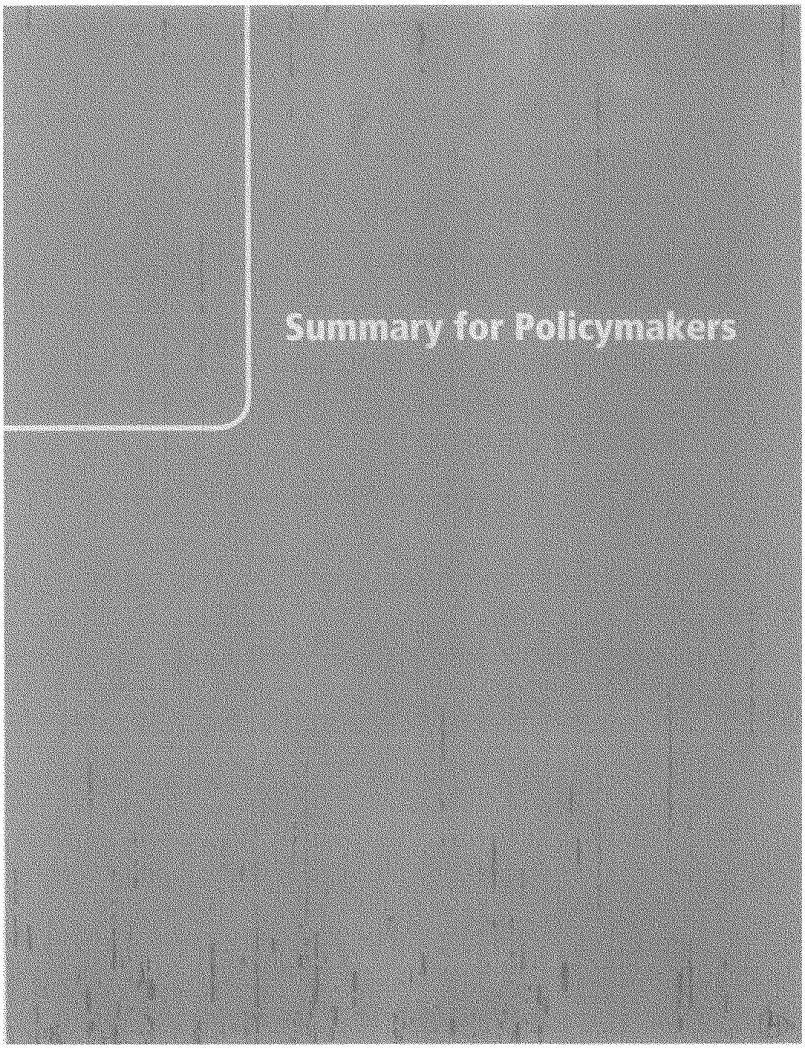
While California has taken a leading role in confronting climate change by adopting policies that transition the state's energy sector towards more renewable and sustainable sources, incentivizing low-carbon and zero-emission vehicles, and investing in new infrastructure.

I have said this before, and I will say it again: mitigating and adapting to the effects of climate change will require a multi-pronged approach at all levels -- state, local, federal, and globally. This means continued efforts at all levels of government, requiring all voices to be heard as there is no one silver bullet solutions that solves everything.

The United States as a nation has an obligation to set an example of what it means to live sustainably. We must continue to strive towards sustainable solutions for all in an equal, and fair way.

As today's testimony has reminded us, the most devastating effects of climate change will impact the young and the generations yet to come the most. I refuse to sit by and do nothing. For years in California and in Washington I have worked on meaningful solutions to address climate change, and that will continue.

ADDITIONAL MATERIALS SUBMITTED FOR THE RECORD



SPM

Summary for Policymakers

Drafting Authors:
Myles Allen (UK), Mustafa Babiker (Sudan), Yang Chen (China), Heleen de Coninck (Netherlands/EU), Sarah Connors (UK), Renée van Diemen (Netherlands), Opha Pauline Dube (Botswana), Kristie L. Ebi (USA), Francois Engelbrecht (South Africa), Marion Ferrat (UK/France), James Ford (UK/Canada), Piers Forster (UK), Sabine Fuss (Germany), Tania Guillén Bolaños (Germany/Nicaragua), Jordan Harold (UK), Ove Hoegh-Guldberg (Australia), Jean-Charles Hourcade (France), Daniel Huppmann (Austria), Daniela Jacob (Germany), Kejun Jiang (China), Tom Gabriel Johansen (Norway), Mikiko Kainuma (Japan), Kiane de Kleijne (Netherlands/EU), Elmar Kriegler (Germany), Debora Ley (Guatemala/Mexico), Diana Liverman (USA), Natalie Mahowald (USA), Valérie Masson-Delmotte (France), J. B. Robin Matthews (UK), Richard Millar (UK), Katja Mintenbeck (Germany), Angela Morelli (Norway/Italy), Wilfran Moufouma-Okia (France/Congo), Luis Mundaca (Sweden/Chile), Maike Nicolai (Germany), Chukwumerije Okereke (UK/Nigeria), Minal Pathak (India), Antony Payne (UK), Roz Pidcock (UK), Anna Pirani (Italy), Elvira Poloczanska (UK/Australia), Hans-Otto Pörtner (Germany), Aromar Revi (India), Keywan Riahi (Austria), Debra C. Roberts (South Africa), Joeri Rogelj (Austria/Belgium), Joyashree Roy (India), Sonia I. Seneviratne (Switzerland), Priyadarshi R. Shukla (India), James Skea (UK), Raphael Slade (UK), Drew Shindell (USA), Chandni Singh (India), William Solecki (USA), Linda Steg (Netherlands), Michael Taylor (Jamaica), Petra Tschakert (Australia/Austria), Henri Waisman (France), Rachel Warren (UK), Panmao Zhai (China), Kirsten Zickfeld (Canada).

This Summary for Policymakers should be cited as:
IPCC, 2018: Summary for Policymakers. 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* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Introduction

This Report responds to the invitation for IPCC '... to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways' contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement.[1]

The IPCC accepted the invitation in April 2016, deciding to prepare this 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.

This Summary for Policymakers (SPM) presents the key findings of the Special Report, based on the assessment of the available scientific, technical and socio-economic literature[2] relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above pre-industrial levels. The level of confidence associated with each key finding is reported using the IPCC calibrated language.[3] The underlying scientific basis of each key finding is indicated by references provided to chapter elements. In the SPM, knowledge gaps are identified associated with the underlying chapters of the Report.

A. Understanding Global Warming of 1.5°C[4]

A.1 Human activities are estimated to have caused approximately 1.0°C of global warming[5] above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (*high confidence*) (Figure SPM.1) {1.2}

A.1.1 Reflecting the long-term warming trend since pre-industrial times, observed global mean surface temperature (GMST) for the decade 2006–2015 was 0.87°C (*likely* between 0.75°C and 0.99°C)[6] higher than the average over the 1850–1900 period (*very high confidence*). Estimated anthropogenic global warming matches the level of observed warming to within ±20% (*likely range*). Estimated anthropogenic global warming is currently increasing at 0.2°C (*likely* between 0.1°C and 0.3°C) per decade due to past and ongoing emissions (*high confidence*). {1.2.1, Table 1.1, 1.2.4}

A.1.2 Warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic. Warming is generally higher over land than over the ocean. (*high confidence*) {1.2.1, 1.2.2, Figure 1.1, Figure 1.3, 3.3.1, 3.3.2}

A.1.3 Trends in intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred (*medium confidence*). This assessment is based on several lines of evidence, including attribution studies for changes in extremes since 1950. {3.3.1, 3.3.2, 3.3.3}

---

1 Decision 1/CP.21, paragraph 21.

2 The assessment covers literature accepted for publication by 15 May 2018.

3 Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or a result: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%, more likely than not >50–100%, more unlikely than likely 0–<50%, extremely unlikely 0–5%) may also be used when appropriate. Assessed likelihood is typeset in italics, for example, *very likely*. This is consistent with AR5.

4 See also Box SPM.1: Core Concepts Central to this Special Report.

5 Present level of global warming is defined as the average of a 30-year period centred on 2017 assuming the recent rate of warming continues.

6 This range spans the four available peer-reviewed estimates of the observed GMST change and also accounts for additional uncertainty due to possible short-term natural variability. {1.2.1, Table 1.1}

A.2 Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (*high confidence*), but these emissions alone are *unlikely* to cause global warming of 1.5°C (*medium confidence*). (Figure SPM.1) {1.2, 3.3, Figure 1.5}

A.2.1 Anthropogenic emissions (including greenhouse gases, aerosols and their precursors) up to the present are *unlikely* to cause further warming of more than 0.5°C over the next two to three decades (*high confidence*) or on a century time scale (*medium confidence*). {1.2.4, Figure 1.5}

A.2.2 Reaching and sustaining net zero global anthropogenic CO_2 emissions and declining net non-CO_2 radiative forcing would halt anthropogenic global warming on multi-decadal time scales (*high confidence*). The maximum temperature reached is then determined by cumulative net global anthropogenic CO_2 emissions up to the time of net zero CO_2 emissions (*high confidence*) and the level of non-CO_2 radiative forcing in the decades prior to the time that maximum temperatures are reached (*medium confidence*). On longer time scales, sustained net negative global anthropogenic CO_2 emissions and/or further reductions in non-CO_2 radiative forcing may still be required to prevent further warming due to Earth system feedbacks and to reverse ocean acidification (*medium confidence*) and will be required to minimize sea level rise (*high confidence*). {Cross-Chapter Box 2 in Chapter 1, 1.2.3, 1.2.4, Figure 1.4, 2.2.1, 2.2.2, 3.4.4.8, 3.4.5.1, 3.6.3.2}

A.3 Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (*high confidence*). (Figure SPM.2) {1.3, 3.3, 3.4, 5.6}

A.3.1 Impacts on natural and human systems from global warming have already been observed (*high confidence*). Many land and ocean ecosystems and some of the services they provide have already changed due to global warming (*high confidence*). (Figure SPM.2) {1.4, 3.4, 3.5}

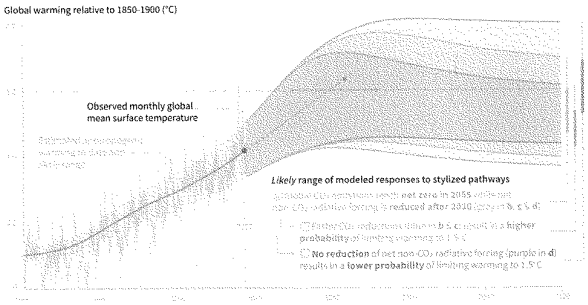
A.3.2 Future climate-related risks depend on the rate, peak and duration of warming. In the aggregate, they are larger if global warming exceeds 1.5°C before returning to that level by 2100 than if global warming gradually stabilizes at 1.5°C, especially if the peak temperature is high (e.g., about 2°C) (*high confidence*). Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems (*high confidence*). {3.2, 3.4.4, 3.6.3, Cross-Chapter Box 8 in Chapter 3}

A.3.3 Adaptation and mitigation are already occurring (*high confidence*). Future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multilevel and cross-sectoral climate mitigation and by both incremental and transformational adaptation (*high confidence*). {1.2, 1.3, Table 3.5, 4.2.2, Cross-Chapter Box 9 in Chapter 4, Box 4.2, Box 4.3, Box 4.6, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.1, 4.4.4, 4.4.5, 4.5.3}

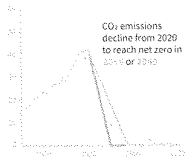
SPM

Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

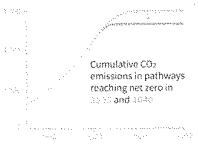
a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways



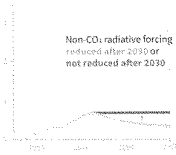
b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)



c) Cumulative net CO_2 emissions
Billion tonnes CO_2 ($GtCO_2$)



d) Non-CO_2 radiative forcing pathways
Watts per square metre (W/m^2)



Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions shown in panel (**c**).

Maximum temperature rise is determined by cumulative net CO_2 emissions and net non-CO_2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

Figure SPM.1 | Panel a: Observed monthly global mean surface temperature (GMST, grey line up to 2017, from the HadCRUT4, GISTEMP, Cowtan–Way, and NOAA datasets) change and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading indicating assessed *likely* range). Orange dashed arrow and horizontal orange error bar show respectively the central estimate and *likely* range of the time at which 1.5°C is reached if the current rate of warming continues. The grey plume on the right of panel a shows the *likely* range of warming responses, computed with a simple climate model, to a stylized pathway (hypothetical future) in which net CO_2 emissions (grey line in panels b and c) decline in a straight line from 2020 to reach net zero in 2055 and net non-CO_2 radiative forcing (grey line in panel d) increases to 2030 and then declines. The blue plume in panel a) shows the response to faster CO_2 emissions reductions (blue line in panel b), reaching net zero in 2040, reducing cumulative CO_2 emissions (panel c). The purple plume shows the response to net CO_2 emissions declining to zero in 2055, with net non-CO_2 forcing remaining constant after 2030. The vertical error bars on right of panel a) show the *likely* ranges (thin lines) and central terciles (33rd – 66th percentiles, thick lines) of the estimated distribution of warming in 2100 under these three stylized pathways. Vertical dotted error bars in panels b, c and d show the *likely* range of historical annual and cumulative global net CO_2 emissions in 2017 (data from the Global Carbon Project) and of net non-CO_2 radiative forcing in 2011 from AR5, respectively. Vertical axes in panels c and d are scaled to represent approximately equal effects on GMST. {1.2.1, 1.2.3, 1.2.4, 2.3, Figure 1.2 and Chapter 1 Supplementary Material, Cross-Chapter Box 2 in Chapter 1}

B. Projected Climate Change, Potential Impacts and Associated Risks

B.1 Climate models project robust[7] differences in regional climate characteristics between present-day and global warming of 1.5°C,[8] and between 1.5°C and 2°C.[8] These differences include increases in: mean temperature in most land and ocean regions (*high confidence*), hot extremes in most inhabited regions (*high confidence*), heavy precipitation in several regions (*medium confidence*), and the probability of drought and precipitation deficits in some regions (*medium confidence*). {3.3}

B.1.1 Evidence from attributed changes in some climate and weather extremes for a global warming of about 0.5°C supports the assessment that an additional 0.5°C of warming compared to present is associated with further detectable changes in these extremes (*medium confidence*). Several regional changes in climate are assessed to occur with global warming up to 1.5°C compared to pre-industrial levels, including warming of extreme temperatures in many regions (*high confidence*), increases in frequency, intensity, and/or amount of heavy precipitation in several regions (*high confidence*), and an increase in intensity or frequency of droughts in some regions (*medium confidence*). {3.2, 3.3.1, 3.3.2, 3.3.3, 3.3.4, Table 3.2}

B.1.2 Temperature extremes on land are projected to warm more than GMST (*high confidence*): extreme hot days in mid-latitudes warm by up to about 3°C at global warming of 1.5°C and about 4°C at 2°C, and extreme cold nights in high latitudes warm by up to about 4.5°C at 1.5°C and about 6°C at 2°C (*high confidence*). The number of hot days is projected to increase in most land regions, with highest increases in the tropics (*high confidence*). {3.3.1, 3.3.2, Cross-Chapter Box 8 in Chapter 3}

B.1.3 Risks from droughts and precipitation deficits are projected to be higher at 2°C compared to 1.5°C of global warming in some regions (*medium confidence*). Risks from heavy precipitation events are projected to be higher at 2°C compared to 1.5°C of global warming in several northern hemisphere high-latitude and/or high-elevation regions, eastern Asia and eastern North America (*medium confidence*). Heavy precipitation associated with tropical cyclones is projected to be higher at 2°C compared to 1.5°C global warming (*medium confidence*). There is generally *low confidence* in projected changes in heavy precipitation at 2°C compared to 1.5°C in other regions. Heavy precipitation when aggregated at global scale is projected to be higher at 2°C than at 1.5°C of global warming (*medium confidence*). As a consequence of heavy precipitation, the fraction of the global land area affected by flood hazards is projected to be larger at 2°C compared to 1.5°C of global warming (*medium confidence*). {3.3.1, 3.3.3, 3.3.4, 3.3.5, 3.3.6}

B.2 By 2100, global mean sea level rise is projected to be around 0.1 metre lower with global warming of 1.5°C compared to 2°C (*medium confidence*). Sea level will continue to rise well beyond 2100 (*high confidence*), and the magnitude and rate of this rise depend on future emission pathways. A slower rate of sea level rise enables greater opportunities for adaptation in the human and ecological systems of small islands, low-lying coastal areas and deltas (*medium confidence*). {3.3, 3.4, 3.6}

B.2.1 Model-based projections of global mean sea level rise (relative to 1986–2005) suggest an indicative range of 0.26 to 0.77 m by 2100 for 1.5°C of global warming, 0.1 m (0.04–0.16 m) less than for a global warming of 2°C (*medium confidence*). A reduction of 0.1 m in global sea level rise implies that up to 10 million fewer people would be exposed to related risks, based on population in the year 2010 and assuming no adaptation (*medium confidence*). {3.4.4, 3.4.5, 4.3.2}

B.2.2 Sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century (*high confidence*). Marine ice sheet instability in Antarctica and/or irreversible loss of the Greenland ice sheet could result in multi-metre rise in sea level over hundreds to thousands of years. These instabilities could be triggered at around 1.5°C to 2°C of global warming (*medium confidence*). (Figure SPM.2) {3.3.9, 3.4.5, 3.5.2, 3.6.3, Box 3.3}

---

7 Robust is here used to mean that at least two thirds of climate models show the same sign of changes at the grid point scale, and that differences in large regions are statistically significant.

8 Projected changes in impacts between different levels of global warming are determined with respect to changes in global mean surface air temperature.

B.2.3 Increasing warming amplifies the exposure of small islands, low-lying coastal areas and deltas to the risks associated with sea level rise for many human and ecological systems, including increased saltwater intrusion, flooding and damage to infrastructure (*high confidence*). Risks associated with sea level rise are higher at 2°C compared to 1.5°C. The slower rate of sea level rise at global warming of 1.5°C reduces these risks, enabling greater opportunities for adaptation including managing and restoring natural coastal ecosystems and infrastructure reinforcement (*medium confidence*). {Figure SPM.2} {3.4.5, Box 3.5}

B.3 On land, impacts on biodiversity and ecosystems, including species loss and extinction, are projected to be lower at 1.5°C of global warming compared to 2°C. Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans (*high confidence*). {Figure SPM.2} {3.4, 3.5, Box 3.4, Box 4.2, Cross-Chapter Box 8 in Chapter 3}

B.3.1 Of 105,000 species studied,[9] 6% of insects, 8% of plants and 4% of vertebrates are projected to lose over half of their climatically determined geographic range for global warming of 1.5°C, compared with 18% of insects, 16% of plants and 8% of vertebrates for global warming of 2°C (*medium confidence*). Impacts associated with other biodiversity-related risks such as forest fires and the spread of invasive species are lower at 1.5°C compared to 2°C of global warming (*high confidence*). {3.4.3, 3.5.2}

B.3.2 Approximately 4% (interquartile range 2–7%) of the global terrestrial land area is projected to undergo a transformation of ecosystems from one type to another at 1°C of global warming, compared with 13% (interquartile range 8–20%) at 2°C (*medium confidence*). This indicates that the area at risk is projected to be approximately 50% lower at 1.5°C compared to 2°C (*medium confidence*). {3.4.3.1, 3.4.3.5}

B.3.3 High-latitude tundra and boreal forests are particularly at risk of climate change-induced degradation and loss, with woody shrubs already encroaching into the tundra (*high confidence*) and this will proceed with further warming. Limiting global warming to 1.5°C rather than 2°C is projected to prevent the thawing over centuries of a permafrost area in the range of 1.5 to 2.5 million km^2 (*medium confidence*). {3.3.2, 3.4.3, 3.5.5}

B.4 Limiting global warming to 1.5°C compared to 2°C is projected to reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels (*high confidence*). Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans, as illustrated by recent changes to Arctic sea ice and warm-water coral reef ecosystems (*high confidence*). {3.3, 3.4, 3.5, Box 3.4, Box 3.5}

B.4.1 There is *high confidence* that the probability of a sea ice-free Arctic Ocean during summer is substantially lower at global warming of 1.5°C when compared to 2°C. With 1.5°C of global warming, one sea ice-free Arctic summer is projected per century. This likelihood is increased to at least one per decade with 2°C global warming. Effects of a temperature overshoot are reversible for Arctic sea ice cover on decadal time scales (*high confidence*). {3.3.8, 3.4.4.7}

B.4.2 Global warming of 1.5°C is projected to shift the ranges of many marine species to higher latitudes as well as increase the amount of damage to many ecosystems. It is also expected to drive the loss of coastal resources and reduce the productivity of fisheries and aquaculture (especially at low latitudes). The risks of climate-induced impacts are projected to be higher at 2°C than those at global warming of 1.5°C (*high confidence*). Coral reefs, for example, are projected to decline by a further 70–90% at 1.5°C (*high confidence*) with larger losses (>99%) at 2°C (*very high confidence*). The risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or more (*high confidence*). {3.4.4, Box 3.4}

9 Consistent with earlier studies, illustrative numbers were adopted from one recent meta-study.

B.4.3 The level of ocean acidification due to increasing CO_2 concentrations associated with global warming of 1.5°C is projected to amplify the adverse effects of warming, and even further at 2°C, impacting the growth, development, calcification, survival, and thus abundance of a broad range of species, for example, from algae to fish (*high confidence*). {3.3.10, 3.4.4}

B.4.4 Impacts of climate change in the ocean are increasing risks to fisheries and aquaculture via impacts on the physiology, survivorship, habitat, reproduction, disease incidence, and risk of invasive species (*medium confidence*) but are projected to be less at 1.5°C of global warming than at 2°C. One global fishery model, for example, projected a decrease in global annual catch for marine fisheries of about 1.5 million tonnes for 1.5°C of global warming compared to a loss of more than 3 million tonnes for 2°C of global warming (*medium confidence*). {3.4.4, Box 3.4}

B.5 Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C. (Figure SPM.2) {3.4, 3.5, 5.2, Box 3.2, Box 3.3, Box 3.5, Box 3.6, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 5.2}

B.5.1 Populations at disproportionately higher risk of adverse consequences with global warming of 1.5°C and beyond include disadvantaged and vulnerable populations, some indigenous peoples, and local communities dependent on agricultural or coastal livelihoods (*high confidence*). Regions at disproportionately higher risk include Arctic ecosystems, dryland regions, small island developing states, and Least Developed Countries (*high confidence*). Poverty and disadvantage are expected to increase in some populations as global warming increases; limiting global warming to 1.5°C, compared with 2°C, could reduce the number of people both exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050 (*medium confidence*). {3.4.10, 3.4.11, Box 3.5, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 4.2.2.2, 5.2.1, 5.2.2, 5.2.3, 5.6.3}

B.5.2 Any increase in global warming is projected to affect human health, with primarily negative consequences (*high confidence*). Lower risks are projected at 1.5°C than at 2°C for heat-related morbidity and mortality (*very high confidence*) and for ozone-related mortality if emissions needed for ozone formation remain high (*high confidence*). Urban heat islands often amplify the impacts of heatwaves in cities (*high confidence*). Risks from some vector-borne diseases, such as malaria and dengue fever, are projected to increase with warming from 1.5°C to 2°C, including potential shifts in their geographic range (*high confidence*). {3.4.7, 3.4.8, 3.5.5.8}

B.5.3 Limiting warming to 1.5°C compared with 2°C is projected to result in smaller net reductions in yields of maize, rice, wheat, and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America, and in the CO_2-dependent nutritional quality of rice and wheat (*high confidence*). Reductions in projected food availability are larger at 2°C than at 1.5°C of global warming in the Sahel, southern Africa, the Mediterranean, central Europe, and the Amazon (*medium confidence*). Livestock are projected to be adversely affected with rising temperatures, depending on the extent of changes in feed quality, spread of diseases, and water resource availability (*high confidence*). {3.4.6, 3.5.4, 3.5.5, Box 3.1, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4}

B.5.4 Depending on future socio-economic conditions, limiting global warming to 1.5°C compared to 2°C may reduce the proportion of the world population exposed to a climate change-induced increase in water stress by up to 50%, although there is considerable variability between regions (*medium confidence*). Many small island developing states could experience lower water stress as a result of projected changes in aridity when global warming is limited to 1.5°C, as compared to 2°C (*medium confidence*). {3.3.5, 3.4.2, 3.4.8, 3.5.5, Box 3.2, Box 3.5, Cross-Chapter Box 9 in Chapter 4}

B.5.5 Risks to global aggregated economic growth due to climate change impacts are projected to be lower at 1.5°C than at 2°C by the end of this century[10] (*medium confidence*). This excludes the costs of mitigation, adaptation investments and the benefits of adaptation. Countries in the tropics and Southern Hemisphere subtropics are projected to experience the largest impacts on economic growth due to climate change should global warming increase from 1.5°C to 2°C (*medium confidence*). {3.5.2, 3.5.3}

10 Here, impacts on economic growth refer to changes in gross domestic product (GDP). Many impacts, such as loss of human lives, cultural heritage and ecosystem services, are difficult to value and monetize.

B.5.6 Exposure to multiple and compound climate-related risks increases between 1.5°C and 2°C of global warming, with greater proportions of people both so exposed and susceptible to poverty in Africa and Asia (*high confidence*). For global warming from 1.5°C to 2°C, risks across energy, food, and water sectors could overlap spatially and temporally, creating new and exacerbating current hazards, exposures, and vulnerabilities that could affect increasing numbers of people and regions (*medium confidence*). {Box 3.5, 3.3.1, 3.4.5.3, 3.4.5.6, 3.4.11, 3.5.4.9}

B.5.7 There are multiple lines of evidence that since AR5 the assessed levels of risk increased for four of the five Reasons for Concern (RFCs) for global warming to 2°C (*high confidence*). The risk transitions by degrees of global warming are now: from high to very high risk between 1.5°C and 2°C for RFC1 (Unique and threatened systems) (*high confidence*); from moderate to high risk between 1°C and 1.5°C for RFC2 (Extreme weather events) (*medium confidence*); from moderate to high risk between 1.5°C and 2°C for RFC3 (Distribution of impacts) (*high confidence*); from moderate to high risk between 1.5°C and 2.5°C for RFC4 (Global aggregate impacts) (*medium confidence*); and from moderate to high risk between 1°C and 2.5°C for RFC5 (Large-scale singular events) (*medium confidence*). {Figure SPM.2} {3.4.13; 3.5, 3.5.2}

B.6 Most adaptation needs will be lower for global warming of 1.5°C compared to 2°C (*high confidence*). There are a wide range of adaptation options that can reduce the risks of climate change (*high confidence*). There are limits to adaptation and adaptive capacity for some human and natural systems at global warming of 1.5°C, with associated losses (*medium confidence*). The number and availability of adaptation options vary by sector (*medium confidence*). {Table 3.5, 4.3, 4.5, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5}

B.6.1 A wide range of adaptation options are available to reduce the risks to natural and managed ecosystems (e.g., ecosystem-based adaptation, ecosystem restoration and avoided degradation and deforestation, biodiversity management, sustainable aquaculture, and local knowledge and indigenous knowledge), the risks of sea level rise (e.g., coastal defence and hardening), and the risks to health, livelihoods, food, water, and economic growth, especially in rural landscapes (e.g., efficient irrigation, social safety nets, disaster risk management, risk spreading and sharing, and community-based adaptation) and urban areas (e.g., green infrastructure, sustainable land use and planning, and sustainable water management) (*medium confidence*). {4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.5.3, 4.5.4, 5.3.2, Box 4.2, Box 4.3, Box 4.6, Cross-Chapter Box 9 in Chapter 4}.

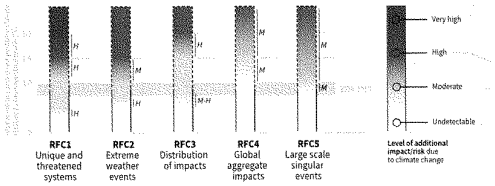
B.6.2 Adaptation is expected to be more challenging for ecosystems, food and health systems at 2°C of global warming than for 1.5°C (*medium confidence*). Some vulnerable regions, including small islands and Least Developed Countries, are projected to experience high multiple interrelated climate risks even at global warming of 1.5°C (*high confidence*). {3.3.1, 3.4.5, Box 3.5, Table 3.5, Cross-Chapter Box 9 in Chapter 4, 5.6, Cross-Chapter Box 12 in Chapter 5, Box 5.3}

B.6.3 Limits to adaptive capacity exist at 1.5°C of global warming, become more pronounced at higher levels of warming and vary by sector, with site-specific implications for vulnerable regions, ecosystems and human health (*medium confidence*). {Cross-Chapter Box 12 in Chapter 5, Box 3.5, Table 3.5}

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

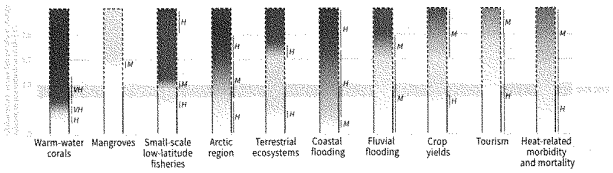
Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)



Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.
Red indicates severe and widespread impacts/risks.
Yellow indicates that impacts/risks are detectable and attributable to climate change with at least medium confidence.
White indicates that no impacts are detectable and attributable to climate change.

Impacts and risks for selected natural, managed and human systems



Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high

Figure SPM.2 | Five integrative reasons for concern (RFCs) provide a framework for summarizing key impacts and risks across sectors and regions, and were introduced in the IPCC Third Assessment Report. RFCs illustrate the implications of global warming for people, economies and ecosystems. Impacts and/or risks for each RFC are based on assessment of the new literature that has appeared. As in AR5, this literature was used to make expert judgments to assess the levels of global warming at which levels of impact and/or risk are undetectable, moderate, high or very high. The selection of impacts and risks to natural, managed and human systems in the lower panel is illustrative and is not intended to be fully comprehensive. {3.4, 3.5, 3.5.2.1, 3.5.2.2, 3.5.2.3, 3.5.2.4, 3.5.2.5, 5.4.1, 5.5.3, 5.6.1, Box 3.4}

RFC1 Unique and threatened systems: ecological and human systems that have restricted geographic ranges constrained by climate-related conditions and have high endemism or other distinctive properties. Examples include coral reefs, the Arctic and its indigenous people, mountain glaciers and biodiversity hotspots.

RFC2 Extreme weather events: risks/impacts to human health, livelihoods, assets and ecosystems from extreme weather events such as heat waves, heavy rain, drought and associated wildfires, and coastal flooding.

RFC3 Distribution of impacts: risks/impacts that disproportionately affect particular groups due to uneven distribution of physical climate change hazards, exposure or vulnerability.

RFC4 Global aggregate impacts: global monetary damage, global-scale degradation and loss of ecosystems and biodiversity.

RFC5 Large-scale singular events: are relatively large, abrupt and sometimes irreversible changes in systems that are caused by global warming. Examples include disintegration of the Greenland and Antarctic ice sheets.

C. Emission Pathways and System Transitions Consistent with 1.5°C Global Warming

C.1 In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range). For limiting global warming to below 2°C[11] CO_2 emissions are projected to decline by about 25% by 2030 in most pathways (10–30% interquartile range) and reach net zero around 2070 (2065–2080 interquartile range). Non-CO_2 emissions in pathways that limit global warming to 1.5°C show deep reductions that are similar to those in pathways limiting warming to 2°C. (*high confidence*) (Figure SPM.3a) {2.1, 2.3, Table 2.4}

C.1.1 CO_2 emissions reductions that limit global warming to 1.5°C with no or limited overshoot can involve different portfolios of mitigation measures, striking different balances between lowering energy and resource intensity, rate of decarbonization, and the reliance on carbon dioxide removal. Different portfolios face different implementation challenges and potential synergies and trade-offs with sustainable development. (*high confidence*) (Figure SPM.3b) {2.3.2, 2.3.4, 2.4, 2.5.3}

C.1.2 Modelled pathways that limit global warming to 1.5°C with no or limited overshoot involve deep reductions in emissions of methane and black carbon (35% or more of both by 2050 relative to 2010). These pathways also reduce most of the cooling aerosols, which partially offsets mitigation effects for two to three decades. Non-CO_2 emissions[12] can be reduced as a result of broad mitigation measures in the energy sector. In addition, targeted non-CO_2 mitigation measures can reduce nitrous oxide and methane from agriculture, methane from the waste sector, some sources of black carbon, and hydrofluorocarbons. High bioenergy demand can increase emissions of nitrous oxide in some 1.5°C pathways, highlighting the importance of appropriate management approaches. Improved air quality resulting from projected reductions in many non-CO_2 emissions provide direct and immediate population health benefits in all 1.5°C model pathways. (*high confidence*) (Figure SPM.3a) {2.2.1, 2.3.3, 2.4.4, 2.5.3, 4.3.6, 5.4.2}

C.1.3 Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO_2 since the pre-industrial period, that is, staying within a total carbon budget (*high confidence*).[13] By the end of 2017, anthropogenic CO_2 emissions since the pre-industrial period are estimated to have reduced the total carbon budget for 1.5°C by approximately 2200 ± 320 $GtCO_2$ (*medium confidence*). The associated remaining budget is being depleted by current emissions of 42 ± 3 $GtCO_2$ per year (*high confidence*). The choice of the measure of global temperature affects the estimated remaining carbon budget. Using global mean surface air temperature, as in AR5, gives an estimate of the remaining carbon budget of 580 $GtCO_2$ for a 50% probability of limiting warming to 1.5°C, and 420 $GtCO_2$ for a 66% probability (*medium confidence*).[14] Alternatively, using GMST gives estimates of 770 and 570 $GtCO_2$, for 50% and 66% probabilities,[15] respectively (*medium confidence*). Uncertainties in the size of these estimated remaining carbon budgets are substantial and depend on several factors. Uncertainties in the climate response to CO_2 and non-CO_2 emissions contribute ±400 $GtCO_2$ and the level of historic warming contributes ±250 $GtCO_2$ (*medium confidence*). Potential additional carbon release from future permafrost thawing and methane release from wetlands would reduce budgets by up to 100 $GtCO_2$ over the course of this century and more thereafter (*medium confidence*). In addition, the level of non-CO_2 mitigation in the future could alter the remaining carbon budget by 250 $GtCO_2$ in either direction (*medium confidence*). {1.2.4, 2.2.2, 2.6.1, Table 2.2, Chapter 2 Supplementary Material}

C.1.4 Solar radiation modification (SRM) measures are not included in any of the available assessed pathways. Although some SRM measures may be theoretically effective in reducing an overshoot, they face large uncertainties and knowledge gaps

11 References to pathways limiting global warming to 2°C are based on a 66% probability of staying below 2°C.

12 Non-CO_2 emissions included in this Report are all anthropogenic emissions other than CO_2 that result in radiative forcing. These include short-lived climate forcers, such as methane, some fluorinated gases, ozone precursors, aerosols or aerosol precursors, such as black carbon and sulphur dioxide, respectively, as well as long-lived greenhouse gases, such as nitrous oxide or some fluorinated gases. The radiative forcing associated with non-CO_2 emissions and changes in surface albedo is referred to as non-CO_2 radiative forcing. {2.2.1}

13 There is a clear scientific basis for a total carbon budget consistent with limiting global warming to 1.5°C. However, neither this total carbon budget nor the fraction of this budget taken up by past emissions were assessed in this Report.

14 Irrespective of the measure of global temperature used, updated understanding and further advances in methods have led to an increase in the estimated remaining carbon budget of about 300 $GtCO_2$ compared to AR5. (*medium confidence*) {2.2.2}

15 These estimates use observed GMST to 2006–2015 and estimate future temperature changes using near surface air temperatures.

as well as substantial risks and institutional and social constraints to deployment related to governance, ethics, and impacts on sustainable development. They also do not mitigate ocean acidification. (*medium confidence*) {4.3.8, Cross-Chapter Box 10 in Chapter 4}

Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO_2, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM.3b.

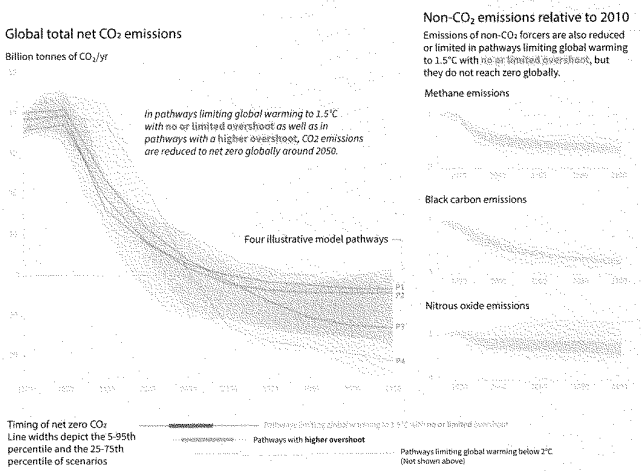


Figure SPM.3a | Global emissions pathway characteristics. The main panel shows global net anthropogenic CO_2 emissions in pathways limiting global warming to 1.5°C with no or limited (less than 0.1°C) overshoot and pathways with higher overshoot. The shaded area shows the full range for pathways analysed in this Report. The panels on the right show non-CO_2 emissions ranges for three compounds with large historical forcing and a substantial portion of emissions coming from sources distinct from those central to CO_2 mitigation. Shaded areas in these panels show the 5–95% (light shading) and interquartile (dark shading) ranges of pathways limiting global warming to 1.5°C with no or limited overshoot. Box and whiskers at the bottom of the figure show the timing of pathways reaching global net zero CO_2 emission levels, and a comparison with pathways limiting global warming to 2°C with at least 66% probability. Four illustrative model pathways are highlighted in the main panel and are labelled P1, P2, P3 and P4, corresponding to the LED, S1, S2, and S5 pathways assessed in Chapter 2. Descriptions and characteristics of these pathways are available in Figure SPM.3b. {2.1, 2.2, 2.3, Figure 2.5, Figure 2.10, Figure 2.11}

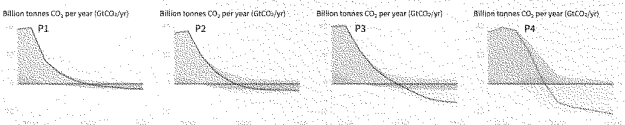
SPM

Characteristics of four illustrative model pathways

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limits global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector. This has implications for emissions and several other pathway characteristics.

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways

Fossil fuel and industry · AFOLU · BECCS



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Global indicators	P1	P2	P3	P4	**Interquartile range**
Pathway classification	No or limited overshoot	No or limited overshoot	No or limited overshoot	Higher overshoot	No or limited overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-58,-40)
in 2050 (% rel to 2010)	-93	-95	-91	-97	(-107,-94)
Kyoto-GHG emissions in 2030 (% rel to 2010)*	-50	-49	-35	-2	(-51,-39)
in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
*Final energy demand** in 2030 (% rel to 2010)*	-15	-5	17	39	(-12,7)
in 2050 (% rel to 2010)	-32	2	21	44	(-11,22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47,65)
in 2050 (%)	77	81	63	70	(69,86)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78,-59)
in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95,-74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
in 2050 (% rel to 2010)	-74	-53	21	-48	(-96,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(-29,80)
in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(245,436)
in 2050 (% rel to 2010)	833	1327	878	1137	(576,1299)
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550,1017)
of which BECCS ($GtCO_2$)	0	151	414	1191	(364,662)
Land area of bioenergy crops in 2050 (million km^2)	0.2	0.9	2.8	7.2	(1.5,3.2)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
in 2050 (% rel to 2010)	-33	-69	-23	2	(-47,-24)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,3)
in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

** Kyoto-gas emissions are based on IPCC Second Assessment Report GWP-100*
*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

Figure SPM.3b | Characteristics of four illustrative model pathways in relation to global warming of 1.5°C introduced in Figure SPM.3a. These pathways were selected to show a range of potential mitigation approaches and vary widely in their projected energy and land use, as well as their assumptions about future socio-economic developments, including economic and population growth, equity and sustainability. A breakdown of the global net anthropogenic CO_2 emissions into the contributions in terms of CO_2 emissions from fossil fuel and industry; agriculture, forestry and other land use (AFOLU); and bioenergy with carbon capture and storage (BECCS) is shown. AFOLU estimates reported here are not necessarily comparable with countries' estimates. Further characteristics for each of these pathways are listed below each pathway. These pathways illustrate relative global differences in mitigation strategies, but do not represent central estimates, national strategies, and do not indicate requirements. For comparison, the right-most column shows the interquartile ranges across pathways with no or limited overshoot of 1.5°C. Pathways P1, P2, P3 and P4 correspond to the LED, S1, S2 and S5 pathways assessed in Chapter 2 (Figure SPM.3a). {2.2.1, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.4.1, 2.4.2, 2.4.4, 2.5.3, Figure 2.5, Figure 2.6, Figure 2.9, Figure 2.10, Figure 2.11, Figure 2.14, Figure 2.15, Figure 2.16, Figure 2.17, Figure 2.24, Figure 2.25, Table 2.4, Table 2.6, Table 2.7, Table 2.9, Table 4.1}

C.2 Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (*high confidence*). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (*medium confidence*). {2.3, 2.4, 2.5, 4.2, 4.3, 4.4, 4.5}

C.2.1 Pathways that limit global warming to 1.5°C with no or limited overshoot show system changes that are more rapid and pronounced over the next two decades than in 2°C pathways (*high confidence*). The rates of system changes associated with limiting global warming to 1.5°C with no or limited overshoot have occurred in the past within specific sectors, technologies and spatial contexts, but there is no documented historic precedent for their scale (*medium confidence*). {2.3.3, 2.3.4, 2.4, 2.5, 4.2.1, 4.2.2, Cross-Chapter Box 11 in Chapter 4}

C.2.2 In energy systems, modelled global pathways (considered in the literature) limiting global warming to 1.5°C with no or limited overshoot (for more details see Figure SPM.3b) generally meet energy service demand with lower energy use, including through enhanced energy efficiency, and show faster electrification of energy end use compared to 2°C (*high confidence*). In 1.5°C pathways with no or limited overshoot, low-emission energy sources are projected to have a higher share, compared with 2°C pathways, particularly before 2050 (*high confidence*). In 1.5°C pathways with no or limited overshoot, renewables are projected to supply 70–85% (interquartile range) of electricity in 2050 (*high confidence*). In electricity generation, shares of nuclear and fossil fuels with carbon dioxide capture and storage (CCS) are modelled to increase in most 1.5°C pathways with no or limited overshoot. In modelled 1.5°C pathways with limited or no overshoot, the use of CCS would allow the electricity generation share of gas to be approximately 8% (3–11% interquartile range) of global electricity in 2050, while the use of coal shows a steep reduction in all pathways and would be reduced to close to 0% (0–2% interquartile range) of electricity (*high confidence*). While acknowledging the challenges, and differences between the options and national circumstances, political, economic, social and technical feasibility of solar energy, wind energy and electricity storage technologies have substantially improved over the past few years (*high confidence*). These improvements signal a potential system transition in electricity generation. (Figure SPM.3b) {2.4.1, 2.4.2, Figure 2.1, Table 2.6, Table 2.7, Cross-Chapter Box 6 in Chapter 3, 4.2.1, 4.3.1, 4.3.3, 4.5.2}

C.2.3 CO_2 emissions from industry in pathways limiting global warming to 1.5°C with no or limited overshoot are projected to be about 65–90% (interquartile range) lower in 2050 relative to 2010, as compared to 50–80% for global warming of 2°C (*medium confidence*). Such reductions can be achieved through combinations of new and existing technologies and practices, including electrification, hydrogen, sustainable bio-based feedstocks, product substitution, and carbon capture, utilization and storage (CCUS). These options are technically proven at various scales but their large-scale deployment may be limited by economic, financial, human capacity and institutional constraints in specific contexts, and specific characteristics of large-scale industrial installations. In industry, emissions reductions by energy and process efficiency by themselves are insufficient for limiting warming to 1.5°C with no or limited overshoot (*high confidence*). {2.4.3, 4.2.1, Table 4.1, Table 4.3, 4.3.3, 4.3.4, 4.5.2}

C.2.4 The urban and infrastructure system transition consistent with limiting global warming to 1.5°C with no or limited overshoot would imply, for example, changes in land and urban planning practices, as well as deeper emissions reductions in transport and buildings compared to pathways that limit global warming below 2°C (*medium confidence*). Technical measures

and practices enabling deep emissions reductions include various energy efficiency options. In pathways limiting global warming to 1.5°C with no or limited overshoot, the electricity share of energy demand in buildings would be about 55–75% in 2050 compared to 50–70% in 2050 for 2°C global warming (*medium confidence*). In the transport sector, the share of low-emission final energy would rise from less than 5% in 2020 to about 35–65% in 2050 compared to 25–45% for 2°C of global warming (*medium confidence*). Economic, institutional and socio-cultural barriers may inhibit these urban and infrastructure system transitions, depending on national, regional and local circumstances, capabilities and the availability of capital (*high confidence*). {2.3.4, 2.4.3, 4.2.1, Table 4.1, 4.3.3, 4.5.2}

C.2.5 Transitions in global and regional land use are found in all pathways limiting global warming to 1.5°C with no or limited overshoot, but their scale depends on the pursued mitigation portfolio. Model pathways that limit global warming to 1.5°C with no or limited overshoot project a 4 million km^2 reduction to a 2.5 million km^2 increase of non-pasture agricultural land for food and feed crops and a 0.5–11 million km^2 reduction of pasture land, to be converted into a 0–6 million km^2 increase of agricultural land for energy crops and a 2 million km^2 reduction to 9.5 million km^2 increase in forests by 2050 relative to 2010 (*medium confidence*).[16] Land-use transitions of similar magnitude can be observed in modelled 2°C pathways (*medium confidence*). Such large transitions pose profound challenges for sustainable management of the various demands on land for human settlements, food, livestock feed, fibre, bioenergy, carbon storage, biodiversity and other ecosystem services (*high confidence*). Mitigation options limiting the demand for land include sustainable intensification of land-use practices, ecosystem restoration and changes towards less resource-intensive diets (*high confidence*). The implementation of land-based mitigation options would require overcoming socio-economic, institutional, technological, financing and environmental barriers that differ across regions (*high confidence*). {2.4.4, Figure 2.24, 4.3.2, 4.3.7, 4.5.2, Cross-Chapter Box 7 in Chapter 3}

C.2.6 Additional annual average energy-related investments for the period 2016 to 2050 in pathways limiting warming to 1.5°C compared to pathways without new climate policies beyond those in place today are estimated to be around 830 billion USD2010 (range of 150 billion to 1700 billion USD2010 across six models[17]). This compares to total annual average energy supply investments in 1.5°C pathways of 1460 to 3510 billion USD2010 and total annual average energy demand investments of 640 to 910 billion USD2010 for the period 2016 to 2050. Total energy-related investments increase by about 12% (range of 3% to 24%) in 1.5°C pathways relative to 2°C pathways. Annual investments in low-carbon energy technologies and energy efficiency are upscaled by roughly a factor of six (range of factor of 4 to 10) by 2050 compared to 2015 (*medium confidence*). {2.5.2, Box 4.8, Figure 2.27}

C.2.7 Modelled pathways limiting global warming to 1.5°C with no or limited overshoot project a wide range of global average discounted marginal abatement costs over the 21st century. They are roughly 3-4 times higher than in pathways limiting global warming to below 2°C (*high confidence*). The economic literature distinguishes marginal abatement costs from total mitigation costs in the economy. The literature on total mitigation costs of 1.5°C mitigation pathways is limited and was not assessed in this Report. Knowledge gaps remain in the integrated assessment of the economy-wide costs and benefits of mitigation in line with pathways limiting warming to 1.5°C. {2.5.2; 2.6; Figure 2.26}

16 The projected land-use changes presented are not deployed to their upper limits simultaneously in a single pathway.

17 Including two pathways limiting warming to 1.5°C with no or limited overshoot and four pathways with higher overshoot.

C.3 All pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1000 $GtCO_2$ over the 21st century. CDR would be used to compensate for residual emissions and, in most cases, achieve net negative emissions to return global warming to 1.5°C following a peak (*high confidence*). CDR deployment of several hundreds of $GtCO_2$ is subject to multiple feasibility and sustainability constraints (*high confidence*). Significant near-term emissions reductions and measures to lower energy and land demand can limit CDR deployment to a few hundred $GtCO_2$ without reliance on bioenergy with carbon capture and storage (BECCS) (*high confidence*). {2.3, 2.4, 3.6.2, 4.3, 5.4}

C.3.1 Existing and potential CDR measures include afforestation and reforestation, land restoration and soil carbon sequestration, BECCS, direct air carbon capture and storage (DACCS), enhanced weathering and ocean alkalinization. These differ widely in terms of maturity, potentials, costs, risks, co-benefits and trade-offs (*high confidence*). To date, only a few published pathways include CDR measures other than afforestation and BECCS. {2.3.4, 3.6.2, 4.3.2, 4.3.7}

C.3.2 In pathways limiting global warming to 1.5°C with limited or no overshoot, BECCS deployment is projected to range from 0–1, 0–8, and 0–16 $GtCO_2\ yr^{-1}$ in 2030, 2050, and 2100, respectively, while agriculture, forestry and land-use (AFOLU) related CDR measures are projected to remove 0–5, 1–11, and 1–5 $GtCO_2\ yr^{-1}$ in these years (*medium confidence*). The upper end of these deployment ranges by mid-century exceeds the BECCS potential of up to 5 $GtCO_2\ yr^{-1}$ and afforestation potential of up to 3.6 $GtCO_2\ yr^{-1}$ assessed based on recent literature (*medium confidence*). Some pathways avoid BECCS deployment completely through demand-side measures and greater reliance on AFOLU-related CDR measures (*medium confidence*). The use of bioenergy can be as high or even higher when BECCS is excluded compared to when it is included due to its potential for replacing fossil fuels across sectors (*high confidence*). (Figure SPM.3b) {2.3.3, 2.3.4, 2.4.2, 3.6.2, 4.3.1, 4.2.3, 4.3.2, 4.3.7, 4.4.3, Table 2.4}

C.3.3 Pathways that overshoot 1.5°C of global warming rely on CDR exceeding residual CO_2 emissions later in the century to return to below 1.5°C by 2100, with larger overshoots requiring greater amounts of CDR (Figure SPM.3b) (*high confidence*). Limitations on the speed, scale, and societal acceptability of CDR deployment hence determine the ability to return global warming to below 1.5°C following an overshoot. Carbon cycle and climate system understanding is still limited about the effectiveness of net negative emissions to reduce temperatures after they peak (*high confidence*). {2.2, 2.3.4, 2.3.5, 2.6, 4.3.7, 4.5.2, Table 4.11}

C.3.4 Most current and potential CDR measures could have significant impacts on land, energy, water or nutrients if deployed at large scale (*high confidence*). Afforestation and bioenergy may compete with other land uses and may have significant impacts on agricultural and food systems, biodiversity, and other ecosystem functions and services (*high confidence*). Effective governance is needed to limit such trade-offs and ensure permanence of carbon removal in terrestrial, geological and ocean reservoirs (*high confidence*). Feasibility and sustainability of CDR use could be enhanced by a portfolio of options deployed at substantial, but lesser scales, rather than a single option at very large scale (*high confidence*). (Figure SPM.3b) {2.3.4, 2.4.4, 2.5.3, 2.6, 3.6.2, 4.3.2, 4.3.7, 4.5.2, 5.4.1, 5.4.2; Cross-Chapter Boxes 7 and 8 in Chapter 3, Table 4.11, Table 5.3, Figure 5.3}

C.3.5 Some AFOLU-related CDR measures such as restoration of natural ecosystems and soil carbon sequestration could provide co-benefits such as improved biodiversity, soil quality, and local food security. If deployed at large scale, they would require governance systems enabling sustainable land management to conserve and protect land carbon stocks and other ecosystem functions and services (*medium confidence*). (Figure SPM.4) {2.3.3, 2.3.4, 2.4.2, 2.4.4, 3.6.2, 5.4.1, Cross-Chapter Boxes 3 in Chapter 1 and 7 in Chapter 3, 4.3.2, 4.3.7, 4.4.1, 4.5.2, Table 2.4}

D. Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

D.1 Estimates of the global emissions outcome of current nationally stated mitigation ambitions as submitted under the Paris Agreement would lead to global greenhouse gas emissions[18] in 2030 of 52–58 $GtCO_2eq\ yr^{-1}$ (*medium confidence*). Pathways reflecting these ambitions would not limit global warming to 1.5°C, even if supplemented by very challenging increases in the scale and ambition of emissions reductions after 2030 (*high confidence*). Avoiding overshoot and reliance on future large-scale deployment of carbon dioxide removal (CDR) can only be achieved if global CO_2 emissions start to decline well before 2030 (*high confidence*). {1.2, 2.3, 3.3, 3.4, 4.2, 4.4, Cross-Chapter Box 11 in Chapter 4}

D.1.1 Pathways that limit global warming to 1.5°C with no or limited overshoot show clear emission reductions by 2030 (*high confidence*). All but one show a decline in global greenhouse gas emissions to below 35 $GtCO_2eq\ yr^{-1}$ in 2030, and half of available pathways fall within the 25–30 $GtCO_2eq\ yr^{-1}$ range (interquartile range), a 40–50% reduction from 2010 levels (*high confidence*). Pathways reflecting current nationally stated mitigation ambition until 2030 are broadly consistent with cost-effective pathways that result in a global warming of about 3°C by 2100, with warming continuing afterwards (*medium confidence*). {2.3.3, 2.3.5, Cross-Chapter Box 11 in Chapter 4, 5.5.3.2}

D.1.2 Overshoot trajectories result in higher impacts and associated challenges compared to pathways that limit global warming to 1.5°C with no or limited overshoot (*high confidence*). Reversing warming after an overshoot of 0.2°C or larger during this century would require upscaling and deployment of CDR at rates and volumes that might not be achievable given considerable implementation challenges (*medium confidence*). {1.3.3, 2.3.4, 2.3.5, 2.5.1, 3.3, 4.3.7, Cross-Chapter Box 8 in Chapter 3, Cross-Chapter Box 11 in Chapter 4}

D.1.3 The lower the emissions in 2030, the lower the challenge in limiting global warming to 1.5°C after 2030 with no or limited overshoot (*high confidence*). The challenges from delayed actions to reduce greenhouse gas emissions include the risk of cost escalation, lock-in in carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options in the medium to long term (*high confidence*). These may increase uneven distributional impacts between countries at different stages of development (*medium confidence*). {2.3.5, 4.4.5, 5.4.2}

D.2 The avoided climate change impacts on sustainable development, eradication of poverty and reducing inequalities would be greater if global warming were limited to 1.5°C rather than 2°C, if mitigation and adaptation synergies are maximized while trade-offs are minimized (*high confidence*). {1.1, 1.4, 2.5, 3.3, 3.4, 5.2, Table 5.1}

D.2.1 Climate change impacts and responses are closely linked to sustainable development which balances social well-being, economic prosperity and environmental protection. The United Nations Sustainable Development Goals (SDGs), adopted in 2015, provide an established framework for assessing the links between global warming of 1.5°C or 2°C and development goals that include poverty eradication, reducing inequalities, and climate action. (*high confidence*) {Cross-Chapter Box 4 in Chapter 1, 1.4, 5.1}

D.2.2 The consideration of ethics and equity can help address the uneven distribution of adverse impacts associated with 1.5°C and higher levels of global warming, as well as those from mitigation and adaptation, particularly for poor and disadvantaged populations, in all societies (*high confidence*). {1.1.1, 1.1.2, 1.4.3, 2.5.3, 3.4.10, 5.1, 5.2, 5.3. 5.4, Cross-Chapter Box 4 in Chapter 1, Cross-Chapter Boxes 6 and 8 in Chapter 3, and Cross-Chapter Box 12 in Chapter 5}

D.2.3 Mitigation and adaptation consistent with limiting global warming to 1.5°C are underpinned by enabling conditions, assessed in this Report across the geophysical, environmental-ecological, technological, economic, socio-cultural and institutional

18 GHG emissions have been aggregated with 100-year GWP values as introduced in the IPCC Second Assessment Report.

dimensions of feasibility. Strengthened multilevel governance, institutional capacity, policy instruments, technological innovation and transfer and mobilization of finance, and changes in human behaviour and lifestyles are enabling conditions that enhance the feasibility of mitigation and adaptation options for 1.5°C-consistent systems transitions. (*high confidence*) {1.4, Cross-Chapter Box 3 in Chapter 1, 2.5.1, 4.4, 4.5, 5.6}

D.3 Adaptation options specific to national contexts, if carefully selected together with enabling conditions, will have benefits for sustainable development and poverty reduction with global warming of 1.5°C, although trade-offs are possible (*high confidence*). {1.4, 4.3, 4.5}

D.3.1 Adaptation options that reduce the vulnerability of human and natural systems have many synergies with sustainable development, if well managed, such as ensuring food and water security, reducing disaster risks, improving health conditions, maintaining ecosystem services and reducing poverty and inequality (*high confidence*). Increasing investment in physical and social infrastructure is a key enabling condition to enhance the resilience and the adaptive capacities of societies. These benefits can occur in most regions with adaptation to 1.5°C of global warming (*high confidence*). {1.4.3, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.4.1, 4.4.3, 4.5.3, 5.3.1, 5.3.2}

D.3.2 Adaptation to 1.5°C global warming can also result in trade-offs or maladaptations with adverse impacts for sustainable development. For example, if poorly designed or implemented, adaptation projects in a range of sectors can increase greenhouse gas emissions and water use, increase gender and social inequality, undermine health conditions, and encroach on natural ecosystems (*high confidence*). These trade-offs can be reduced by adaptations that include attention to poverty and sustainable development (*high confidence*). {4.3.2, 4.3.3, 4.5.4, 5.3.2; Cross-Chapter Boxes 6 and 7 in Chapter 3}

D.3.3 A mix of adaptation and mitigation options to limit global warming to 1.5°C, implemented in a participatory and integrated manner, can enable rapid, systemic transitions in urban and rural areas (*high confidence*). These are most effective when aligned with economic and sustainable development, and when local and regional governments and decision makers are supported by national governments (*medium confidence*). {4.3.2, 4.3.3, 4.4.1, 4.4.2}

D.3.4 Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low-carbon buildings are also designed for efficient cooling. Trade-offs between mitigation and adaptation, when limiting global warming to 1.5°C, such as when bioenergy crops, reforestation or afforestation encroach on land needed for agricultural adaptation, can undermine food security, livelihoods, ecosystem functions and services and other aspects of sustainable development. (*high confidence*) {3.4.3, 4.3.2, 4.3.4, 4.4.1, 4.5.2, 4.5.3, 4.5.4}

D.4 Mitigation options consistent with 1.5°C pathways are associated with multiple synergies and trade-offs across the Sustainable Development Goals (SDGs). While the total number of possible synergies exceeds the number of trade-offs, their net effect will depend on the pace and magnitude of changes, the composition of the mitigation portfolio and the management of the transition. (*high confidence*) {Figure SPM.4} {2.5, 4.5, 5.4}

D.4.1 1.5°C pathways have robust synergies particularly for the SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production) and 14 (oceans) (*very high confidence*). Some 1.5°C pathways show potential trade-offs with mitigation for SDGs 1 (poverty), 2 (hunger), 6 (water) and 7 (energy access), if not managed carefully (*high confidence*). {Figure SPM.4} {5.4.2; Figure 5.4, Cross-Chapter Boxes 7 and 8 in Chapter 3}

D.4.2 1.5°C pathways that include low energy demand (e.g., see P1 in Figure SPM.3a and SPM.3b), low material consumption, and low GHG-intensive food consumption have the most pronounced synergies and the lowest number of trade-offs with respect to sustainable development and the SDGs (*high confidence*). Such pathways would reduce dependence on CDR. In modelled pathways, sustainable development, eradicating poverty and reducing inequality can support limiting warming to 1.5°C (*high confidence*). {Figure SPM.3b, Figure SPM.4} {2.4.3, 2.5.1, 2.5.3, Figure 2.4, Figure 2.28, 5.4.1, 5.4.2, Figure 5.4}

Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.

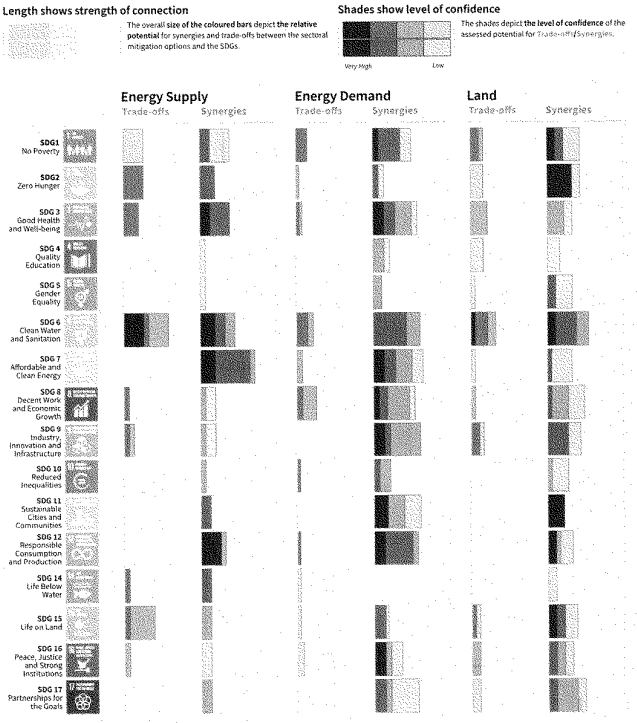


Figure SPM.4 | Potential synergies and trade-offs between the sectoral portfolio of climate change mitigation options and the Sustainable Development Goals (SDGs). The SDGs serve as an analytical framework for the assessment of the different sustainable development dimensions, which extend beyond the time frame of the 2030 SDG targets. The assessment is based on literature on mitigation options that are considered relevant for 1.5°C. The assessed strength of the SDG interactions is based on the qualitative and quantitative assessment of individual mitigation options listed in Table 5.2. For each mitigation option, the strength of the SDG-connection as well as the associated confidence of the underlying literature (shades of green and red) was assessed. The strength of positive connections (synergies) and negative connections (trade-offs) across all individual options within a sector (see Table 5.2) are aggregated into sectoral potentials for the whole mitigation portfolio. The (white) areas outside the bars, which indicate no interactions, have *low confidence* due to the uncertainty and limited number of studies exploring indirect effects. The strength of the connection considers only the effect of mitigation and does not include benefits of avoided impacts. SDG 13 (climate action) is not listed because mitigation is being considered in terms of interactions with SDGs and not vice versa. The bars denote the strength of the connection, and do not consider the strength of the impact on the SDGs. The energy demand sector comprises behavioural responses, fuel switching and efficiency options in the transport, industry and building sector as well as carbon capture options in the industry sector. Options assessed in the energy supply sector comprise biomass and non-biomass renewables, nuclear, carbon capture and storage (CCS) with bioenergy, and CCS with fossil fuels. Options in the land sector comprise agricultural and forest options, sustainable diets and reduced food waste, soil sequestration, livestock and manure management, reduced deforestation, afforestation and reforestation, and responsible sourcing. In addition to this figure, options in the ocean sector are discussed in the underlying report. {5.4, Table 5.2, Figure 5.2}

Information about the net impacts of mitigation on sustainable development in 1.5°C pathways is available only for a limited number of SDGs and mitigation options. Only a limited number of studies have assessed the benefits of avoided climate change impacts of 1.5°C pathways for the SDGs, and the co-effects of adaptation for mitigation and the SDGs. The assessment of the indicative mitigation potentials in Figure SPM.4 is a step further from AR5 towards a more comprehensive and integrated assessment in the future.

D.4.3 1.5°C and 2°C modelled pathways often rely on the deployment of large-scale land-related measures like afforestation and bioenergy supply, which, if poorly managed, can compete with food production and hence raise food security concerns (*high confidence*). The impacts of carbon dioxide removal (CDR) options on SDGs depend on the type of options and the scale of deployment (*high confidence*). If poorly implemented, CDR options such as BECCS and AFOLU options would lead to trade-offs. Context-relevant design and implementation requires considering people's needs, biodiversity, and other sustainable development dimensions (*very high confidence*). {Figure SPM.4} {5.4.1.3, Cross-Chapter Box 7 in Chapter 3}

D.4.4 Mitigation consistent with 1.5°C pathways creates risks for sustainable development in regions with high dependency on fossil fuels for revenue and employment generation (*high confidence*). Policies that promote diversification of the economy and the energy sector can address the associated challenges (*high confidence*). {5.4.1.2, Box 5.2}

D.4.5 Redistributive policies across sectors and populations that shield the poor and vulnerable can resolve trade-offs for a range of SDGs, particularly hunger, poverty and energy access. Investment needs for such complementary policies are only a small fraction of the overall mitigation investments in 1.5°C pathways. (*high confidence*) {2.4.3, 5.4.2, Figure 5.5}

D.5 Limiting the risks from global warming of 1.5°C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes (*high confidence*). {2.3, 2.4, 2.5, 3.2, 4.2, 4.4, 4.5, 5.2, 5.5, 5.6}

D.5.1 Directing finance towards investment in infrastructure for mitigation and adaptation could provide additional resources. This could involve the mobilization of private funds by institutional investors, asset managers and development or investment banks, as well as the provision of public funds. Government policies that lower the risk of low-emission and adaptation investments can facilitate the mobilization of private funds and enhance the effectiveness of other public policies. Studies indicate a number of challenges, including access to finance and mobilization of funds. (*high confidence*) {2.5.1, 2.5.2, 4.4.5}

D.5.2 Adaptation finance consistent with global warming of 1.5°C is difficult to quantify and compare with 2°C. Knowledge gaps include insufficient data to calculate specific climate resilience-enhancing investments from the provision of currently underinvested basic infrastructure. Estimates of the costs of adaptation might be lower at global warming of 1.5°C than for 2°C. Adaptation needs have typically been supported by public sector sources such as national and subnational government budgets, and in developing countries together with support from development assistance, multilateral development banks, and United Nations Framework Convention on Climate Change channels (*medium confidence*). More recently there is a

growing understanding of the scale and increase in non-governmental organizations and private funding in some regions (*medium confidence*). Barriers include the scale of adaptation financing, limited capacity and access to adaptation finance (*medium confidence*). {4.4.5, 4.6}

D.5.3 Global model pathways limiting global warming to 1.5°C are projected to involve the annual average investment needs in the energy system of around 2.4 trillion USD2010 between 2016 and 2035, representing about 2.5% of the world GDP (*medium confidence*). {4.4.5, Box 4.8}

D.5.4 Policy tools can help mobilize incremental resources, including through shifting global investments and savings and through market and non-market based instruments as well as accompanying measures to secure the equity of the transition, acknowledging the challenges related with implementation, including those of energy costs, depreciation of assets and impacts on international competition, and utilizing the opportunities to maximize co-benefits (*high confidence*). {1.3.3, 2.3.4, 2.3.5, 2.5.1, 2.5.2, Cross-Chapter Box 8 in Chapter 3, Cross-Chapter Box 11 in Chapter 4, 4.4.5, 5.5.2}

D.5.5 The systems transitions consistent with adapting to and limiting global warming to 1.5°C include the widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation. These imply enhanced technological innovation capabilities, including in industry and finance. Both national innovation policies and international cooperation can contribute to the development, commercialization and widespread adoption of mitigation and adaptation technologies. Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion. (*high confidence*) {4.4.4, 4.4.5}.

D.5.6 Education, information, and community approaches, including those that are informed by indigenous knowledge and local knowledge, can accelerate the wide-scale behaviour changes consistent with adapting to and limiting global warming to 1.5°C. These approaches are more effective when combined with other policies and tailored to the motivations, capabilities and resources of specific actors and contexts (*high confidence*). Public acceptability can enable or inhibit the implementation of policies and measures to limit global warming to 1.5°C and to adapt to the consequences. Public acceptability depends on the individual's evaluation of expected policy consequences, the perceived fairness of the distribution of these consequences, and perceived fairness of decision procedures (*high confidence*). {1.1, 1.5, 4.3.5, 4.4.1, 4.4.3, Box 4.3, 5.5.3, 5.6.5}

D.6 Sustainable development supports, and often enables, the fundamental societal and systems transitions and transformations that help limit global warming to 1.5°C. Such changes facilitate the pursuit of climate-resilient development pathways that achieve ambitious mitigation and adaptation in conjunction with poverty eradication and efforts to reduce inequalities (*high confidence*). {Box 1.1, 1.4.3, Figure 5.1, 5.5.3, Box 5.3}

D.6.1 Social justice and equity are core aspects of climate-resilient development pathways that aim to limit global warming to 1.5°C as they address challenges and inevitable trade-offs, widen opportunities, and ensure that options, visions, and values are deliberated, between and within countries and communities, without making the poor and disadvantaged worse off (*high confidence*). {5.5.2, 5.5.3, Box 5.3, Figure 5.1, Figure 5.6, Cross-Chapter Boxes 12 and 13 in Chapter 5}

D.6.2 The potential for climate-resilient development pathways differs between and within regions and nations, due to different development contexts and systemic vulnerabilities (*very high confidence*). Efforts along such pathways to date have been limited (*medium confidence*) and enhanced efforts would involve strengthened and timely action from all countries and non-state actors (*high confidence*). {5.5.1, 5.5.3, Figure 5.1}

D.6.3 Pathways that are consistent with sustainable development show fewer mitigation and adaptation challenges and are associated with lower mitigation costs. The large majority of modelling studies could not construct pathways characterized by lack of international cooperation, inequality and poverty that were able to limit global warming to 1.5°C. (*high confidence*) {2.3.1, 2.5.1, 2.5.3, 5.5.2}

D.7 Strengthening the capacities for climate action of national and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support the implementation of ambitious actions implied by limiting global warming to 1.5°C (*high confidence*). International cooperation can provide an enabling environment for this to be achieved in all countries and for all people, in the context of sustainable development. International cooperation is a critical enabler for developing countries and vulnerable regions (*high confidence*). {1.4, 2.3, 2.5, 4.2, 4.4, 4.5, 5.3, 5.4, 5.5, 5.6, 5, Box 4.1, Box 4.2, Box 4.7, Box 5.3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 13 in Chapter 5}

D.7.1 Partnerships involving non-state public and private actors, institutional investors, the banking system, civil society and scientific institutions would facilitate actions and responses consistent with limiting global warming to 1.5°C (*very high confidence*). {1.4, 4.4.1, 4.2.2, 4.4.3, 4.4.5, 4.5.3, 5.4.1, 5.6.2, Box 5.3}.

D.7.2 Cooperation on strengthened accountable multilevel governance that includes non-state actors such as industry, civil society and scientific institutions, coordinated sectoral and cross-sectoral policies at various governance levels, gender-sensitive policies, finance including innovative financing, and cooperation on technology development and transfer can ensure participation, transparency, capacity building and learning among different players (*high confidence*). {2.5.1, 2.5.2, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.5.3, Cross-Chapter Box 9 in Chapter 4, 5.3.1, 5.5.3, Cross-Chapter Box 13 in Chapter 5, 5.6.1, 5.6.3}

D.7.3 International cooperation is a critical enabler for developing countries and vulnerable regions to strengthen their action for the implementation of 1.5°C-consistent climate responses, including through enhancing access to finance and technology and enhancing domestic capacities, taking into account national and local circumstances and needs (*high confidence*). {2.3.1, 2.5.1, 4.4.1, 4.4.2, 4.4.4, 4.4.5, 5.4.1 5.5.3, 5.6.1, Box 4.1, Box 4.2, Box 4.7}.

D.7.4 Collective efforts at all levels, in ways that reflect different circumstances and capabilities, in the pursuit of limiting global warming to 1.5°C, taking into account equity as well as effectiveness, can facilitate strengthening the global response to climate change, achieving sustainable development and eradicating poverty (*high confidence*). {1.4.2, 2.3.1, 2.5.1, 2.5.2, 2.5.3, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.5.3, 5.3.1, 5.4.1, 5.5.3, 5.6.1, 5.6.2, 5.6.3}

Box SPM.1: Core Concepts Central to this Special Report

Global mean surface temperature (GMST): Estimated global average of near-surface air temperatures over land and sea ice, and sea surface temperatures over ice-free ocean regions, with changes normally expressed as departures from a value over a specified reference period. When estimating changes in GMST, near-surface air temperature over both land and oceans are also used.[19] {1.2.1.1}

Pre-industrial: The multi-century period prior to the onset of large-scale industrial activity around 1750. The reference period 1850–1900 is used to approximate pre-industrial GMST. {1.2.1.2}

Global warming: The estimated increase in GMST averaged over a 30-year period, or the 30-year period centred on a particular year or decade, expressed relative to pre-industrial levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue. {1.2.1}

Net zero CO_2 emissions: Net zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period.

Carbon dioxide removal (CDR): Anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO_2 uptake not directly caused by human activities.

Total carbon budget: Estimated cumulative net global anthropogenic CO_2 emissions from the pre-industrial period to the time that anthropogenic CO_2 emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

Remaining carbon budget: Estimated cumulative net global anthropogenic CO_2 emissions from a given start date to the time that anthropogenic CO_2 emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

Temperature overshoot: The temporary exceedance of a specified level of global warming.

Emission pathways: In this Summary for Policymakers, the modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways. Emission pathways are classified by their temperature trajectory over the 21st century: pathways giving at least 50% probability based on current knowledge of limiting global warming to below 1.5°C are classified as 'no overshoot'; those limiting warming to below 1.6°C and returning to 1.5°C by 2100 are classified as '1.5°C limited-overshoot'; while those exceeding 1.6°C but still returning to 1.5°C by 2100 are classified as 'higher-overshoot'.

Impacts: Effects of climate change on human and natural systems. Impacts can have beneficial or adverse outcomes for livelihoods, health and well-being, ecosystems and species, services, infrastructure, and economic, social and cultural assets.

Risk: The potential for adverse consequences from a climate-related hazard for human and natural systems, resulting from the interactions between the hazard and the vulnerability and exposure of the affected system. Risk integrates the likelihood of exposure to a hazard and the magnitude of its impact. Risk also can describe the potential for adverse consequences of adaptation or mitigation responses to climate change.

Climate-resilient development pathways (CRDPs): Trajectories that strengthen sustainable development at multiple scales and efforts to eradicate poverty through equitable societal and systems transitions and transformations while reducing the threat of climate change through ambitious mitigation, adaptation and climate resilience.

19 Past IPCC reports, reflecting the literature, have used a variety of approximately equivalent metrics of GMST change.

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR THE COUNTY OF KING

AJI P., a minor child by and through his guardian HELAINA PIPER; ADONIS W., a minor child, by and through his guardian HELAINA PIPER; WREN W., a minor child by and through her guardian MIKE WAGENBACH; LARA F. & ATHENA F., minor children by and through their guardian MONIQUE DINH; GABRIEL M., a minor child by and through his guardians VALERY and RANDY MANDELL; JAMIE M., a minor child by and through her guardians MARK and JANETH MARGOLIN; INDIA B., a minor child by and through her guardians, JIM BRIGGS and MELISSA BATES; JAMES CHARLES D., a minor child by and through his guardian DAWNEEN DELACRUZ; KYLIE JOANN D., a minor child, by and through her guardian DAWNEEN DELACRUZ; KAILANI S., a minor child, by and through her guardian, JOHN SIROIS; DANIEL M., a minor child, by and through his guardian, FAWN SHARP; and BODHI K., a minor child, by and through his guardian MARIS ABELSON, Plaintiffs, v. STATE OF WASHINGTON; JAY INSLEE, in his official capacity as Governor of Washington; WASHINGTON DEPARTMENT OF ECOLOGY; MAIA BELLON, in her official capacity as Director of the	No. COMPLAINT FOR DECLARATORY & INJUNCTIVE RELIEF

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

WASHINGTON DEPARTMENT OF ECOLOGY; WASHINGTON DEPARTMENT OF COMMERCE; BRIAN BONLENDER, in his official capacity as Director of the WASHINGTON DEPARTMENT OF COMMERCE; WASHINGTON STATE TRANSPORTATION COMMISSION; WASHINGTON DEPARTMENT OF TRANSPORTATION; and ROGER MILLER, in his official capacity as Secretary of the WASHINGTON DEPARTMENT OF TRANSPORTATION,

Defendants.

INTRODUCTION

1. Plaintiffs are twelve young Washingtonians, under the age of 18, who have serious ongoing injuries because of Defendants' deliberate indifference to their rights to life, liberty, property, and a healthful and pleasant environment, including a stable climate system, in violation of Washington's Constitution and the Public Trust Doctrine. They bring this action on behalf of themselves because the fossil fuel-based energy and transportation system created, supported, and operated by the Defendants, and the systematic, affirmative aggregate actions which make up and support that system, severely endangers Plaintiffs and their ability to grow to adulthood safely and enjoy the rights, benefits, and privileges of past generations of Washingtonians due to the resulting climate change.

2. Defendants have created, operate and maintain a fossil fuel-based energy and transportation system that has caused and is causing widespread harm to the Plaintiffs in violation of the constitution and Public Trust Doctrine. Although Washington law grants explicit responsibility and authority to the state entities and officials sued herein to develop and

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

promulgate energy and transportation policy, these Defendants have implemented this responsibility in a way that violates Plaintiffs' constitutional rights.

3. Because the Defendants have long known that Plaintiffs would and currently are living under dangerous climatic conditions that create an unreasonable risk of present and future harm as a result of greenhouse gas emissions resulting from the fossil fuel-based energy and transportation system they have created, operate, and maintain, but have not responded reasonably to this urgent crisis and instead have affirmatively acted to exacerbate the climate crisis and delay meaningful science-based action, Plaintiffs seek an injunction compelling Defendants to develop and implement a comprehensive plan targeted to achieving Washington's obligation to stabilize the climate system and protect the vital natural resources on which Plaintiffs now and in the future will depend.

4. Pursuant to Revised Code of Washington ("RCW") 7.24 (the Uniform Declaratory Judgment Act), RCW 34.05 (Administrative Procedure Act), the Washington State Constitution, and the Public Trust Doctrine, Aji P., Adonis W., Wren W., Lara and Athena F., Gabriel M., Jamie M., India B., James Charles D., Kylie Joann D., Kailani S., Daniel M., and Bodhi K., all minor children by and through their respective guardians (collectively, "Plaintiffs") hereby ask this Court to declare and enforce the State of Washington's constitutional and Public Trust obligations to protect their inalienable and fundamental common law and constitutional rights to life, liberty, property, public trust resources, and a healthful and pleasant environment, rights that include a stable climate system that sustains human life and liberty.

5. Plaintiffs are and will continue to be mutually and adversely impacted by excessive human-caused atmospheric carbon dioxide ("CO_2") concentrations that now exceed 403 parts per million ("ppm"), as compared to the natural pre-industrial levels of 280 ppm. These

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

unconstitutional conditions, which Defendants have created and exacerbated in part through their creation and management of a fossil fuel-based energy and transportation system, have caused substantial impairment to the vital natural resources on which Plaintiffs and both current and future generations of Washingtonians depend, in the exercise of their inherent rights.

6. CO_2 and other greenhouse gas pollutants (collectively, "GHGs") in Washington are causing dangerously increasing temperatures, changing precipitation patterns, heatwaves, rising seas and storm-surge flooding, increasing droughts and violent storms, ocean acidification and warming, beach and farmland soil erosion, freshwater degradation, increased wildfires, resource and species extinctions, increased pestilence with resultant diseases and other adverse health risks, and other adverse impacts (collectively, "Climate Change Impacts"), all of which threaten the habitability of Washington and the life, liberty and property of these Plaintiffs.

7. The viability of all of Washington's Public Trust resources, including the atmosphere (air), tidelands and shorelands, navigable waters, lakes, rivers, beaches, forests, and wild flora and fauna (each individually, a "Public Trust Resource," and collectively, "Public Trust Resources"), and access to and use of such resources, including but not limited to public access, fishing, navigation, and environmental quality, are essential rights secured by the Constitution and common law of Washington.

8. The Defendants have common-law fiduciary and constitutional duties to refrain from actions that exacerbate Climate Change Impacts. The Defendants, through their actions and inactions as public officials who create and manage Washington's fossil fuel-based energy and transportation system and are responsible for responding to the threat of climate change, are materially causing and contributing to the increasing injurious effects of Climate Change

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

Impacts. Defendants' systemic course of conduct with respect to CO_2 and GHG emissions has exacerbated the dangerous situation Youth Plaintiffs presently face.

9. The Defendants have common-law fiduciary and constitutional duties to take action on behalf of the Youth Plaintiffs and the State of Washington to reduce and mitigate the adverse effects of Climate Change Impacts. Defendants have not used their authority, or fulfilled their duty, to mitigate Washington's GHG emissions and safeguard Plaintiffs' fundamental and inalienable rights.

10. Defendants have had decades of knowledge and opportunity to address the catastrophic harms the Plaintiffs face and have acted with shocking deliberate indifference and abdication of duty to address this crisis, which threatens to destroy vast areas of Washington State that are essential to the lives, liberties, and property of Plaintiffs.

11. Plaintiffs bring this lawsuit so the Court can declare and enforce their rights under the Public Trust Doctrine, sections 3, 12, and 30 of Article I, and section 1 of Article XVII of the Washington State Constitution, before it is too late.

PARTIES

Plaintiffs

12. Plaintiff Aji P., by and through his guardian and mother Helaina Piper, is a 17- year-old citizen of the U.S. and a resident of West Seattle, Washington. Aji is experiencing Climate Change Impacts caused by Defendants, and has been harmed by the increasing severity of such impacts. Aji's health and wellbeing has been harmed by the increasing number of wildfires in the Cascade Mountains and the smoke and ash-filled skies of Seattle, where air quality is dangerous. Aji's physical outdoor activities are limited by the increasing summer temperatures and days over 90 degrees F. Aji's ability to recreate in and enjoy the Puget Sound is harmed by

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

Climate Change Impacts, which are causing dead zones to occur in Puget Sound and ocean acidification that is killing fish and shellfish. Climate Change Impacts are also harming Aji's recreational and aesthetic interests in the forests in the west where Aji visits and plans to continue visiting, including forests that have been decimated by pine beetles. Aji's ability to snowboard has been limited by the reduced snow in the mountains where he recreates during the winter months.

13. Plaintiff India B., by and through her natural guardians Jim Briggs and Melissa Bates, is a 16-year old who lives with her mother and father on a small farm in Cle Elum, Washington, on the east slopes of the Cascades in an important agricultural community. India has lived her whole life on the same small, family farm, raising sheep for wool and meat, dairy goats, horses, and chickens. India is terrified, and experiences emotional and mental distress, knowing that she could lose her family farm, which is becoming increasingly threatened by Climate Change Impacts. Already, India's family has had to sell off much of their flock of sheep and many of the horses due to the rising costs of feed, which is largely due to Climate Change Impacts. India's brother grew up on horseback, helping her father train horses, but now horses have become a luxury instead of a way of life. Their animals ordinarily would graze off the land and feed on hay in the winter, but with climate change-induced drought, wildfires, and extreme weather events, India's family struggles to feed animals year-round. Even though India's family has water rights that are more than 100 years old, two years ago, because of drought, her family was only able to access half the water needed to provide for their farm. The Climate Change Impacts harming India's family farm and the economic vitality of the whole farming region are projected to worsen, according to experts, and the prognosis will not change without action from Defendants on climate recovery. India has already been repeatedly harmed and her life and farm

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

threatened by wildfires made worse by climate change. Severe wildfires have burned forests near India's farm and forced her family to make evacuation plans for them and their animals. India has had to evacuate to escape the terrible asthma attacks she suffers because of the smoke, and which threaten her health and personal safety. India has suffered from asthma since she was a child and her symptoms get much worse when air quality is diminished due to the smoke from the increasing number of climate change-induced and exacerbated wildfires near her home. In the summer of 2017, India also lost days of school and extracurricular activities from the hazardous air quality from wildfires.

14. Plaintiff James Charles D., by and through his natural guardian, Dawneen DeLaCruz, is a 17-year-old member of the Quinault Indian Nation, who lives with his family and attends school in Taholah, on the Washington coast. Taholah is the lower village of the Quinault Indian Nation that must be relocated because of sea level rise caused by Climate Change Impacts. James enjoys traditional cultural activities such as digging for clams both on and off the Reservation, but his ability to do so has been, and continues to be, limited because of algal blooms, ocean acidification, and warmer ocean temperatures, all Climate Change Impacts. James' personal security and property interests in his home are injured and threatened because his home of Taholah now floods every winter. James' educational interests are also harmed because his school has to close when there is flooding because his teachers cannot make it into town to teach. As he has grown up, James has been harmed by increasingly severe storms along the Washington coast. James and his family lose their power supply every year and had to purchase a backup generator as a result. He has lived in his home in Taholah for about 11 years, over half of his life, but will be forced to leave his home when the village is relocated as a result of Climate Change Impacts. All of the Quinault Indian Nation's essential services for young people are in

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

Taholah and will have to be relocated, even though there is very little funding to do that. This forced relocation from Climate Change Impacts injures James' cultural, spiritual, familial, property and recreational interests. This critical loss of his place-based heritage, a heritage that dates back to time immemorial, is irreplaceable and permanent. This loss affects James' ability to practice his religion, to choose how and where to raise family, to continue his subsistence and medicinal harvest, and to choose a career path based on his Nation's traditions and culture. These losses cause James emotional and mental distress. Climate Change Impacts are already harming James' practice of his native cultural traditions and these harms will only worsen over time absent meaningful action from governments to stop climate change.

15. Plaintiff Kylie JoAnn D., by and through her natural guardian, Dawneen DeLaCruz, is a 12-year-old member of the Quinault Indian Nation, who lives with her family and attends school in Taholah, Washington. Like her brother, Kylie will have to leave her home in Tahola when the village is relocated to higher ground, leaving the only home in which she has ever lived. Also like her brother, Kylie enjoys participating in traditional cultural activities, including the canoe journey, digging for clams, and fishing, but her ability to access and enjoy all of these activities is lessened due to Climate Change Impacts.

16. Plaintiff Kailani S., by and through her natural guardian John Sirois, is a 13-year old who lives with her family in Spokane, Washington. Kailani is an enrolled member of the Confederated Tribes of the Colville Reservation, which is located in the North-Central part of Washington State. Kailani just recently moved to Spokane, Washington from the Colville Reservation, but she returns regularly to visit her grandmother and to participate in cultural activities. Kailani is being harmed by the diminishing snowpack in Washington compared to the snow that used to exist in her Tribe's history. Kailani loves to go fishing with her family and has

Law Offices of Andrea K. Rodgers
3026 NW Esplanade
Seattle, WA 98117

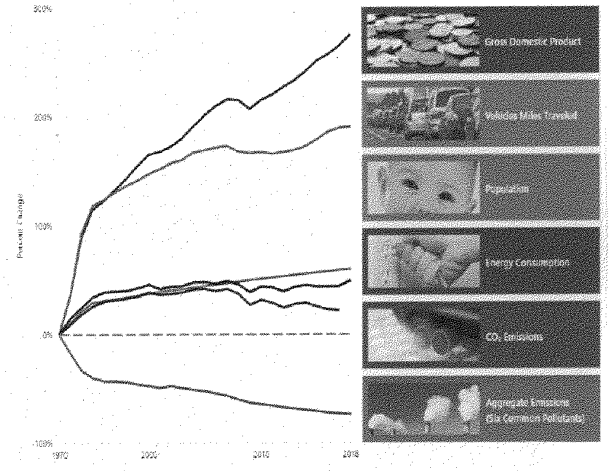
Submission for the Record
Rep. Buddy Carter
Select Committee on the Climate Crisis
September 18, 2019

Economic Growth with Cleaner Air

Between 1970 and 2018, the combined emissions of the six common pollutants ($PM_{2.5}$ and PM_{10}, SO_2, NO_x, VOCs, CO and Pb) dropped by 74 percent. This progress occurred while the U.S. economy continued to grow, Americans drove more miles and population and energy use increased.

To learn more about the EPA and environmental milestones to reduce pollution please visit the EPA history website.

Click any of the legend items on the right side of the chart to hide or include trend lines. The y-axis may change based on the selections.



https://gispub.epa.gov/air/trendsreport/2019/#growth