Climate change briefing

The implications for Washington state of the Intergovernmental Panel on Climate Change's Special Report on Global Warming of 1.5°C and the Fourth National Climate Assessment.

CLIMATE IMPACTS GROUP
UNIVERSITY of WASHINGTON
College of the Environment

Amy Snover, PhD
Director, Climate Impacts Group
University Director, NW Climate Science Center
University of Washington

WA Senate Environment, Energy & Technology Committee
15 January 2019

CLIMATE IMPACTS GROUP

Since 1995

The Climate Impacts Group supports the development of climate resilience by advancing understanding and awareness of climate risks & supporting science-based action to manage those risks.

The Scientific Evidence Base

Global

State of knowledge of the global climate impacts & energy system, with input from over 2,000 international experts

+

National

State of knowledge of the national climate impacts, with expert input from hundreds of U.S. scientists

+

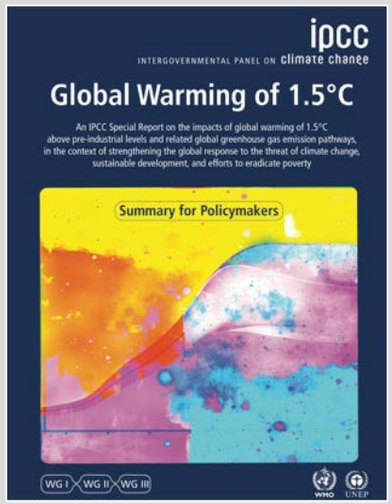
Regional

State of knowledge of regional climate impacts, locally-specific data & tools for climate risk assessment & management

Images: NASA/GSFC/Suomi NPP; census.gov; wikipedia

The Scientific Evidence Base

Global

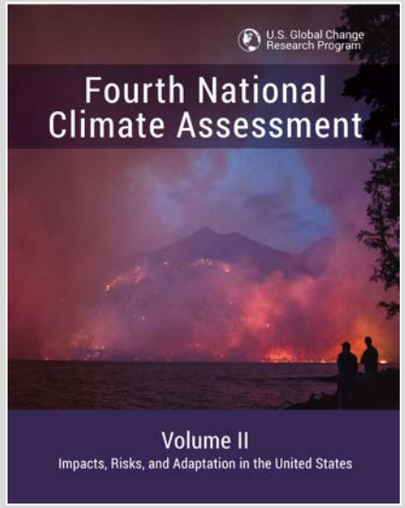


The IPCC Special Report on Global Warming of 1.5°C

ipcc.ch/sr15/

+

National

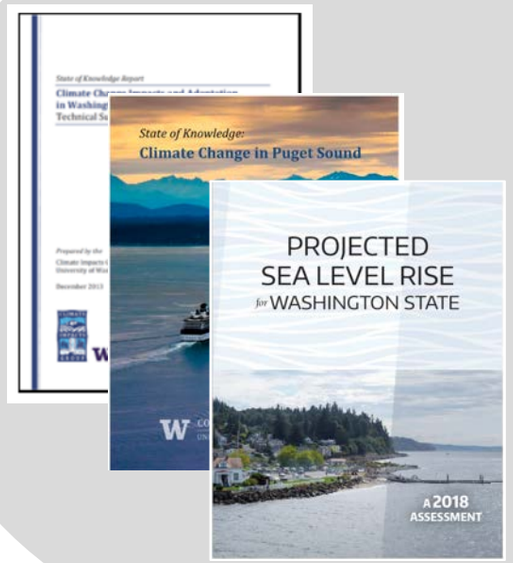


The Fourth National Climate Assessment

nca2018.globalchange.gov

+

Regional



UW Climate Impacts Group Special Reports

cig.uw.edu/resources/special-reports/

The nations of the world agree to…

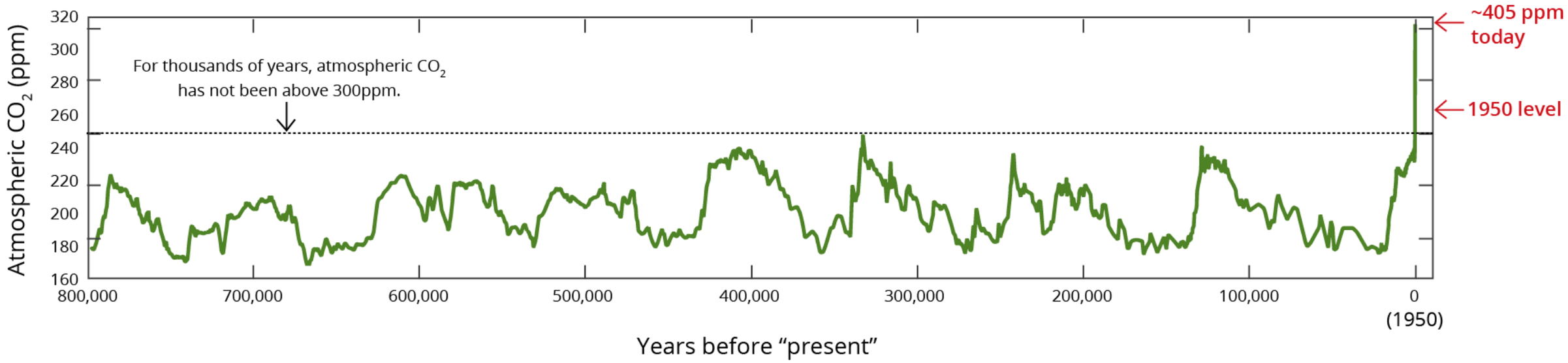
"stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-caused] interference with the climate system."

- 1992 United Nations Framework Convention on Climate Change

NASA

How have we changed the atmosphere?

Human activities have caused current levels of atmospheric greenhouse gases to exceed any level measured for at least the past 800,000 years.



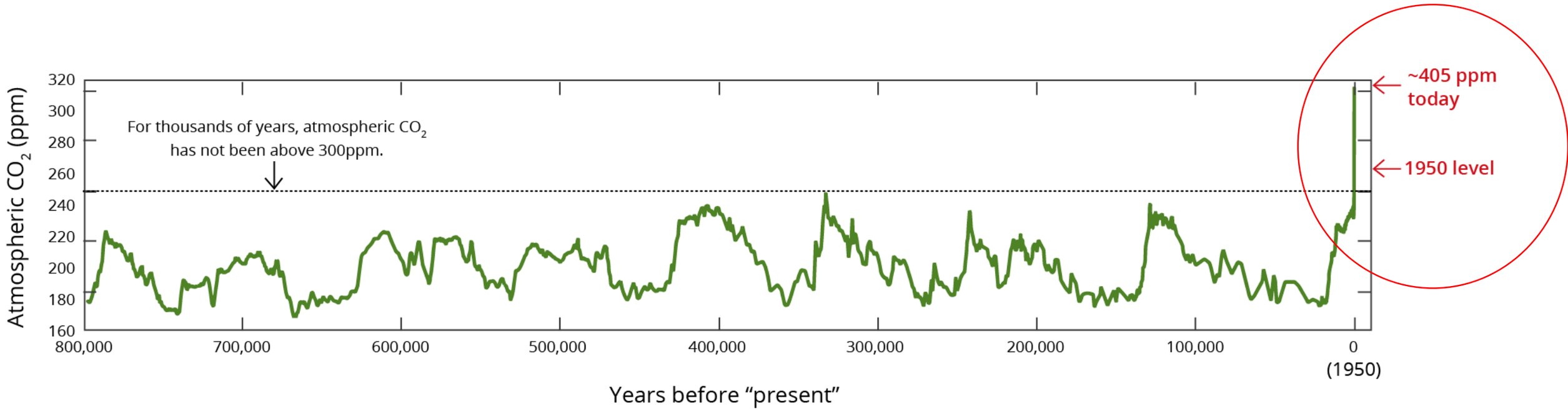
800,000 years ago

Time

Today

Data: Jouzel et al. 2007 (Science 317:793-6); Luthi et al. 2008 (Nature 453:379-82); NOAA (www.esrl.noaa.gov/gmd/ccgg/trends).

Human activities have caused current levels of atmospheric greenhouse gases to exceed any level measured for at least the past 800,000 years.



800,000 years ago

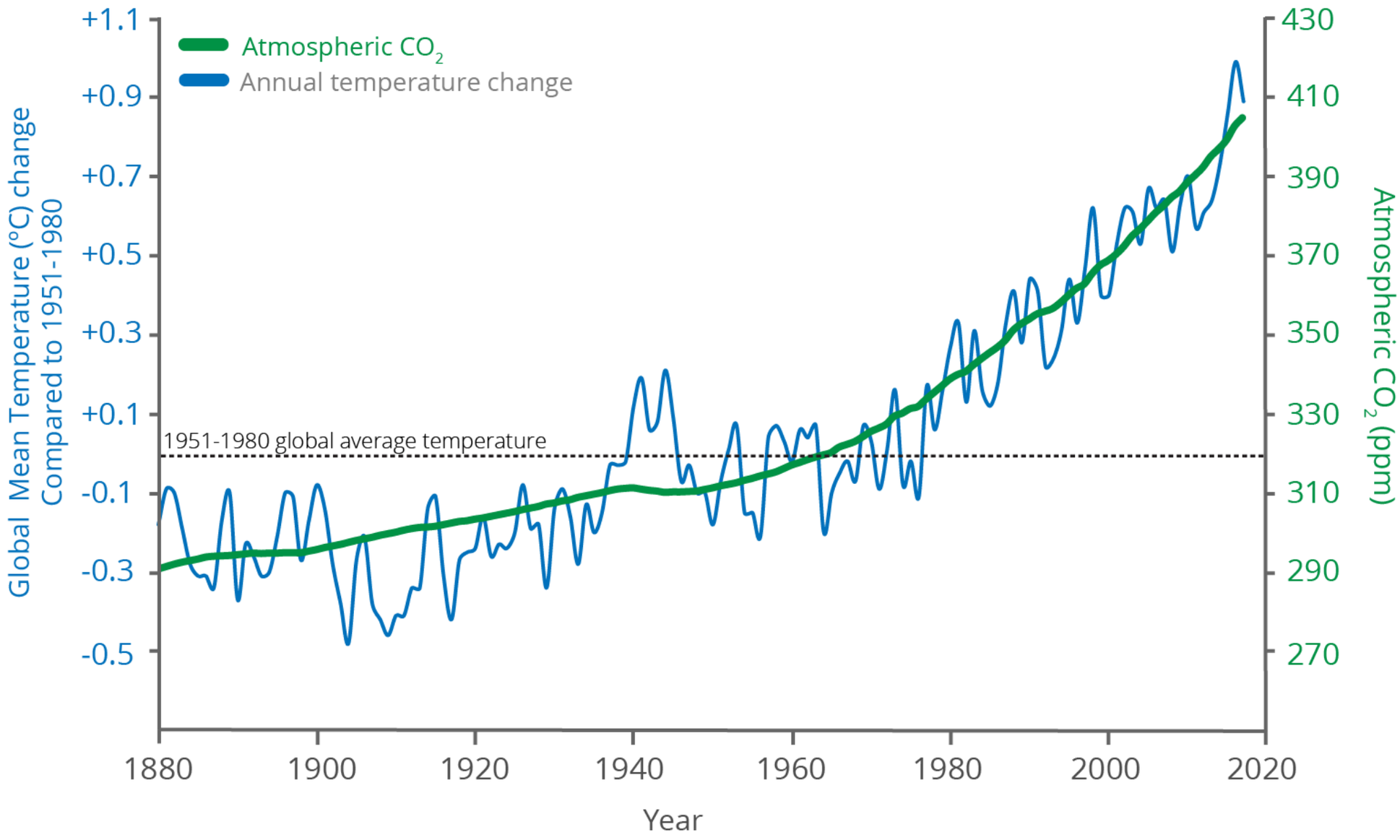
Time

Today

Data: Jouzel et al. 2007 (Science 317:793-6); Luthi et al. 2008 (Nature 453:379-82); NOAA (www.esrl.noaa.gov/gmd/ccgg/trends).

How much has it warmed?

Global average temperatures have increased about 1°C since pre-industrial times. Close to 100% of this warming is the result of human activity. (IPCC 2018)

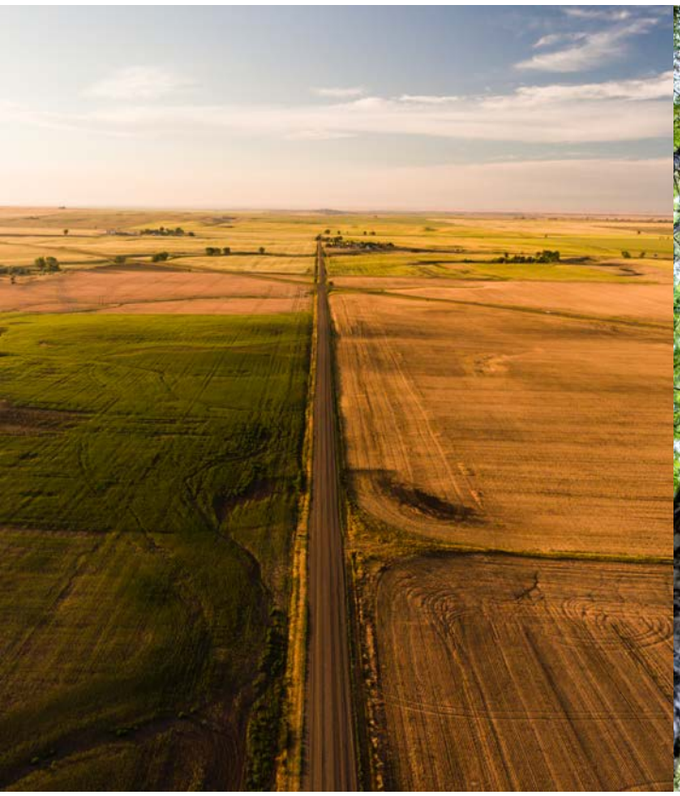
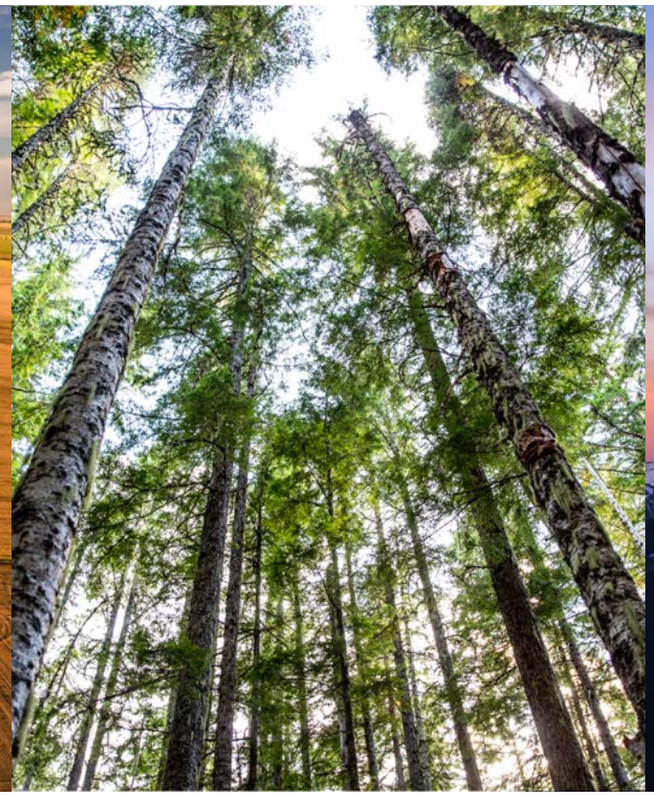


Data: NASA GISS, NOAA ESRL, NOAA NCEI

The impacts of climate change are being felt around the world

Photos: Grist, UW, Brad Kramer

Observed Changes in the Northwest

Photos: University of Washington

Northwest average annual temperature has increased 1.54°F (1895-2011)

Climate Science Special Report 2017

1986–2016 relative to 1901-1960

The coldest day of the year in the NW is 4.78°F warmer than it was during the first half of the 20th century

NCA, 2018

1986–2016 relative to 1901-1960

The frost-free season has lengthened by 16 days across the Northwest

NCA 2014

1991-2012 relative to 1901-1960

Washington Cascades snowpack decreased ~25% between the mid-20th century & 2006

Source: Stoelinga et al. 2009; Mote et al. 2008

The number of large fires and area burned in the Northwest increased from 1973 to 2012

Source: Westerling 2016

Human-generated CO_2 is increasing ocean acidification in Puget Sound surface waters

Source: Feely et al. 2016

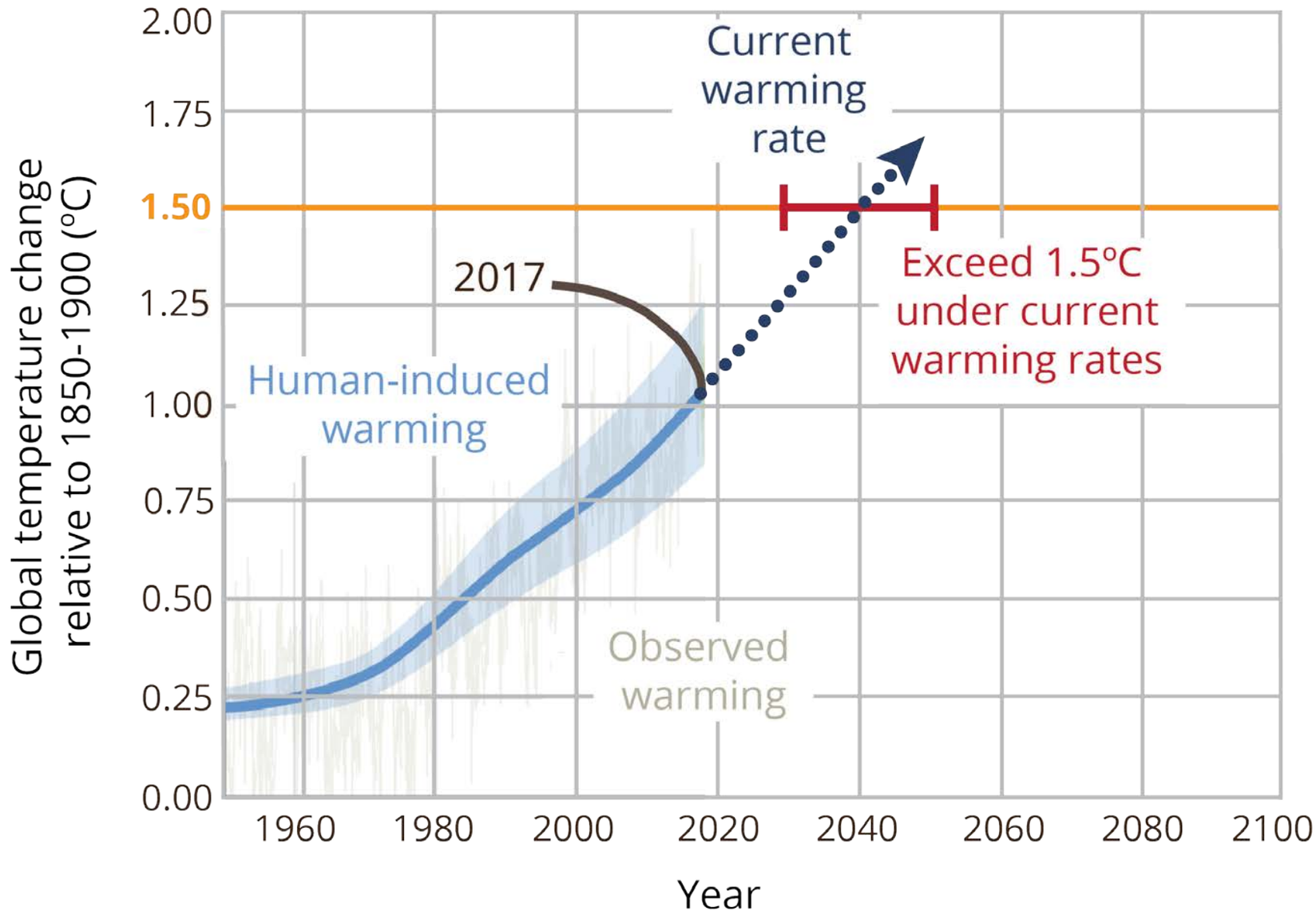
Photo credit: JennRation Designs

Sea level increased 8.6 inches at the Seattle tide gauge (1900-2008)

Source: Mauger et al. 2015

How close are we to “dangerous” climate change?

If current rates of warming continue, global warming could reach 1.5°C as soon as 2030



Modified from IPCC 2018

Why does it matter?

Global costs and challenges from climate change will worsen with any additional warming

		1.5°C	2.0°C	Impacts of 2.0°C
Extreme Heat	Global population exposed to heatwaves	~4 billion	~6 billion	~2 billion more people
Agriculture & Fisheries	Reduction in global corn harvests	10%	15%	1.5x worse
	Decline in marine fisheries	4.5 million metric tons	6.0 million metric tons	1.3x worse
Plants & Animals	Further decline in coral reefs	70-90%	99%	up to 1.4x worse
	Vertebrates, plants & insects losing at least 1/2 of their range	7%	15%	2x worse
Water Resources	Global population exposed to new or aggravated water scarcity	4%	8%	2x worse
	People exposed to drought each month	114.3 million	190.4 million	76.1 million more people
	Additional global population affected by river floods	108.4 million	146.3 million	37.9 million more people
Economy	Global costs of warming	$54 trillion	$69 trillion	$15 trillion more
	U.S. Gross Domestic Product (GDP) losses	0.6%	1.2%	2x worse

Data: IPCC 2018
Figure: Climate Impacts Group (modified from World Resources Institute)

A small amount of additional warming will challenge Washington's communities, economy and ecosystems

Change with 1.5°C		Risks
More very hot days (above 90°F)	↑ 67%	Heat-related illness and deaths Warmer streams stressing salmon More frequent harmful algal blooms
Reduced snowpack (April 1st snow water equivalent)	↓ 38%	Reduced water storage Irrigation shortages Winter and summer recreation losses
Higher winter streamflow (October-March)	↑ 16%	River flooding Costly stormwater management and flood protection Negative effects on salmon populations

Change with 1.5°C		Risks
Lower summer streamflow (April-September)	↓ 23%	Reduced summer hydropower Conflicts over water resources Negative effects on salmon populations
Sea level rise	↑ 1.4 feet	Coastal flooding and inundation Damage to coastal infrastructure and communities Bluff erosion

Data: NCA 2018, Climate Impacts Group, Miller et al. 2018
Figure: Climate Impacts Group

A small amount of additional warming will challenge Washington's communities, economy and ecosystems

Change with 1.5°C		Risks
More very hot days (above 90°F)	↑ 67%	Heat-related illness and deaths Warmer streams stressing salmon More frequent harmful algal blooms
Reduced snowpack (April 1st snow water equivalent)	↓ 38%	Reduced water storage Irrigation shortages Winter and summer recreation losses
Higher winter streamflow (October-March)	↑ 16%	River flooding Costly stormwater management and flood protection Negative effects on salmon populations

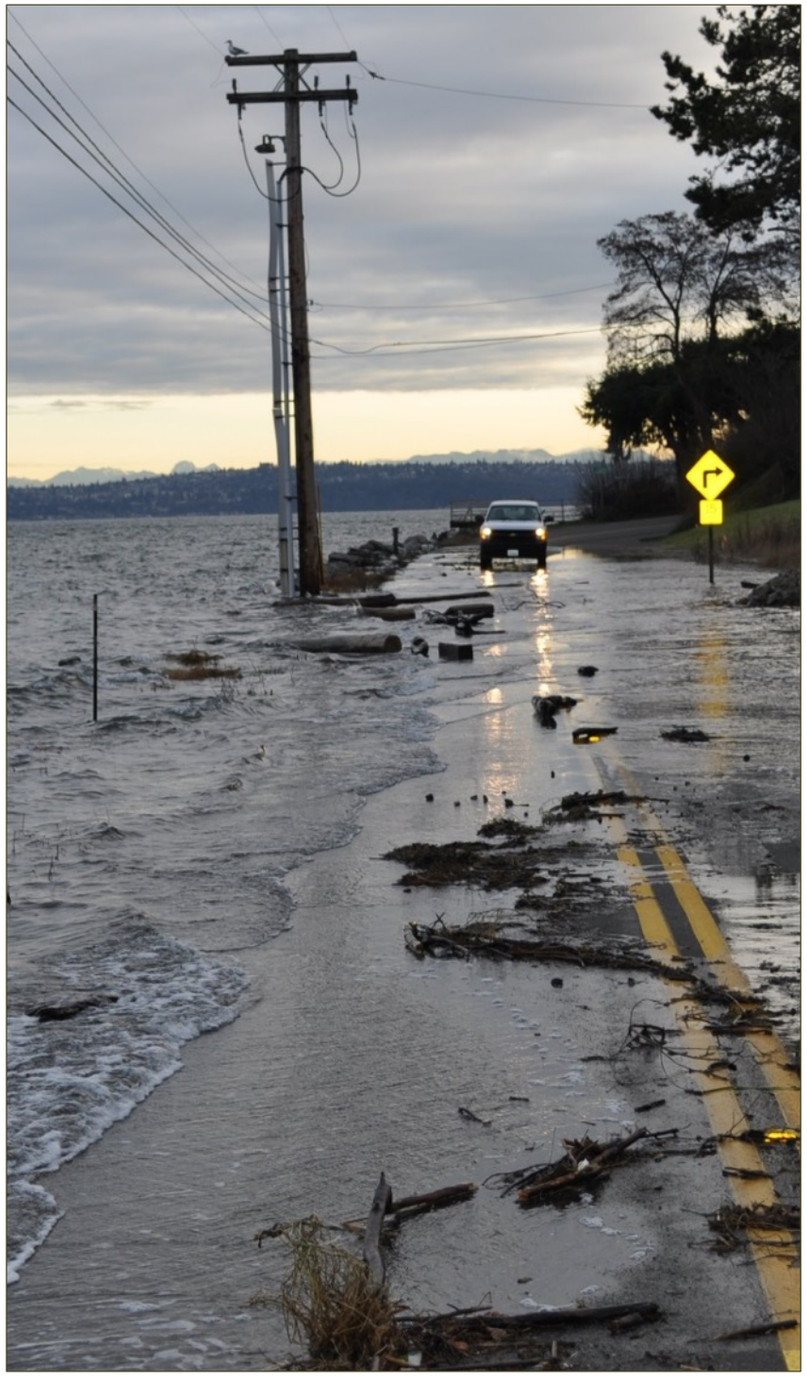
Change with 1.5°C		Risks
Lower summer streamflow (April-September)	↓ 23%	Reduced summer hydropower Conflicts over water resources Negative effects on salmon populations
Sea level rise	↑ 1.4 feet	Coastal flooding and inundation Damage to coastal infrastructure and communities Bluff erosion

… but we're on the path to ***more*** warming

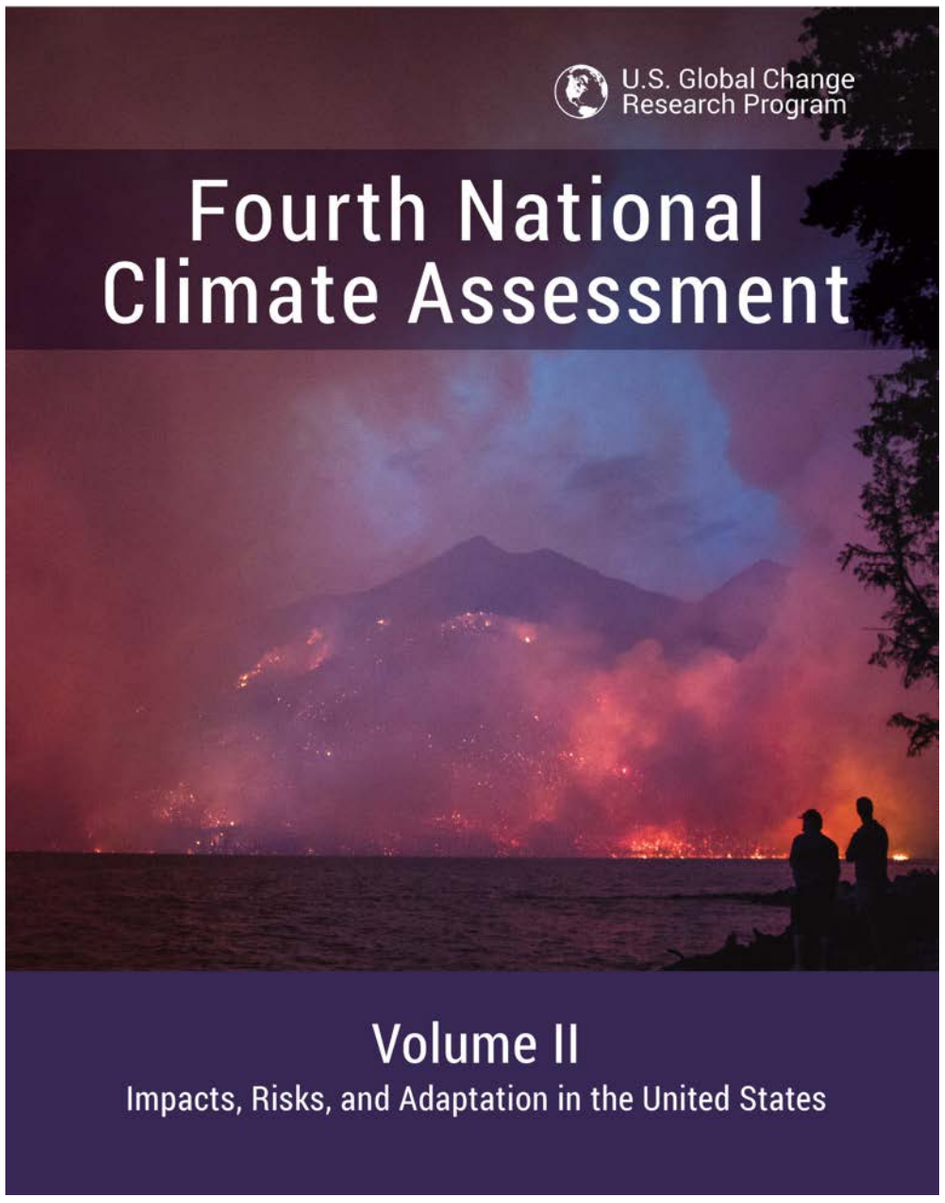
Key drivers of climate change impacts in WA

Snowpack loss, changing streamflow, reduced water supply in the face of competing demands

Combined impacts of wildfire, insects, disease will transform NW forests



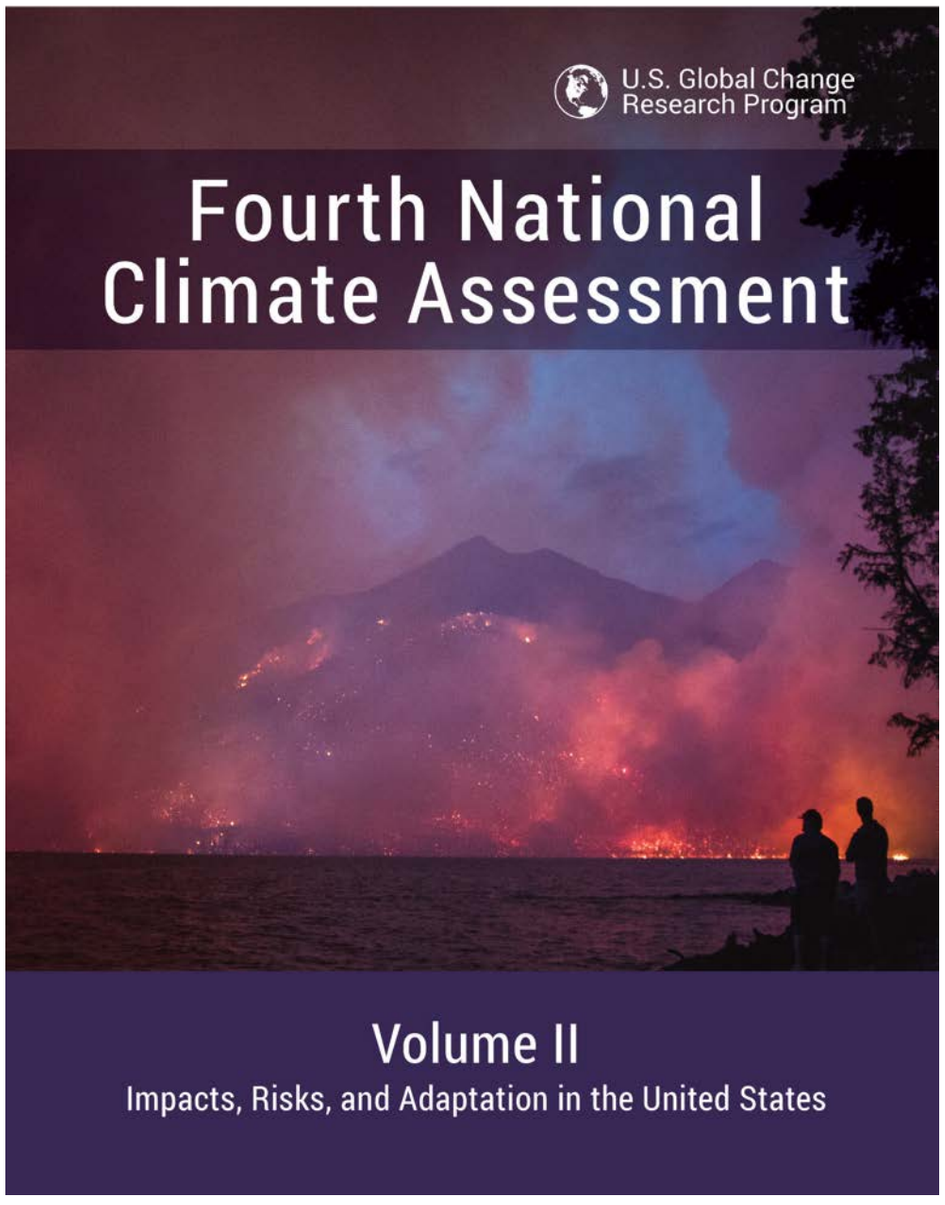
Climate impacts from land & sea combine in the coastal zone



2018

“Without substantial and sustained global mitigation and regional adaptation efforts, climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century.”

Northwest impacts of concern



2018

Natural resource sectors & economies at risk

Endangered natural world & cultural heritage

Increasing risks to critical infrastructure

More challenges for a stressed health system

Vulnerable frontline communities

NW natural resource economies at risk

Response options: water markets, investments in rural economic vitality, new farming practices/crops

Photos: Roop (CIG); Harvold Berry Farm; Ashley Ahearn

Source: NCA 2018

Endangered natural environment & cultural heritage

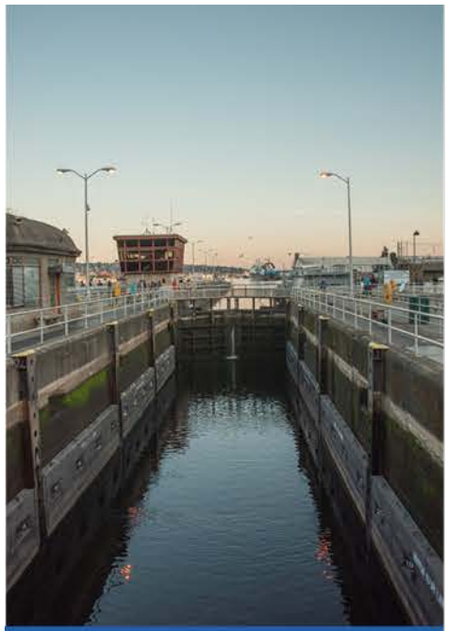
Response options: restore, protect & connect habitat; climate-informed plant, fish, game & cultural resource management

Photos: UW; Travis King; Matt Nagle, Puyallup Tribal News, WDFW.

Source: NCA 2018

Threats to critical NW infrastructure

Response options: design for future climate, update risk maps & engineering design standards, consider cascading impacts & redundant systems



Shoreline Infrastructure

Sea level rise and storm surge

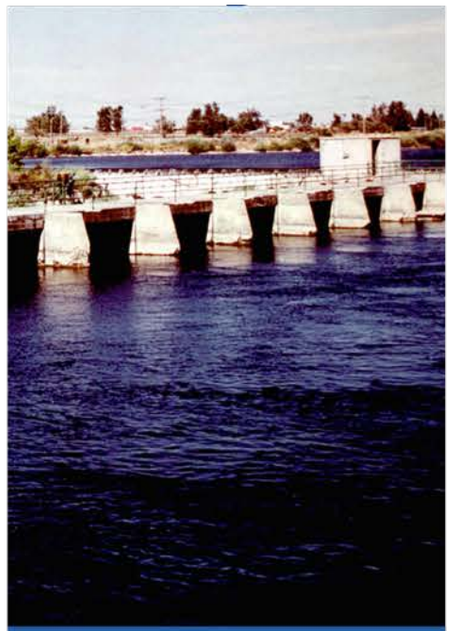
Electricity Demand

Warmer temperatures, more frequent heat waves

Transmission and Distribution

Changes in extreme weather patterns

Increasing risk of wildfires



Hydroelectric Project Operations

Increasing risk of landslides and erosion

Reduced snowpack and changes in runoff timing

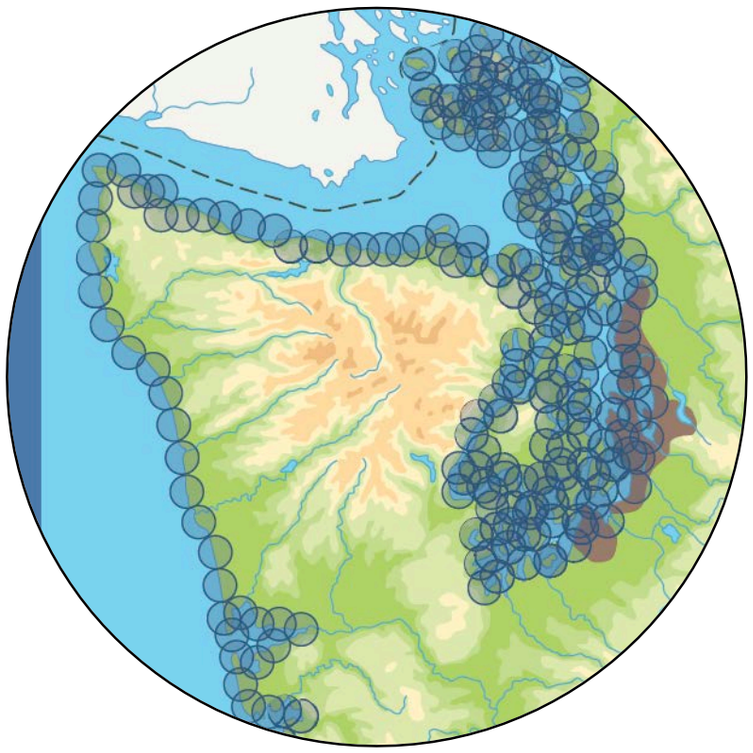
Fish Habitat Restoration

Higher peak streamflows and flood risk

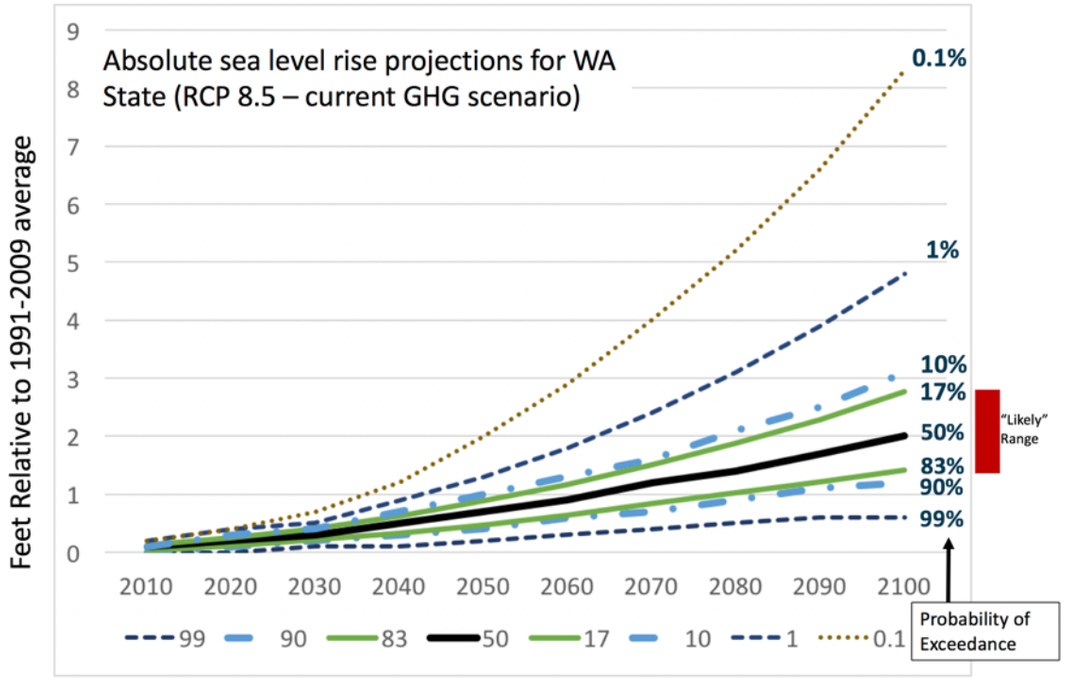
Lower summer streamflows

Source: NCA 2018

New science for WA decision making



State-of-the-science local sea level rise scenarios for risk-based decision making



Source: Miller et al. 2018 (Climate Impacts Group & WA Sea Grant – WA Coastal Resilience Project)
https://cig.uw.edu/resources/special-reports/sea-level-rise-in-washington-state-a-2018-assessment/

Challenges for the NW's stressed health system

Response options: expand monitoring & surveillance, community warnings & education and health system response capacities

Photos: CNN, Janice Peterson/US Forest Service, Community Science Institute

Source: NCA 2018

Vulnerable frontline communities

Response options: build inclusive processes, invest in communities, protect outdoor workers…

Photo: Anna King, Northwest News Network

Source: NCA 2018

2015: A preview of the future

Warmest year on record for the NW
~2.7ºC warmer than pre-industrial

7th driest January to June in the Northwest

Lowest snowpack on record for WA
30% of normal (1970-1999 average)

Data: NCA 2018
Figure: Climate Impacts Group

2015 provides a preview of impacts likely to become more frequent under global warming

FISHERIES

Low summer streamflow & warm waters resulted in fishery closures

>250,000 Columbia River sockeye salmon died

RECREATION

Low snowpack led to reductions in winter & summer recreation

42% shorter ski season at Stevens Pass

WILDFIRE

The most severe wildfire season in Washington's recorded history

>1,000,000 acres burned

>$253 million fire supression

AGRICULTURE

Warm temperatures & reduced water availability stressed WA agriculture

17 major crops with reduced yields

$633-733 million economic losses

Data: NCA 2018
Figure: Climate Impacts Group

Can we avoid 1.5°C of warming?

If current emission rates continue, the Earth's total carbon budget for limiting warming to 1.5°C will be used up in about 10 years.

The carbon budget is the maximum total amount of CO_2 and other greenhouse gases that can be emitted before causing warming above a specific level.

IPCC 2018

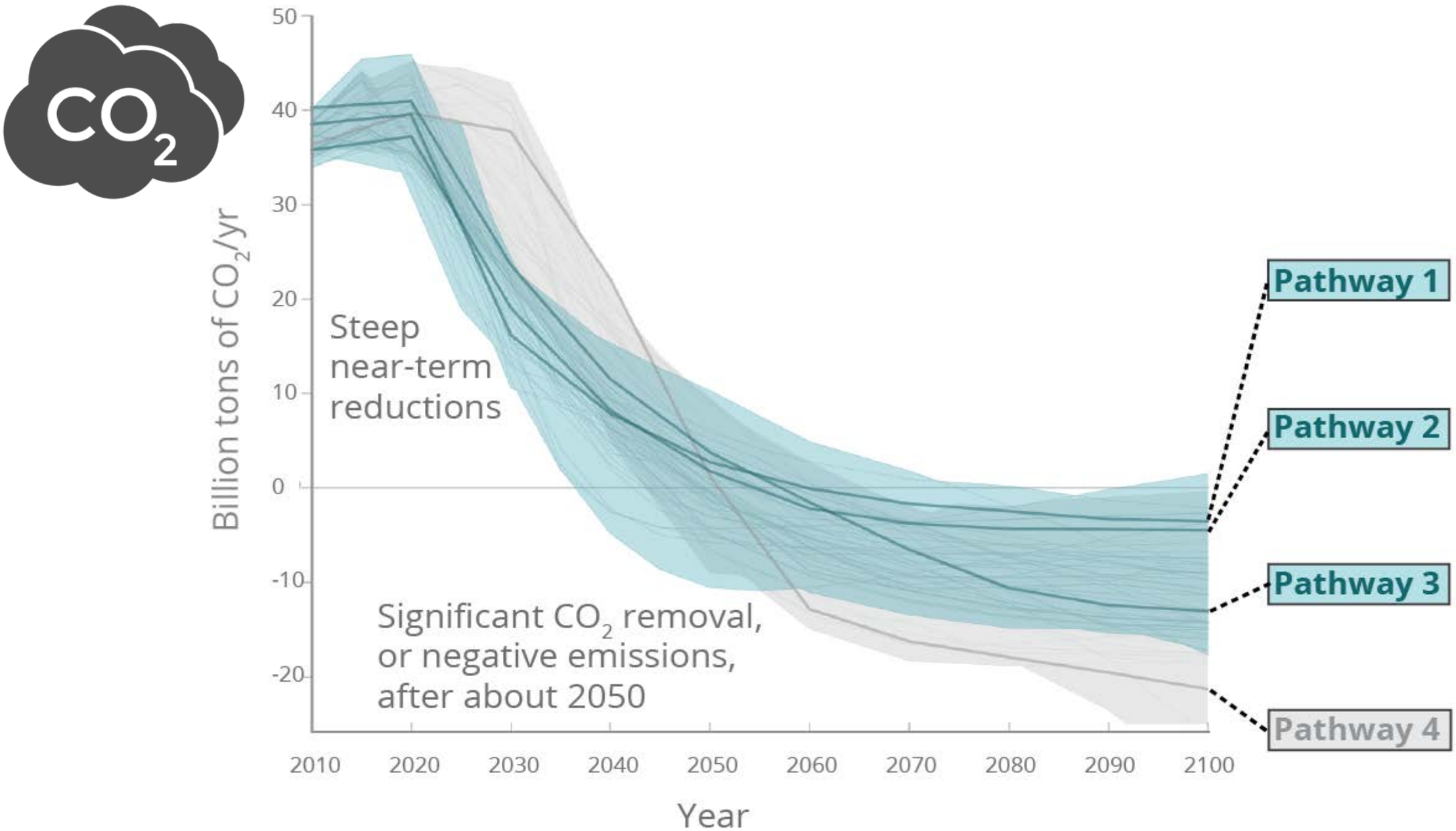
Stabilizing temperatures at ***any level*** requires net-zero emissions

As long as more CO_2 is added to the atmosphere than is removed, as is currently the case, global temperatures will continue to increase.

IPCC 2018

Limited time left to limit warming to 1.5°C

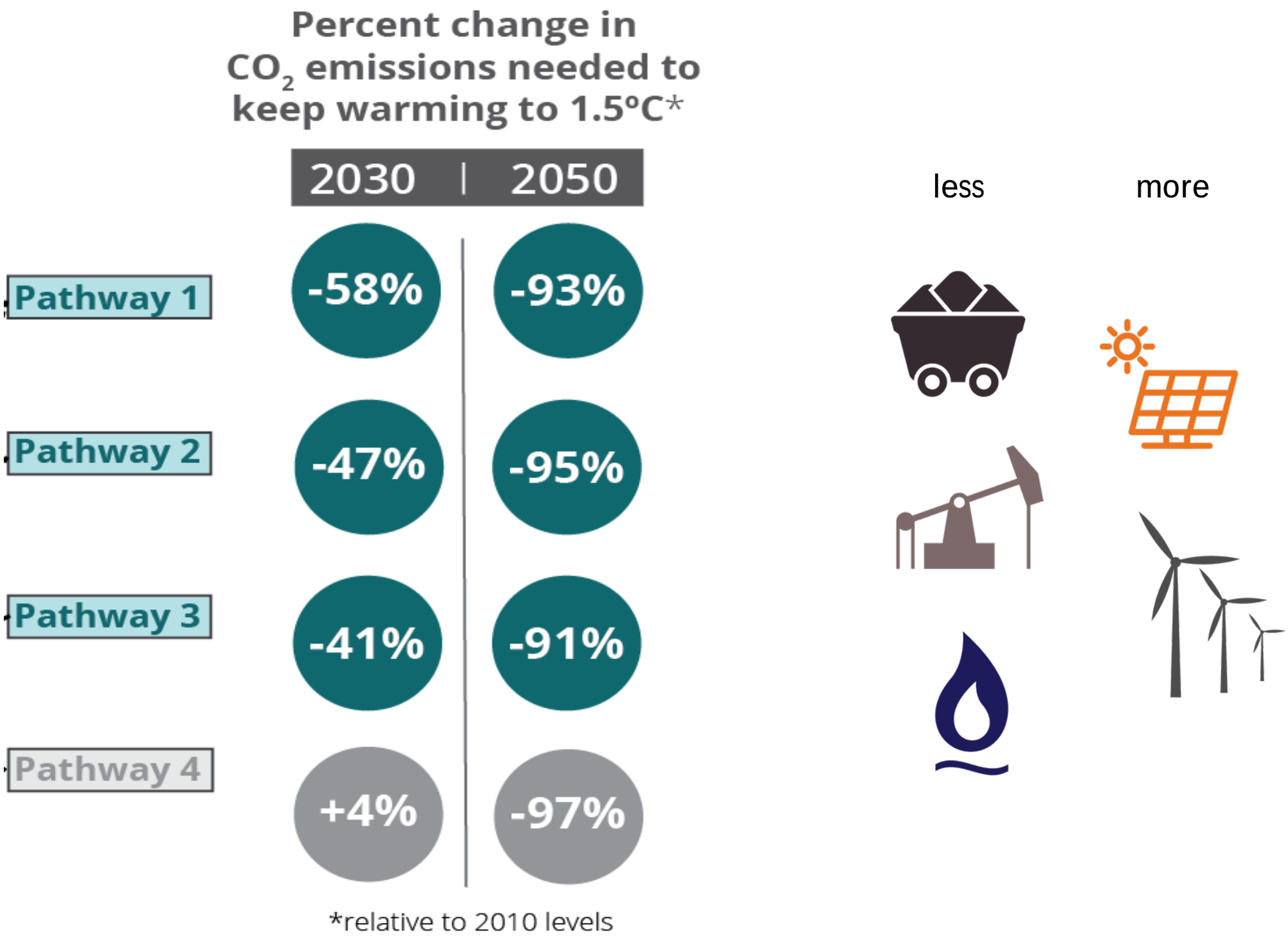
but we have options



Modified from IPCC 2018

Emission reductions required in all sectors

along with increased renewables, efficiency, carbon dioxide removal



Data from IPCC 2018

The extent of harm from global warming depends on…

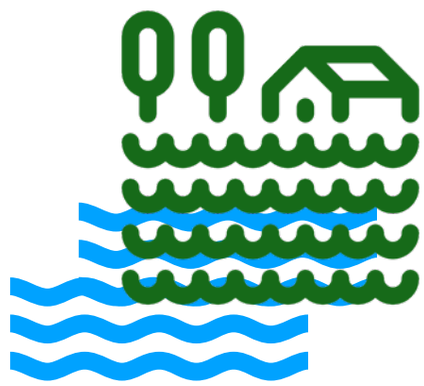
How much warming occurs

Our resilience to warming’s impacts

Today’s actions shape tomorrow’s risks through…

Choices about energy use, fuel type … greenhouse gas emissions

Deciding whether to plan & manage our communities, economy & ecosystems for the climate of the future or the climate of the past



Current efforts “do not yet approach the scale considered necessary to avoid substantial damages to the economy, environment and human health over the coming decades.”

- 4th National Climate Assessment
November 2018

Image: NASA/GSFC/Suomi NPP

Humans have caused ~1°C of warming, with impacts observed around the world.

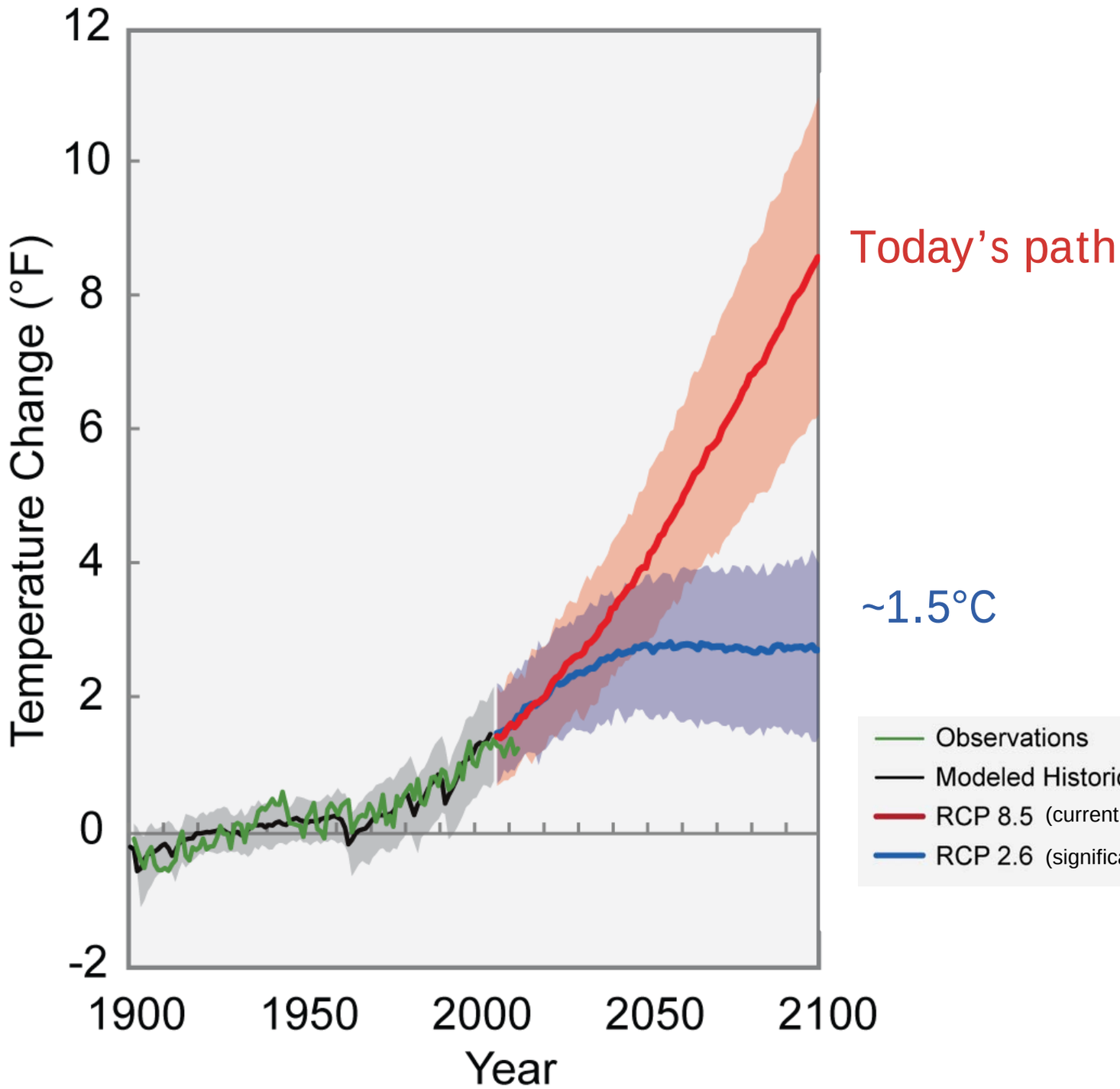
Climate-related risks are higher for global warming of 1.5°C than at present, and even higher at 2°C warming.

The window of time for limiting warming to 1.5°C and 2°C continues to narrow.

At the same time, additional emissions commit us to increasingly severe global and local impacts.

Efforts to both reduce and prepare for climate change must be rapidly scaled up in order to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent "dangerous interference with the climate system" and adequately prepare our state for the changes underway.

Which future? We choose.



Source: NCA 2018

Amy Snover

UW Climate Impacts Group

@CIG_UW | aksnover@uw.edu

cig.uw.edu

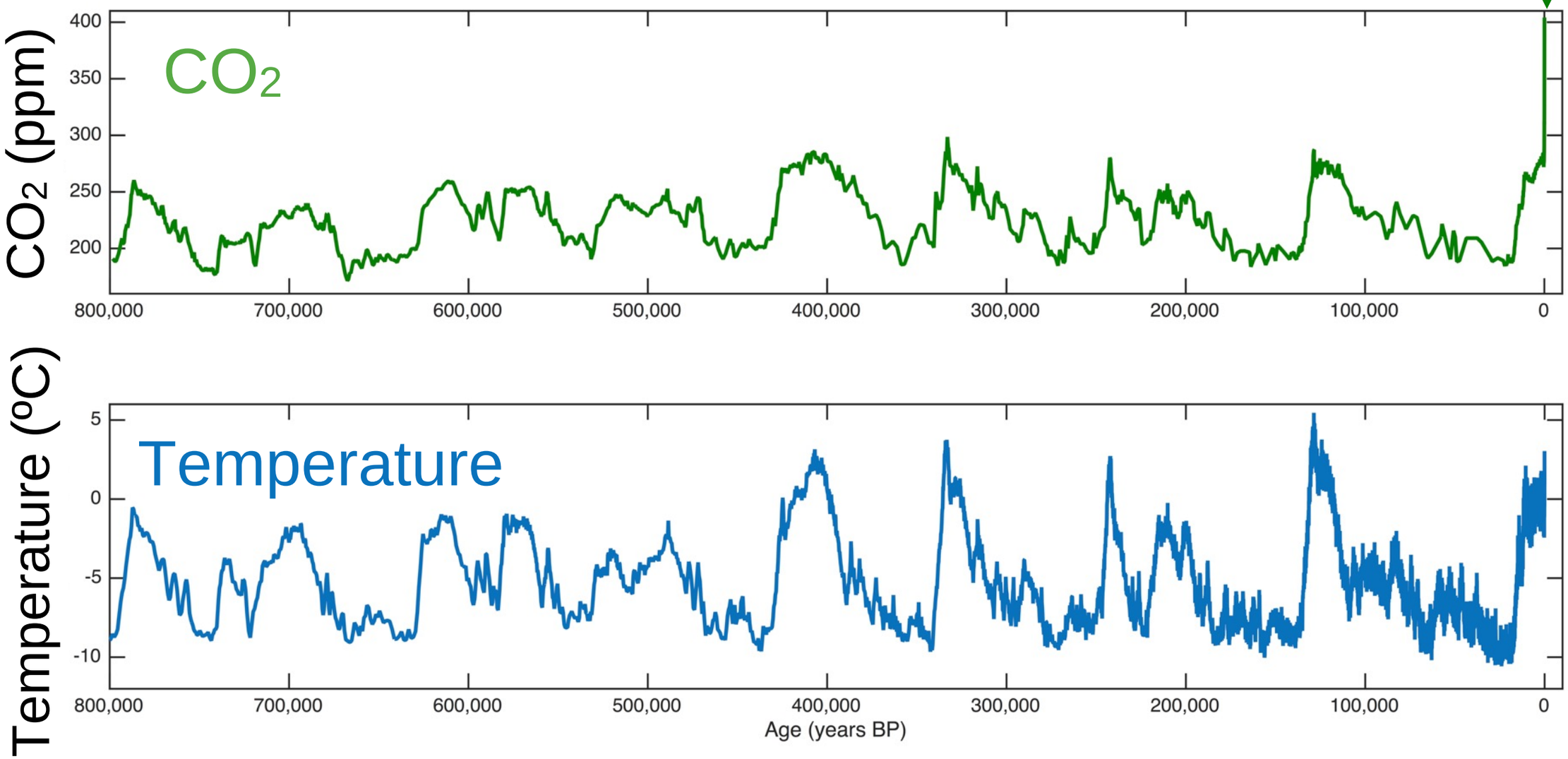
COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

EXTRAS

Available at CIG.uw.edu

800,000 yrs of CO_2 & Temperature

~410 ppm today



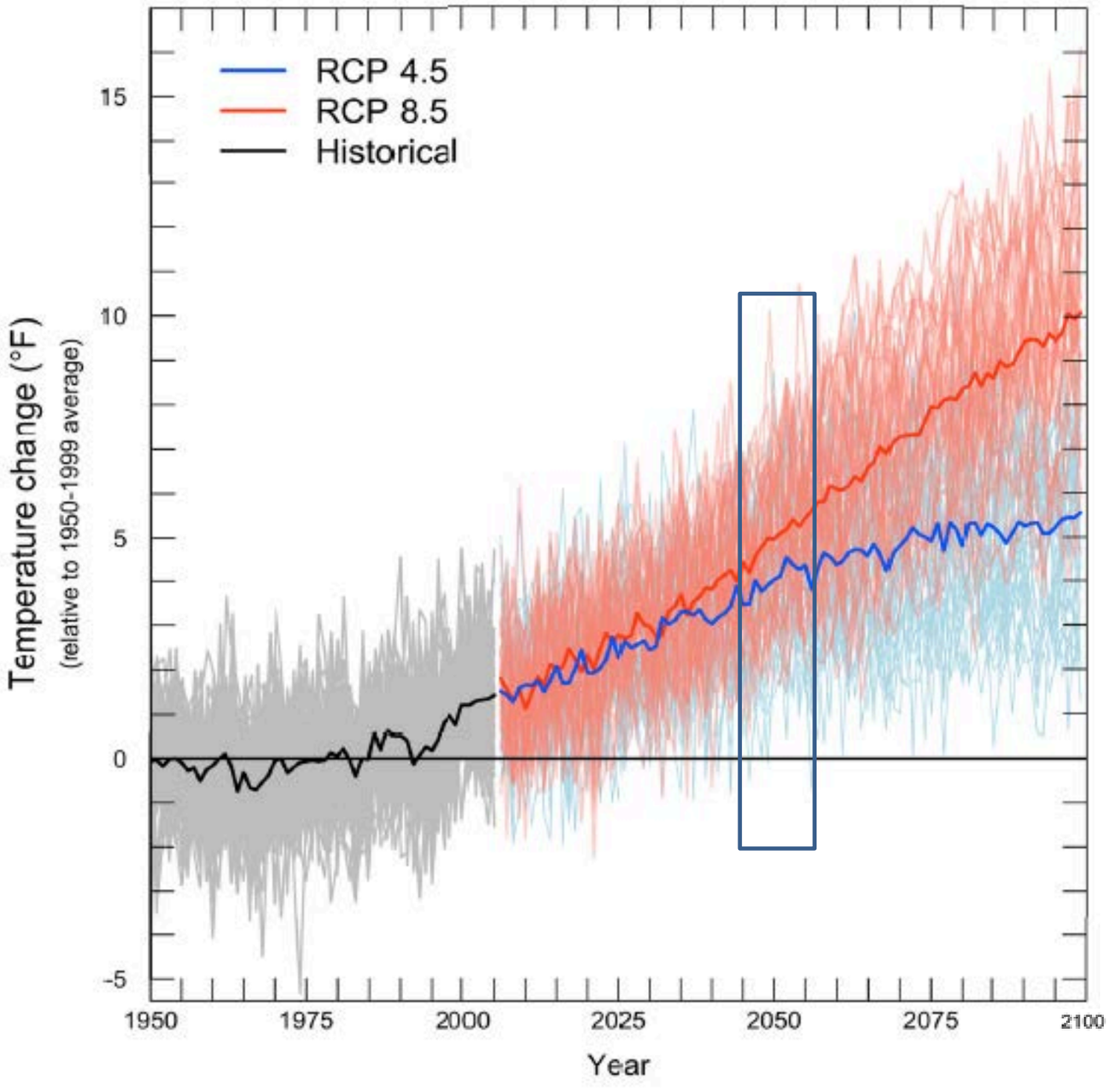
800,000 years ago

Time ⟶

Today

Data: Jouzel et al., 2007; Luthi et al., 2008

All scenarios: Continued NW warming



In the 2050s

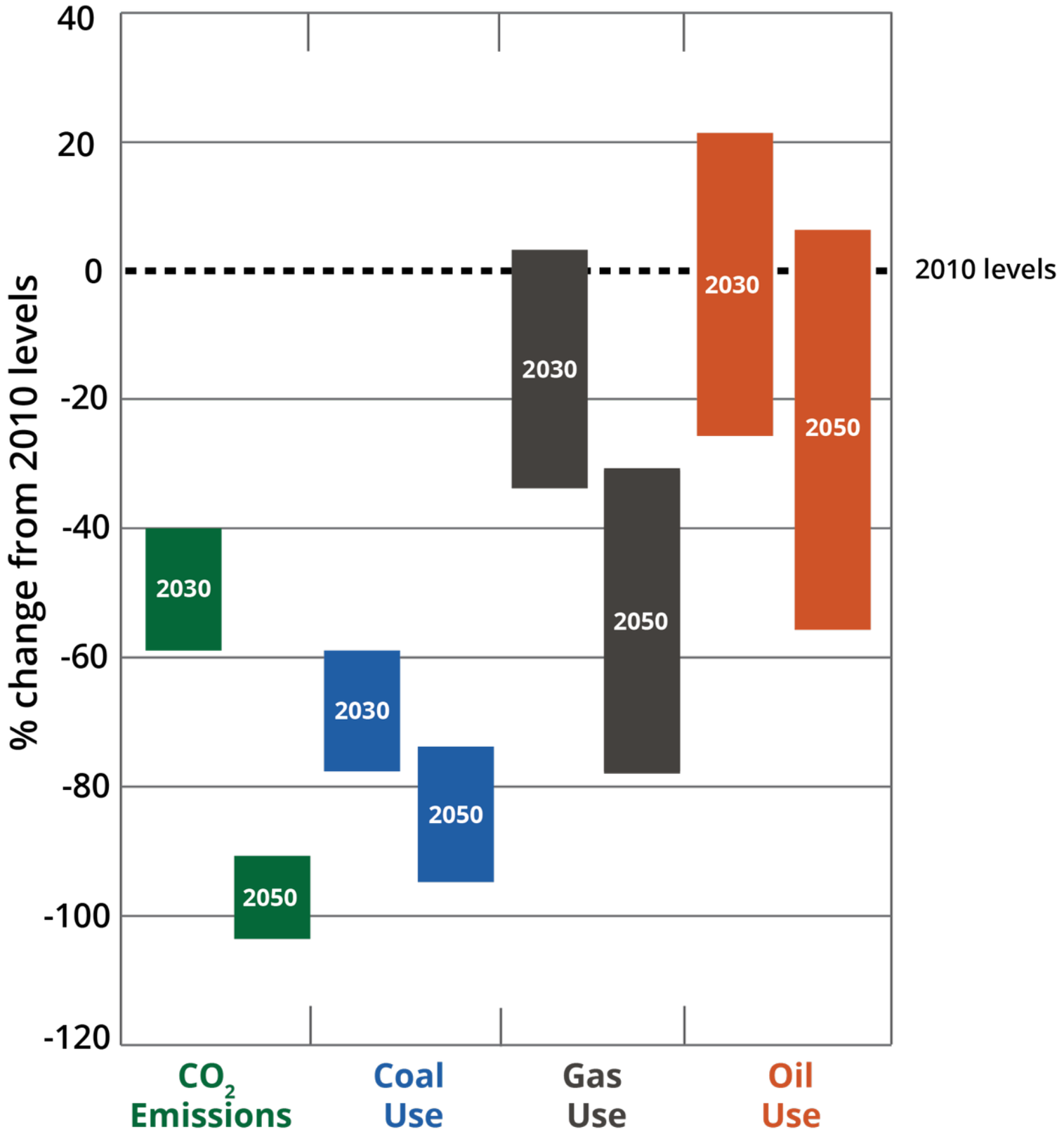
Business as usual:
3-9°F warmer

Very low emissions
2-7°F warmer

Relative to 1950-1999

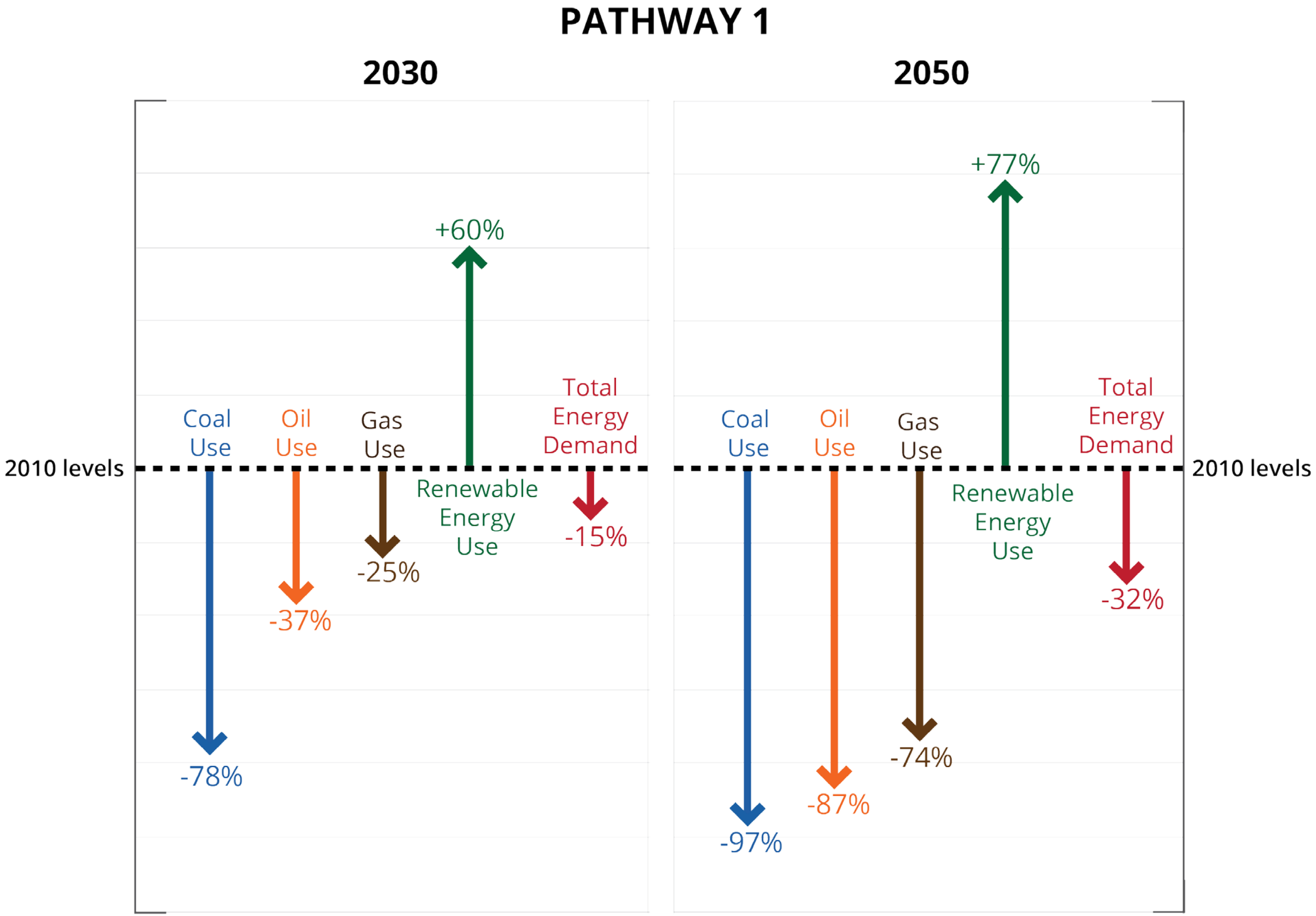
Snover et al. 2013

Mitigation strategies required to reduced global net CO_2 emissions to achieve no or limited overshoot of 1.5ºC (2.6ºF)



Data: IPCC, 2018

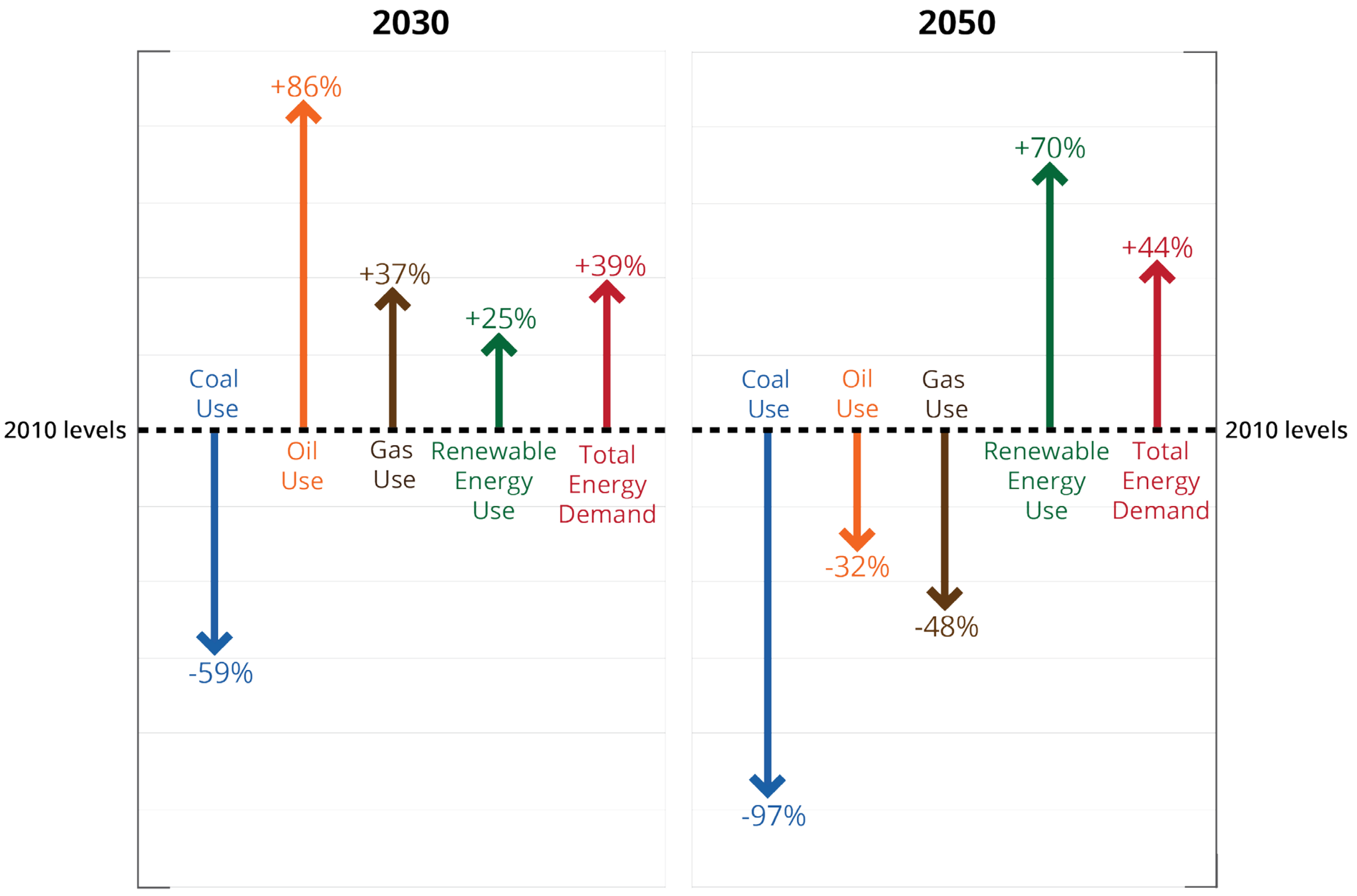
Mitigation strategies required to reduced global net CO_2 emissions to achieve no overshoot of 1.5ºC (2.6ºF)



Data: IPCC, 2018

Mitigation strategies required to reduced global net CO_2 emissions with overshoot of 1.5ºC (2.6ºF)

PATHWAY 4



Data: IPCC, 2018