



## Class 21: Climate Projections – Society and Economics

- What societal and economic impacts are expected?
- Acting now vs. later

### Learning Objectives

1. Be able to explain three broad social impacts of climate change
2. Understand the approaches that have been taken so far to attempt to slow climate change
3. Understand why addressing climate change now versus delaying response is both an ethical and economic question
4. Identify how two economic sectors will be impacted by climate change



Climate  
Communication,  
Advocacy &  
Literacy Lab  
& UVM's Clean  
Energy Fund

PRESENTS

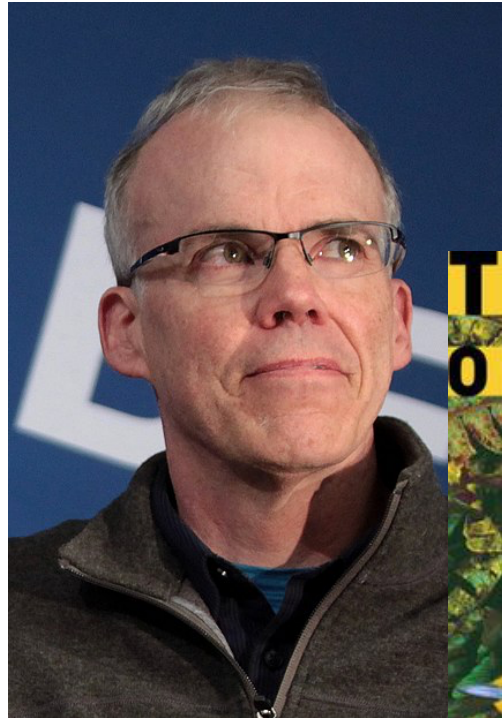
**BILL**

**MCKIBBEN**

CLIMATE SCHOLAR AND AUTHOR  
**FALTER: HAS THE HUMAN GAME  
BEGUN TO PLAY ITSELF OUT?**

Monday, December 2  
Silver Maple Ballroom | 4:30 - 5:30PM

Bill McKibben is an Environmental Author,  
Schuman Distinguished Scholar at Middlebury  
College, Climate Activist & Founder of 350.org

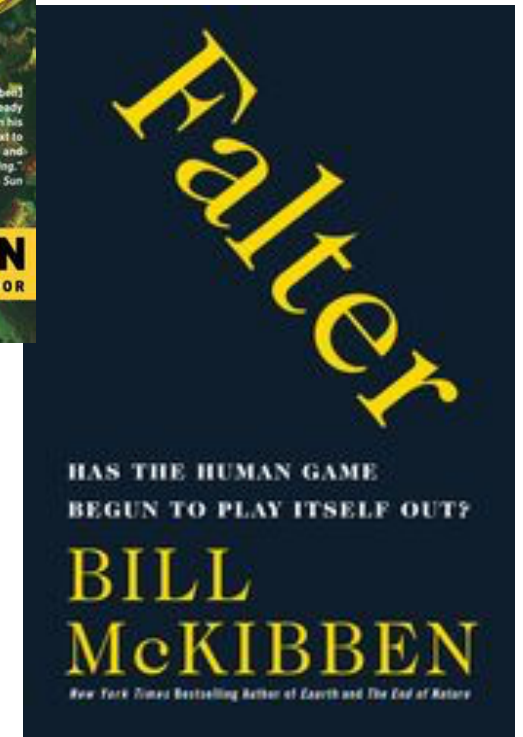
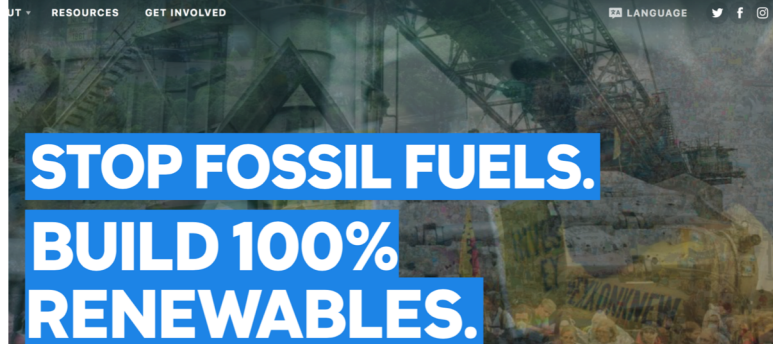


**Meghan Oates**

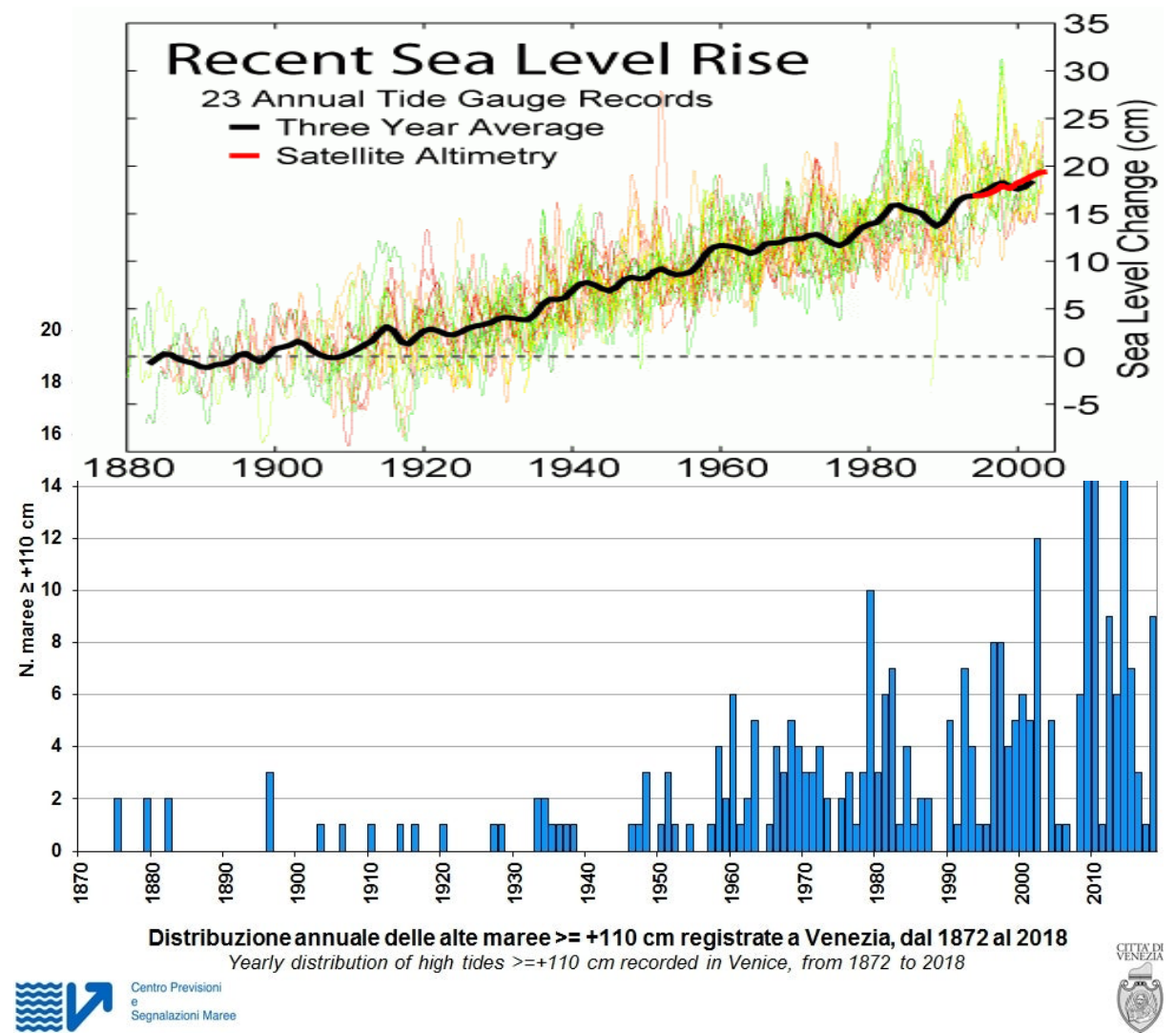
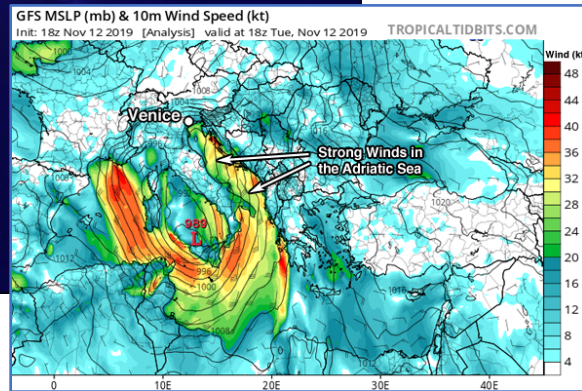
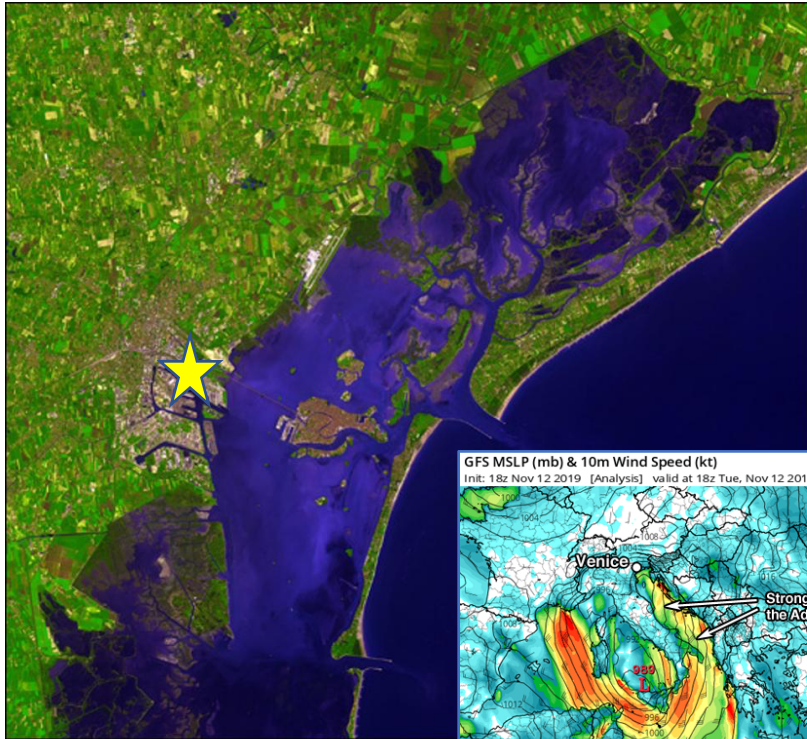


► Help 350.org build a powerful climate  
movement.

We believe in a safe climate and a better future — a just, prosperous,  
and equitable world built with the power of ordinary people. Help us get  
there!



# Science in the news - Venice under water



“The key lesson here is that these researchers framed the threat that Venice and other coastal regions face as being a trifecta of effects: land sinking, **sea level rising, and more severe storm surges.**” *Forbes*

# Venice – Cultural treasure and economic engine

**Venice is built on 118 small islands** and seems to float on the waters of the lagoon, composing an unforgettable landscape

**Venice is a unique artistic achievement.** The lagoon of Venice also has one of the highest concentrations of masterpieces in the world

**Venice symbolizes the people's victorious struggle against the elements** as they managed to master a hostile nature. It was from Venice that Marco Polo (1254-1324) set out in search of China, Annam, Tonkin, Sumatra, India and Persia.

<https://whc.unesco.org/en/list/394/>

“Critical as the climate crisis is, the city faces a more immediate risk: the rising tide of tourists, presently estimated at 25 million a year and projected to reach 38 million by 2025. Tourists €2billion annually in gross revenue to Venice alone.”

<https://www.theguardian.com/cities/2019/apr/30/sinking-city-how-venice-is-managing-europes-worst-tourism-crisis>

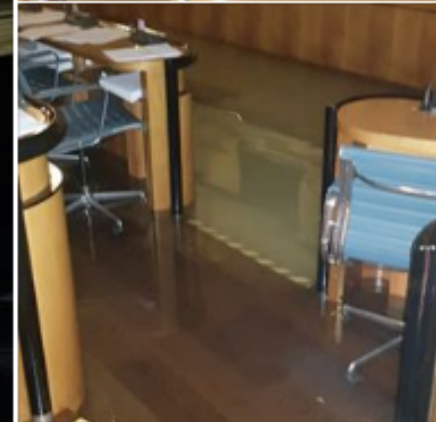


# Venice council flooded moments after rejecting climate crisis plan

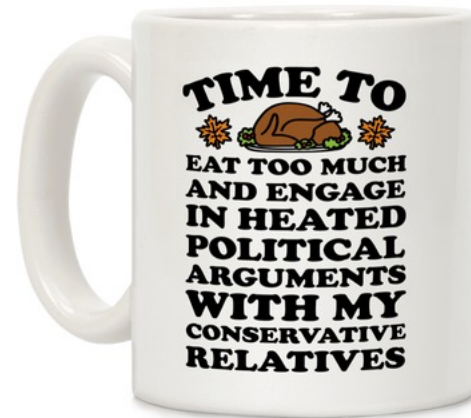
**Rightwing parties reject proposals as lagoon city faces worst flooding in 53 years**

In a [Facebook](#) post, Andrea Zanoni, the deputy chairman of the regional council's environment committee, explained the circumstances surrounding Tuesday night's event.

"The room flooded two minutes after the majority League, Brothers of Italy and Forza Italia had failed our amendments to counter climate change," he wrote, referring to two Italian right-wing parties and the center-right Forza Italia party.



# Thanksgiving Assignment



One way of communicating what you have learned about climate, climate change, and why it matters. Good conversation starter if you parents ask you what you've been doing at UVM all semester after the BIG meal.

# Assignment to prepare for end of class and Final Paper

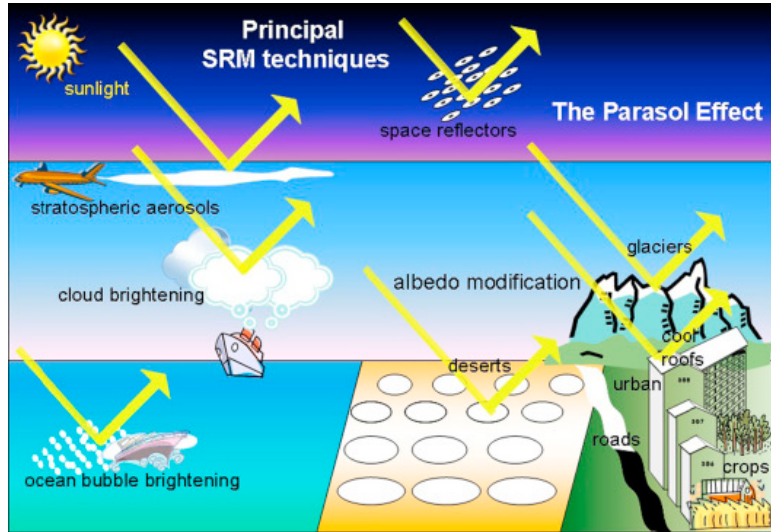
- 1. List the name of your home town paper and its URL (presuming it's on-line).**
- 2. Got your paper's web site and find its policy for public letters, often called an OP-ED, opinion, or an extended letter to the editor. You are looking for a means by which the paper will allow you to voice your opinion. Find that policy and copy it as your answer to this question.**
- 3. Read several OP-EDs or extended letters to the editor in your home town paper. Pick the one you find most convincing and give it's URL or upload a PDF. Then, In ONE SHORT PARAGRAPH, provide the title of the OP ED in your answer and tell us what it was about the writing style and presentation that made the OP-ED so convincing to you!**

**DUE TUESDAY DECEMBER 3 - we will announce FINAL PAPER topic then – it will be due TUESDAY DECEMBER 10 and be 400-600 words.**

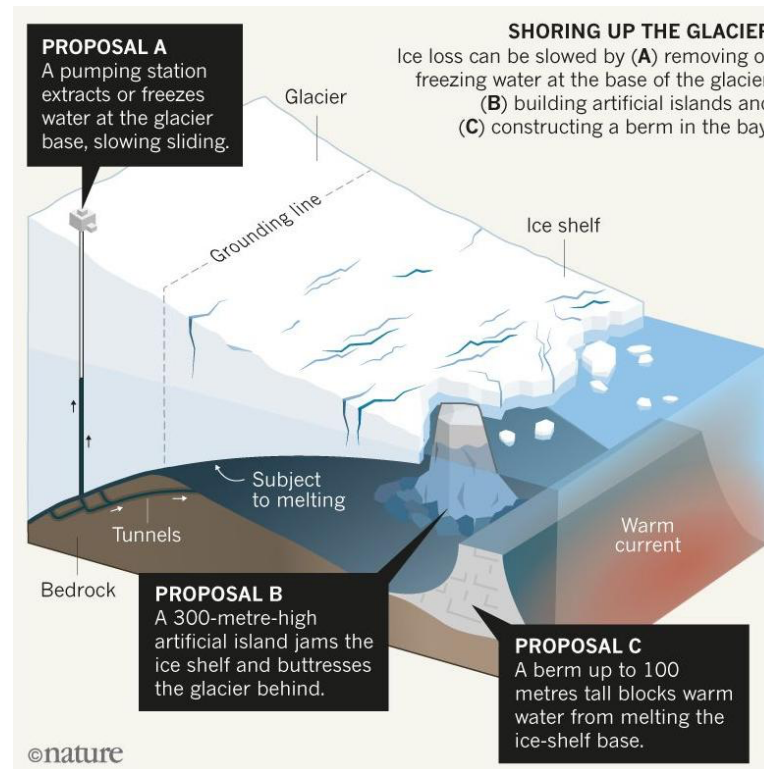


# Geoengineering Review

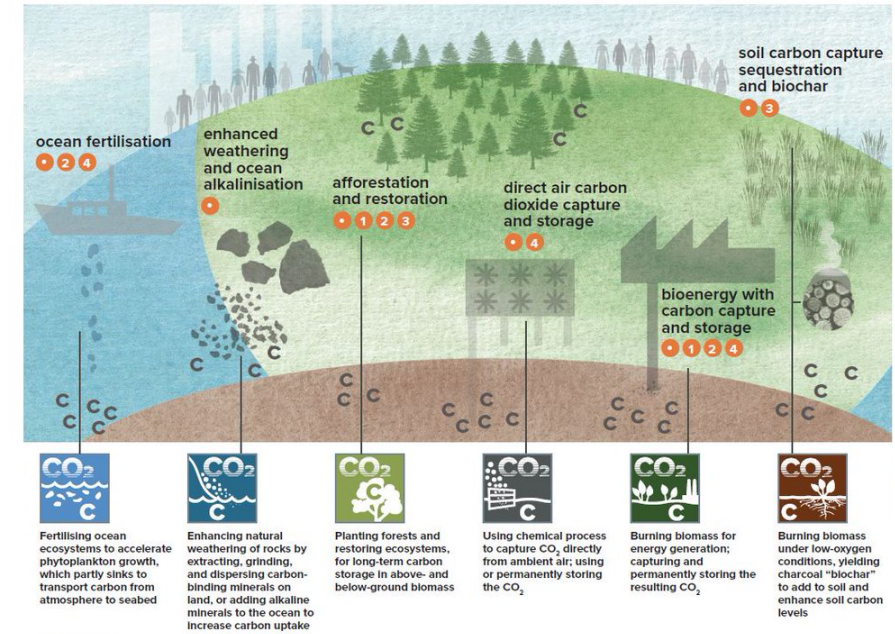
## 1. Solar radiation management



## 2. Manage the Cryosphere



## 3. Greenhouse Gas Removal



# Arguments against geoengineering

**IT DOESN'T WORK:** None of the technologies have a track record, all of them come with major risks and unknowns.

**WEAPONIZATION:** Geoengineering interventions can have regional winners and losers; to the extent that geoengineering successfully changes climate patterns in a predictable way, it will inevitably be weaponized.

**DETRACTS FROM REAL SOLUTIONS:** Geoengineering threatens to delay the implementation of a transition away from fossil fuels, and could redirect funding and investments away from real climate solutions. Some geoengineering proposals require vast amounts of energy.

**HUMAN RIGHTS AND BIODIVERSITY:** Many geoengineering proposals require the intensive exploitation of vast amounts of land. Those projects would inevitably displace millions of people and potentially wipe out entire ecosystems.

# Arguments for geoengineering

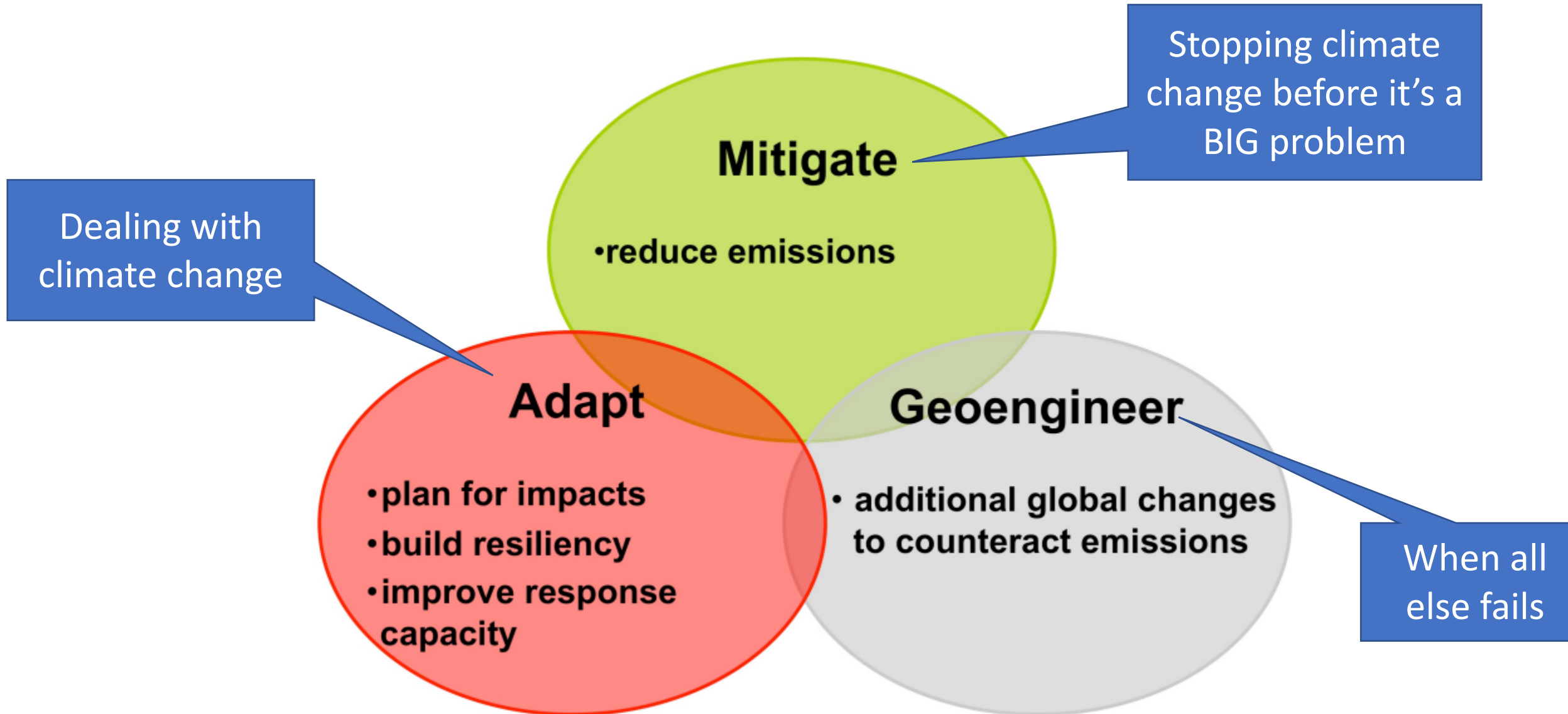
**Climate change could kill an estimated half-million people annually** by the middle of this century, through famine, flooding, heat stress, and human conflict.

Preventing temperatures from rising 2 °C above preindustrial levels, long considered the danger zone that should be avoided at all cost, **now looks nearly impossible.**

Notably, even if every nation sticks to the commitments it's made under the politically ambitious Paris climate accords, **global temperatures could still soar more than 5 °C by 2100.**

**280 million more people without access to adequate water;** 120 million more people exposed to major river floods; 12 million more people subjected to coastal flooding; 24% decline in global maize productivity

# REVIEW

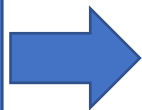


# Today's Class: Societal and Economic Implications

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Societal  
Impacts



Decarbonization  
Strategies



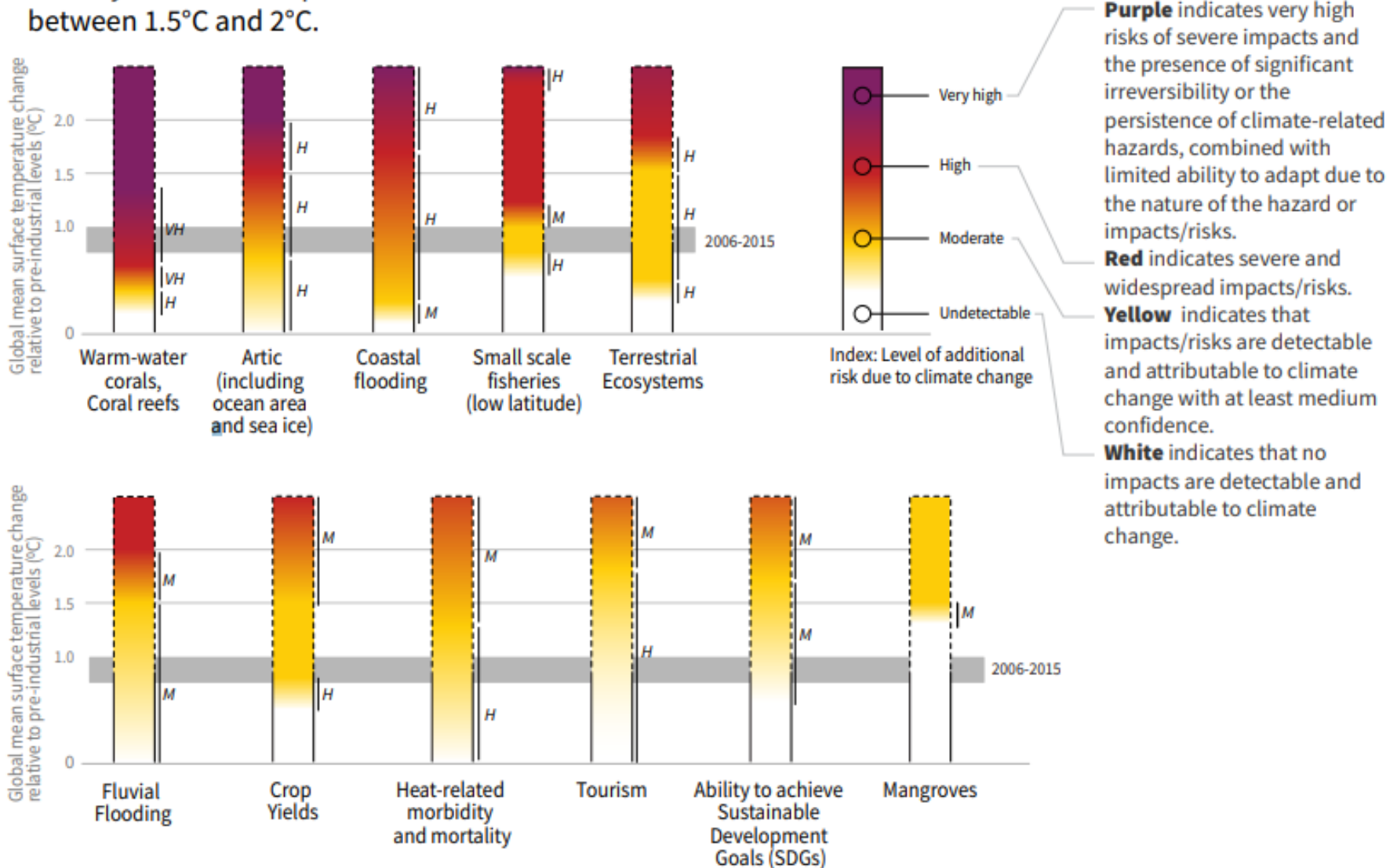
The BIG  
question: now  
vs. later



Economic  
Impacts

## Risks and/or impacts for specific natural, managed and human systems

The key elements are presented here as a function of the risk level assessed between 1.5°C and 2°C.



**Societal Impacts**  
*The hotter it gets, the greater the risks to society*

# Think-pair-share

List three, large scale societal impacts you and your partner think will be caused by climate change



## Air Pollution & Increasing Allergens

Asthma, cardiovascular disease,  
respiratory allergies

## Extreme Heat

Heat-related illness and death,  
cardiovascular failure

## Severe Weather

Injuries, fatalities, loss of homes,  
mental health impacts

## Environmental Degradation

Forced migration, civil conflict, mental  
health impacts, loss of jobs and income

## Degraded Living Conditions & Social Inequities

Exacerbation of existing social and health  
inequities and vulnerabilities

## Changes In Vector Ecology

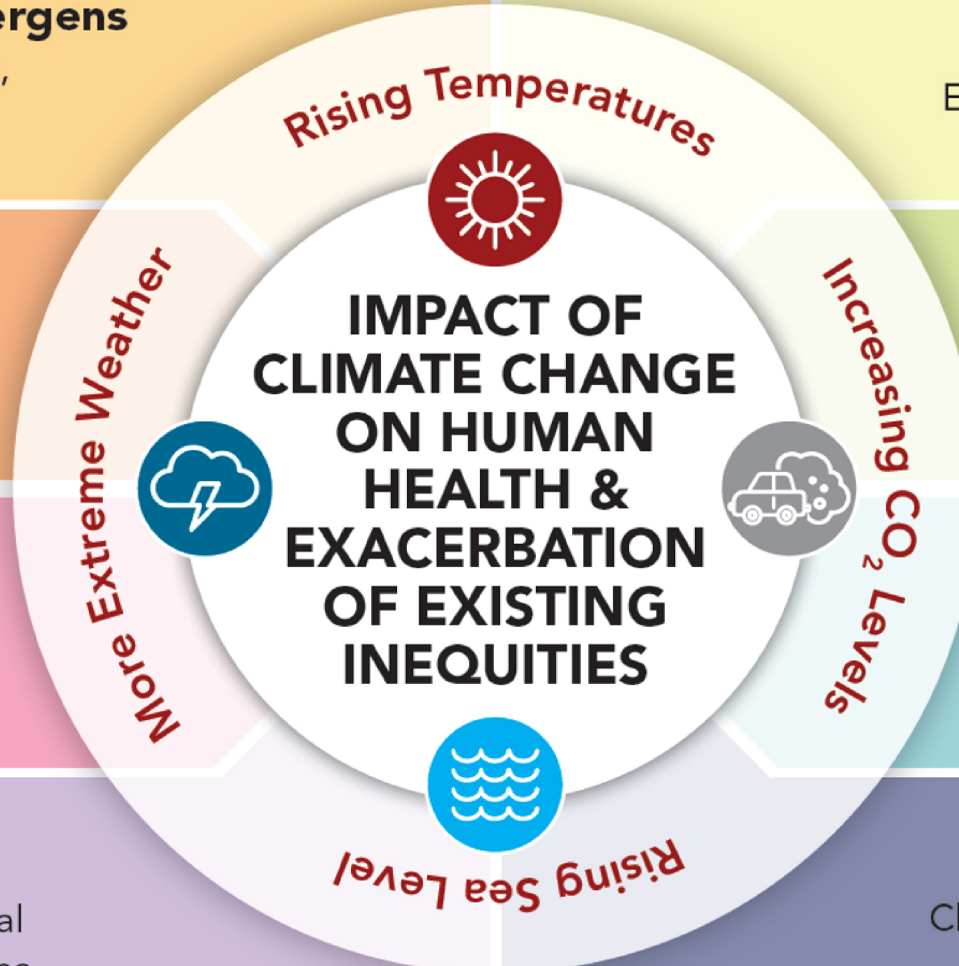
Malaria, dengue, encephalitis,  
hantavirus, Rift Valley fever, Lyme  
disease, chikungunya, West Nile virus

## Water & Food Supply Impacts

Malnutrition, diarrheal disease

## Water Quality Impacts

Cholera, cryptosporidiosis, Campylobacter,  
leptospirosis, harmful algal blooms



Adapted from CDC, J. Patz



# Societal Impacts of Climate change

- **Human Migrations** (driven by coastal flooding, heat, drought )
- **Resource shortages** (water, food, arable land)
- **Weather Damages** (storms, flooding, erosion)
- **Conflict** (as a net result of all of the above)

**Climate change is a matter of life and death.**

**3 out of 4 people** living in poverty rely on agriculture & natural resources to survive.



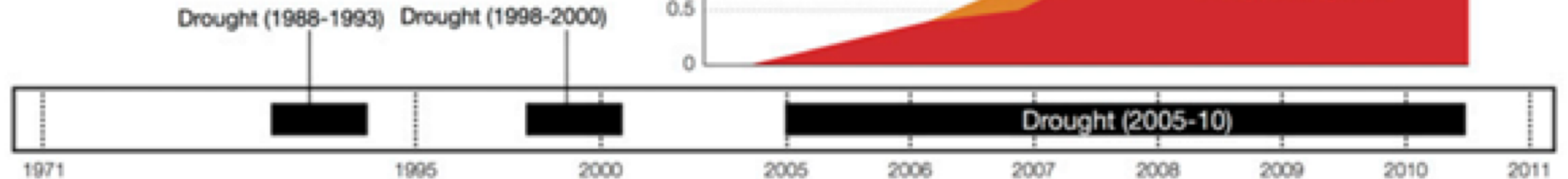
# Did drought lead to Middle East instability??

## Timeline of Events

### Prior to the 2011 Uprising

**1970s-1990s**

*Agricultural policies promote production of staple crops, leading to increase in number of groundwater wells and use of inefficient and outdated irrigation methods*



**12 March, 1971**  
*Hafez al-Assad becomes president of Syria*

*Syria achieves self-sufficiency in wheat production*

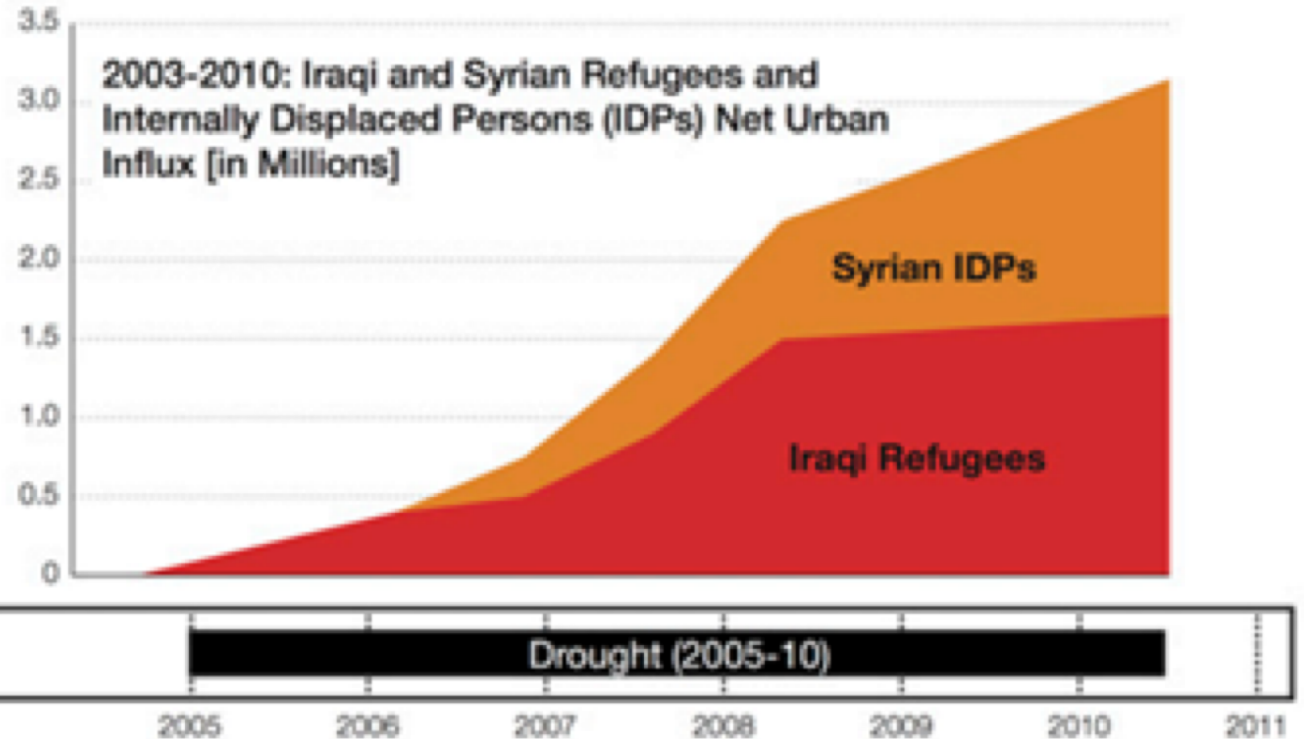
*Drying of the Khabur River in NE Syria*

**Since 2005**  
*Apartment prices in Damascus have more than doubled*

**Winter 2007-08:**  
*Driest in observed record*

**Since 2007**  
*Wheat, rice, and feed prices have doubled*

**March 2011**  
*Uprising in Syria*



## POSSIBLE MOBILITY RESPONSES TO DIFFERENT CLIMATE HAZARDS

Dependent on vulnerability and capacity



Slow onset



Slow or repeated sudden onset



Sudden-medium onset



Sudden onset



Soil gradually dries but access to irrigation allows people to continue planting



Sea-level rise or coastal erosion inundate lands and homes permanently



Drought or persistent heat waves reduce crop yields and incomes, contributing to movement



Floods, storms or cyclones temporarily displace people until infrastructure is restored



Stay and adapt



Migrate on a long-term basis



Displacement

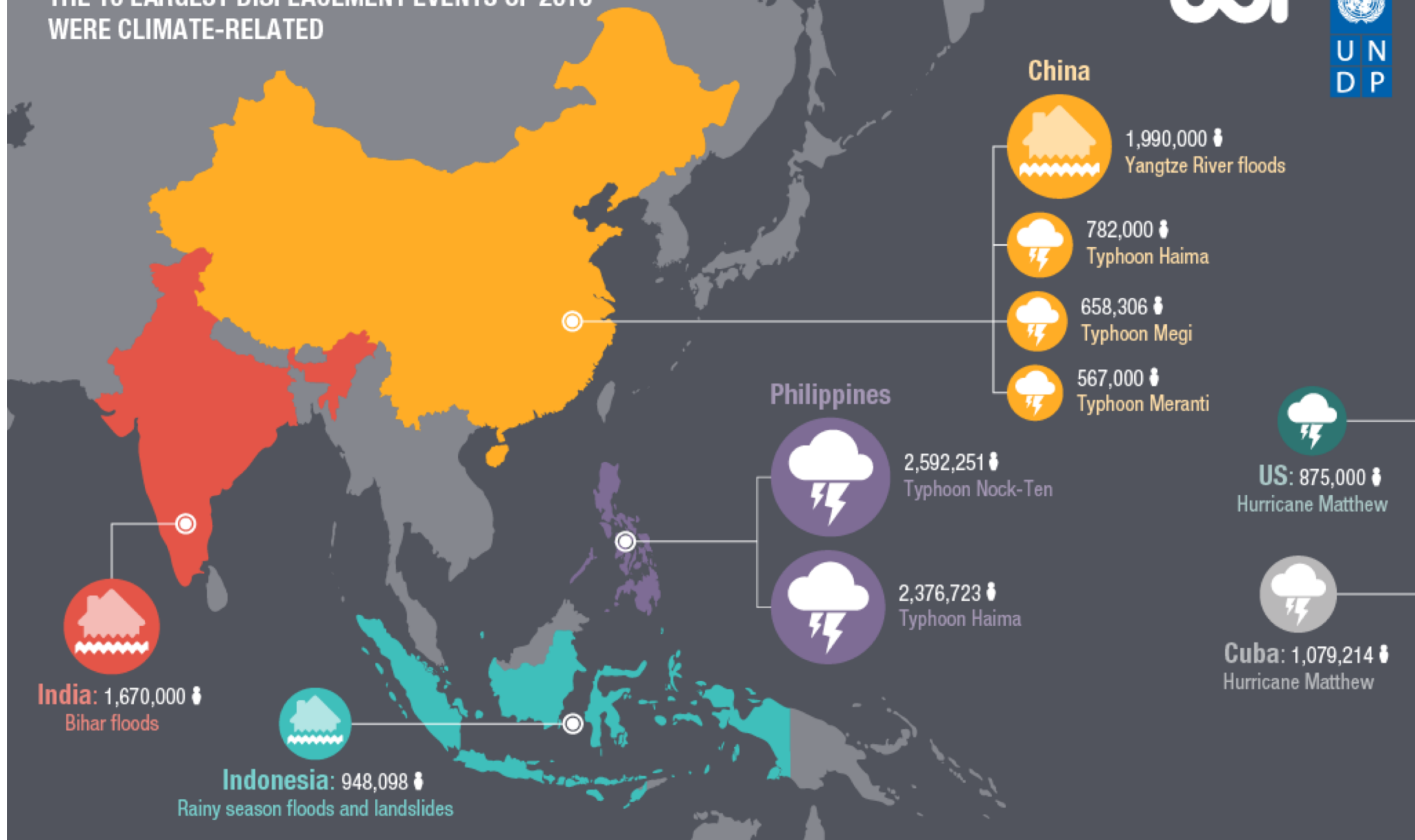


Migrate on a cyclical or temporary basis

People react differently to different climate and weather stressors

<https://www.odi.org/opinion/10470-infographics-climate-change-migration-and-displacement>

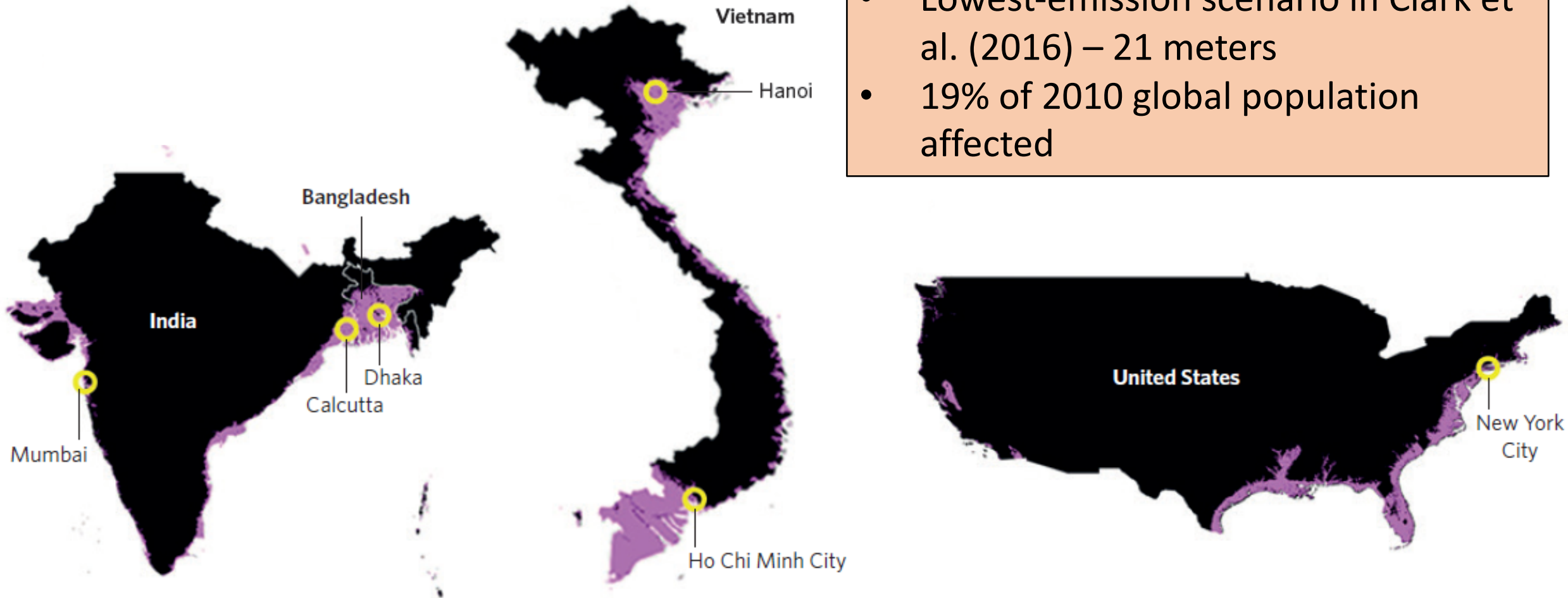
# THE 10 LARGEST DISPLACEMENT EVENTS OF 2016 WERE CLIMATE-RELATED



# Societal Impacts – 12,000 CE

## Long-term sea level rise

- Lowest-emission scenario in Clark et al. (2016) – 21 meters
- 19% of 2010 global population affected

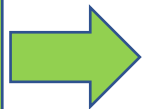


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Societal  
Impacts



Decarbonization  
Strategies



The BIG  
question: now  
vs. later



Economic  
Impacts

# The Economics of Decarbonization

<b>Climate Policy Toolkit</b>	<b>Supply-side</b>	<b>Demand-side</b>
<b>Restrictive (of fossil fuels)</b>	<i>Keep carbon in the ground</i>	<i>Nudge consumers away from carbon</i>
<b>Supportive (of alternatives)</b>	<i>Boost supply of alternatives</i>	<i>Encourage consumers to use alternatives</i>

# The Economics of Decarbonization – Restrictive Supply Side

## **Would require regulations specifically forbidding further extraction of fossil fuels**

- Possible that as the threat of more stringent green policies rises, fossil fuel companies will increase production (while the getting's good)
- Would decrease fossil fuel prices, increase consumption, and increase carbon emissions





# The Economics of Decarbonization

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# The Economics of Decarbonization – Supportive Supply Side

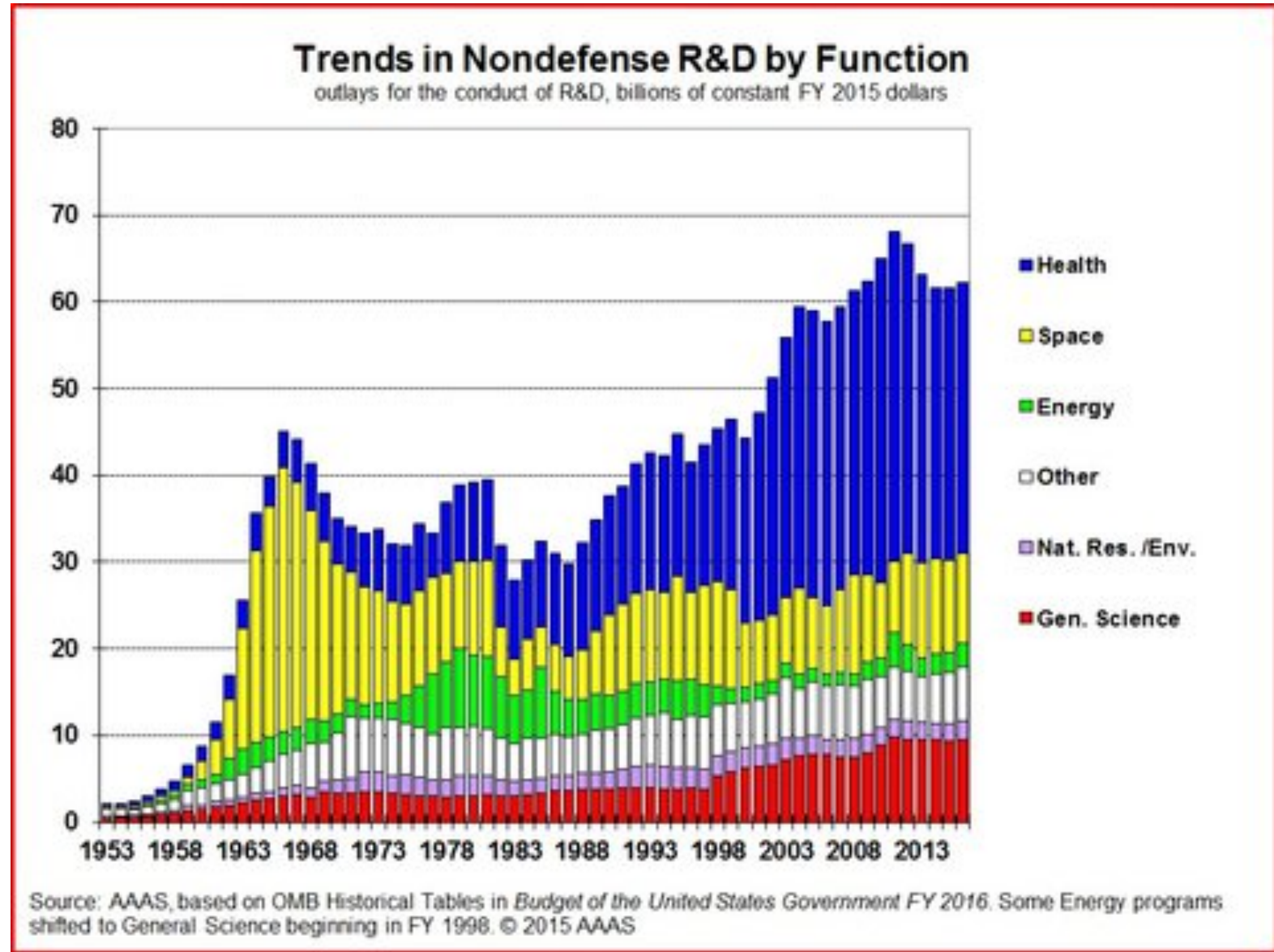
**Need to improve alternative energy technology**

**Must be cheaper to produce and store energy**



# The Economics of Decarbonization – Supportive Supply Side

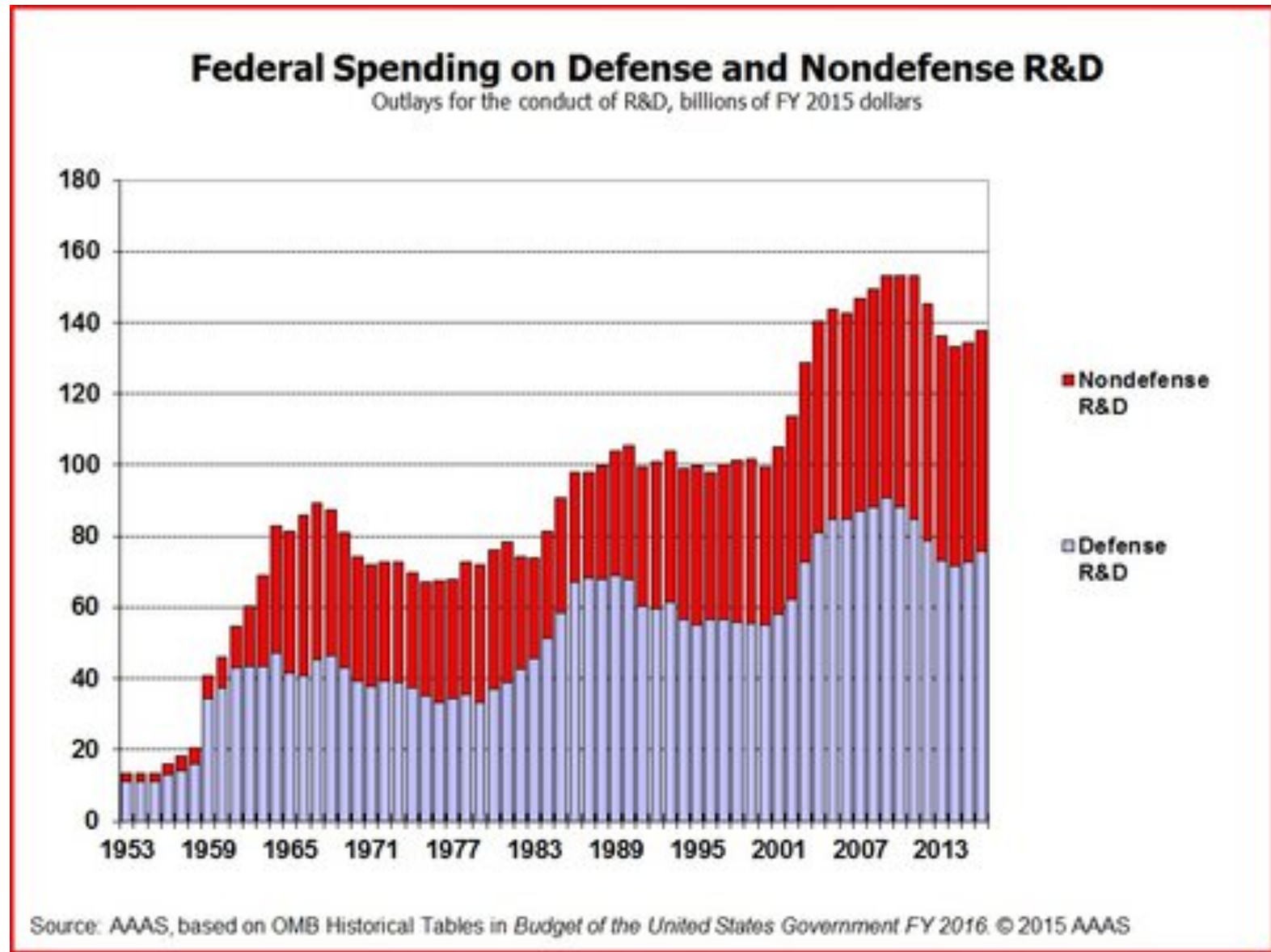
US has invested very little in energy for decades



# The Economics of Decarbonization – Supportive Supply Side

US has invested very little in energy for decades

Especially compared to how much we spend on defense



# The Economics of Decarbonization

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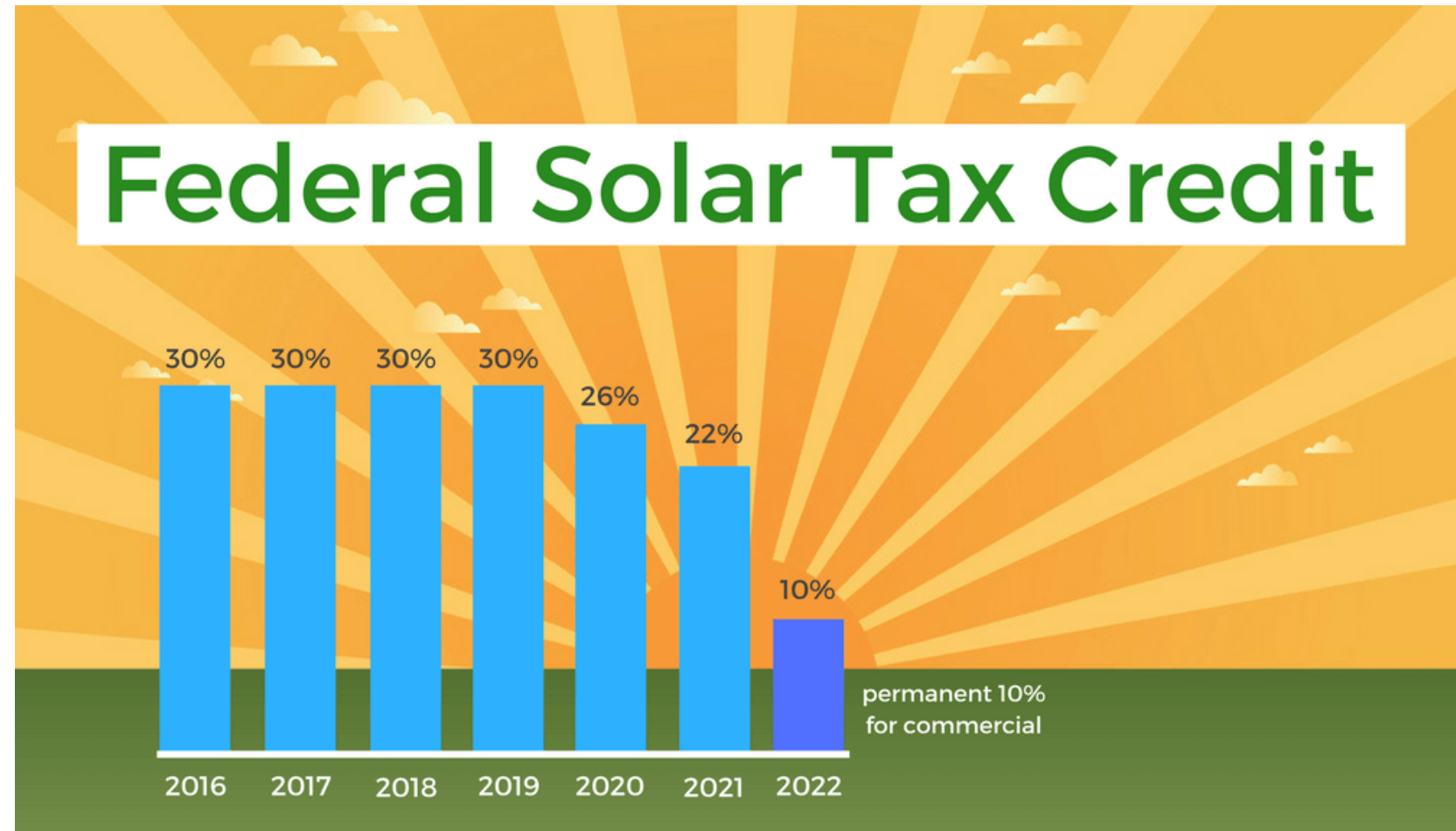
# The Economics of Decarbonization – Supportive Demand Side

## Tax credits for using renewable energy

Has inherent issues of inequity

Upfront cost for renewable infrastructure installment

Wealthier households can immediately take advantage



# The Economics of Decarbonization – Supportive Demand Side

## Vermont Weatherization Program

Tax on purchase of carbon-bearing heating fuels (e.g., propane)

Money raised goes to improving energy efficiency for low-income housing



Rep. Scott Beck, R-St. Johnsbury, speaks to the House Republican caucus in June 2018. Photo by Colin Meyn/VTDigger



# The Economics of Decarbonization

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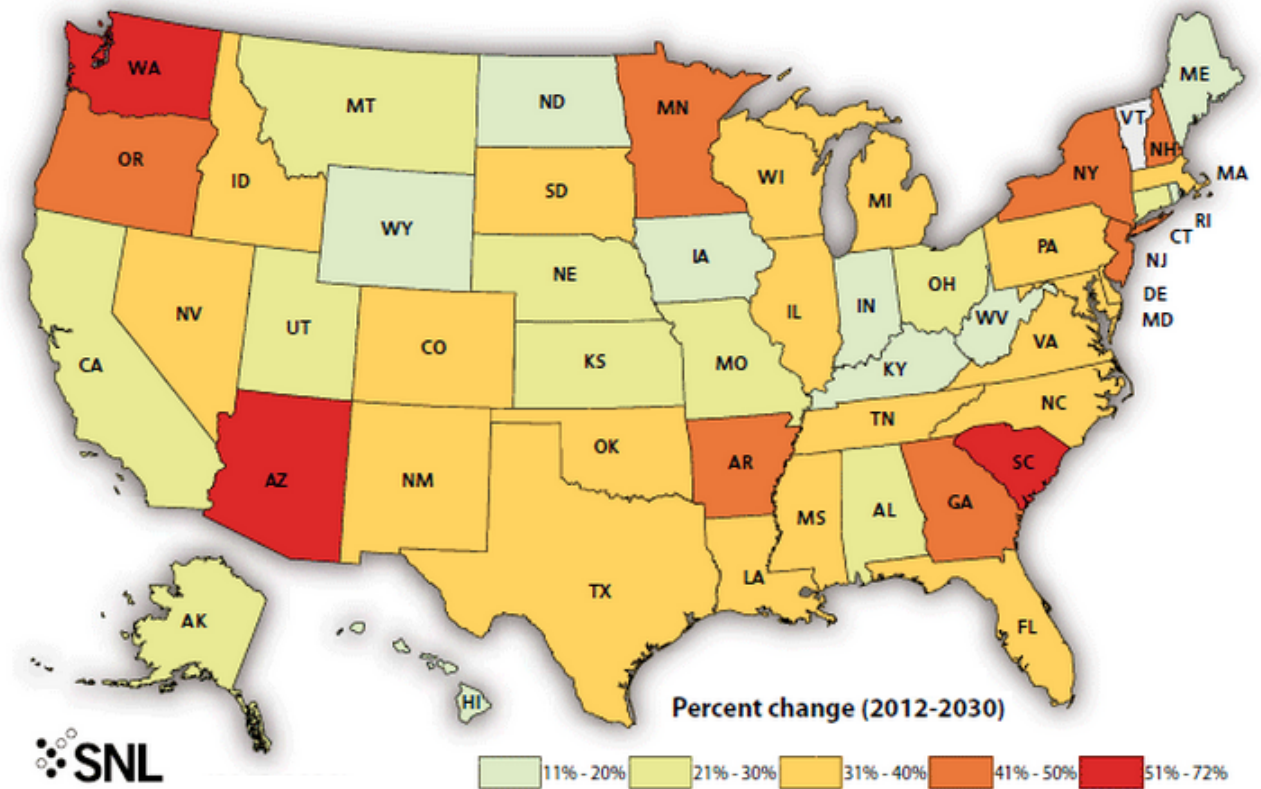


# The Economics of Decarbonization – Restrictive Demand Side

## 1. Regulate Emissions

- “Clean Power Plan” set emissions reductions for power plants

## EPA's proposed carbon emissions rates for existing plant



# The Economics of Decarbonization – Restrictive Demand Side

## 1. Regulate Emissions

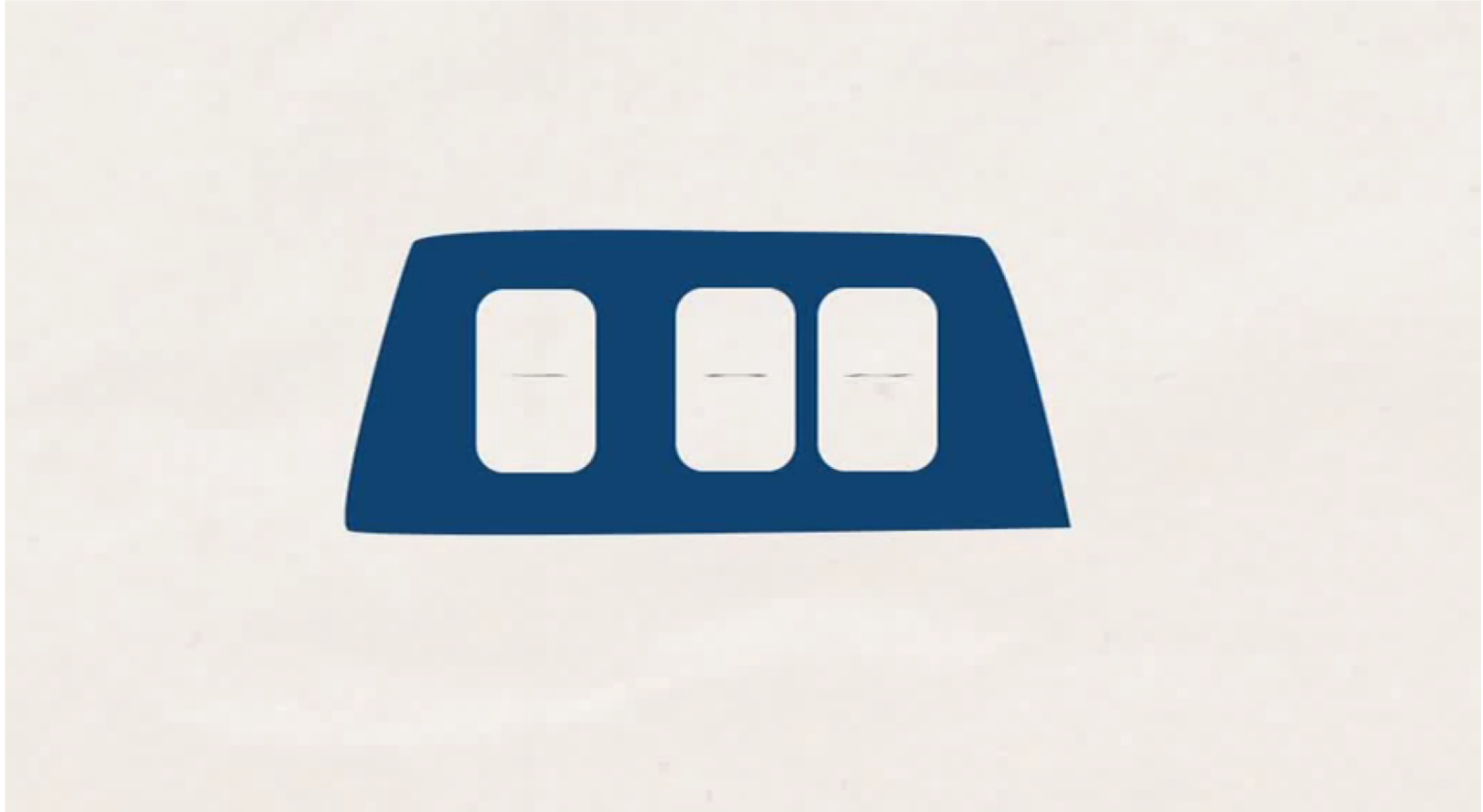
- “Clean Power Plan” set emissions reductions for power plants
- Easy to repeal by certain parties



# The Economics of Decarbonization – Restrictive Demand Side

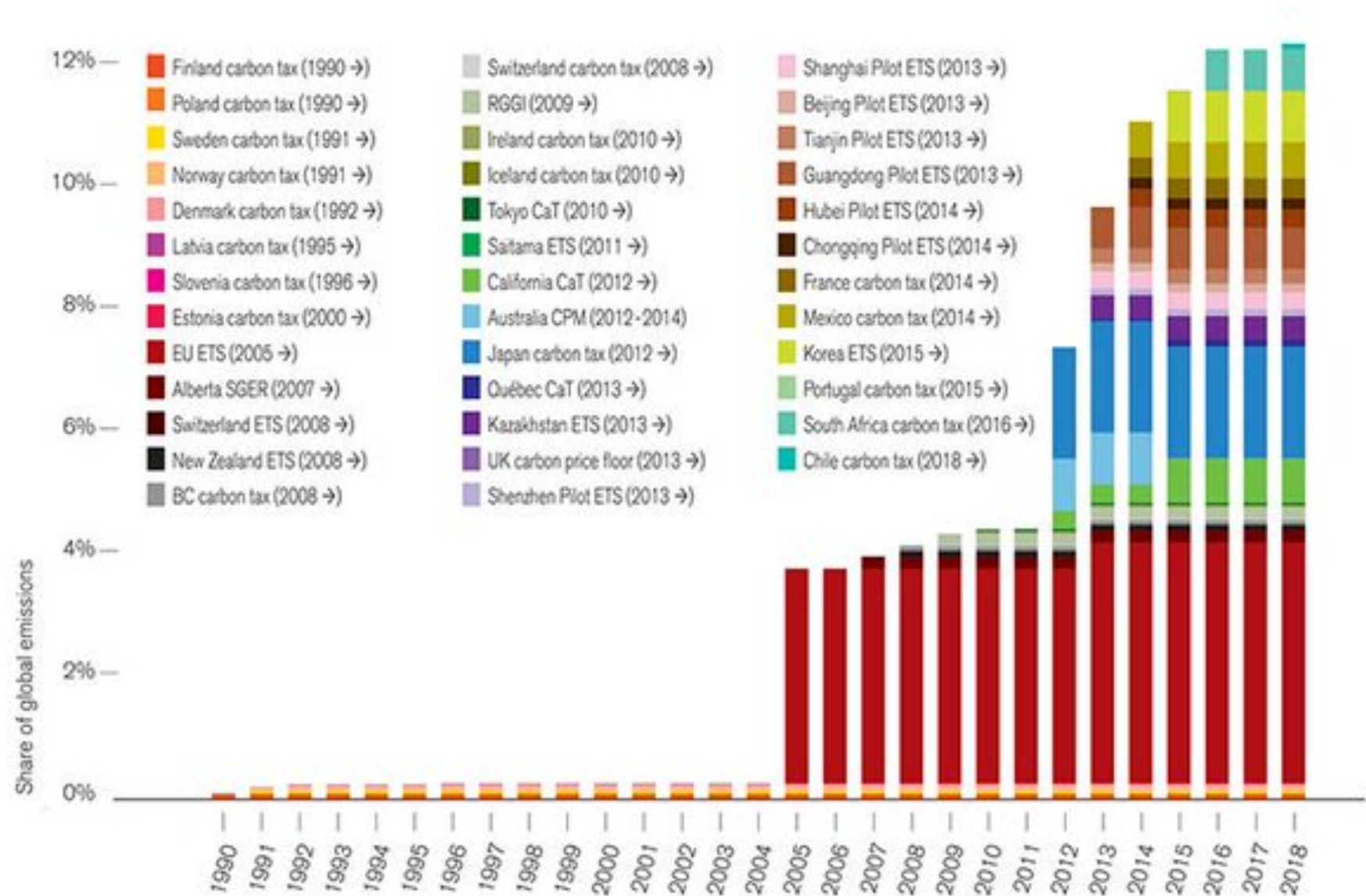
## 2. Put a price on carbon

- Price attached to the burning of fossil fuels based on their carbon content (e.g., \$25 per ton of CO<sub>2</sub>)
- Provides incentive for innovation
- Tax revenue can be put towards other needs



# The Economics of Decarbonization – Restrictive Demand Side

Carbon markets are growing...



# The Economics of Decarbonization

**All options (or combination of options) will require significant economic costs immediately**

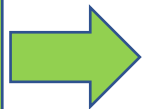
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The BIG  
question: now  
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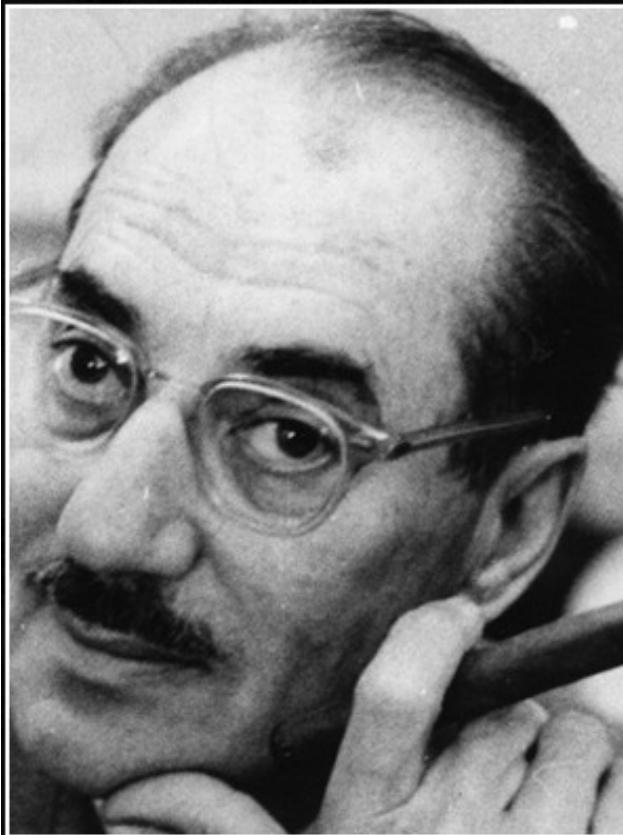


Economic  
Impacts

# The BIG Question: Present vs. Future

## The BIG question:

- How do we compare present costs of decarbonization against future benefits of reducing climate impacts?



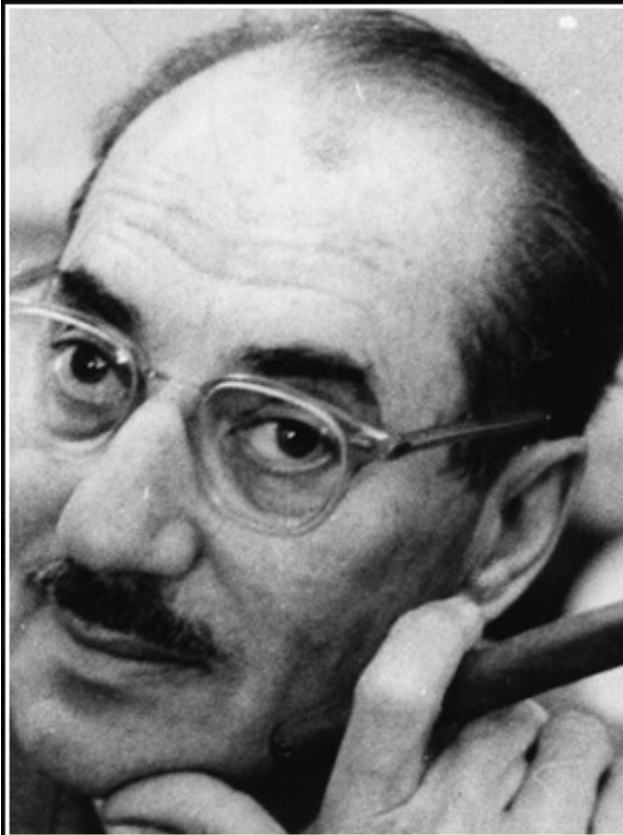
What have future generations ever  
done for us?

— *Groucho Marx* —

# The BIG Question: Present vs. Future

## The BIG question:

- How do we compare present costs of decarbonization against future benefits of reducing climate impacts? **Both an ethical and economic question!!**



What have future generations ever  
done for us?

— *Groucho Marx* —



# The BIG Question: Present vs. Future

## Ethics of the BIG question

- Reducing climate impacts for future generations

*Surely we have a responsibility  
to leave for future generations  
a planet that is healthy and  
habitable by  
all species*



Sir David Attenborough

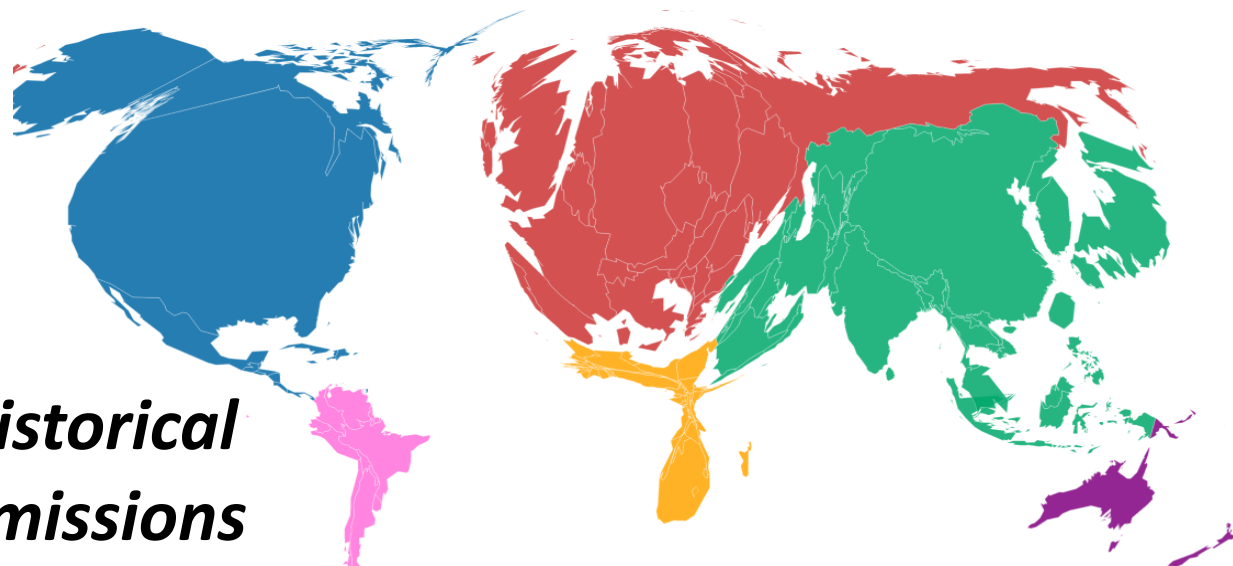
[philharding.net/quotes-corner/](http://philharding.net/quotes-corner/)

# The BIG Question: Present vs. Future

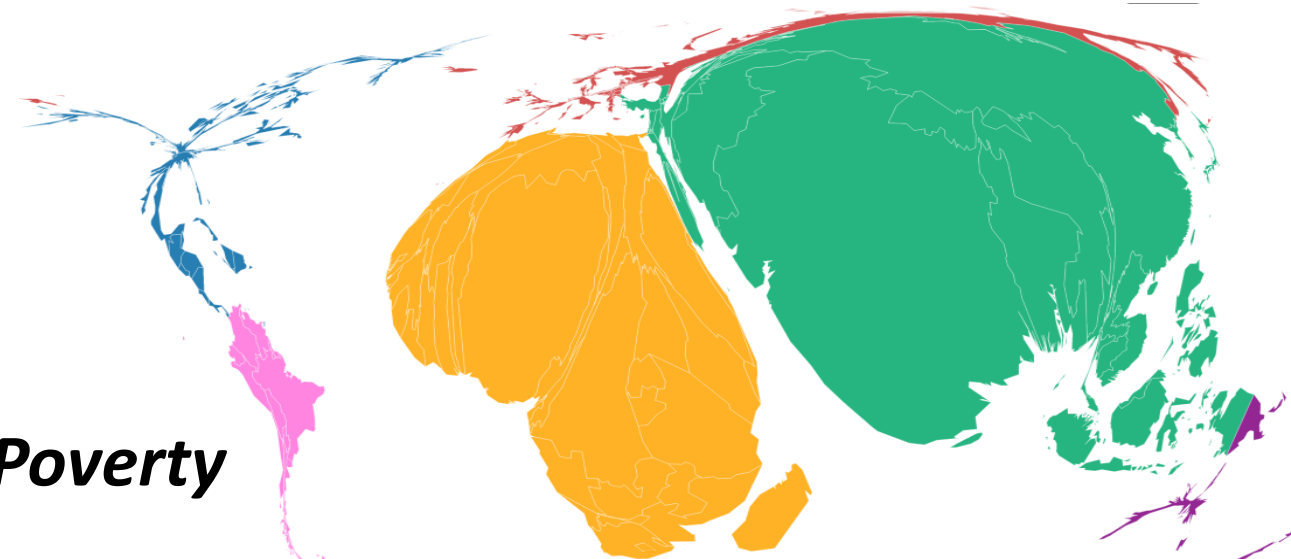
## Ethics of the BIG question

- Reducing climate impacts for future generations
- Unequal impacts – Wealthier countries emit more, poorer countries will be less adaptable to future changes

***Historical emissions***



***Poverty***

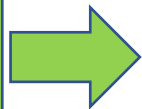


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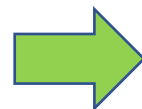
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# Economics – Present vs. Future

**Some things we know with confidence (based on historical data):**

- Most crop yields decrease strongly past a temperature threshold

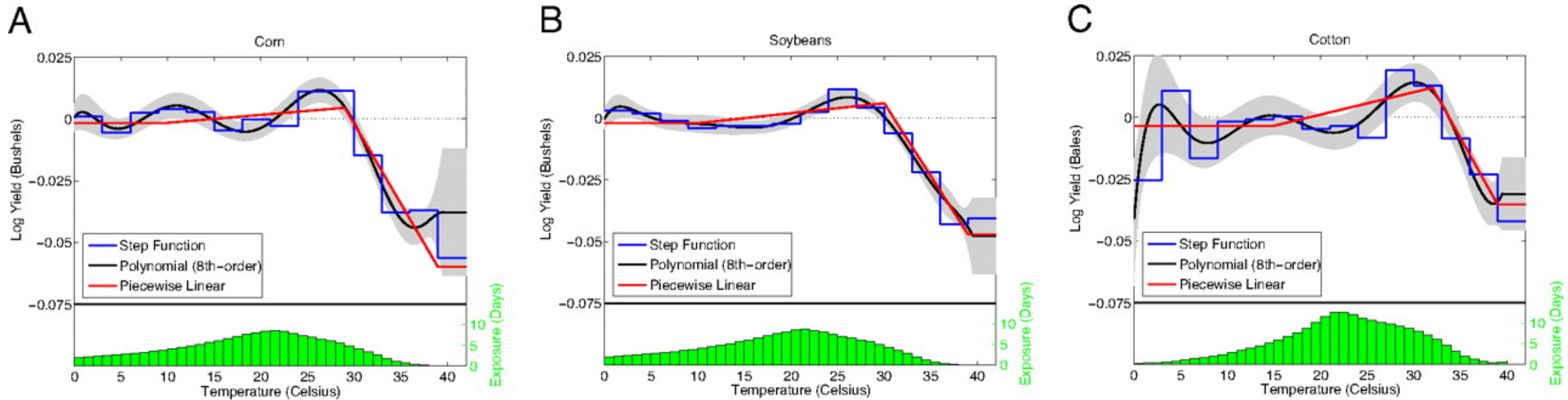
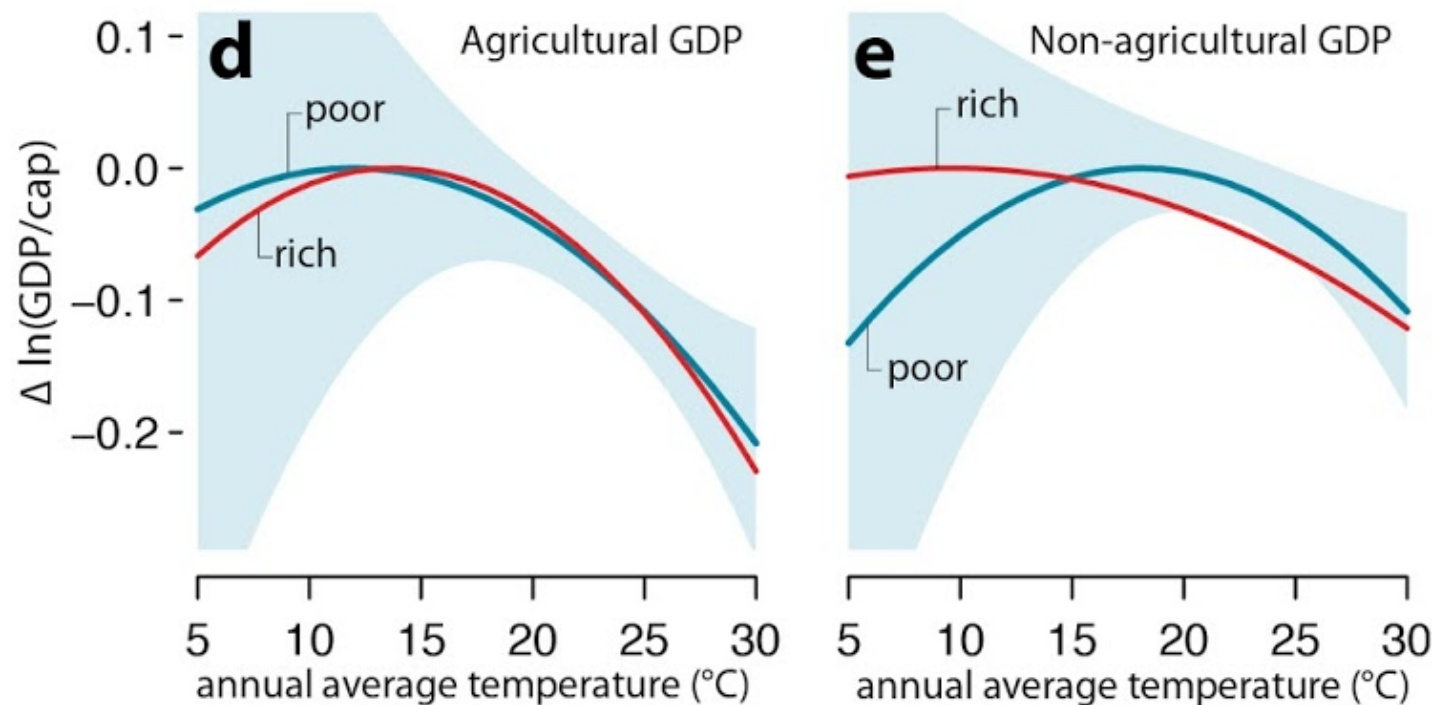


Figure from Schlenker and Roberts (2009)

# Economics – Present vs. Future

## Some things we know with confidence (based on historical data):

- Economic output maximized at moderate temperatures
- Output declines strongly at hotter temperatures
- Especially true for agriculture-heavy countries



# Economics – Present vs. Future

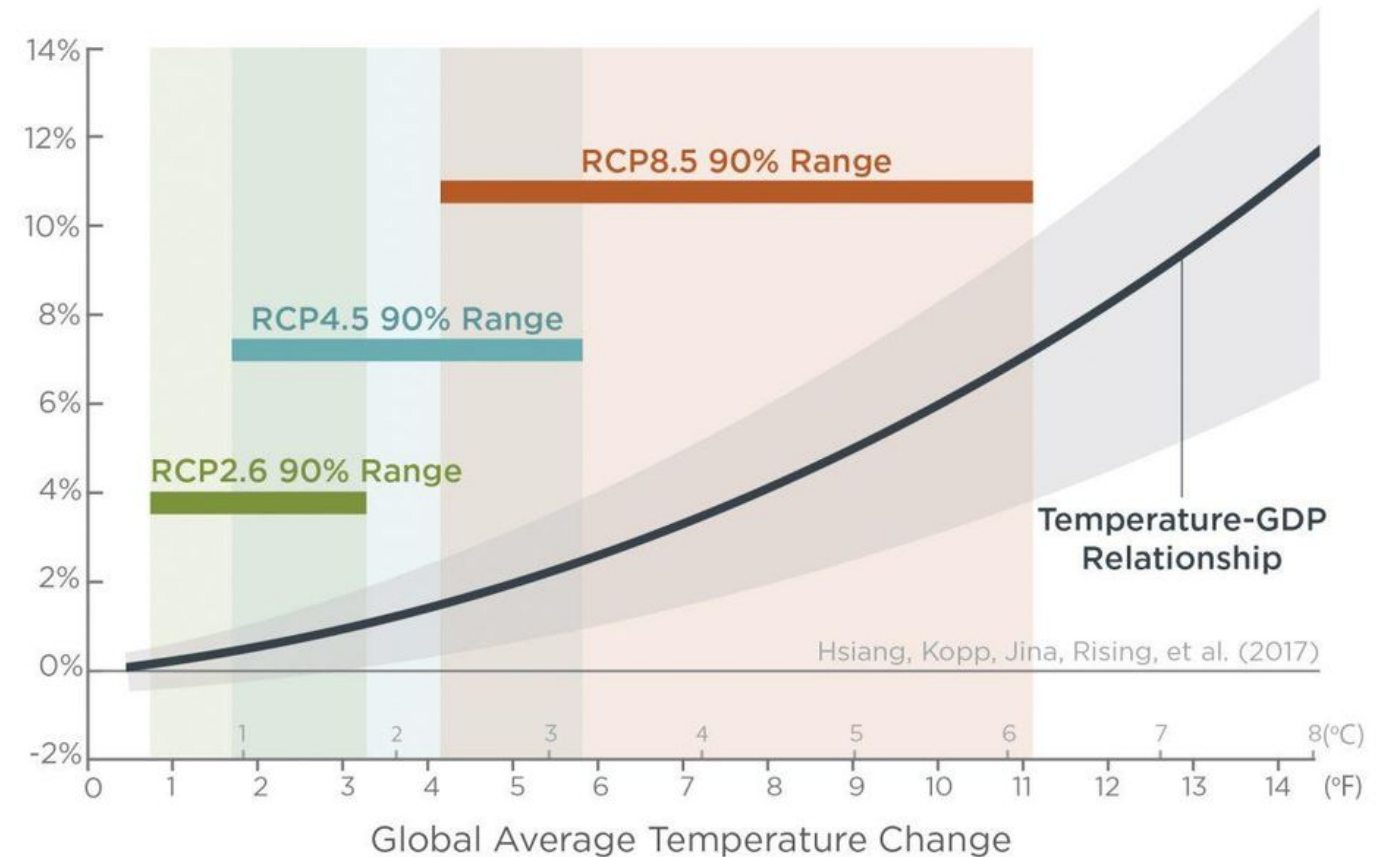
## Some things we must model based our understanding of climate and economics

With increasing temperatures:

- Decreased nutrition in crops
- Decreased productivity from fisheries and agriculture
- Decreased labor productivity
- Increased energy demand

## National Average Economic Damage In USA

Direct damage from mortality, labor productivity, agriculture, energy demand, and coastal storms. Annual % GDP averaged over 2080-2099.

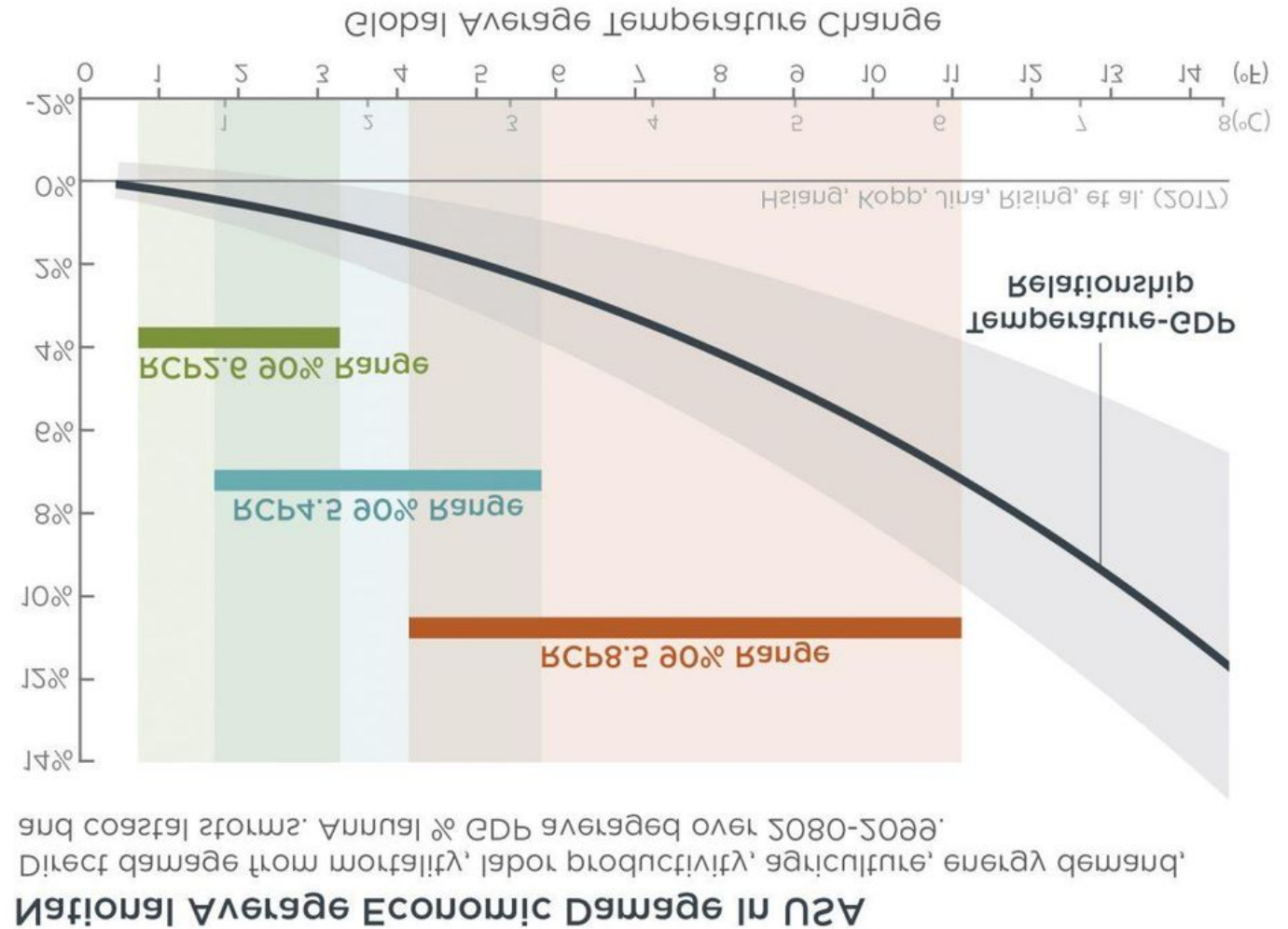


# Economics – Present vs. Future

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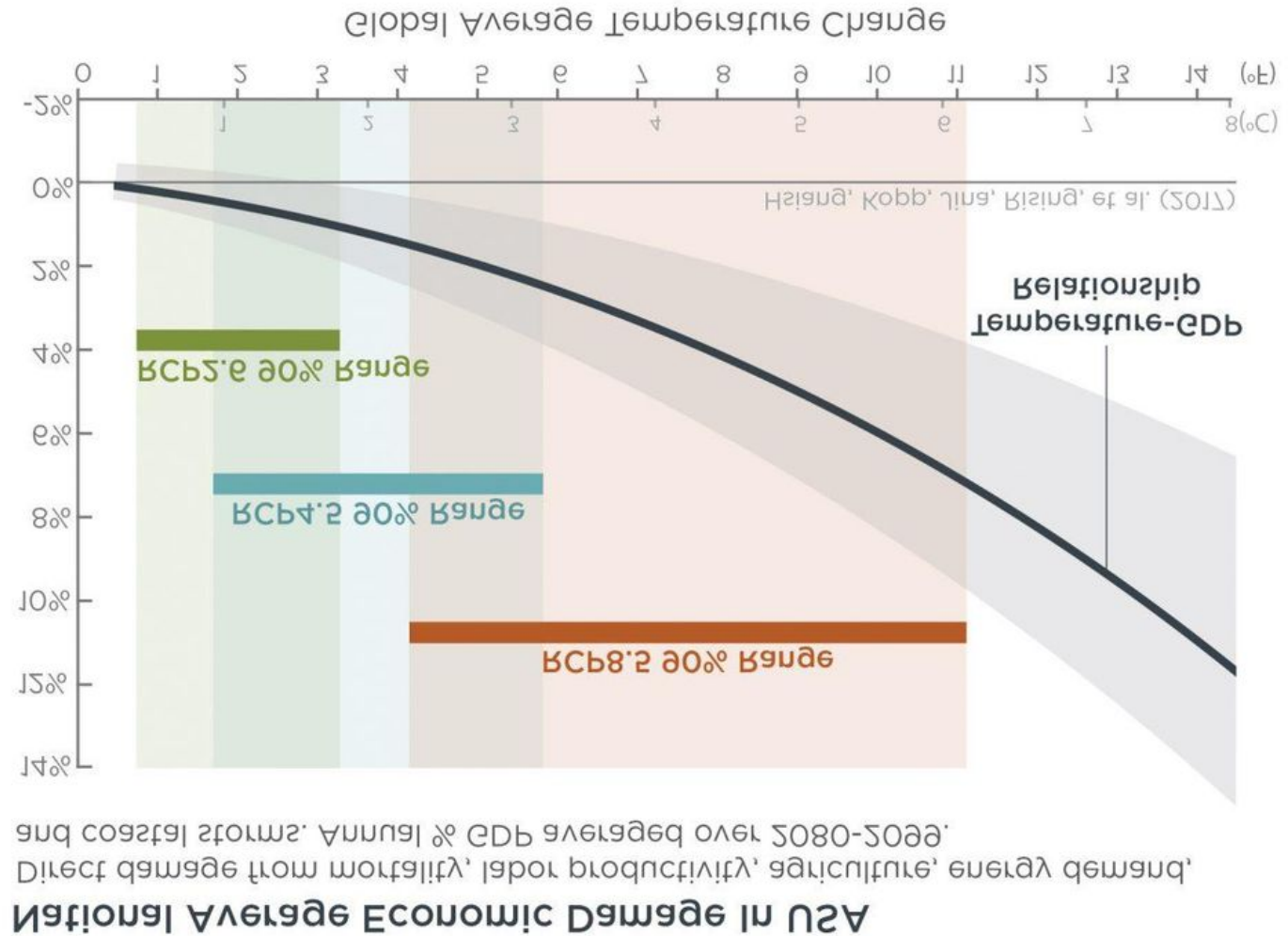
# Economics – Present vs. Future

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With increasing temperatures:

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Figure from Forbes



**Overall: More warming = more economic damage**

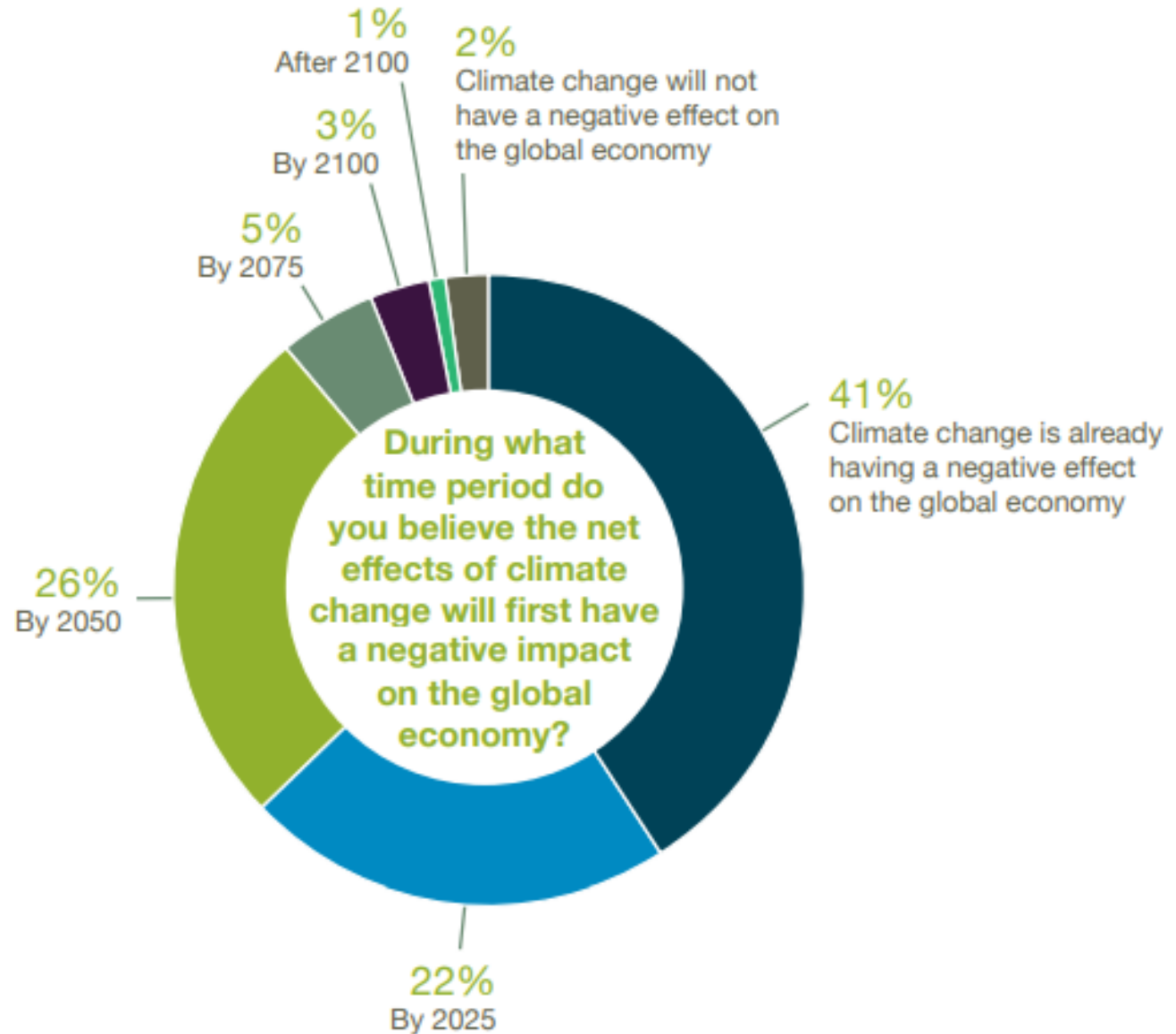


# Economics – Present vs. Future

## Let's ask the experts...

A poll of 365 economic experts (published by NYU Law School):

- Climate change is an immediate economic threat
- It requires action now
- Majority support a market-based carbon reduction mechanism (like a carbon tax)



# Society and Economics Summary

More warming is expected to have **direct (negative) societal and economic impacts**

If tipping point thresholds are passed, the impacts will be much greater

Economic experts believe that **climate change will soon negatively impact the US economy (or it already is), that we should immediately take action to reduce long-term economic impacts, and that a market-based carbon reduction mechanism is the best bet**

REVIEW SESSION UNTIL 1115 then QUIZ



Email your questions to [pbierman@uvm.edu](mailto:pbierman@uvm.edu)  
and I will sort and read them out loud