



# Global Challenges: Weapons of Mass Destruction and Climate Change

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POLI 150

30 April 2024



# Announcements

- Final Exam to be available from 12 AM on April 30 through 11:59 PM on May 3. Cumulative, 15-20 multiple choice questions, open-note and open-book, 2 hour 30 minute time limit.
- Prompts 12 and 13 due on April 30.



# This Week's Class

- Weapons of Mass Destruction
  - Defining WMD
  - Nuclear deterrence
  - Preventing nuclear proliferation
- Climate Change
  - Patterns of international cooperation over climate change
  - Collective action problems review and application
  - Conflicts of interest in the environment



# Key Terms

- WMD
- MAD and mutual deterrence
- Non-Proliferation Treaty
- Coercive disarmament
- Climate change
- Common-pool resources
- Tragedy of the commons



# Central Question

How should the world address the threat of global challenges, such as WMD and climate change?



# Weapons of Mass Destruction

**Weapons of Mass Destruction:** general term for weapons that can inflict damage on a massive scale. Three subcategories:

- **Chemical:** use of chemicals to kill or injure the enemy (e.g. mustard gas in WWI).
- **Biological:** weaponized bacterium, virus, or other biological agents (e.g. anthrax in 2001).
- **Nuclear:** explosive device that uses nuclear reactions (fission or fusion) (e.g. Hiroshima and Nagasaki).



What distinguishes a WMD from a conventional weapon?

- **Indiscriminate violence:** these weapons cannot be precisely targeted. As such, they inflict violence not only on combatants but also on non-combatants in the area.
- **Massive destructive potential:** such weapons enable destruction orders of magnitude above that accomplished by conventional weapons.
- **Social norms:** to some extent, what is and is not a WMD is socially constructed.



# Chemical Weapons

- Modern use begins in WWI.
- Over time, these have changed from simple containers of deadly gas to nearly undetectable nerve agents.
- Used by states (Syrian government) and terrorist groups (Aum Shinrikyo in Tokyo in 1995).
- Chemical Weapons Convention (1997) outlaws production and stockpiling; 97% of the worlds' stockpiles have been destroyed since then.
- **Organization for the Prohibition of Chemical Weapons** is the organization implementing the CWC.





# Biological Weapons

- Used for centuries (e.g. smallpox blankets during French and Indian War, **though it is unclear whether this worked**).
- Developed further for use during the World Wars.
- Used by states (Japan in WWII) and by terrorist groups (**1984 Oregon Salmonella attack**).
- Biological Weapons Convention (1972) bans use and stockpiling, but **some states** maintain or are alleged to maintain an offensive capacity.



# Nuclear Weapons

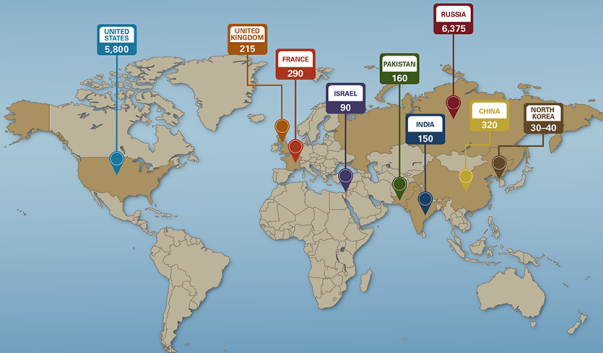
- Developed in the 1930s and 1940s.
- Used twice in war (Hiroshima and Nagasaki).
- Only possessed by nine countries.
- Non-Proliferation Treaty (1968) bans development and spread, but with mixed results.



# Nuclear Powers 2020

## 2020 ESTIMATED GLOBAL NUCLEAR WARHEAD INVENTORIES

The world's nuclear-armed states possess a combined total of nearly 13,500 nuclear warheads; more than 90% belong to Russia and the United States. Approximately 9,500 warheads are in military service, with the rest awaiting dismantlement.



Source: Hans M. Kristensen, Shannon N. Kile, Stockholm International Peace Research Institute, and the U.S. Department of State.  
Updated: August 2020

Arms Control  
Association



# Nuclear Powers 2022










## World nuclear forces, January 2022

Country	Deployed warheads <sup>a</sup>	Stored warheads <sup>b</sup>	Total stockpile <sup>b</sup>	Total inventory 2022 <sup>b</sup>	Total inventory 2021 <sup>b</sup>
United States	1 744	1 964	3 708	5 428	5 550
Russia	1 588	2 889	4 477	5 977	6 255
United Kingdom	120 <sup>e</sup>	60 <sup>f</sup>	180 <sup>f</sup>	225 <sup>f</sup>	225
France	280	10	290	290	290
China		350 <sup>g</sup>	350 <sup>g</sup>	350 <sup>g</sup>	350
India		160	160	160	156
Pakistan		165	165	165	165
Israel		90	90	90	90
North Korea	..	20 <sup>h</sup>	20 <sup>h</sup>	20 <sup>h</sup>	[40–50] <sup>h</sup>
<b>Total</b>	<b>3 732</b>	<b>5 708</b>	<b>9 440</b>	<b>12 705</b>	<b>13 080</b>

**Source: SIPRI Yearbook 2022**



## World nuclear forces, January 2023

Country	Deployed warheads <sup>a</sup>	Stored warheads <sup>b</sup>	Total stockpile <sup>c</sup>		Total inventory <sup>d</sup>	
	2023	2023	2022	2023	2022	2023
 United States	1 770	1 938	3 708	<b>3 708</b>	5 428	<b>5 244</b>
 Russia	1 674	2 815	4 477	<b>4 489</b>	5 977	<b>5 889</b>
 United Kingdom	120	105	225 <sup>e</sup>	<b>225</b>	225	<b>225<sup>f</sup></b>
 France	280	10	290	<b>290</b>	290	<b>290</b>
 China	–	410	350	<b>410</b>	350	<b>410</b>
 India	–	164	160	<b>164</b>	160	<b>164</b>
 Pakistan	–	170	165	<b>170</b>	165	<b>170</b>
 North Korea	–	30	25	<b>30<sup>g</sup></b>	25	<b>30<sup>g</sup></b>
 Israel	–	90	90	<b>90</b>	90	<b>90</b>
<b>Total</b>	<b>3 844</b>	<b>5 732</b>	9 490	<b>9 576</b>	12 710	<b>12 512</b>



# Modern-Day Nuclear Simulation 1

**91.5 million**

Number of immediate casualties, including fatalities (34.1 million) and injuries (57.4 million), resulting from the series of nuclear exchanges

Deaths from nuclear fallout and other long-term effects would significantly increase this estimate

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Created by Alex Wellerstein, Tamara Patton, Moritz Kuett and Alexander Glaser

Sound by Jeff Snyder

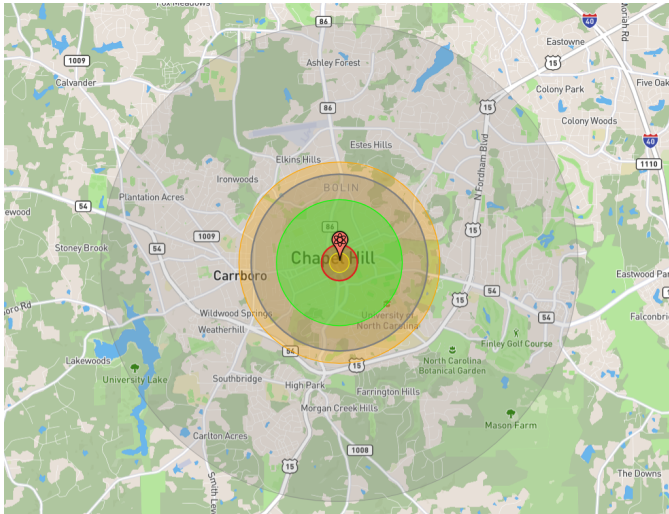
Special thanks to Bruce Blair, Sharon Weiner, Zia Mian and Pavel Podvig

This simulation utilizes data from NUKEMAP ([nuclearsecrecy.com/nukemap](http://nuclearsecrecy.com/nukemap))





# Modern-Day Nuclear Simulation 2





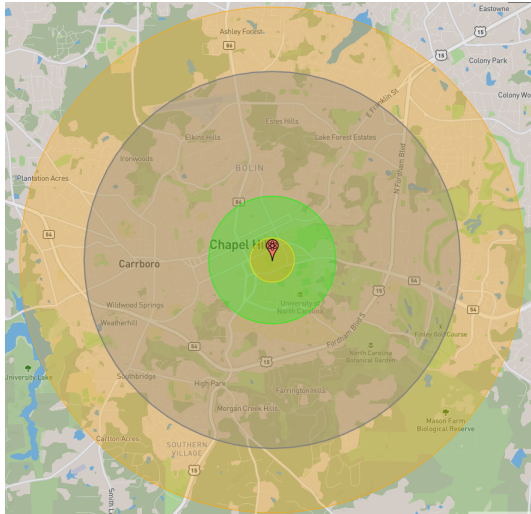
# Effects of Nuclear Weapons

- Prior slide shows impact of 15-kiloton bomb (same as used at Hiroshima) if dropped on our classroom. **Source:** **Nukemap.**
- Circle keys, from innermost:
  - Fireball radius: instant death.
  - Heavy blast damage radius: instant death.
  - Radiation radius: fatalities from blast; fatal due to radiation in about a month.
  - Moderate blast damage radius: Widespread building damage; high fatalities.
  - Thermal radiation radius: Third-degree burns if exposed at this range.
  - Light blast radius: survivable with moderate to minimal injuries (but probably affected by radiation).
- Total deaths: at least 25,000. About 35,000 more injured.





# Modern-Day Nuclear Simulation 3





# Problems of WMD

- (When) might WMD actually make war less likely?
- Why are states often unwilling to disarm?
- Why is monitoring of stockpiles and development so difficult?



# Nuclear Proliferation

- Nuclear proliferation is often discussed as a massive problem facing the world.
- Given the destructive capacity of nuclear weapons, many argue that the international community may be safer without them.
- However, it is possible to argue that nuclear proliferation is a force for peace and stability...



# Theoretical Considerations

- A realist perspective, treating state actors as rational and focused on survival, makes nuclear war unappealing.
- Nuclear war is arguably the worst possible outcome for a state.
- In the language of the bargaining model of war, nuclear weapons mean that the costs  $c$  become essentially infinite, removing any possibility of gains from war.
- Mutually assured destruction is one proposed solution to this.



# Mutually Assured Destruction (MAD)

- **Mutually Assured Destruction:** guaranteed destruction if two nuclear-armed adversaries use their nuclear weapons on each other.
- MAD should create an environment of **mutual deterrence**: neither side will attack the other, forcing them to find other means of resolving disputes.



# Mutual Deterrence Requirements

Requirements for MAD to work:

- 1 Each state has **second-strike capabilities**.
- 2 Leaders care about their survival.
- 3 Weapons not be easily subject to accidental launch.
- 4 Easy to determine origins of any given attack.



Given the successful track-record of deterrence thus far, why do we care about nuclear proliferation (as well as WMD proliferation in general)?

- Even if they reduce the probability of nuclear war, nuclear weapons influence the distribution of power.
- There is a risk of nonstate actors gaining possession (especially for non-nuclear WMD).
- Some states may not meet the requirements for effective MAD deterrence.
- **Mistakes happen!**



# Goldsboro, NC Accident





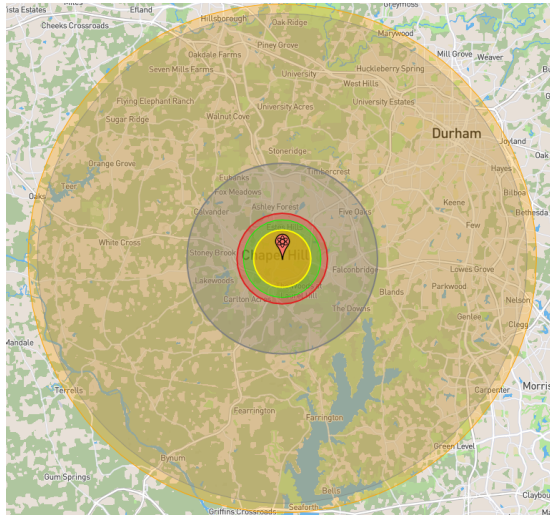


# Goldsboro, NC Nuclear Accident

- On January 23, 1961, an American B-52 Stratofortress flying over NC broke apart due to structural failure.
- It was carrying two 3-4 megaton bombs, both of which fell free of the aircraft during the crash.
- One bomb's parachute deployed, and it landed safely.
- The other one was armed, with a single switch between it and the possibility of detonation.
- This isn't even the only nuclear accident involving US nuclear weapons ([list](#)).
- USSR [also made mistakes](#).



# Goldsboro Accident Bomb Size





# Preventing Nuclear Proliferation

With these concerns in mind, states and some NGOs have attempted to prevent nuclear proliferation in two ways:

- 1 Altering incentives
- 2 Preventing actors from accessing nuclear materials



# Altering Nuclear Incentives

What interest does a state have in acquiring nuclear weapons?

- States attempt to acquire nuclear weapons out of insecurity due to anarchy.
- This implies that guaranteeing their security can prevent them from seeking weapons of their own.



# Altering Nuclear Incentives

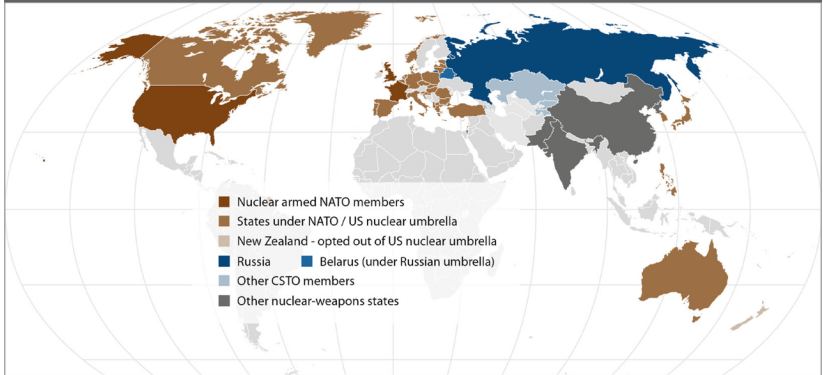
- Credible nuclear defensive alliances are one way to guarantee security for a state without that state having to acquire nuclear weapons of its own.
- Successful example: NATO. Less successful example: Ukraine.



# Nuclear Umbrella

FIGURE 1

OVERVIEW OF NUCLEAR UMBRELLAS





- **Coercive disarmament:** threatening or using military force to disrupt or prevent nuclear development (ex: Israeli efforts against Iran).
  - Examples of access prevention campaigns include North Korea (ultimately acquired nuclear weapons) and Iran (ongoing).
- States may also create monitoring and tracking efforts to prevent nuclear material and information from going to either rogue states or non-state actors, sometimes supported by international agreements such as the nuclear **Non-Proliferation Treaty (NPT)**.



# Iran's Nuclear Program

- Iran has actively pursued nuclear research for both energy and weapons.
- It has faced harsh international sanctions for its efforts.
- It has also faced sabotage (ex: Stuxnet) and targeted assassination against its nuclear program.
- In 2015, a deal (the JCPOA) was reached to lift sanctions in exchange for a large scale reduction in its nuclear program.
  - JCPOA parties: US, Iran, other P5 members, Germany, other EU members
- US withdrew from the JCPOA in 2018, effectively killing it; Iranian progress towards nuclear weapons has since resumed.





# Assessing the NPT

- The **Non-Proliferation Treaty** prohibits all states except for the original five nuclear states from having nuclear weapons.
- Provides for monitoring of compliance through the International Atomic Energy Agency.
- The IAEA can submit charges to the UNSC, asking it to impose sanctions.
- Has had successes (South Africa, Brazil, Argentina) and weaknesses (North Korea, Iraq, Iran, Libya, Ukraine).
- Has the NPT been successful? Somewhat.



# The Global Zero Movement

- (Relatively) informal efforts to reduce nuclear weapons have also emerged.
- One example is **Global Zero**: network of political leaders, activists, military officials, and civic leaders advocating for 0 nuclear weapons.
- Public opinion generally favors reduction of nuclear weapons.
- Is this possible? Desirable?
- Can the US credibly lead a disarmament movement?



## To Ponder...

Is the world safer with or without nuclear weapons?

What would it take to get to a world without nuclear weapons?

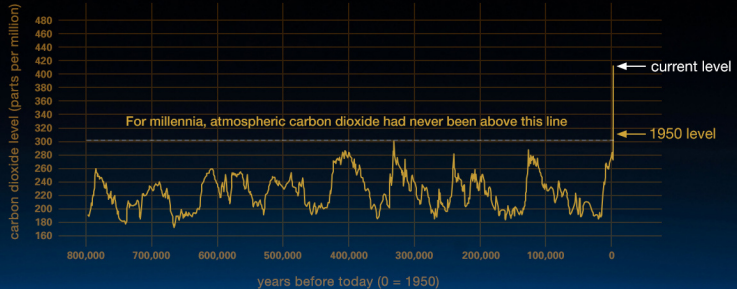


# Climate Change Definitions

- **Climate change AKA “global warming”:**  
human-induced environmental changes leading to increased global temperatures and shifting weather patterns.
- This is distinct from (and more extreme than) the natural changes to Earth’s climate (e.g. start and end of ice ages).
- “Scientific evidence for warming of the climate system is unequivocal.” - UN’s Intergovernmental Panel on Climate Change ([IPCC site](#))
- See [NASA](#) for more details and evidence.



# Atmospheric CO<sub>2</sub>

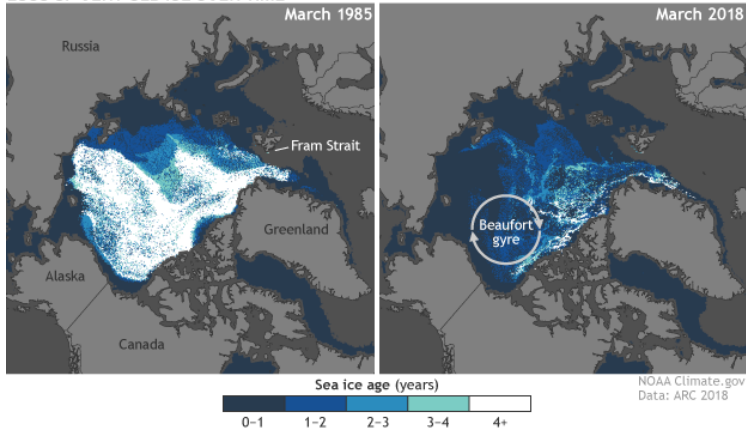


climate.nasa.gov



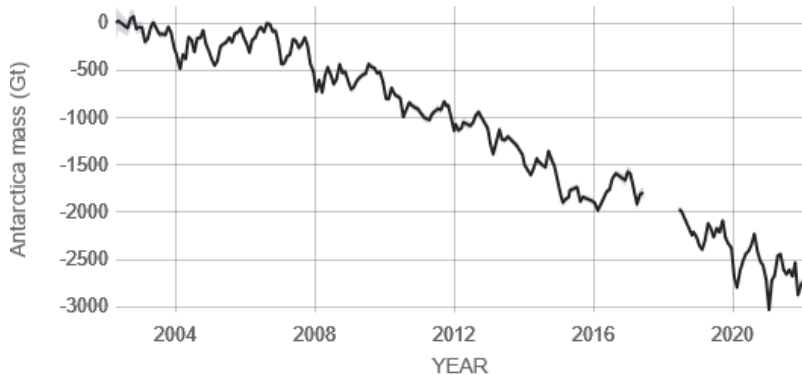
# Arctic Sea Ice Shrinkage

## LOSS OF VERY OLD ICE OVER TIME





# Antarctic Ice Shrinkage



Source: [climate.nasa.gov](https://climate.nasa.gov)



# Politically Salient Impacts

List drawn partially from [NASA](#).

- Rising temperatures and melting ice means rising sea levels. This threatens low-lying coastal areas; existential threat to island states.
- Warming ocean threatens to disrupt oceanic ecosystems, indirectly threatening fishing and related industries.
- Increased disruption of weather patterns and increased incidence of extreme weather events (wildfire, hurricanes, etc.), leading to economic damage and disruption.
- Weather changes also disrupt agricultural patterns (esp. in poorer, warmer countries).
- IR experts believe these effects of climate change will make conflict more likely ([UNSC](#)).





# Climate Change and Conflict

FIGURE A *Global Temperature Deviation and Conflict, 1946–2014*

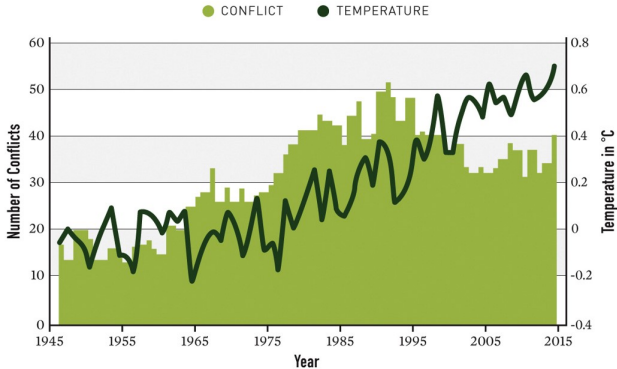


Figure source: Halvard Buhaug, PhD, "Globalt Temperaturavvik Og Konflikt, 1946–2014," in Nils Petter Gleditsch, *Mot en mer fr edelig verden?* [Towards a more peaceful world?] (Oslo: Pax, 2016). Reprinted with permission.

Note: Conflict data are from the UCDP/PRIO database; temperature data, from <http://data.giss.nasa.gov/histemp>. The temperature deviations are measured from the average for the period 1951–80.



Governments have made some progress in cooperating to combat climate change.

- **Montreal Protocol (1987)**: phased out consumption and production of ozone-depleting substances, with evidence of ozone layer repairing itself.
- **United Nations Framework Convention on Climate Change (UNFCCC) (1992)**: soft law that provides structure for efforts on climate change.
- **Kyoto Protocol (1997)**: established specific targets for reducing greenhouse gas emissions.
- **Paris Agreement (2016)**: commitments from 196 countries to reduce emissions.



# Obstacles to Effective Cooperation

- Despite these agreements, cooperation over climate policy has failed to reverse the trends of climate change.
- Problem: Individual actors might have interests in improving the environment, but individual action has little effect.
- Example: 15-20 countries account for 75% of carbon dioxide emissions, but not a single country accounts for more than 30%.
- This phenomenon relating to global cooperation over the environment is often likened to the **Tragedy of the Commons**.



# Tragedy of the Commons Definition

- If a resource is open to all without limit, no one individual has an incentive to conserve that resource.
- As a result, the resource degrades over time until it is completely depleted/unusable.
- **Crucially, no single individual's actions can solve the problem.**
- Examples: fisheries, forests, global atmosphere, livable planet
- The tragedy of the commons explains why states struggle to maintain global **public goods**.



# Types of Goods

Goods differ on two axes: rivalry and excludability.

- Excludable: action can be selectively (not) allowed to use a good.
- Rivalrous: consumption by one actors reduces the amount available for others to consume.



# Types of Goods

	EXCLUDABLE	NONEXCLUDABLE
RIVAL	Private goods	Common-pool resources
NONRIVAL	Club goods	Public goods



# Climate and Collective Action

- **The tragedy of the commons is not the same as a collective action problem.**
- Recall the definition of a **collective action problem**: all members of a group benefit from the provision of the public good, but all have incentives to “defect” by not helping pay the costs of providing the good, and so the public good is never provided.
- In a CAP, actors must work together to provide the good. In a TOC the good exists already and actors must coordinate on its use.



# Climate and Collective Action

- The benefits of a stable global climate are generally a mixture of public goods and common-pool resources.
- Common-pool resources fall victim to the tragedy of the commons.
- Public goods are subject to collective action problems.
- Rational actors have (short-term) incentives to engage in self-interested behavior that ultimately has negative impacts on both public goods and common-pool resources.





# Complicating Factors

Several factors make CAPs and TOCs harder to solve.

- **Size:** more members make CAPs harder to solve (acid rain vs. atmosphere).
- **Complexity:** more complex problems are harder to solve (“dirty-dozen” chemicals).
- **Iteration and linkage:** interacting repeatedly can solve CAP (but this works better with limited number of actors).
- **Bundling:** tying private gains to public goods (advantages of forests).
- **Intensity Disparity:** more affected parties are more likely to bear costs of solutions, if they can.



# Success Story: Montreal Protocol

- Signed in 1980s to address production and consumption of ozone-depleting substances
- Size: limited number of participants, but large enough to matter.
- Bundling: trade restrictions to enforce participation.
- Complexity: scientifically relatively easy to determine a threshold of success.



# Future Success? The Paris Agreement

- Signed in 2016, it is *the* major environment agreement.
- Size: nearly every country of importance.
- Complexity: no clear threshold beyond goal of limiting global temperature increase to +2 Celsius over pre-industrial levels, via reducing greenhouse gas emissions.
- Bundling: none (countries choose their own emissions and schedules).
- US left under Trump then rejoined under Biden, but the framework may be of limited viability if it becomes a revolving door...



# Taxation as a Solution?

- Economists have suggested taxing carbon emissions.
- Makes the cost of using carbon fuels reflect the costs to society for continued usage.
- Problem? Extremely unpopular with industries and consumers!
- Additional problem: this does not necessarily eliminate emissions!



# ‘Property Rights’ as a Solution?

- An alternative solution focuses on rights to emit.
- Some places like Europe or California use a cap-and-trade system.
- Firms are allotted a set level of emissions, and can buy and sell “credits” if they fall below or above the thresholds.
- Creates an incentive to develop green technologies.



# Industry Pressures

- Firms and industries have interests in opposing environmental policies that restrict their profitability.
- Increased environmental constraints would force them to expend more (e.g. treating waste).
- Green energy increases competition for traditional energy industries.
- Consumers also benefit from lax environmental policies, as prices are lower.
- Thus, much like the politics of trade, environmental regulations produces winners and losers, which structures domestic political interactions.

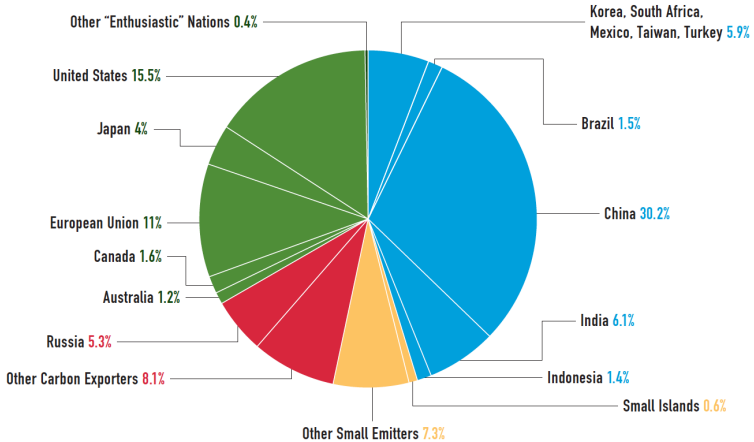


# Bottom-Up Pressure

- There are more individuals that would benefit from a green environment than a degraded environment.
- Why don't we see more green policies? Firms' interests are better organized, and are better able to press the government for lax policies.
- Very similar to protectionist industries' influence over trade policy.
- Furthermore, some firms *benefit* from climate change (e.g. Exxon-Mobil and Arctic oil deposits).



# International Variation in Emission







# Developed vs. Developing Countries

- Historically, developed countries have been most egregious polluters.
- Most states increase their pollution as they develop until they hit a threshold of relatively high development, then become interested in controlling pollution.
- In the future, increases in emission will come from today's developing countries.
- Globally, there are incentives to enact environmentalist policies; at the state level, these developing states may disagree if such policies limit their development.



# Summary

- Climate change is expected to have serious environmental and political impacts in the coming decades.
- Addressing climate change requires states solve a mixture of collective action problems and tragedies of the commons.
- These efforts are complicated by the size and complexity of the issues.
- Substantial competing interests: LDCs vs. developed states, industries vs. citizens, etc.
- Some international treaties provide cause for hope?