Introduction to Climate Change

EES 3310/5310

Global Climate Change

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Class #1: Wednesday, January 19 2022

Some Housekeeping:

- The main class website is at https://ees3310.jgilligan.org
- Copies of the
  - syllabus,
  - reading assignments,
  - lab assignments,
    - readings
    - instructions
    - files you will use for the labs
  - slides from class (also link from QR code on title slide)
- Links to helpful resources.
- Slides:
  - The title slide has QR code with link to online version.
  - PDF versions are also posted to course web site (link on title slide)
  - Slides have two-dimensional navigation (in a browser, hit “?” for help)

Tell me about yourself

On a piece of paper, write down

1. Your name
2. Your year at Vanderbilt
3. Your major, or your academic interests
4. What is something you want to know about climate change?
5. What do you most hope to get from this semester?
6. Tell me something interesting about yourself

Is the Climate Changing?

Is the Climate Changing?

- What does it mean for climate to change?
- How would you know whether it’s changing?

Is the Climate Changing?

- 2020 was the hottest year on record.
- 2016 was the second hottest (statistical tie).
- 2019 was the third hottest.
- 2017 was the fourth hottest.
- 2015 was the fifth hottest.
- 2018 was the sixth hottest.
- 2021 was the seventh hottest.

The last seven years were the seven hottest years on record (141 years).

Studies of paleoclimates find that the past century was the hottest in more than 100,000 years

Nashville

- Yesterday, the lowest temperature was 26°F.
- Before 1980, it used to go below 0°F an average of once a winter
- The last time it went below 0 was Feb. 5, 1996
- Before 1980, the average winter got 12 inches of snow
- Since 2000, we get less than 4 inches on average.

Dangerous heat waves becoming more common.

- Extreme heat waves are now 50 times more frequent than they used to be.
  - 2017 heat wave in Phoenix AZ was too hot for many airplanes
    - More than 40 airline flights grounded.
  - Six of the ten deadliest heat waves in history happened since 2000.
    - 2003 European heat wave: 70,000 deaths
    - 2010 Russian heat wave: 50,000 deaths
  - 2021 Pacific Northwest heat wave killed around 1,200 people.

Pacific Northwest, June 27–29 2021

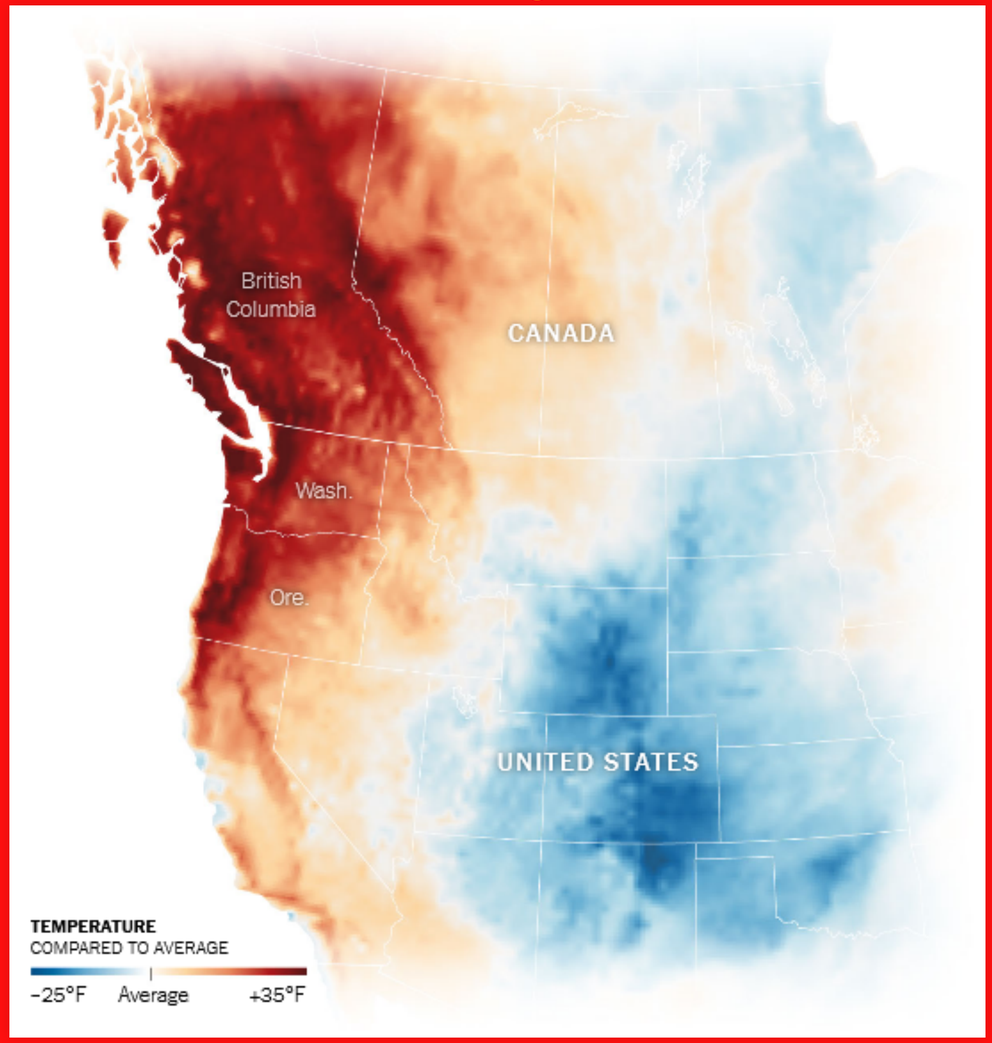

Image credit: N. Popovich & W. Choi-Schagrin, New York Times, Aug. 11, 2021

What Does Science Say?

How Can We Answer These Questions?

- How can you know whether climate is changing?
- How can you know what's causing it?
- How can you know what it will do in the future?

- How can you persuade someone else?
- What would you need to know to be more certain?
- If it is a problem …
  - What can we do about it?
  - What should we do about it?

"It's a pity those awful people were right about the environment."

Nuts and Bolts about the Course

Goals for the Course

- Scientific Understanding:
  - What do we know about climate?
  - How do we know it?
  - How certain are we?
- Applied to:
  - Past climate conditions
  - Causes of climatic change
  - Predictions of future climate change
  - Impact of climate on people’s lives

Structure of the Course

- Science
  - What determines the earth’s temperature?
  - What are people doing that might change this?
  - What do we observe?
  - How will things change in the future?
- Policy:
  - How will these changes affect people’s lives?
  - What can we do?
  - **How much will it cost?**
  - What actions will others agree to?

Overview of the Semester

Textbooks

▪	David Archer, Global Warming: Understanding the Forecast (2nd Edition)
▪	William Nordhaus, The Climate Casino
▪	Roger A. Pielke, Jr., The Climate Fix
▪	Hadley Wickham & Garrett Grolemund, R for Data Science (Free web version online at `http://r4ds.had.co.nz/`)

Laboratory

- Goals:
  - Download and analyze climate data
  - Work with interactive computer models
  - Learn about **reproducible research**
- Computational Tools:
  - Free, open source
  - R and RStudio for data analysis
  - Markdown and RMarkdown for writing reports
  - git and Github for managing files

- Before lab on Monday:
  - Read lab #1 handouts on the course web page
  - Sign up for free account on github.com
  - If you can, download and install free software you will use for the lab
    - git
    - R
    - RStudio
    - Instructions in Lab documentation and "Tools" page in course web site.
  - Mr. Belanger and I will be available to help during lab if you have trouble installing and using the tools.
  - Start playing with R and RStudio if you have time.
  - The first lab is low-stakes: full credit for trying.

Class and Lab Material

- Main source of material: ees3310.jgilligan.org
  - Syllabus
  - Reading assignments for the semester
    - Do the assigned reading **before** class on the day it's assigned for.
  - Reading and assignments for Lab
- Slides from class:
  - Web-based and PDF versions
  - Posted on ees3310.jgilligan.org/schedule/
  - Slides:
    - The title slide has QR code with link to online version.
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Science, Policy, and Climate

Science of Climate

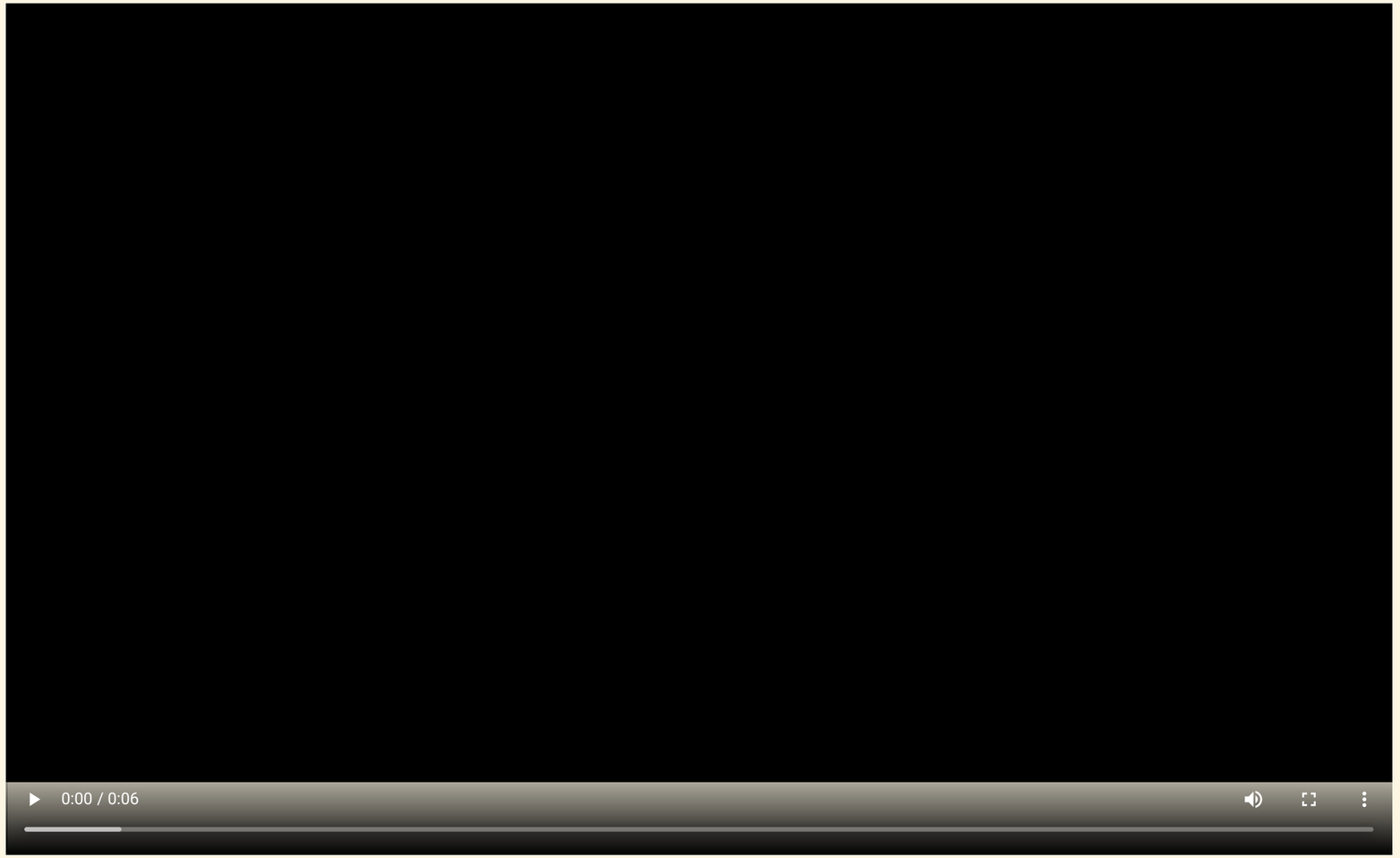
- What determines earth’s temperature?
  - Sunlight
  - Greenhouse effect
  - Other factors
- Chemistry of the atmosphere:
  - What are greenhouse gases?
  - What happens when people release them into the atmosphere?
- Consequences of climate change

Climate Policy

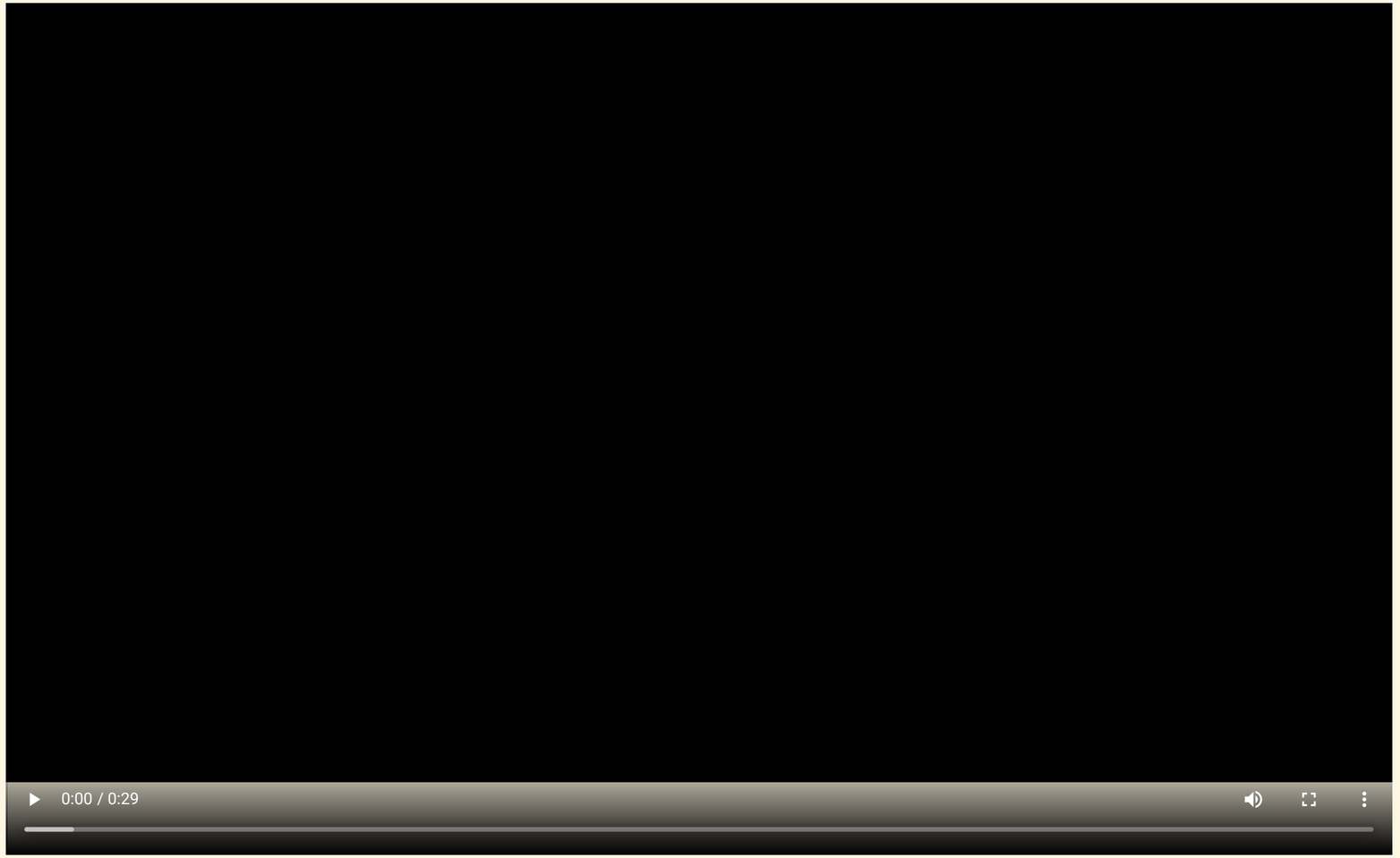
- What are consequences of climate change?
  - What alternatives to fossil fuels?
  - What would they cost?
- How to transition to low-carbon energy?
- Who should pay?
- How to build political agreement?

How Politicians Talk about Climate Change

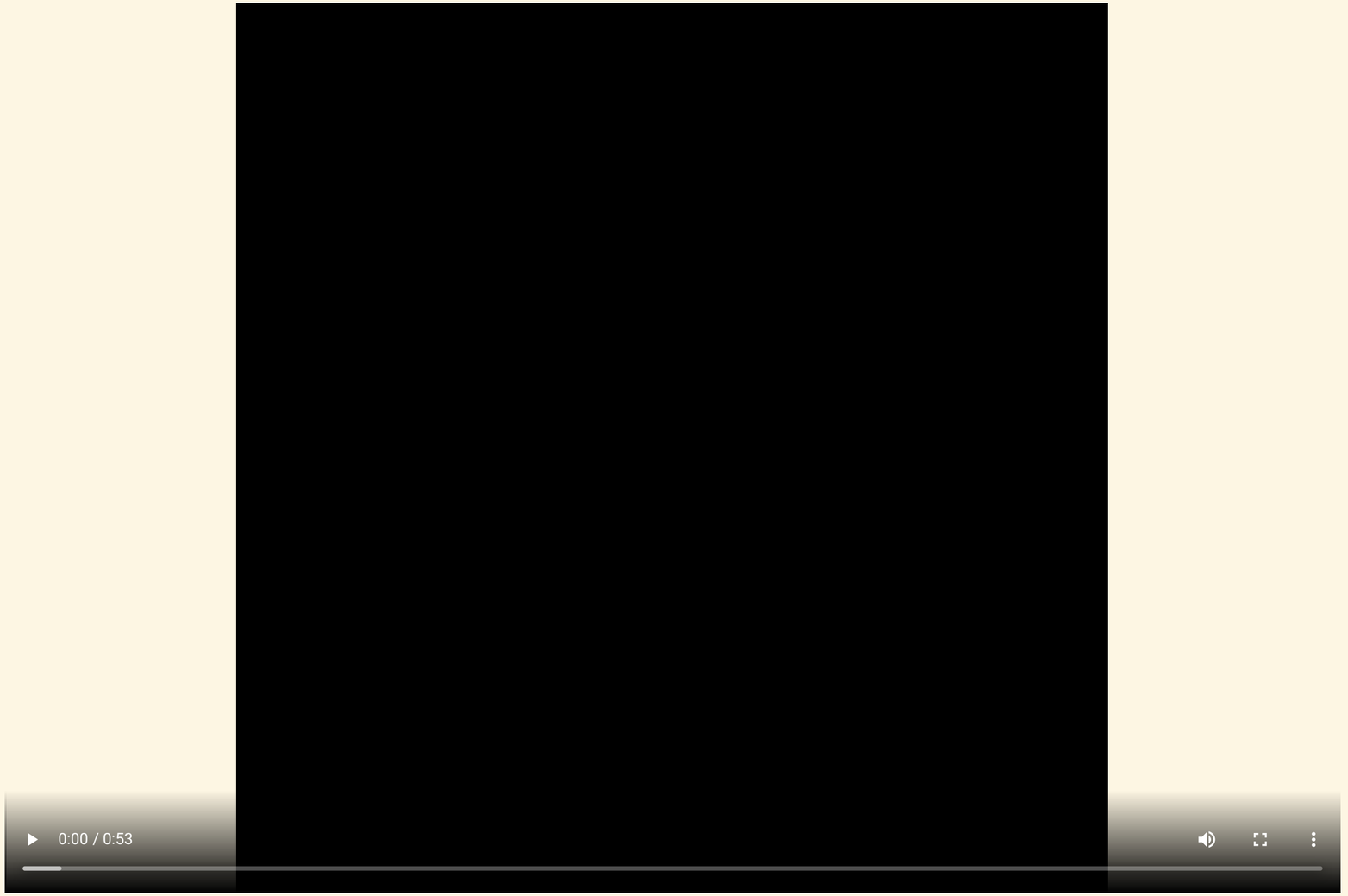
Stereotype of Democrats



Stereotype of Republicans



It Wasn’t Always Like This



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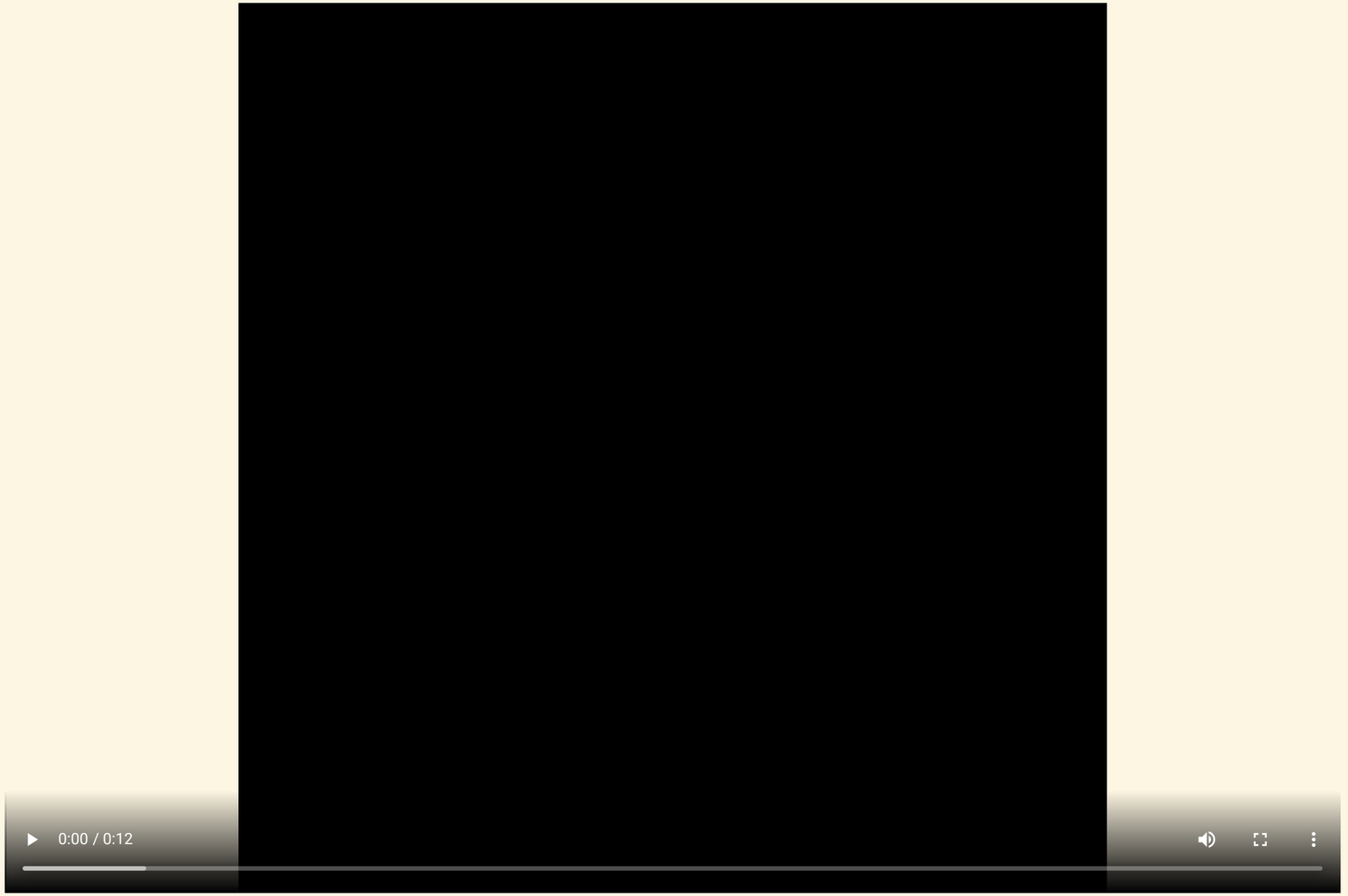

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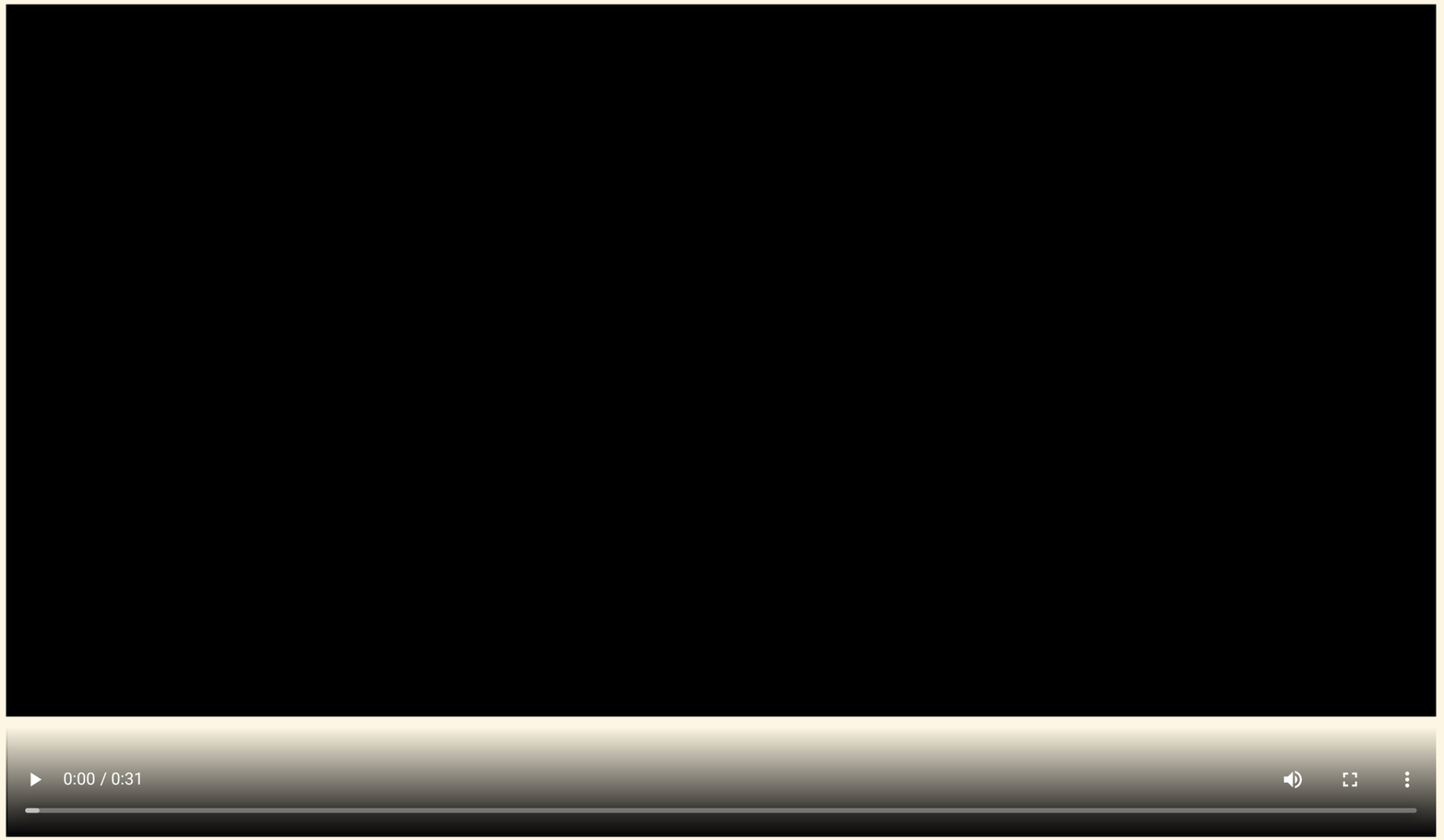

Today’s GOP Climate Activists

- Arthur Laffer (Economic Adviser to President Reagan)
- Bob Inglis (Former Republican Congressman from South Carolina)

What Do You Want To Know About Climate Change?