



AI in Climate Change

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What is Climate Change?

- Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e, more or fewer extreme weather conditions)
- Today when people talk about climate change, beyond the sun or volcanic explosions, they talk about the changes because of human activities, starting from the time when coal was first used as energy in industries.
- Global warming and climate change refer to an increase in average global temperatures. Natural events and human activities are believed to be contributing to an increase in average global temperatures. This is caused primarily by increase in “Greenhouse” gases such as Carbon Dioxide (CO₂).
- A warming planet thus leads to a change in climate which can affect weather in various ways.

The Greenhouse Effect

Some solar radiation is reflected by the Earth and the atmosphere.

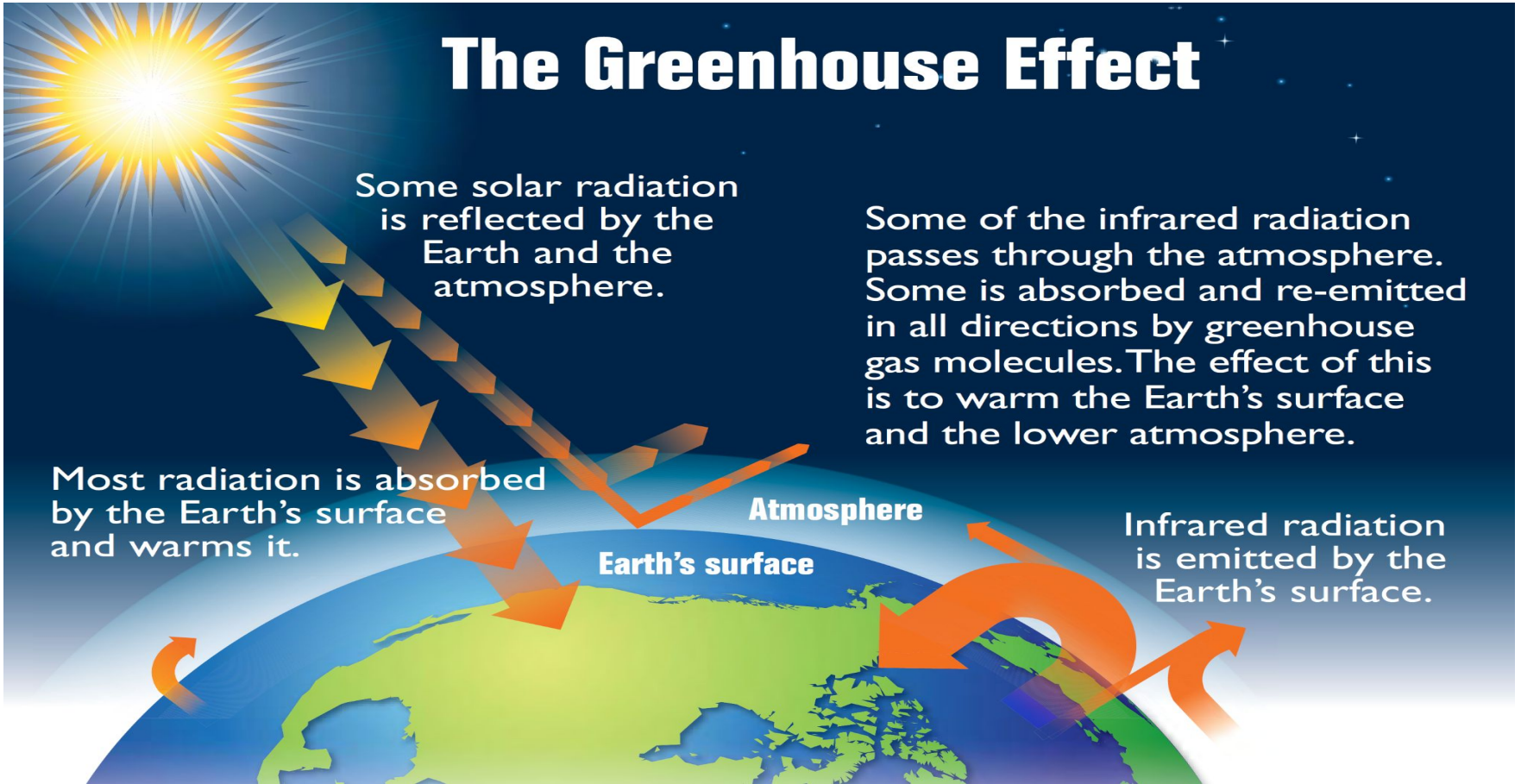
Most radiation is absorbed by the Earth's surface and warms it.

Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.

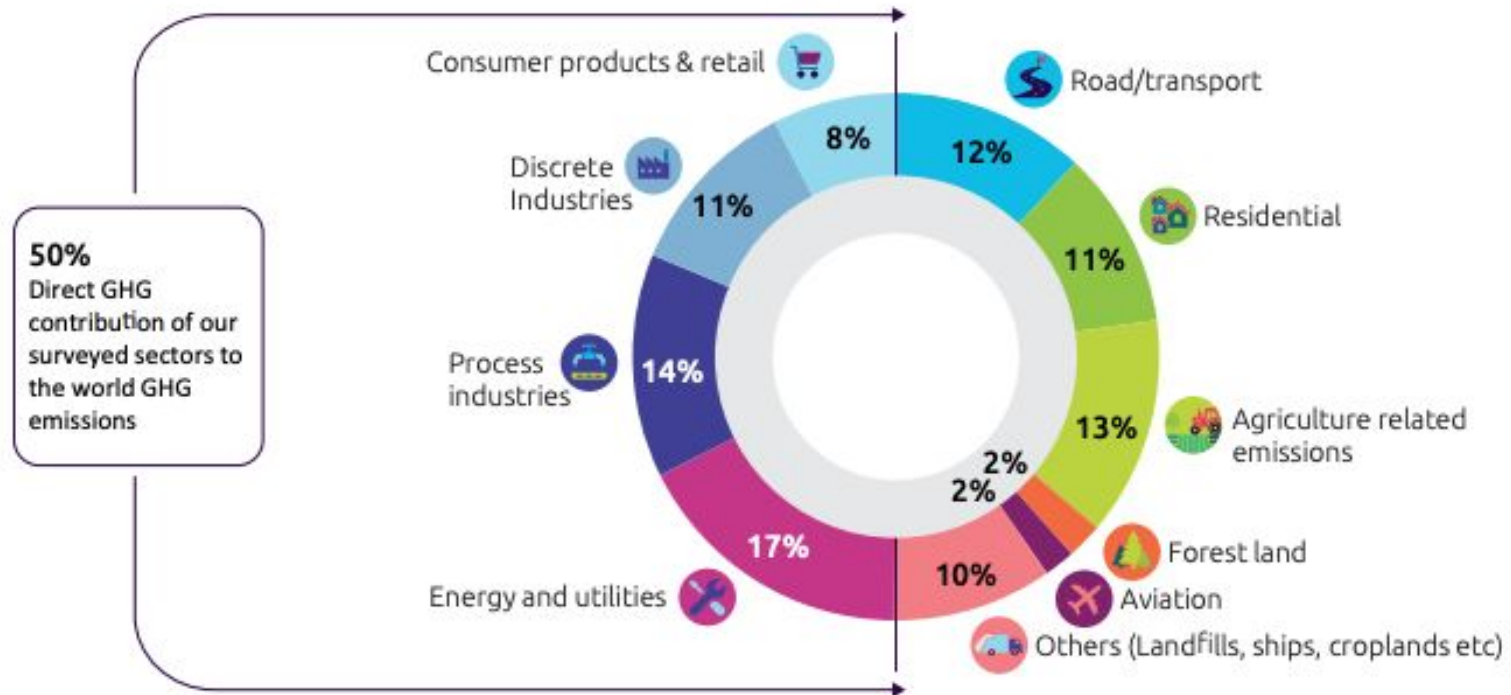
Infrared radiation is emitted by the Earth's surface.

Atmosphere

Earth's surface



Breakdown of global greenhouse gas emissions – 2016



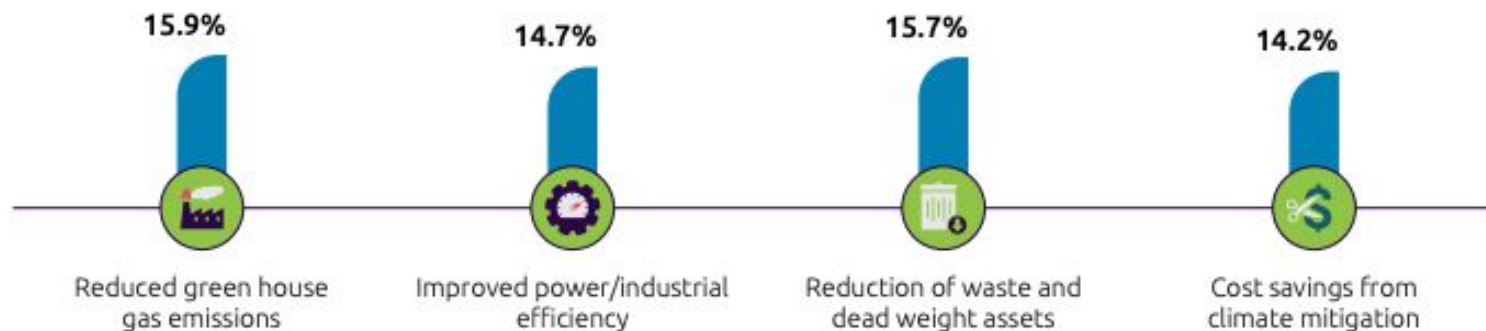
Source: Capgemini Research Institute analysis. Data from CAIT Climate Data Explorer via. Climate Watch/Our World in Data, accessed October 2020.

FACTS/BENEFITS

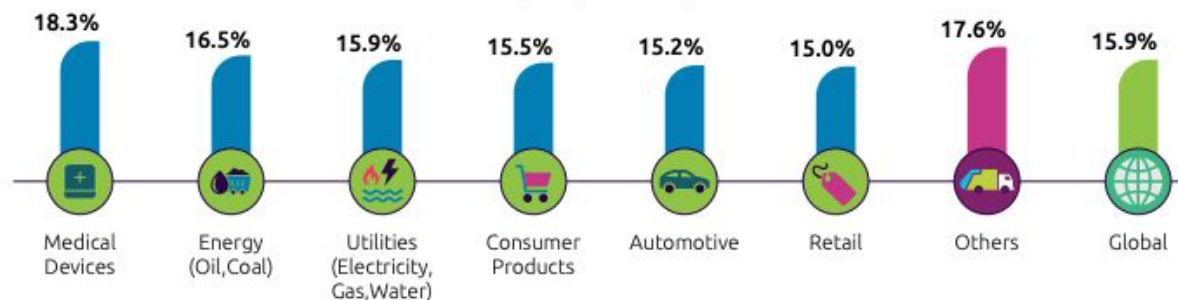
- 1970~2004: 120% increase in emissions (Jeffrey)
- Researchers estimate tech sector will contribute 3-3.6% of GHG emissions by 2020
 - Can increase to 14% by 2040 (Institute)
- AI will likely reduce GHG emissions by 16% (Marr)
- Improve power efficiency by 15% in next 3-5yrs



Average benefits expected from use of AI-enabled use cases climate action in the next three to five years



Average future emission reduction using AI-enabled use cases for the next three to five years (base year 2019)

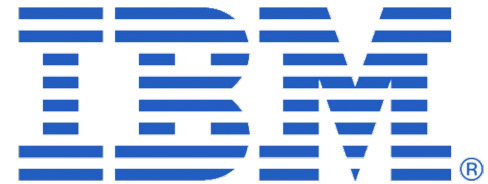


Source: Capgemini Research Institute, AI in climate action survey, July–August 2020, N=190 organizations that have been able to scale AI projects fully or partially for climate. Others include process industry (cement, paper, petro-chemical, paper) and discrete industries (electrical and electronics, air and railway equipment, etc.). (Capgemini Research Institute)

USES



- Google's Deepmind AI predicts wind patterns up to 36 hrs in advance -> optimize wind farms (Marr)
 - Improved efficiency and value by 20% (Jeffrey)
- Cornell University group developed model to find sites for dams to produce lowest amount of GHG emissions
- JJAIBOT
 - Interactive, emotion-based bot helps people understand effects of climate change for awareness
- Dymaxion Labs
 - Help analyze and detect informal settlement growth to help gov. make better decisions on how to help families affected by climate change
- IBM and DHL
 - Predict demand, risk, supply, etc. to optimize processes and reduce emissions
- Data Science Institute (Hazlegreaves)
 - Study effect of Hurricane Maria and study damage more effectively



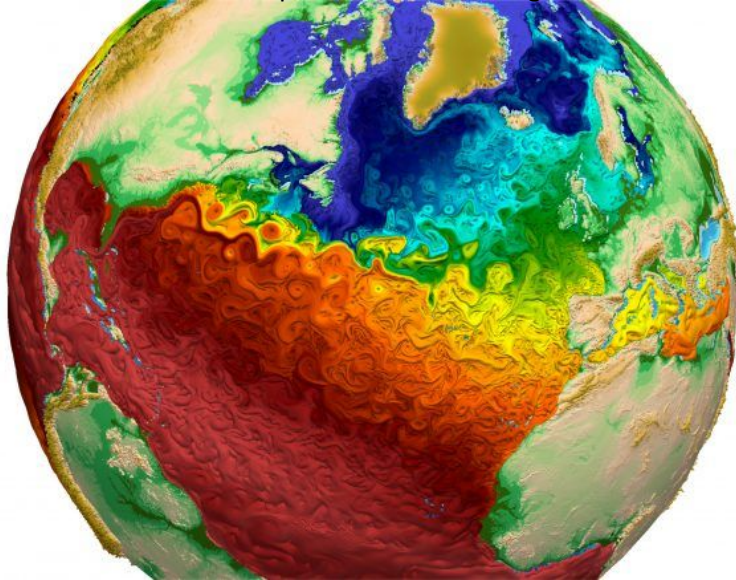
Patents (Current and Abandoned) Related to AI Climate Change

- Method for integrated climate change mitigation & adaptation (Yekutiely, 2009; Abandoned)
- Computer implemented frameworks and methodologies for enabling climate change related risk analysis (Mallon, Brown, Cini, Sullivan, Quinn, 2014; Abandoned)
- Statistical-deterministic approach to natural disaster prediction (Ravela, Emanuel, 2006; Active)
- Statistical prediction functions for natural chaotic systems such as global climate model (Luvalle, 2012; Abandoned)
- Global warming mitigation method (Baird, 2010; Abandoned)

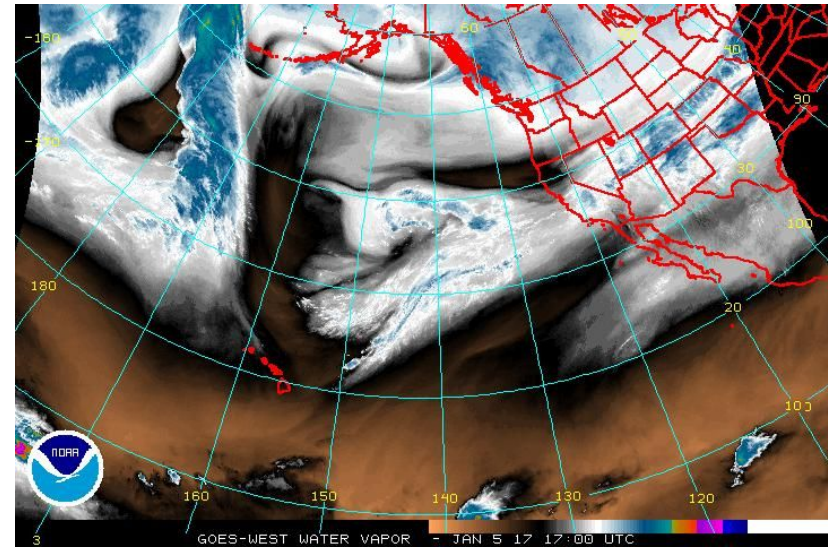
Climate Models

- AI can help construct many different types of models to study the effects of climate change.
- Shown are some examples from an article from the Columbia University Climate School

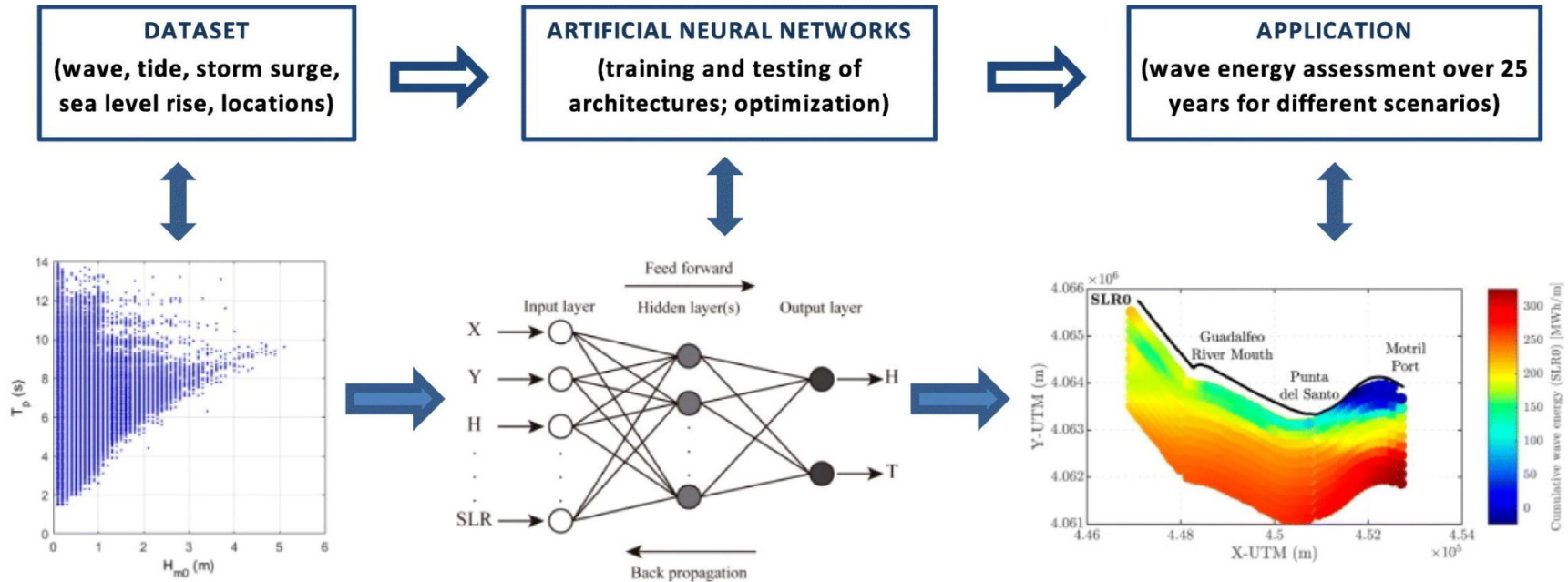
A model of water surface temperatures across the globe



A model of moisture in the atmosphere above California



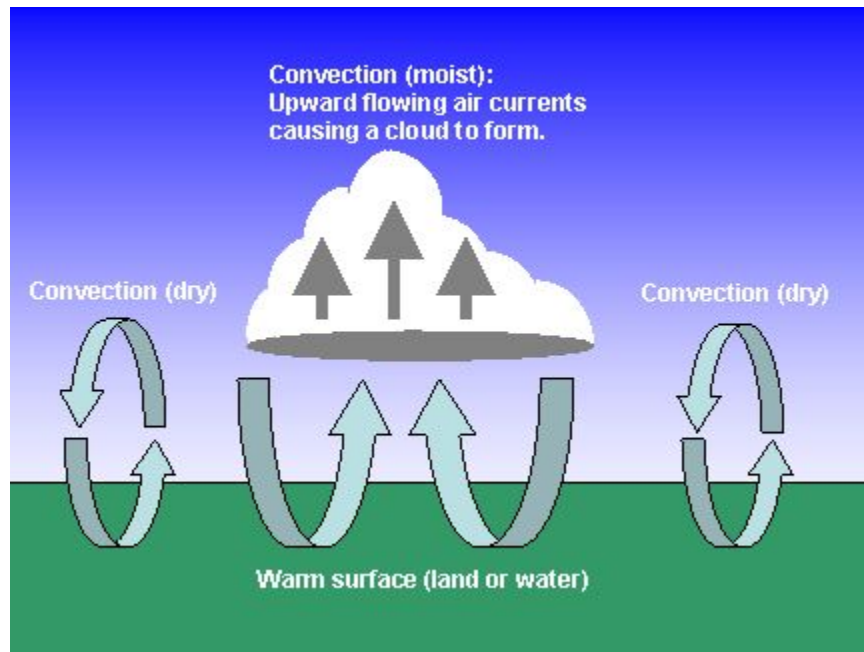
Using AI to monitor wave energy



Moist Convection

An article by Paul O’Gorman and John Dwyer of MIT details how machine learning is used to parameterize changes in moist convection as a result of Climate Change.

Moist convection is essentially when moist air flows upward after contacting a warm surface, causing clouds to form.

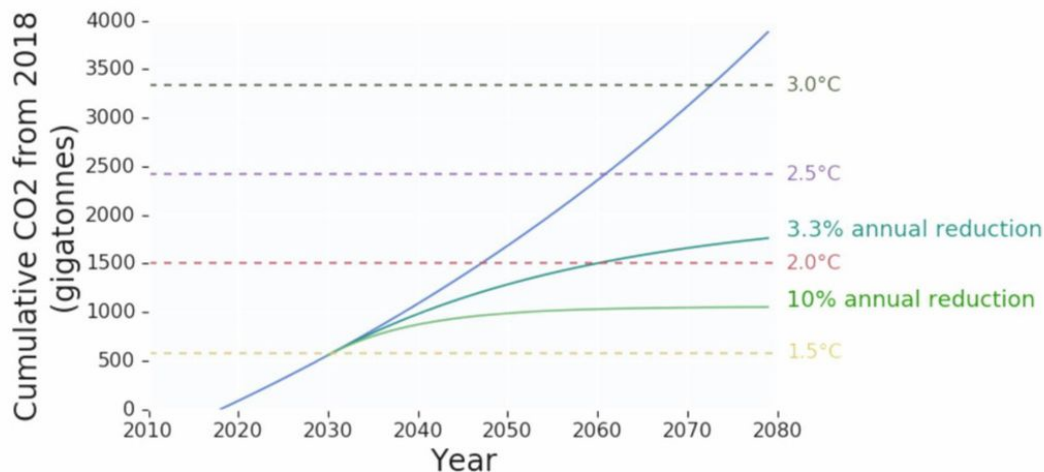


Combatting AI with climate change may not be fast enough...

“We are effectively running out of time to take action.” - Google’s Jeff Dean at the Intergovernmental Panel on Climate Change

Google Research

Decarbonization starting in 2030



Data Privacy

Collecting data for AI-powered climate efforts requires governments to play a role.

Governments may need to collect information from private institutions, such as electricity suppliers. These institutions may not be willing to share this data without some form of compensation.

GREEN BUTTON INITIATIVE:

- Launched by the 2012 White House
- Provides utility customers with simple, secure access to data about their energy usage.



**Green Button
Download
My Data** ®

Resources

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Resources

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