# Tackling climate change with machine learning

Kelly Kochanski

NATION

# Historic excessive heat warning issued in Colorado amid record-smashing temps across Western U

Elinor Aspegren USA TODAY

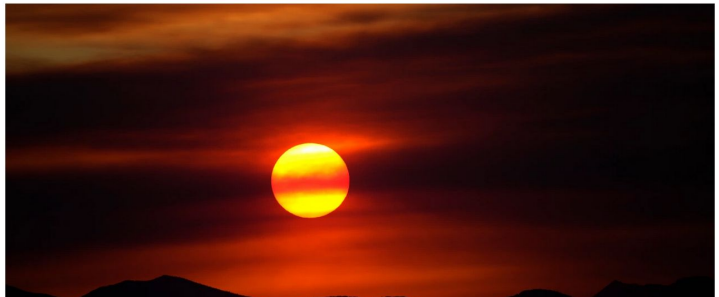
Published 7:56 p.m. ET Jun. 14, 2021 | Updated 9:59 p.m. ET Jun. 15, 2021

DP Colorado weather: An intense and long-lived...

NEWS › WEATHER • News

# Colorado weather: An intense and long-lived heat wave incoming

We've seen hot temperatures this year already but the heat that is approaching will be long-lasting and will challenge records across the entire state.



Sign up for Newsletters and Ale

SUBSCRIBE

Follow Us

MOST POPULAR

1 Ask Amy: Parental terminatio legal end to mothering

2 Trial pitting Bowlen daughters against trustees of Broncos is

United Nations | UN News

Global perspective Human stories

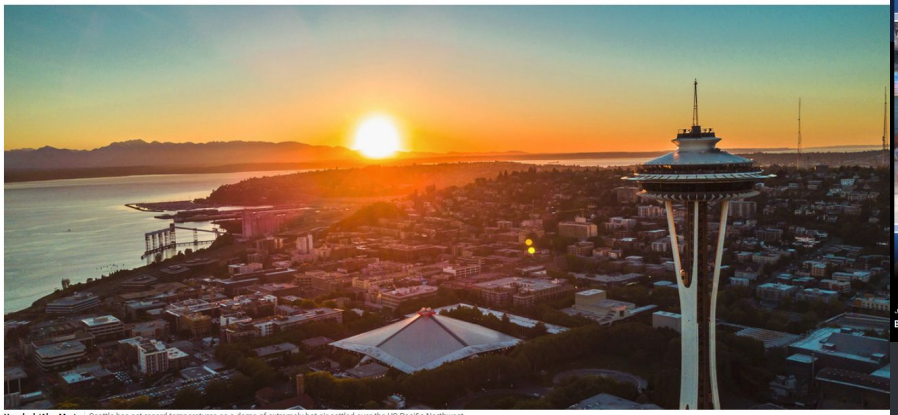
Search

Advanced Search

Home | Topics | In depth | Secretary-General | Media

AUDIO HUB | SUBSCRIBE

# Record-breaking 'pressure-cooker' heatwave hits Canada, US northwest



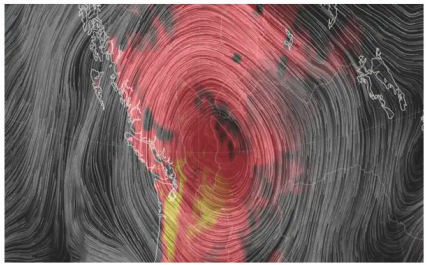
Unsplash/Alex Mertz | Seattle has set record temperatures as a dome of extremely hot air settled over the US Pacific Northwest.

Sections | The Washington Post Democracy Dies in Darkness | Get one year for $40 | Sign in

Capital Weather Gang • Analysis

# The Pacific Northwest heat wave is shocking but shouldn't be a surprise

Climate change studies have warned for more than three decades that this is our future



9

U.S. NEWS | OPINION | COVID-19 | WORLD | BUSINESS | PODCASTS | WATCH NOW

# How climate change 'loads the dice' for heat waves

This week's sizzling temperatures may herald a climate reality that scientists thought was still decades in the future.


June 29, 2021, 3:18 PM MDT / Updated June 29, 2021, 6:09 PM MDT

By Denise Chow

Latest Issues | SCIENTIFIC AMERICAN

CLIMATE

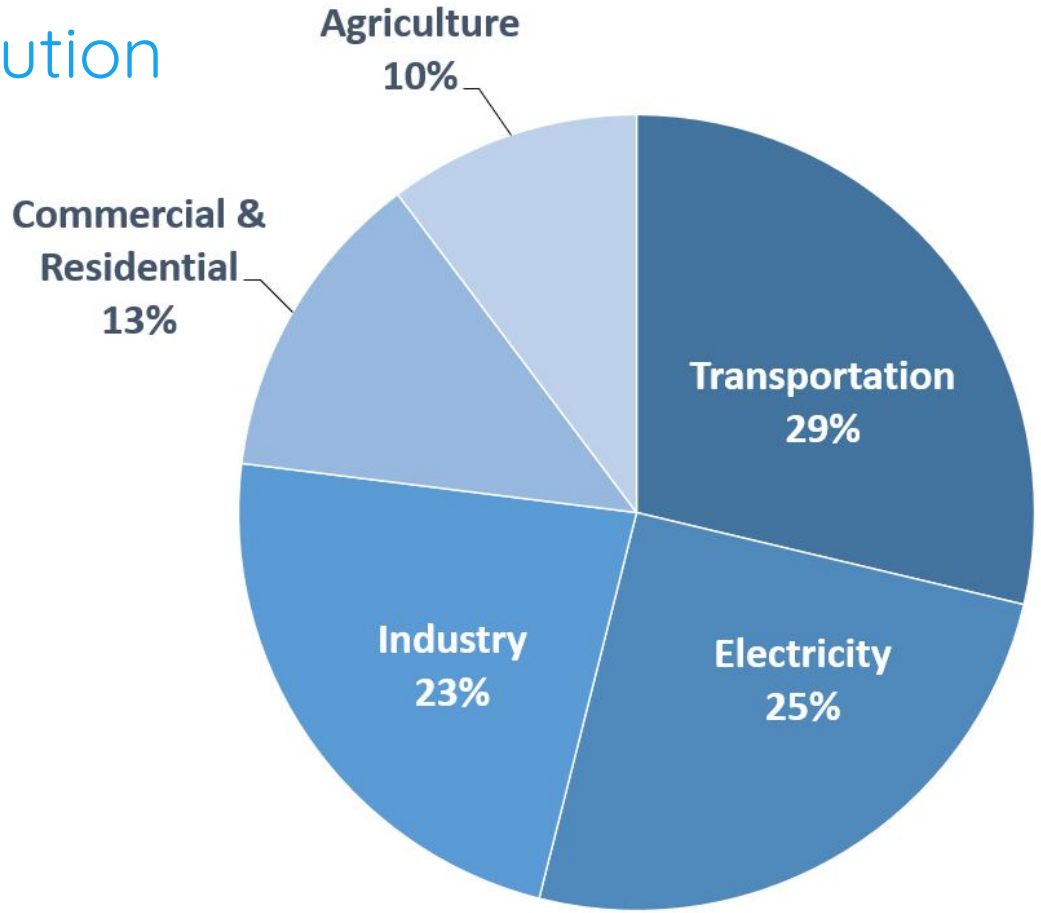
# Unprecedented He Pacific Northwest Climate Cha

acific Ocean cyclones are pumping up the high region

By Anne C. Mulkern, E&E News on June 28,

# What can we do about climate change?

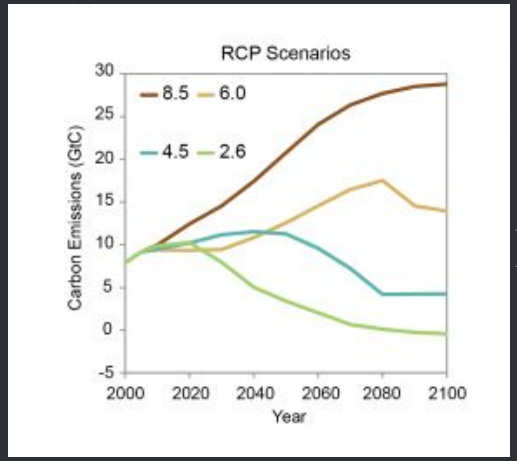
# There is no single solution to carbon emissions



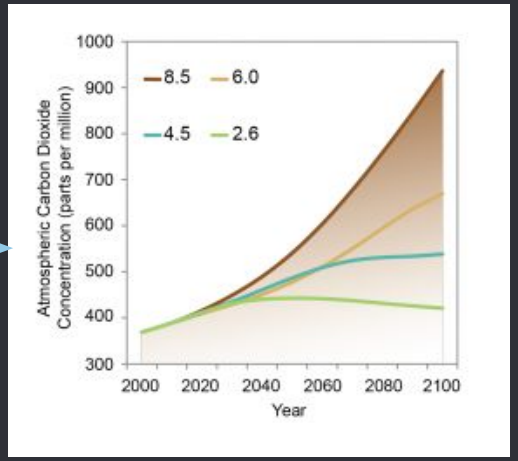

U.S. Environmental Protection Agency (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019

# Mitigating emissions now is much more effective than mitigating them later

Carbon emissions

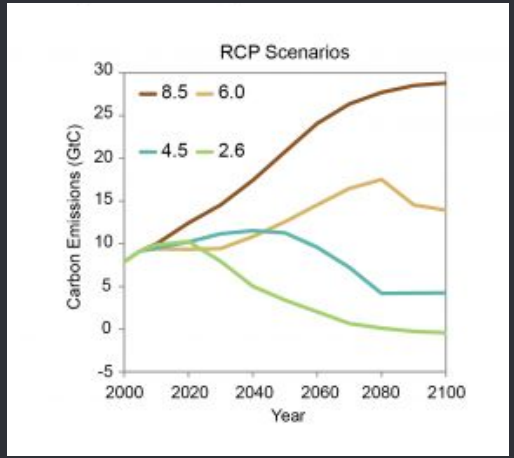



Atmospheric carbon

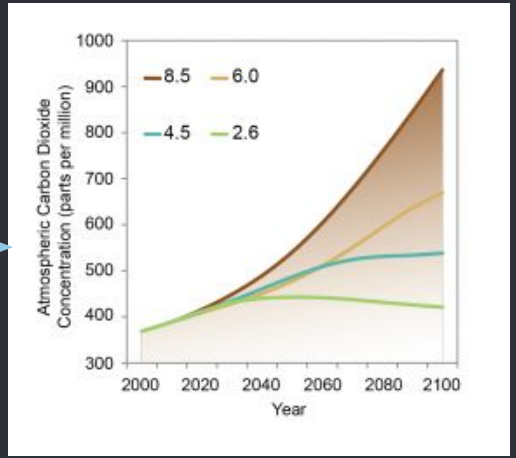


# Mitigating emissions now is much more effective than mitigating them later

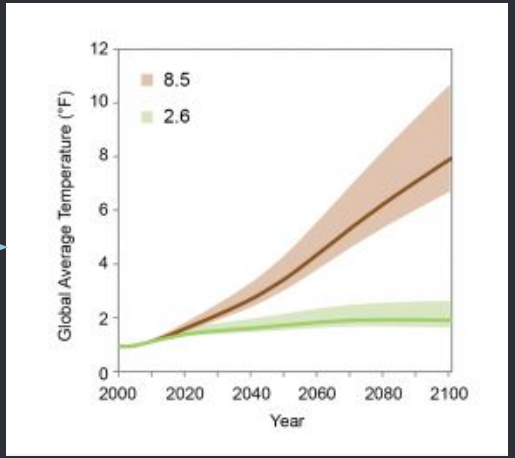
Carbon emissions




Atmospheric carbon




Global temperature




...though we need to adapt to warmer temperatures regardless

# Opportunities

# Tackling Climate Change with Machine Learning

David Rolnick[1]*, Priya L. Donti[2], Lynn H. Kaack[3], Kelly Kochanski[4], Alexandre Lacoste[5], Kris Sankaran[6,7], Andrew Slavin Ross[8], Nikola Milojevic-Dupont[9,10], Natasha Jaques[11], Anna Waldman-Brown[11], Alexandra Luccioni[6,7], Tegan Maharaj[6,7], Evan D. Sherwin[2], S. Karthik Mukkavilli[6,7], Konrad P. Kording[1], Carla Gomes[12], Andrew Y. Ng[13], Demis Hassabis[14], John C. Platt[15], Felix Creutzig[9,10], Jennifer Chayes[16], Yoshua Bengio[6,7]

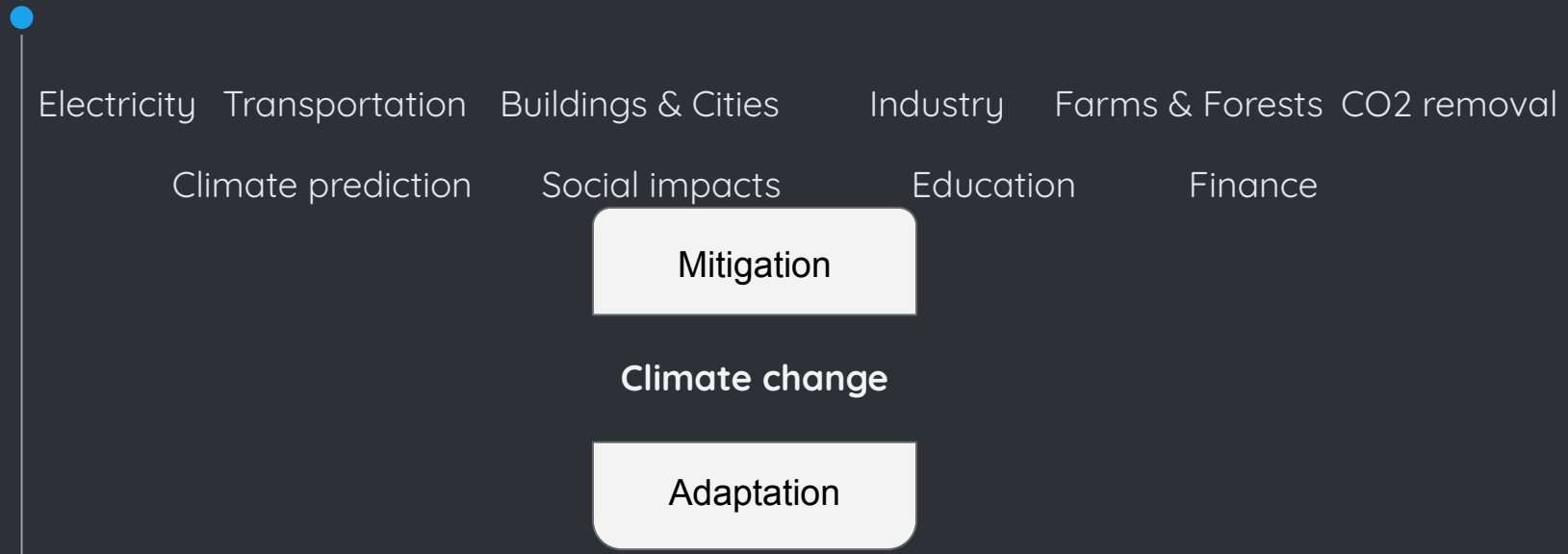
[1]University of Pennsylvania, [2]Carnegie Mellon University, [3]ETH Zürich, [4]University of Colorado Boulder, [5]Element AI, [6]Mila, [7]Université de Montréal, [8]Harvard University, [9]Mercator Research Institute on Global Commons and Climate Change, [10]Technische Universität Berlin, [11]Massachusetts Institute of Technology, [12]Cornell University, [13]Stanford University, [14]DeepMind, [15]Google AI, [16]Microsoft Research

climatechange.ai

Mitigation

Climate change

Adaptation


Electricity
Transportation
Buildings & Cities
Industry
Farms & Forests
CO2 removal
Climate prediction
Social impacts
Education
Finance
Mitigation
Climate change
Adaptation

**Electricity** **Transportation** **Buildings & Cities** Industry Farms & Forests CO2 removal

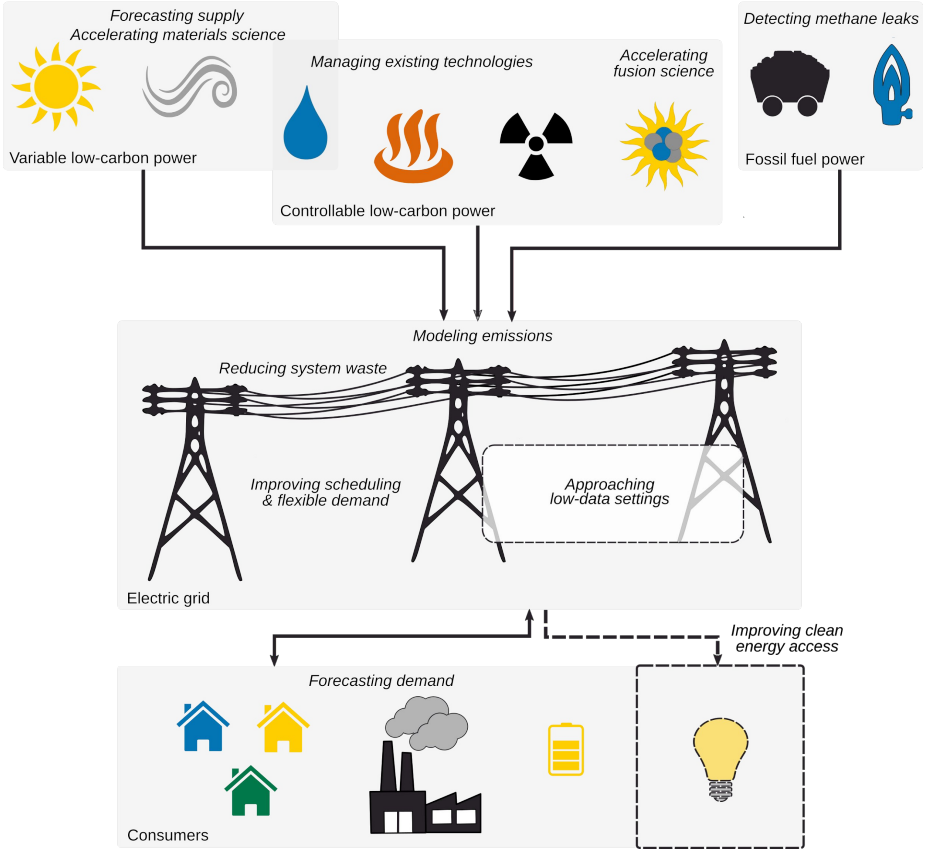
Mitigation

**Climate change**

Adaptation

**Climate prediction** Social impacts Education Finance

# Electricity systems




Priya L. Donti
Carnegie Mellon

# Transportation

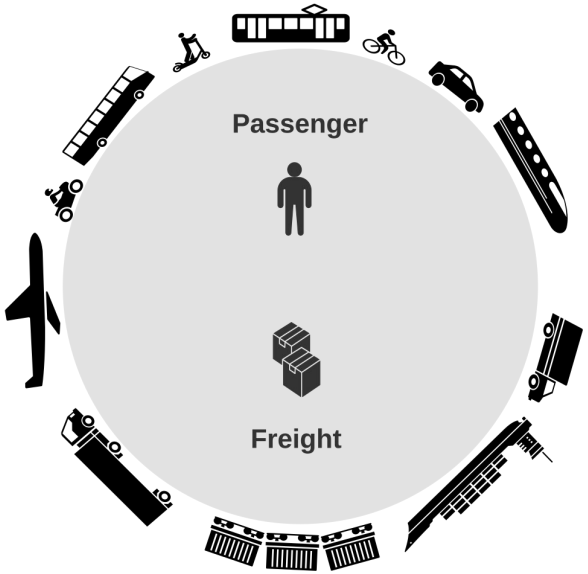
**Reducing transportation activity**

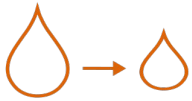
*Analyzing data*
*Remote sensing*
*Forecasting*
*Freight consolidation*
*Alternatives to transport*



**Modal shift**

*Consumer choices*
*Coordinating modes*
*Bike share rebalancing*
*Predictive maintenance*
*Enforcing regulation*



**Vehicle efficiency**

*Designing for efficiency*
*Detecting loading inefficiency*
*3-D printing*
*Autonomous vehicles*

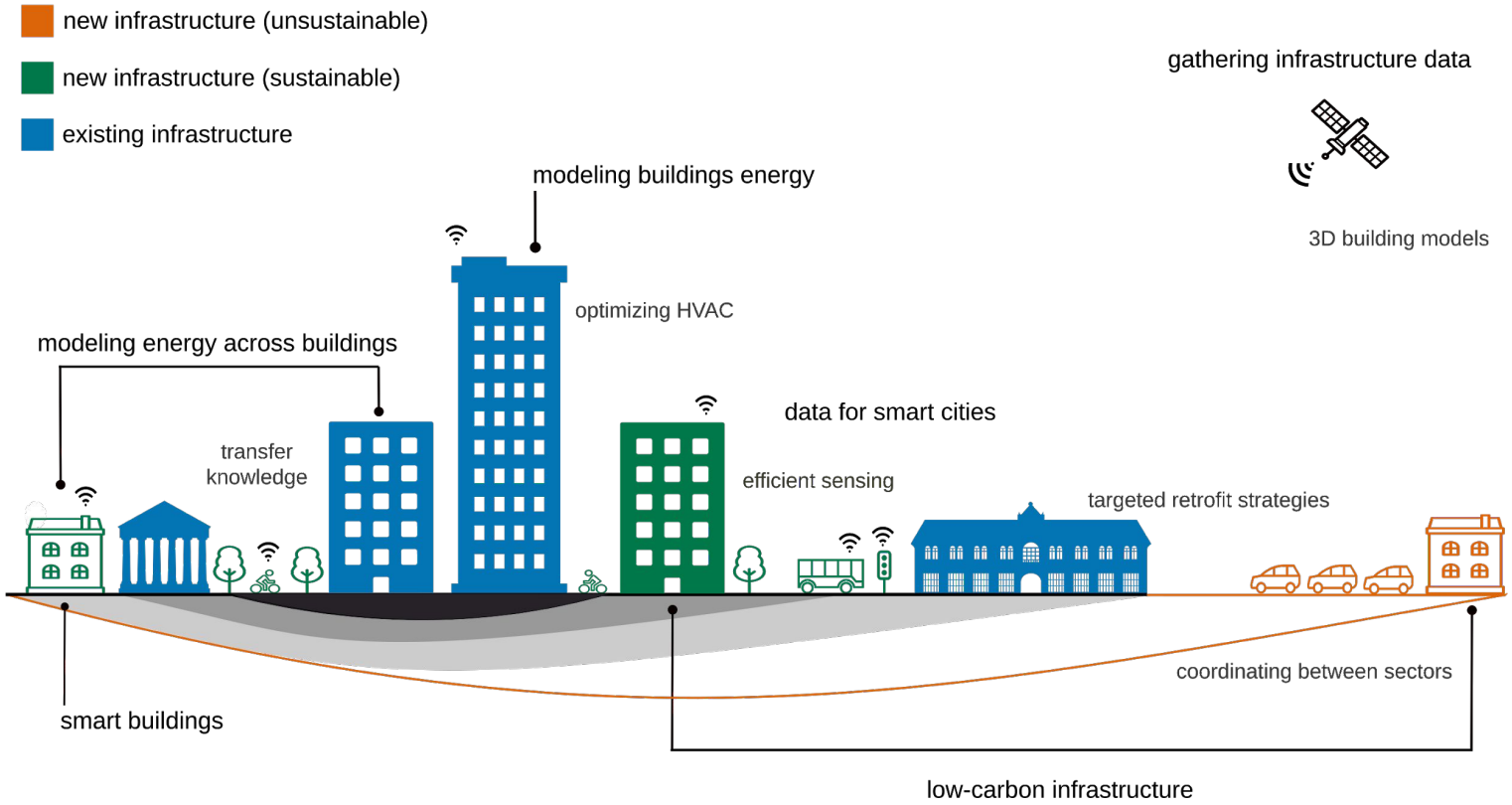
**Alternative fuels**

*Research and development*

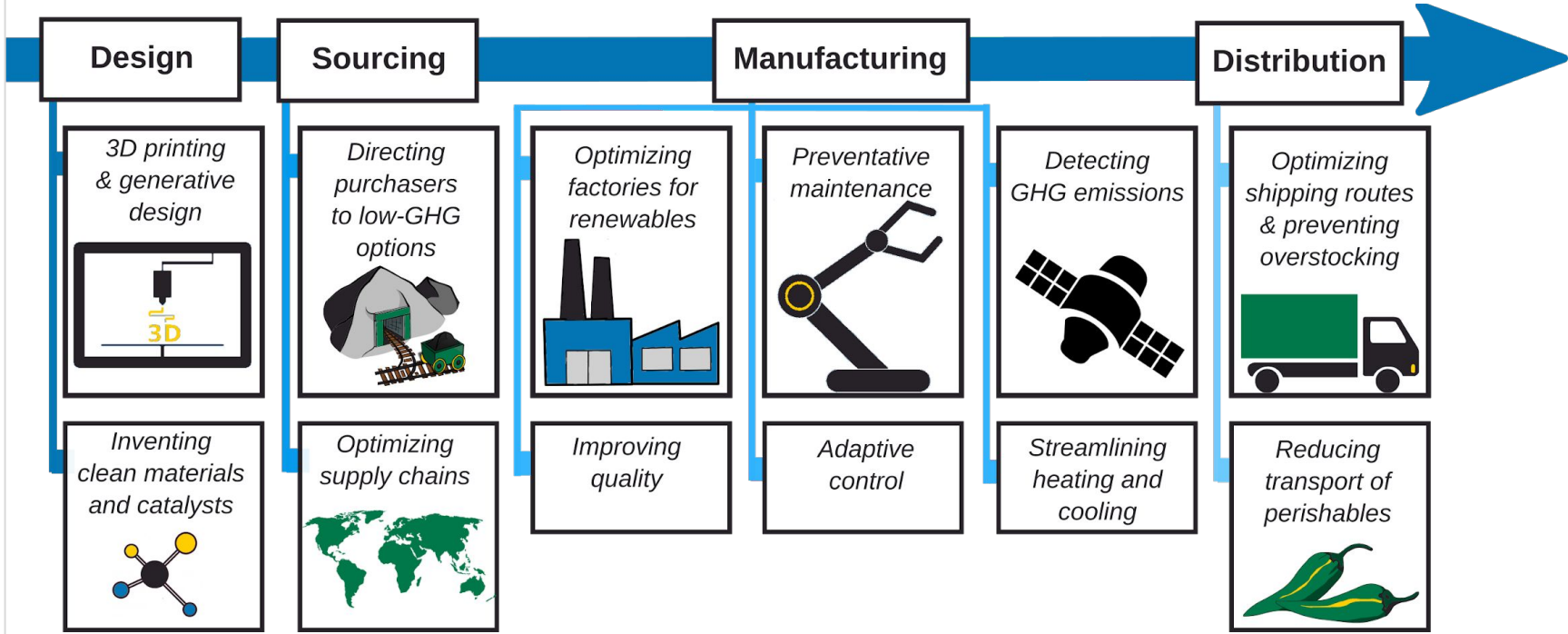
**Electric vehicles**

*Charging patterns*
*Charge scheduling*
*Congestion management*
*Vehicle-to-grid algorithms*
*Battery energy management*

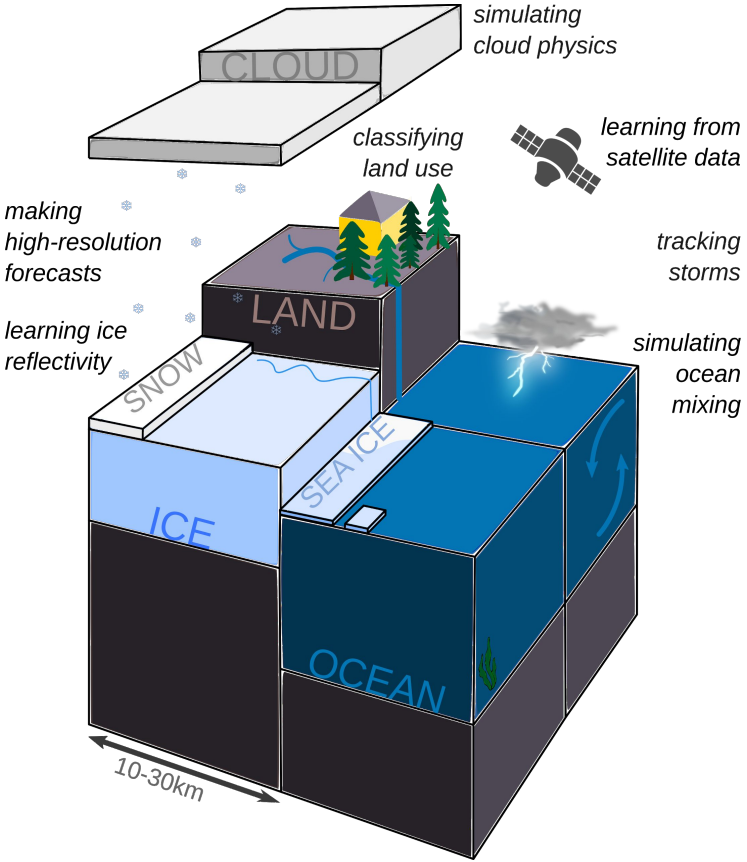
# Buildings and cities



# Industry


Design
Sourcing
Manufacturing
Distribution
3D printing & generative design
3D
Directing purchasers to low-GHG options
Optimizing factories for renewables
Preventative maintenance
Detecting GHG emissions
Optimizing shipping routes & preventing overstocking
Inventing clean materials and catalysts
Optimizing supply chains
Improving quality
Adaptive control
Streamlining heating and cooling
Reducing transport of perishables

# Climate prediction



# Challenges

# Barriers to implementation

| | | Machine learning | Climate science |
|---|---|---|---|
| Cultural Barriers | *What's exciting?* | Big data! | Science! |
| | *Objectives* | Well-defined is useful | Broad is interesting |
| | *Explainability* | Second to prediction | Often the main goal |
| | *Publications* | At conferences | In journals |
| Technical Barriers | *Data* | Ideally clean and labelled | Many unlabeled features |
| | *Data formats* | Images, csv, dataframes | Images, netcdf |
| | *Data use* | Integral to model | Data -> theory -> model |
| | *Existing code* | Python, R, Julia | C/C++, Fortran |

Across many domains, the best work is done by **interdisciplinary teams** of scientists and machine learning experts

# Tackling important problems with interdisciplinary work

## Advice to current graduate students

1. Say “yes” to exciting projects
2. Embrace internships/practicums
3. That code you’ll “only run once”…

**Thank you for listening.**

More info on climate change + ML: www.climatechange.ai

# QUESTIONS?