MIT Climate Project

Elsa Olivetti, Chris Knittel, Jesse Kroll, Sarah McGrath, Christoph Reinhart

March 27, 2025 | MIT Global Change Forum 47

MIT’s Position on Climate Change

“Climate change and its mounting consequences present the greatest and most urgent scientific and societal challenge of our age. Given MIT's depth and breadth of expertise, and our mission of service, I believe we have an urgent responsibility to marshal ourselves to reckon with it.”

Sally Kornbluth, MIT President

Climate Project Goal

MIT should become, within the next decade, one of the world's most prolific and collaborative sources of technological, behavioral, and policy solutions for the global climate challenge.

Climate Project Missions

Decarbonizing Energy and Industry

Elsa Olivetti

Restoring the Atmosphere, Protecting the Land and Oceans

Andrew Babbin

Empowering Frontline Communities

Jesse Kroll

Miho Mazereeuw

Building and Adapting Healthy, Resilient Cities

Christoph Reinhart

Inventing New Policy Approaches

Christopher Knittel

Wild Cards

Benedetto Marelli

Mission Roles

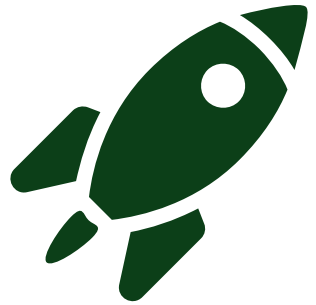
1. Assessment

- Assessing progress within its domain

2. Roadmapping

- Identifying critical gaps and bottlenecks constraining progress, as well as promising new pathways for effective action

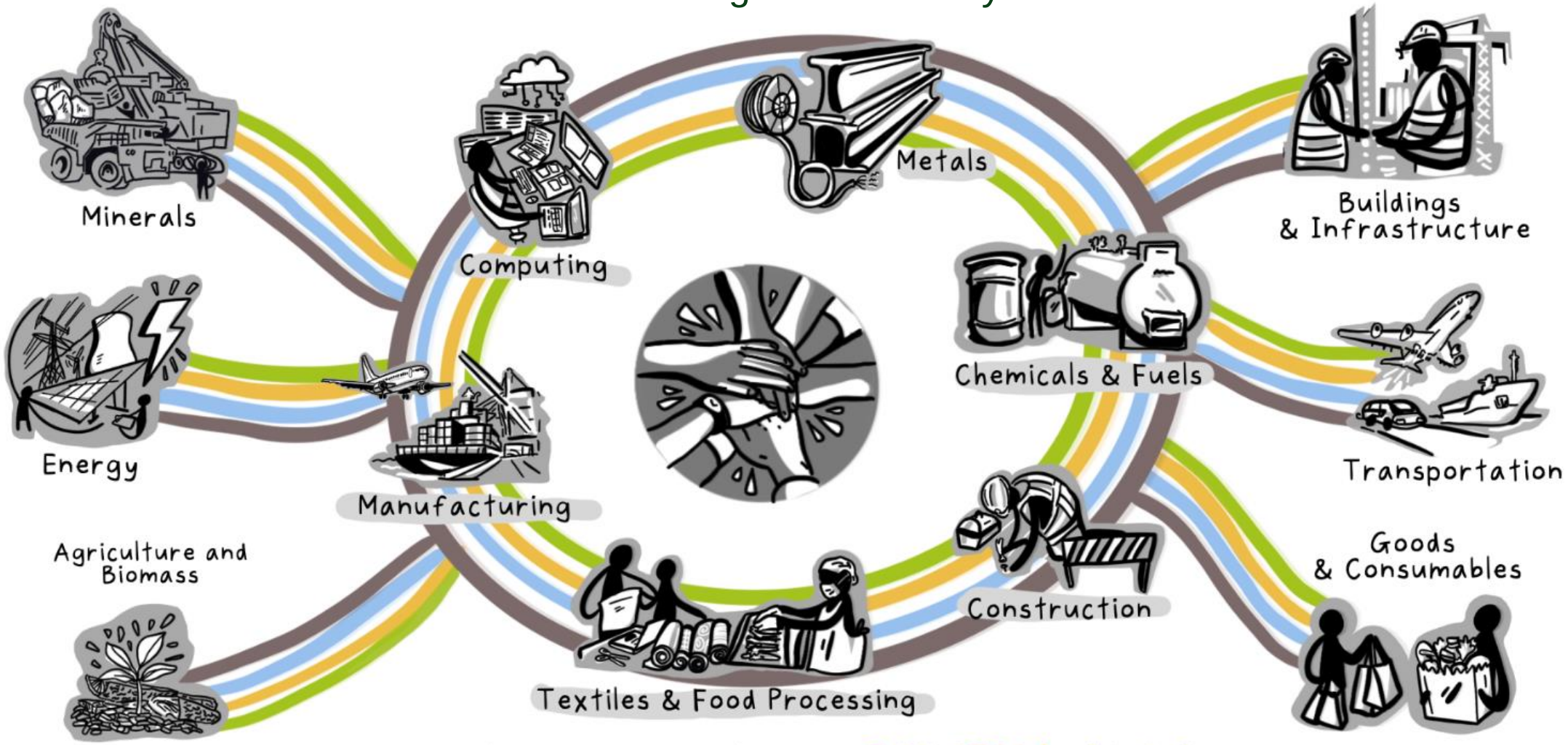
3. Frontier Projects



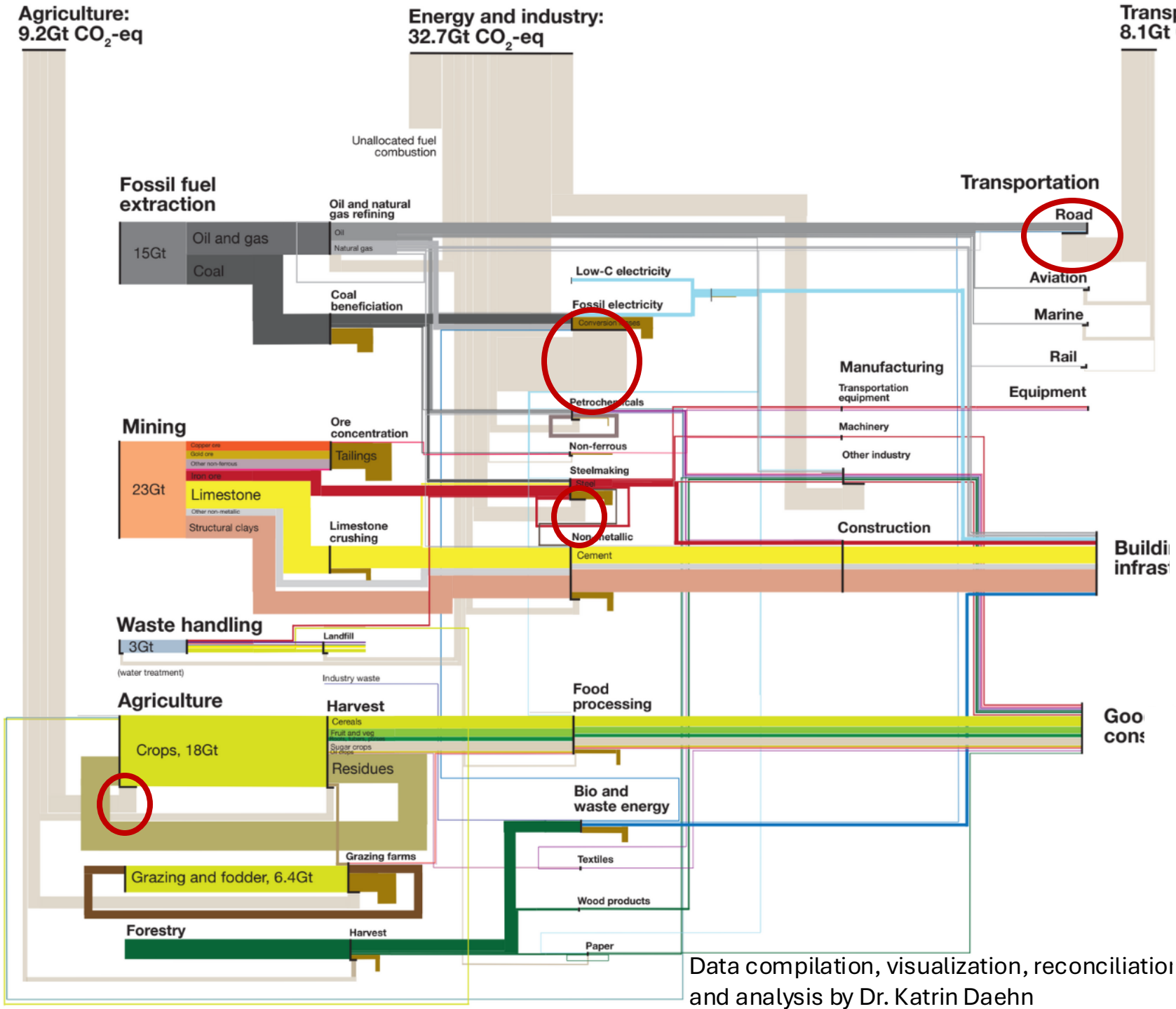
- Selecting, launching, and supporting projects to accelerate progress

Decarbonizing Energy and Industry

Leveraging scale, connection, and co-benefits
across the global economy



Visual credit to Haley McDevitt



Data compilation, visualization, reconciliation and analysis by Dr. Katrin Daehn

Pursuing efforts to electrify 45% of industrial CO_2 emissions

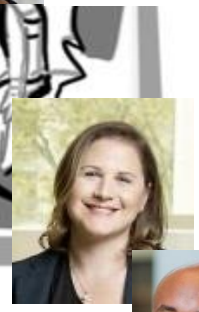
School of Science

School of Engineering

Humanities, Arts & Social Sciences

Yet-Ming Chiang

Antoine Allanore



Bilge Yildz

Mining with limited impact on people & ecosystems

Visual: Haley McDevitt

School of Science

MIT Schwarzman College of Computing

SA+P MIT SCHOOL OF ARCHITECTURE AND PLANNING

MIT MANAGEMENT SLOAN SCHOOL

School of Engineering

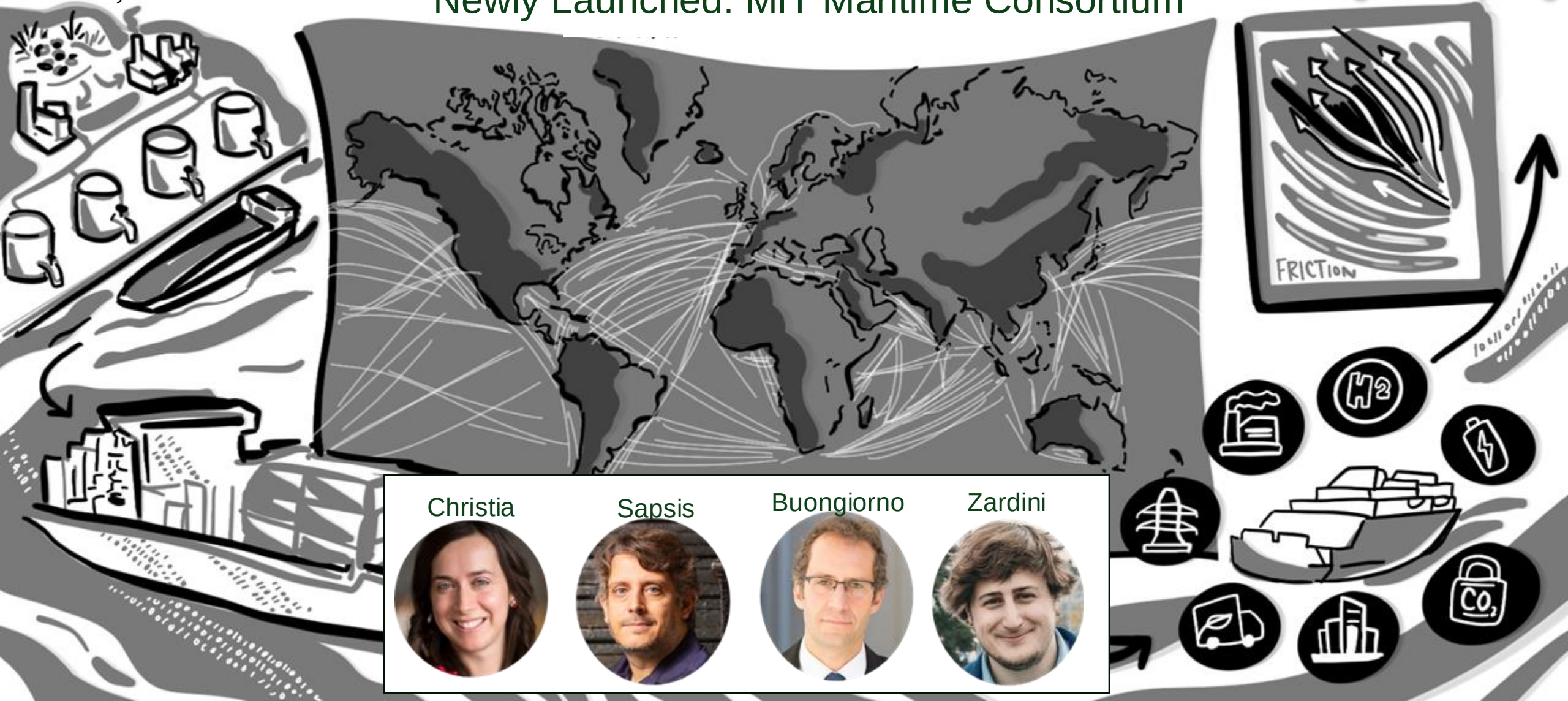
Decarbonize maritime transport by integrating ship design, network optimization, & fuel supply chains

School of Engineering

MIT Schwarzman College of Computing

Visual: Haley McDevitt

Newly Launched: MIT Maritime Consortium



Christia Sapsis

Buongiorno

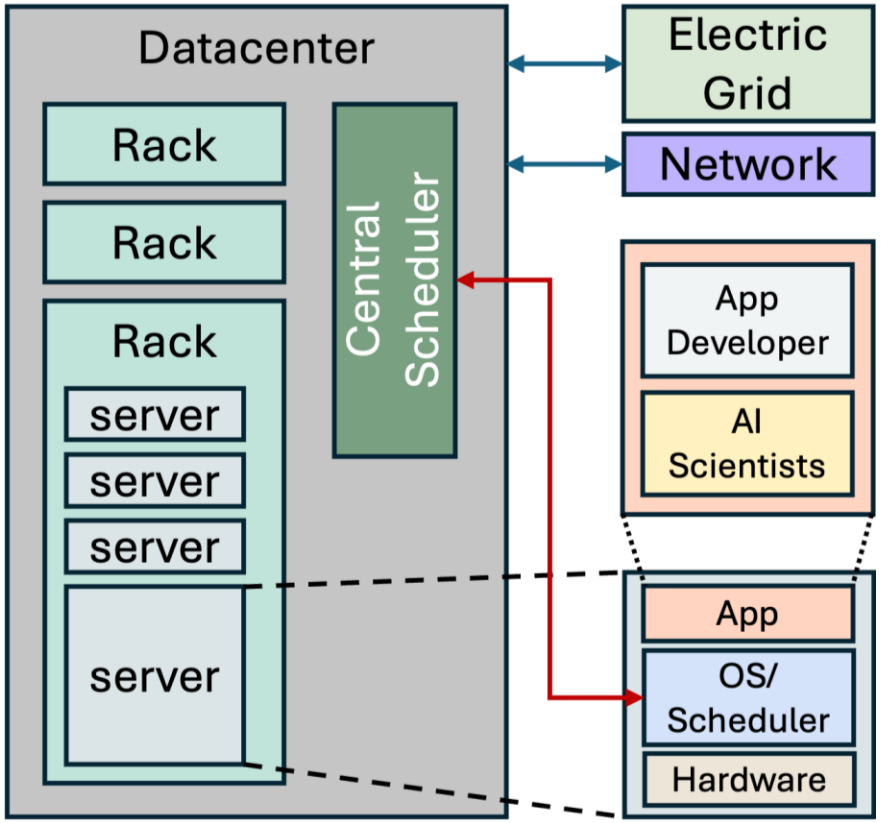
Zardini

Grappling with Unrelenting AI Energy Demand: Decisions at one level in the compute stack have ripple effects on energy, emissions and performance throughout the system

SA+P MIT SCHOOL OF ARCHITECTURE AND PLANNING

MIT School of Engineering

MIT Schwarzman College of Computing



Hardware/Edge Devices


Chandrakasan


Casamento


Cheema


Del Alamo


Han


Palacios


Sze

Computer Systems and Architecture


Emer


Belay


Alizadeh


Delimitrou


Sanchez

Real estate & building energy use


Zheng


Norford


Reinhart


Mueller

Energy Supply: Grid


Coday


Donti


Perreault


Ilic


Annaswamy


Amin

Enabling New Policy Approaches

New institutions and incentives, policies/systems for rapid scaling, and decision support tools.

Technology alone cannot solve the climate crisis. To achieve meaningful progress, there is a critical need for a **robust policy framework** that ***incentivizes firms and consumers*** to **adopt low-carbon alternatives.**

Enabling New Policy Approaches

*What are the structural, **political and economic barriers** limiting the adoption and implementation of climate policy at the I**nternational, national** and **subnational** level*

Key Activities:

- Support the design & development of new policy approaches
- Infuse policy perspectives into each MIT Climate Project Mission

Enabling New Policy Approaches - Process

Guiding Question:

What is the biggest thing getting in the way of progressing climate policy?

Assess national and global progress → Identify critical gaps/bottlenecks constraining progress → Select, launch & support Frontier Projects

Initial areas of exploration:

GLOBAL GOVERNANCE

- Do we need to consider new ways of globally governing the climate?

COSTS & INCENTIVES

- Are we measuring the cost of emissions accurately? Are governments considering the long-term impact of lost revenues resulting from extreme storms to local economies and government budgets?

ECONOMICS

- Can the global economy survive if we uncouple from the use of fossil fuels and their associated emissions?

POLITICS and CAMPAIGNS

- Are we considering the changing political landscapes and key audience needs for designing inclusive policy?
- Who funds the information that leads to public sector opinions that affect election outcomes?

TOOLS

- Can we provide accessible tools to allow policy makers to understand impacts of *specific* proposals

Assess national and global progress

Identify critical gaps/bottlenecks constraining progress

Select, launch & support Frontier Projects

Gap Analysis:

GLOBAL GOVERNANCE

- Harvard-MIT Global Climate Policy Project

COSTS & INCENTIVES

- Physics-based models of extreme events to generate a social cost of carbon

TOOLS

- Energy transmission optimization

HARVARD-MIT GLOBAL CLIMATE POLICY PROJECT (GCPP)

Context

- Addressing climate change requires **global collective action**, supported by international institutions, frameworks, and policies
- UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, and Paris Agreement are **important, but not enough**
  - The Paris Agreement has forged consensus around limiting global warming to ideally 1.5ºC. but **not made sufficient progress towards achieving this goal**
  - The Paris Agreement **lacks enforcement**, and many key multilateral organizations (e.g., WB, IMF) , emerging issues (e.g., solar geoengineering), and policy levers (e.g., trade) are **beyond its purview**

Need to holistically examine and advance global policies and institutions to support climate action

Vision

Working across Harvard and MIT, GCPP will ***identify and advance innovations in global policies and institutions*** *that encourage more ambitious climate action, as a* ***complement to the UNFCCC***

Strengths & value-add of approach

- Multi-disciplinary collaboration
- Reputation and convening power
- Access to cutting-edge research and thought leadership and ability to look over a longer time horizon
- Vibrant global student & alumni network
- Broad policy & stakeholder outreach

Goals

Develop

feasible proposals for innovations in global policies and institutions that will reduce emissions and human suffering from climate change

Galvanize

policymaker and stakeholder action around proposals

Shape

dialogue on emerging issues where policies may need to mature and politics to change

Engage

students and alumni in global climate policy innovation, equipping them with multidisciplinary tools to address policy challenge

Rethinking how we construct the social cost of carbon

- The original social cost of carbon was estimated from ”integrated assessment models”
  - An internally consistent model of the climate and economy
  - The economic model has a “damage function”

- The “new” models (Chicago) are based on regressions of outcomes on temperatures
  - Leave a lot to be desired

- Can we generate a physics-based model of extreme events
  - Working with Kerry on a pilot project

Rapid Decision Support using GenX

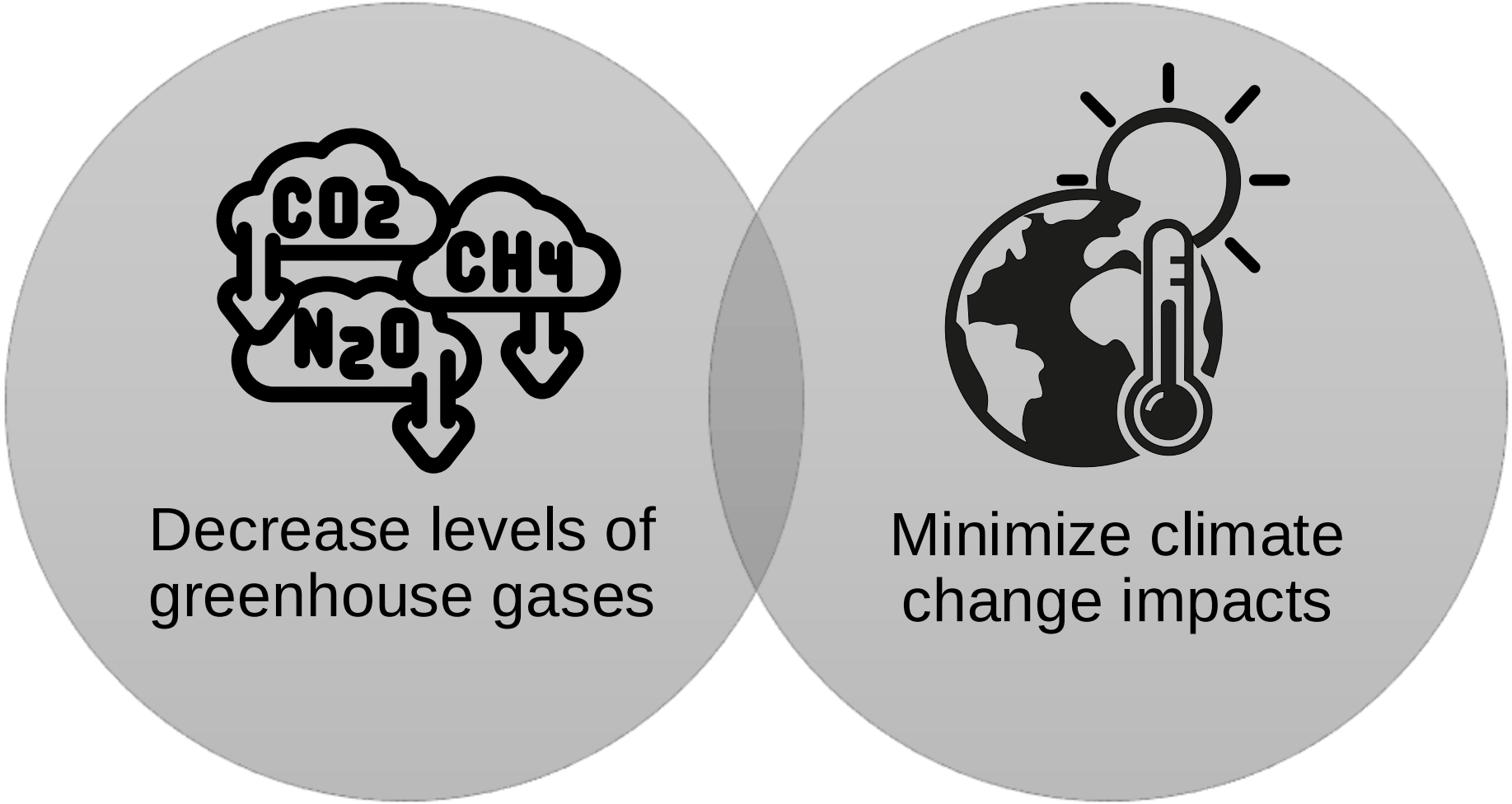
- GenX is an MIT-based “resource planning model”
  - A model of the electricity system that seriously considers its constraints
- Allows you to analyze the impact of a variety of policies
  - E.g., carbon taxes, subsidizing renewables, building transmission, etc.
- The MIT Climate Policy Center has used GenX to model several bills on the floor
  - Those interactions have been quite effective
- Can we (1) make GenX the best, (2) generate a real-time version (3) use this to inform decision making?

Restoring the Atmosphere, Protecting the Land and Oceans

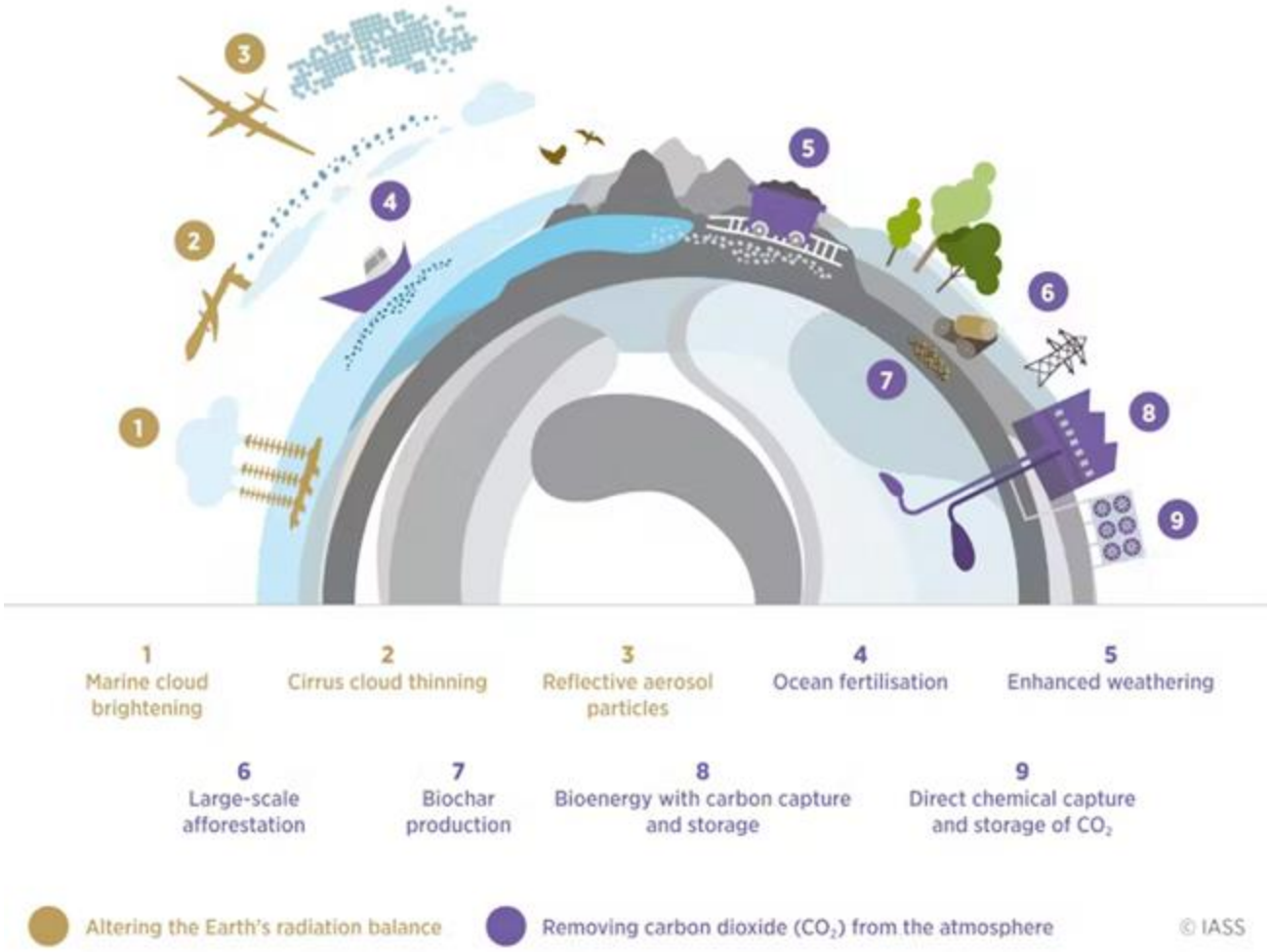
Removing, managing, and storing greenhouse gases.
Protecting ocean and land ecosystems.

Focus on Climate Interventions

Mitigation efforts to:



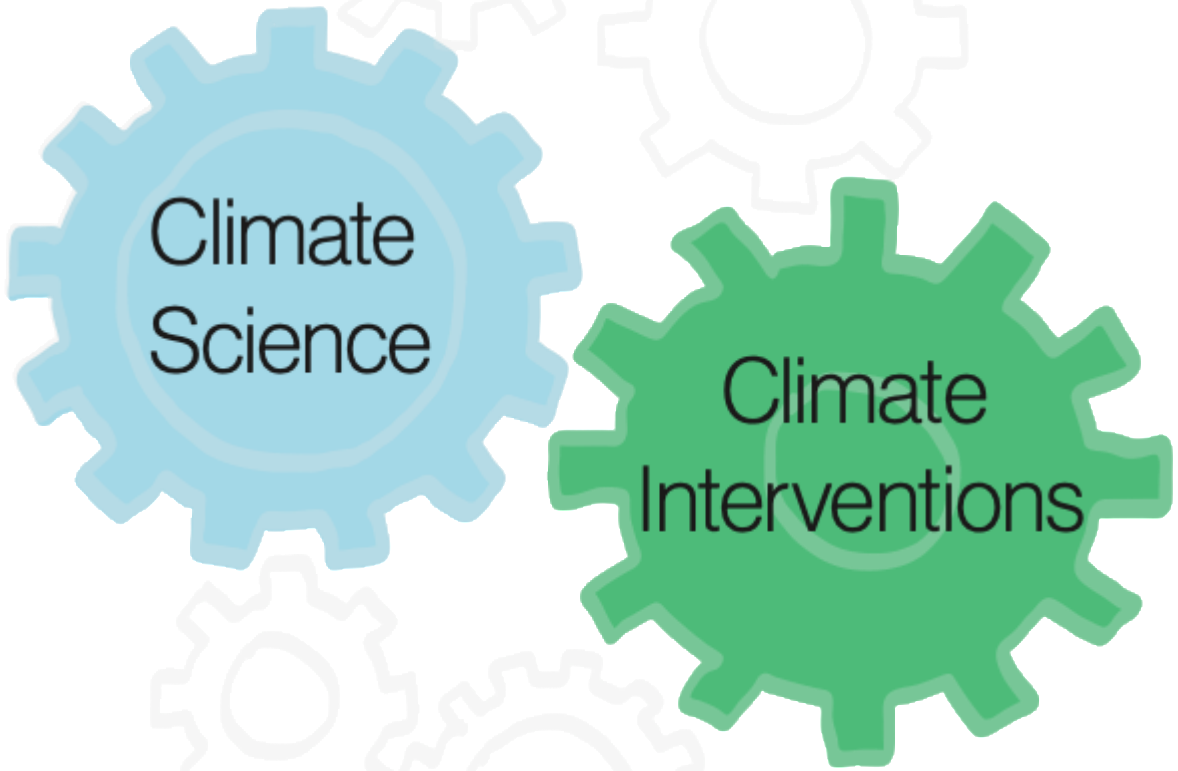
Climate Interventions



Many risks:

- Unknown efficacy
- Unknown downstream impacts
- Unintended consequences
- Lack of governance frameworks

We plan to build knowledge and tools for informed decision making and accelerated action.



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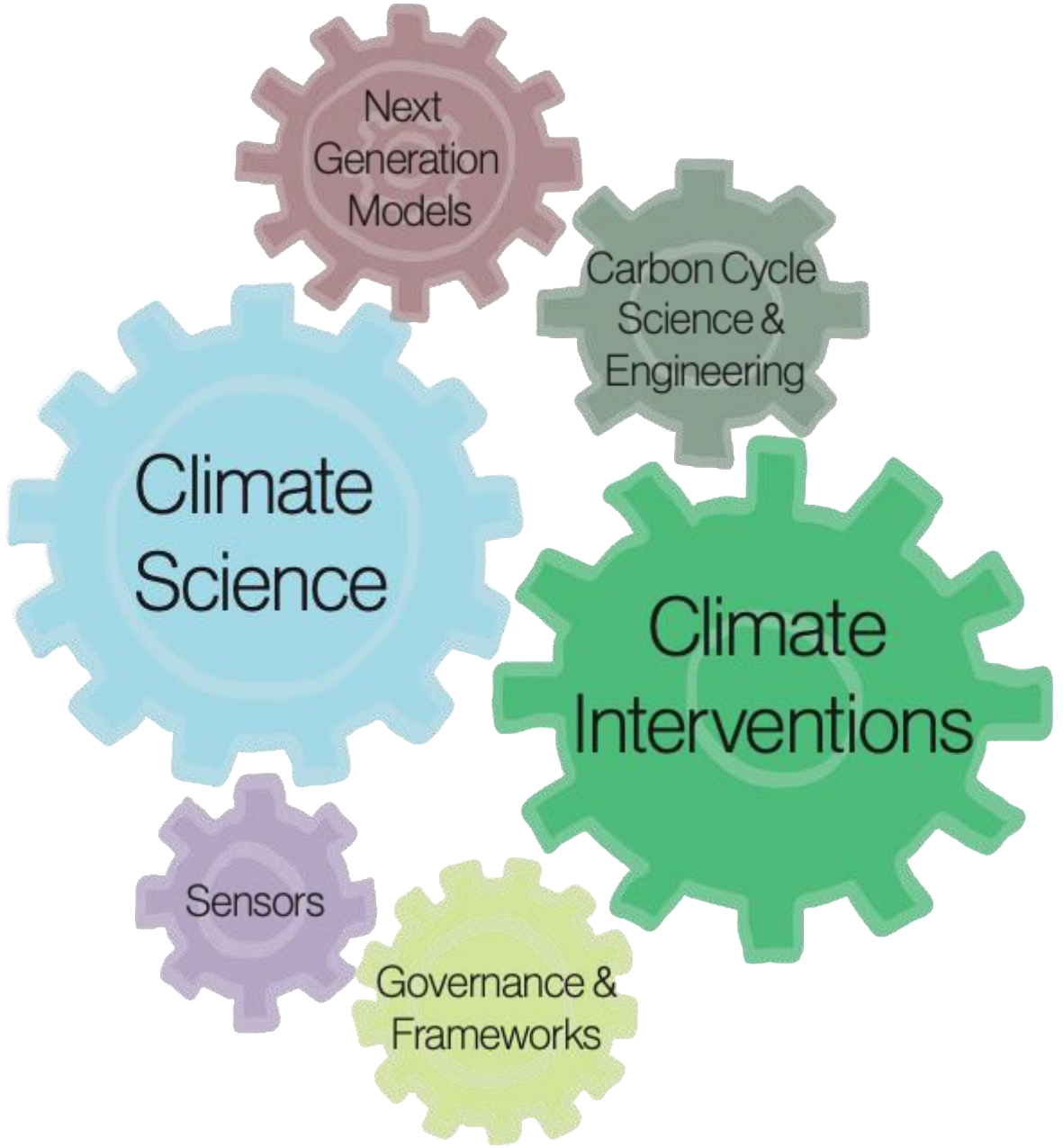
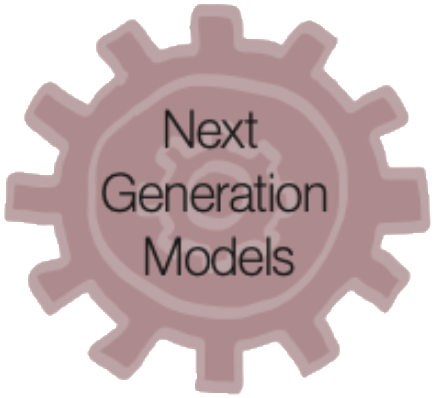
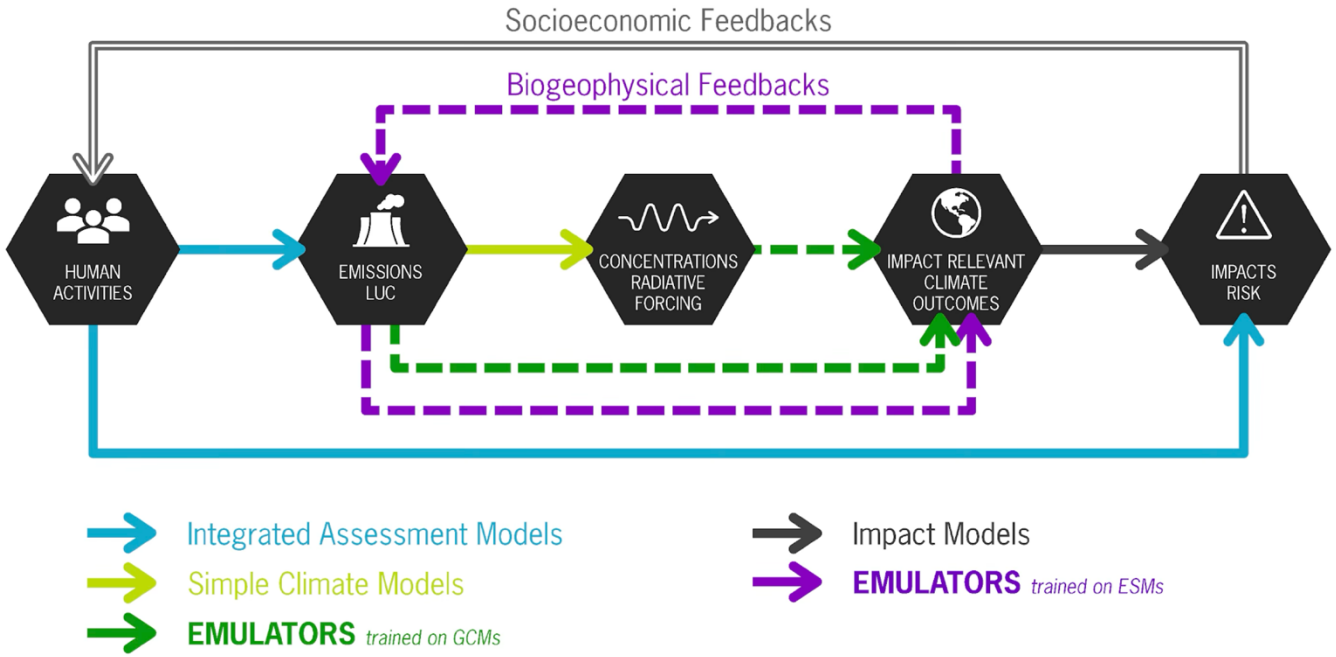


Create next-generation models to inform interventions



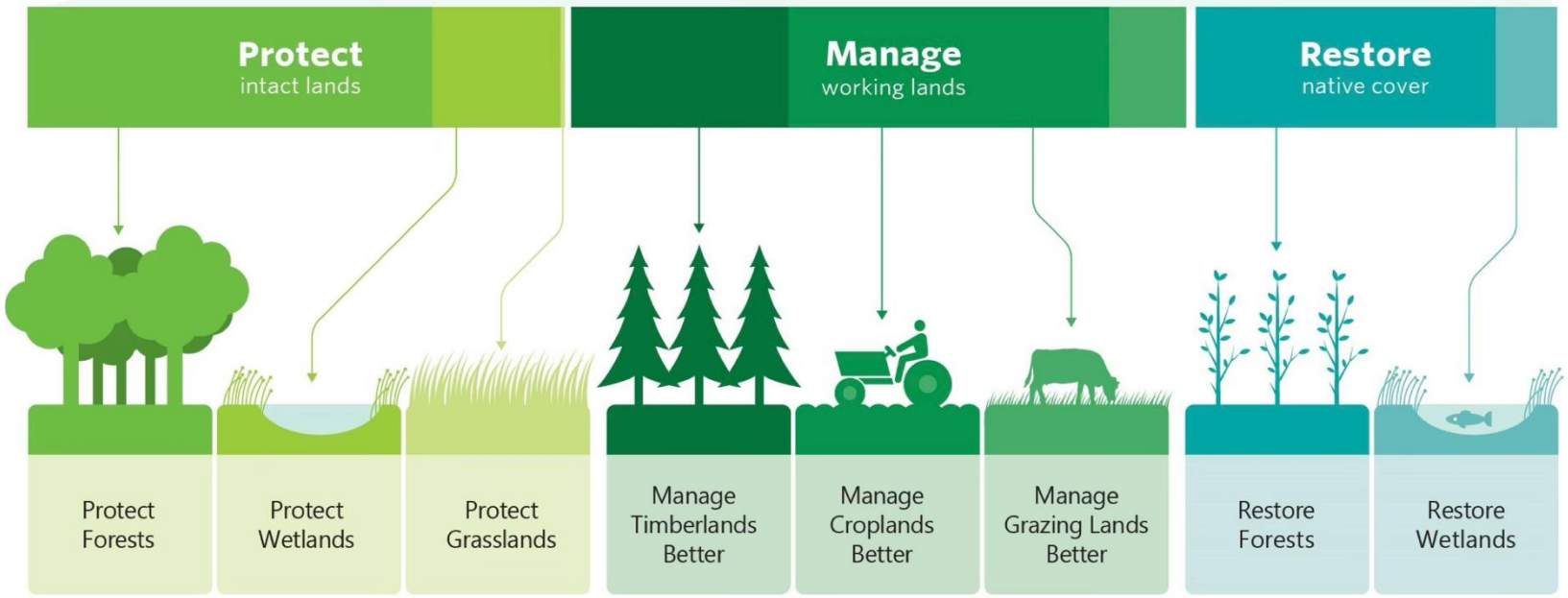
Develop accurate emulators of the climate system, based on state-of-the-art climate models, measurements

Ensure outputs are accessible to stakeholders / decision-makers

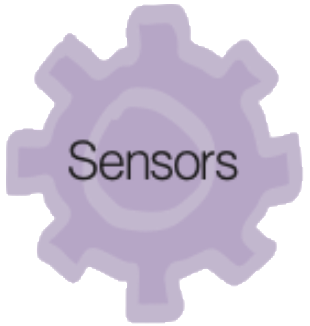


Advance carbon cycle science and engineering

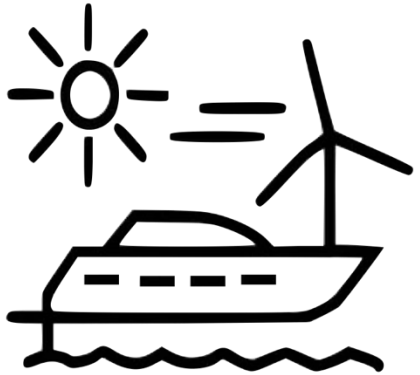
Better understand the present and future global carbon cycle, in order to inform and guide “natural climate solutions” for bringing down CO_2



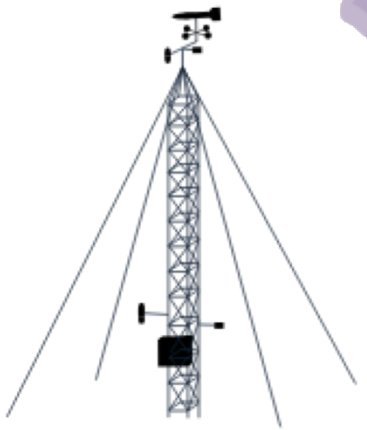
Instrument the planet



Satellites



Autonomous craft



Flux towers

Greatly expand sensor measurements of the Earth system

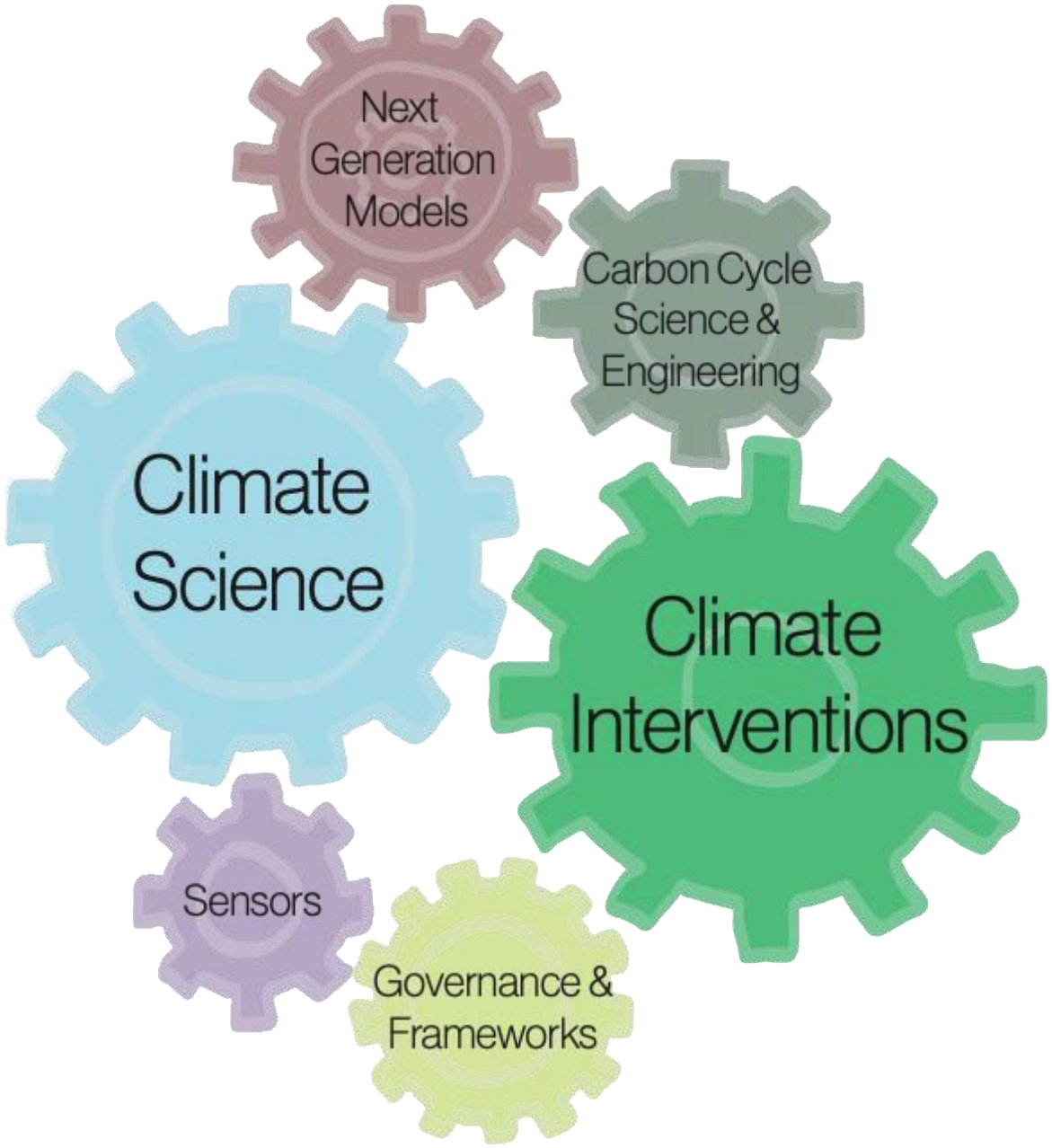
Use state-of-the-art computation tools for data fusion and interpretation

Make data widely available to researchers,
decision-makers, and the public

Develop climate intervention frameworks and governance

Create climate mitigation toolkit with frameworks for climate interventions implementation, measuring, verification, and reporting

Bring together policy makers, stakeholders, industry to accelerate climate mitigation action

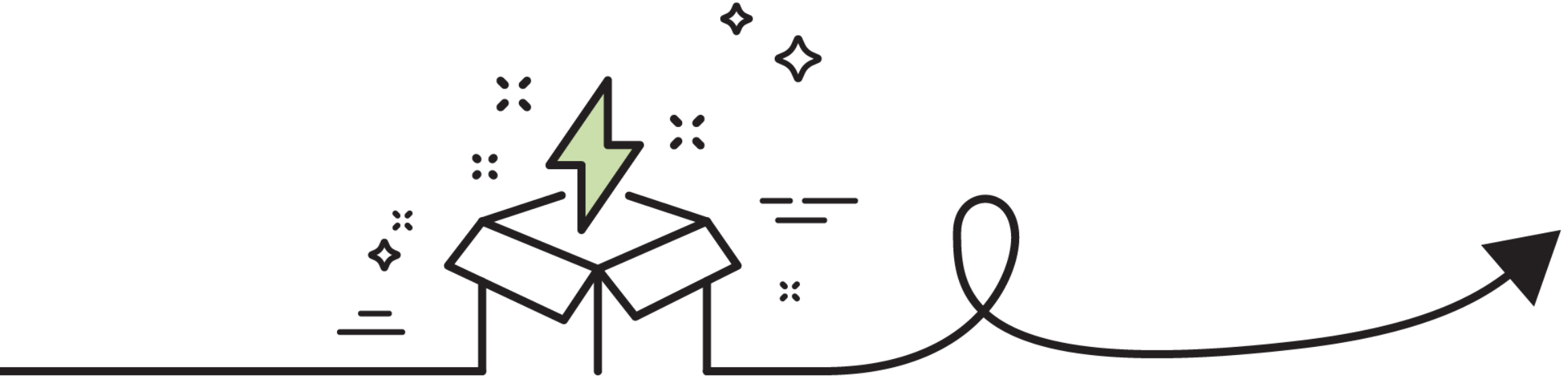

Next Generation Models
Carbon Cycle Science & Engineering
Climate Science
Climate Interventions
Sensors
Governance & Frameworks

Wild Cards

Unconventional solutions
outside the scope of the other Missions.

What is a Wild Card?

High risk innovation



We plan to foster climate-positive behaviors, address climate inequality, and advance sustainable economic systems.

Create behavior change

Changing collective

- decisions,
- opinions, and
- attitudes toward climate change

Advance sustainability resilient prosperity for the Global South

New technologies to address:

- food insecurity in developing economies,
- build grassroots innovation, and
- mitigate human displacement.

Design a global bioeconomy

Following principles of circularity, restoration, and sustainability design biomanufacturing efforts that:

- reduce energy consumption,
- increase access to resources,
- enhance prosperity, and
- preserve ecosystems and biodiversity.

WILD CARD

Changing Behaviors

WILD CARD

Resilience for Global South

WILD CARD

Sustainable Bioeconomy

WILD CARD

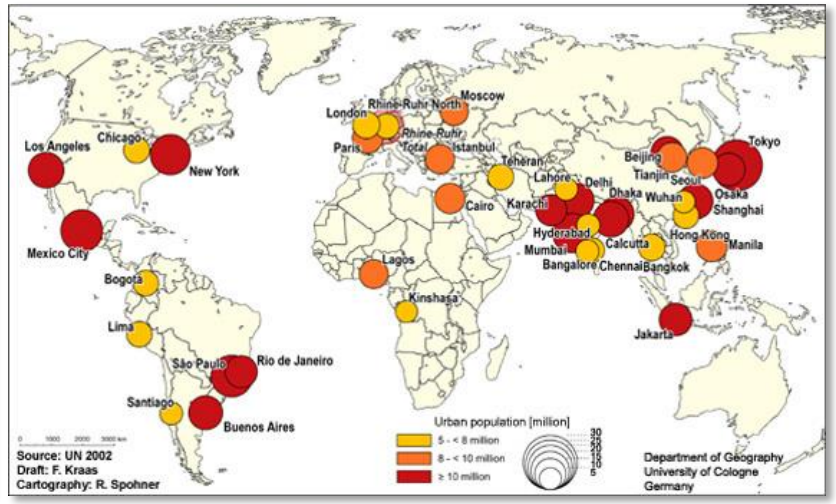
High Risk Idea Incubation & Innovation

Designing Resilient and Prosperous Cities

Cities are a high-leverage opportunity

>75% of world's energy from transportation, buildings and industry

>75% of GHG emissions



3% of all landmass-> Roll-out solutions in targeted locations **for massive impact**

The next 10 years are critical

Massive flock to cities… 2/3 of the global population will live in cities by 2050.

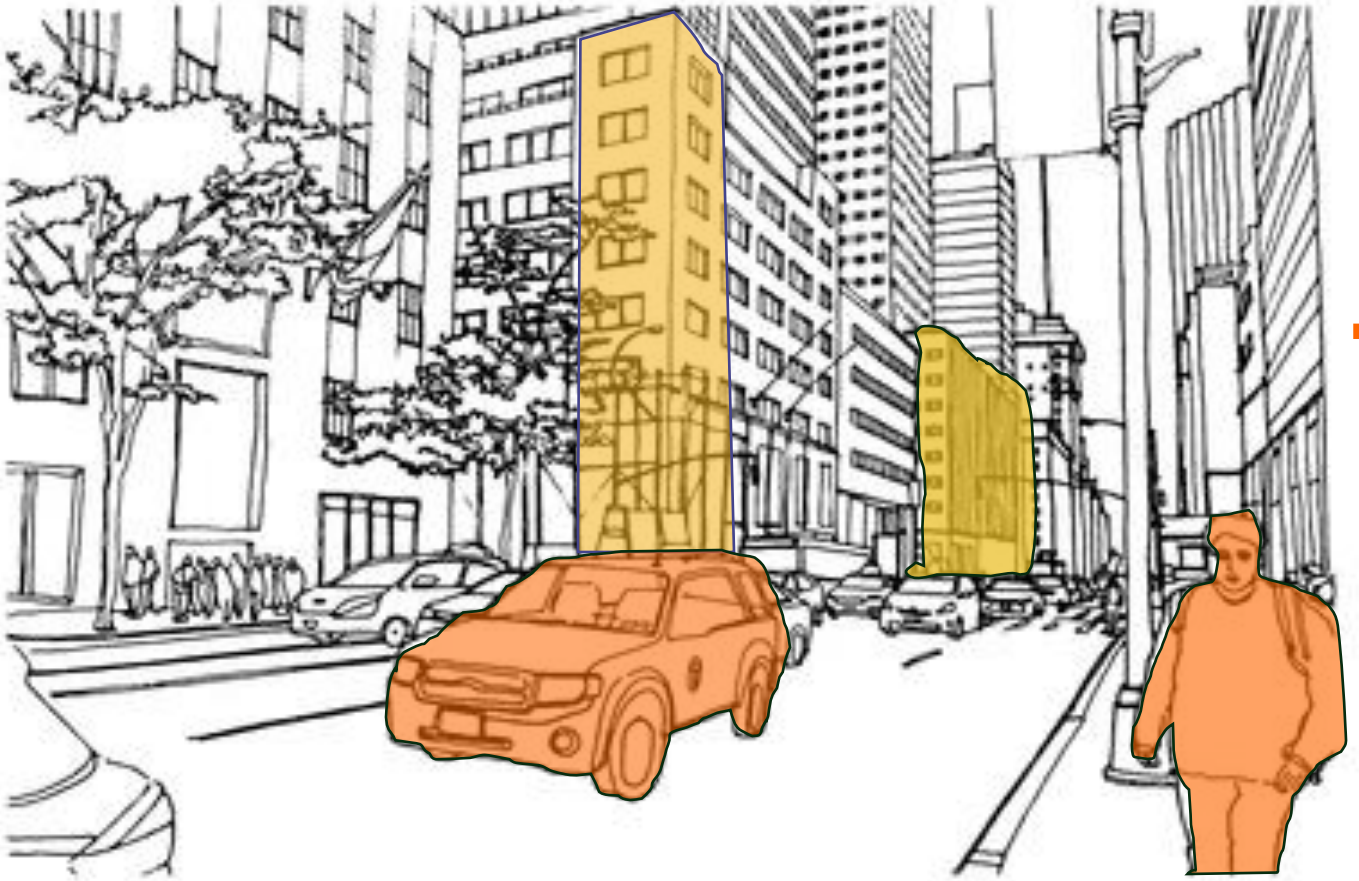
Density is increasing… The global building stock is projected to double by 2050.

Coastal cities are disappearing… Caused by sea-level rise and extreme weather events.

Image: The Guardian (center); The New York Times (right)

Our Approach

Buildings



Transport

Why Buildings?

40%
of anthropogenic GHG emissions

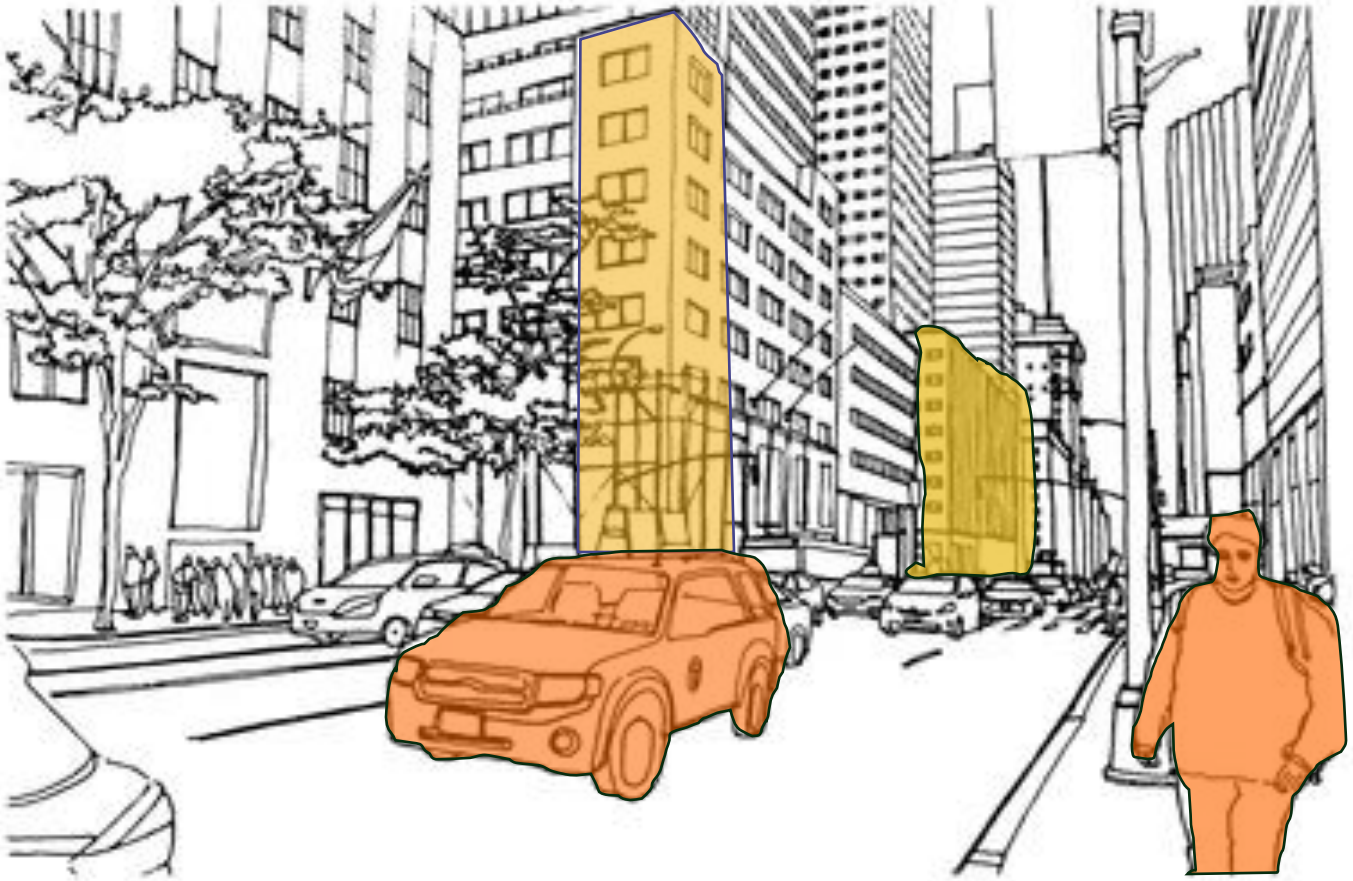
90% of our time
is spent indoors; indoor air quality problems are ubiquitous

$337Trillion
value of the global building sector

Urban Solution Space

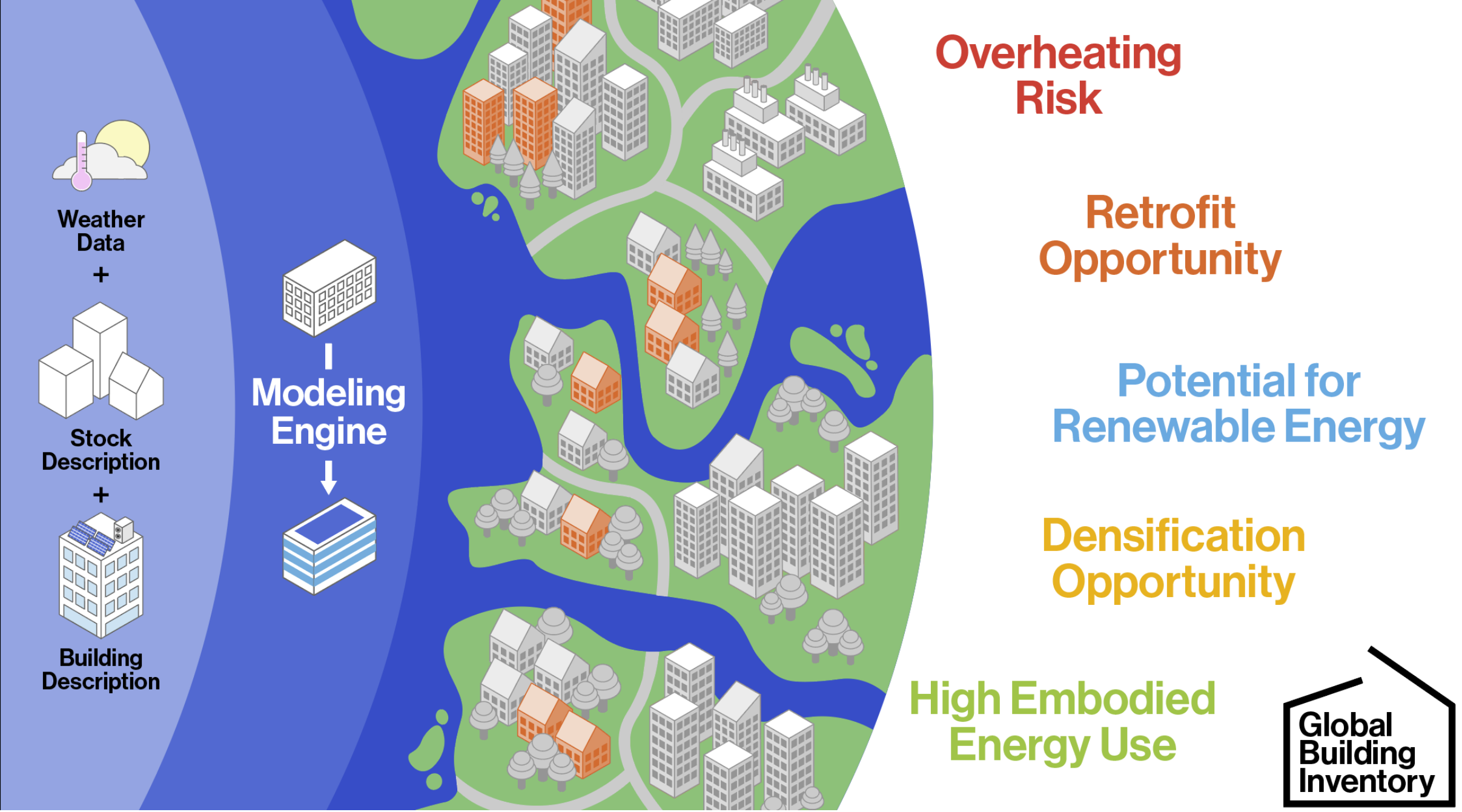
Buildings

- Increase global retrofitting rate to **5%/yr.**
- **All** new construction is carbon neutral.
- **Double** space efficiency for planning & operation.
- **Train 250k** green construction workers.
- **Protect** residents from weather extremes.



Transport

- Encourage integrated urban mobility planning.
- Implement heat resiliency across all processes.
- Find sustainable last mile delivery solutions.
- Promote walkable cities and mixed use zoning.
- Expand electric vehicle network



Develop and freely distribute climate-actionable data sets for all buildings in the world.

Case Study: Retrofit MA

Wep app demo: D Guettler, S Ajienka , M A Jin, S Wolk and C Reinhart under preparation

Climate Action Toolkit

Case Study: MIT- Energy in Action

MIT Lead PI: Mariana Arcaya (DUSP)
Collaborators: La Comunidad, Electrify Everett, Everett Community Growers, MAPC, City of Everett

What: Delivered three evening workshops to inform residents about state retrofit incentive programs which are mostly used by affluent household

Direct impact: Workshops resulted in a waitlist of 600 projects in Everett

What	Collect and develop hands-on engagement tools to support stakeholders to advocate for themselves during the energy transition
	Create common realities through information sharing
Audience	Community organizations and local policymakers
Metrics	Number and global reach of communities who use MIT's Climate Action Toolkit

https://www.instagram.com/electrifyeverett/


Climate Project
Empowering Frontline Community Action
Supporting the world's most vulnerable populations with technologies, designs, and policies for climate relief and resilience.

Co-creating scalable solutions for climate action

Bring together policy makers, stakeholders, local governments, communities and industry to accelerate climate mitigation action

Climate and Health - Reducing adverse health effects of climate change (air, heat, disease)

Potential PIs - Bourouiba, C.Harvey, Harriel, Voldman, ENG, DUSP, ARCH, COMPUTING, J-Pal D-Lab, PKG

Flood, Drought and Fire Resilience - Risk forecasting, community resilience and building & infrastructure adaptation

Potential PIs - O'Gorman, Ravela, Sapsis Fernandez, Angel, Harriel, Meier, Carolini, Mazereeuw
EAPS, ARCH, DUSP, ANTHRO MECHE, MITOS, Co-Lab, GEAR Lab, D-Lab, J-PAL, WildC/ALO

Housing, Circular, Biotech Materials, BioEconomy - Decrease levels of greenhouse gases through building retrofits as well as innovative products in circular and bioeconomy.

Potential PIs - Carolini, Mueller, Kennedy, Carolini, Vale, Sanyal, Mazereeuw DUSP, ARCH, CEE, Wild Cards

Just Transition - Green Economy, Jobs, Advocacy, Responsible Climate Infrastructure

Potential PIs - Walley, Kelly, Harriel, Thompson, Moran Thomas, Susskind, Carolini
SHASS, SLOAN DUSP, Climate Futures, Co-Lab, D-Lab

Livelihood Resilience - Increasing livelihood resilience by working with farmers and Indigenous communities to protect, manage and restore forests and farmlands.

Potential PIs - Carolini, Knox-Hayes, Stoetzer A Harvey + Wood, DUSP, ANTHRO, MEDIA LAB, Solve, PKG

Social Cost of Carbon - Knittel, Emanuel, Steil, SLOAN, EAPS, DUSP