

MIT Environmental Solutions Initiative

An Introduction

Director Prof. John E. Fernández
Executive Director Amanda Graham PhD



ENVIRONMENTAL
SOLUTIONS
INITIATIVE

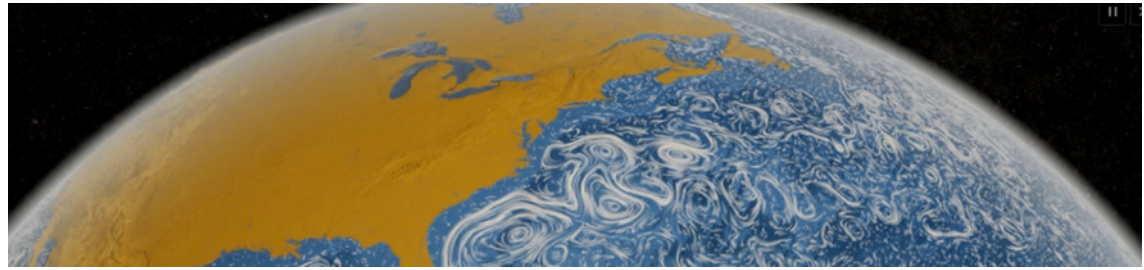


ESI's Mission

To advance science, engineering, policy, design, the humanities, and the arts toward a **people-centric** and **planet-positive** future.

Environmental Solutions Initiative

Research



Education



Convening



ESI Research Domains



Climate Science and
Earth Systems



Cities and Infrastructure



Sustainable Production and
Consumption

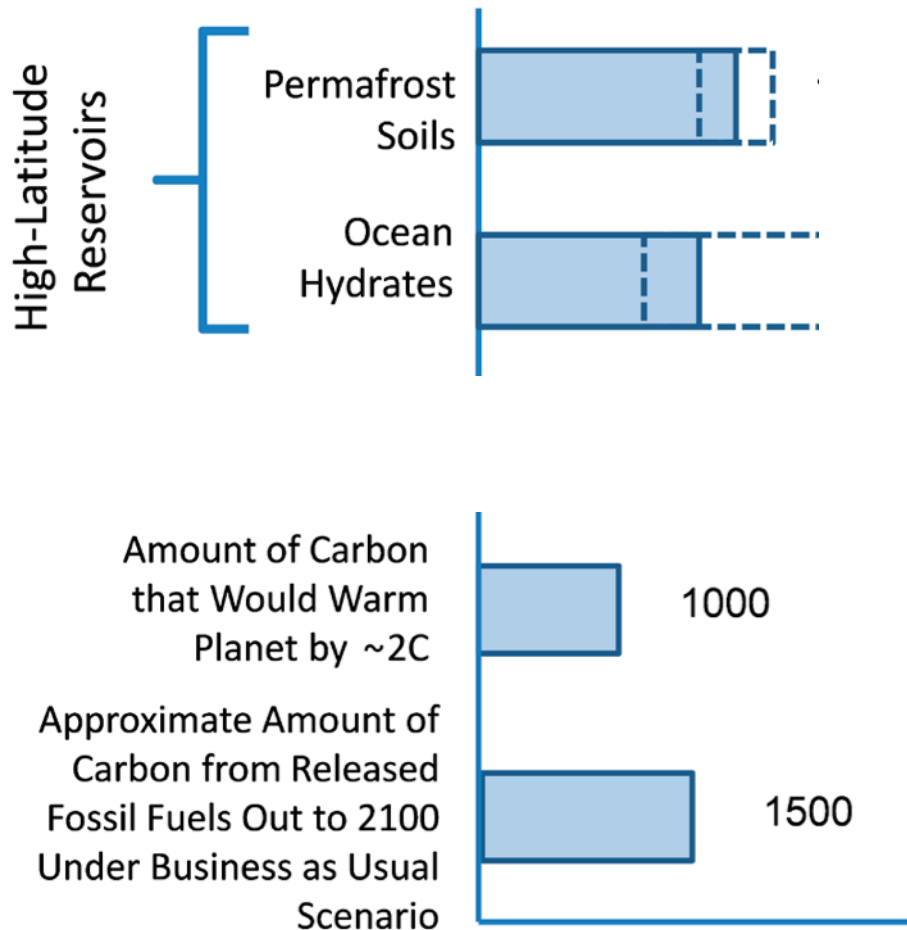


Climate Science and Earth Systems

Aim: to improve our understanding of global climate and earth systems.

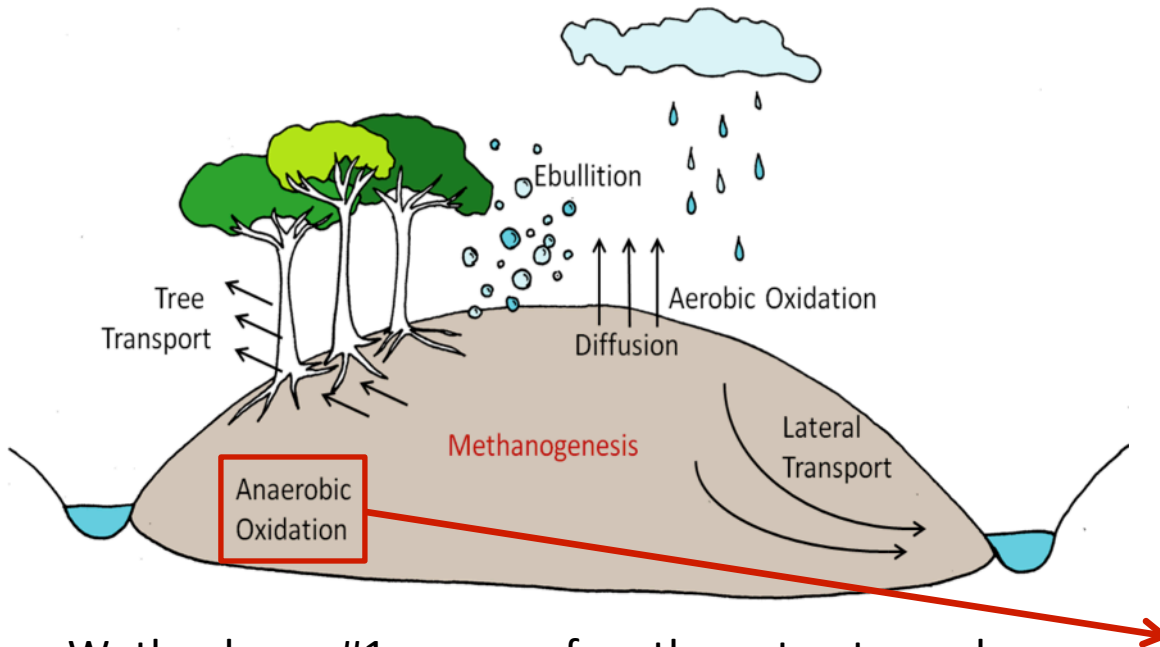
- Improve predictive and high-resolution modeling.
- Increase precision of environmental sensing.
- Better understand ocean warming, acidification, and sea level rise and associated effects on ecological and marine systems.
- Elucidate political and economic dynamics and their impact on local, national, and international climate and environmental policy formulation.

Greenhouse Gas Emissions from Tropical Peatlands



Alison Hoyt, PhD candidate, Civil & Envi. Engineering

Methane in Tropical Peatlands

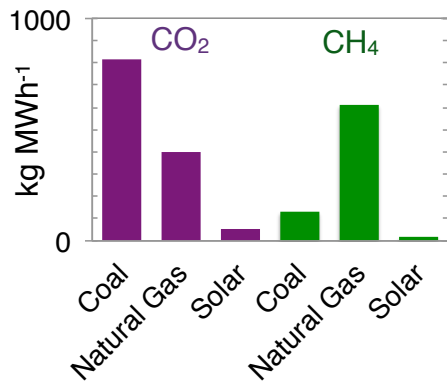


- Wetlands are #1 source of methane to atmosphere
- Anaerobic oxidation of methane at peat-clay transition
- Analysis of archaeal lipids
 - Identified novel structure
 - Novel archaea prevalent in coastal wetlands
- Future plans
 - Isotope labelled incubations
 - Field studies & modelling of sources & sinks

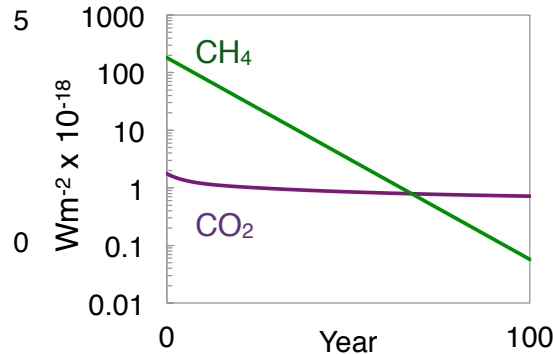


Opportunities for mitigating CH₄ and other non-CO₂ energy-technology-related greenhouse gas emissions

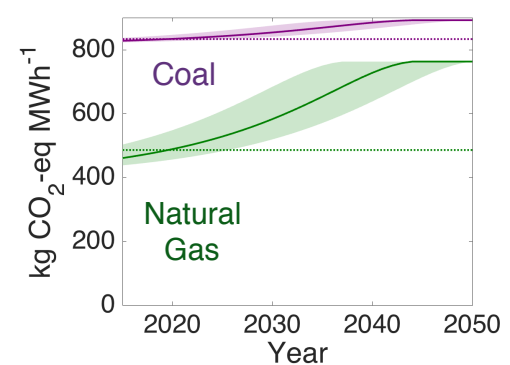
PI: J. Trancik, Co-PI: F. O'Sullivan; Collaborator: S. Solomon, Student: M. Edwards



Technologies emit multiple gases during their life cycles, including CO₂ and CH₄



CO₂ and CH₄ have dissimilar lifetimes, which makes comparing their climate impacts difficult



New, time-dependent metrics suggest bridging timelines for high-CH₄ natural gas

Edwards and Trancik, *Nature Climate Change*, 2014; Roy, Edwards, and Trancik, *Environmental Research Letters*, 2015; Edwards, McNerney & Trancik, *in review*



Cities and Infrastructure

Aim: to generate knowledge and partnerships to shift urban consumption patterns toward a low-carbon future.

- Urban metabolism and the resource intensity of contemporary cities.
- The “Future City” and its environmental opportunities and challenges.
- Urban air pollution and electrification of transportation.
- Environmentally calibrated urban planning and design.
- Resource, waste, and demographic flows between urban and rural environments.

Clearer skies in Beijing: Collecting and interpreting relevant spatiotemporal data for air quality assessment



Will New Limits on Coal Use in China Reduce Toxic Air Pollutants across Asia?



Bad Air Quality



Mercury Deposition

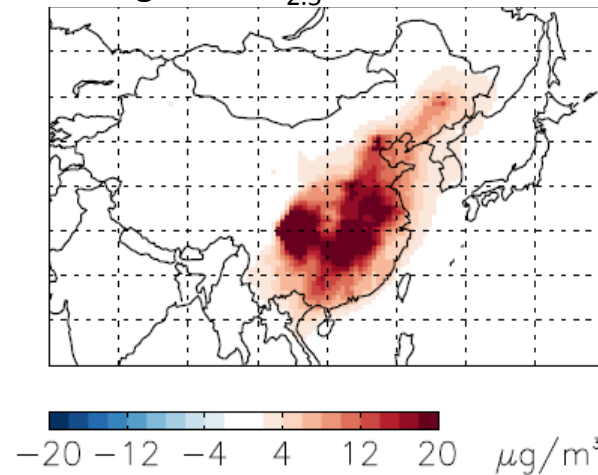


The New York Times | <http://nyti.ms/1LUrRav>

ASIA PACIFIC

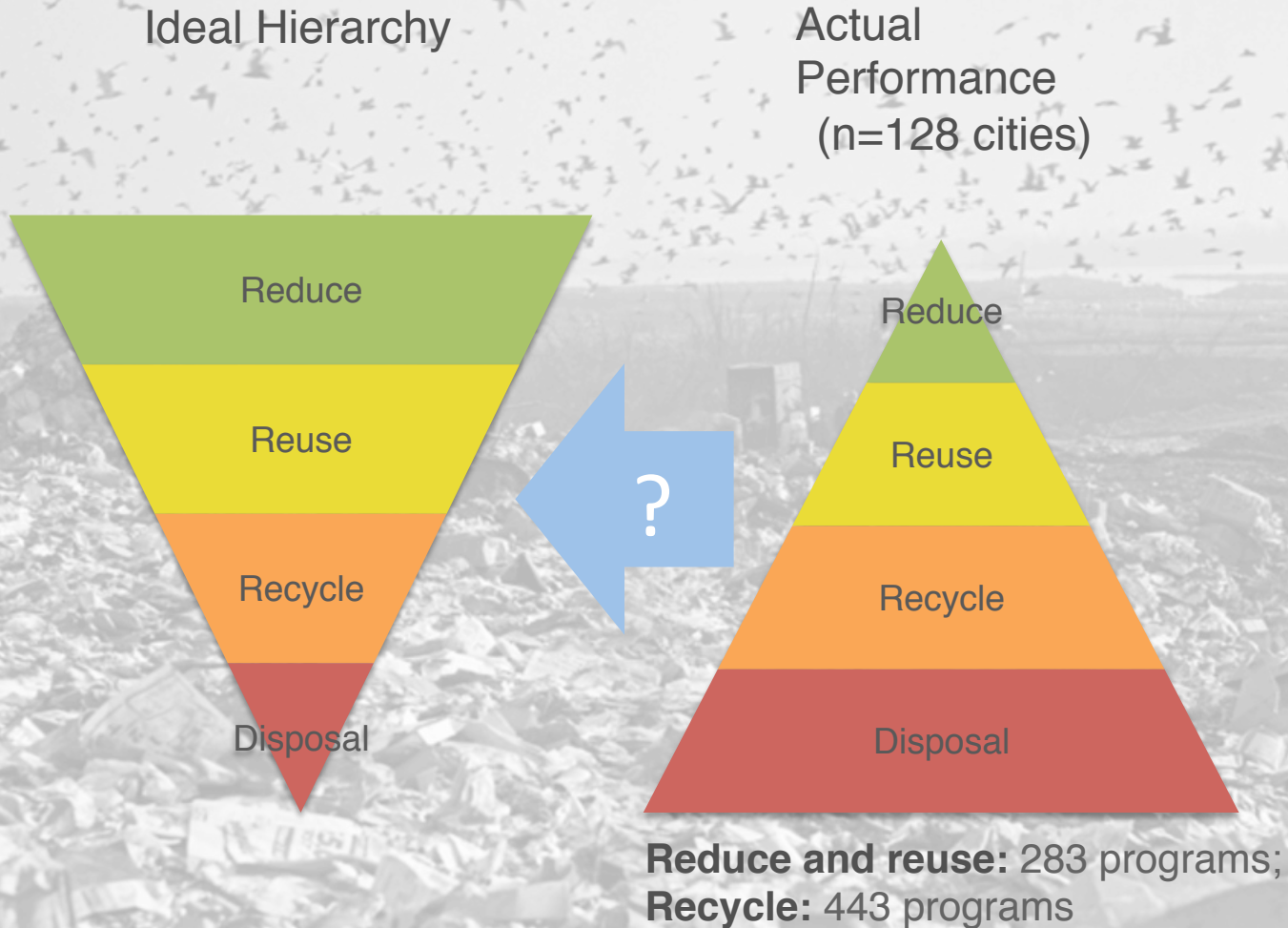
Statistics From China Say Coal Consumption Continues to Drop

Change in PM_{2.5} concentrations (2030-2010)



Even with limits on coal use, air quality in China will **worsen** largely driven by growth in NH₃ (ammonia) emissions

Un-trashing Waste: Fostering Sustainable Consumption in U.S. Cities



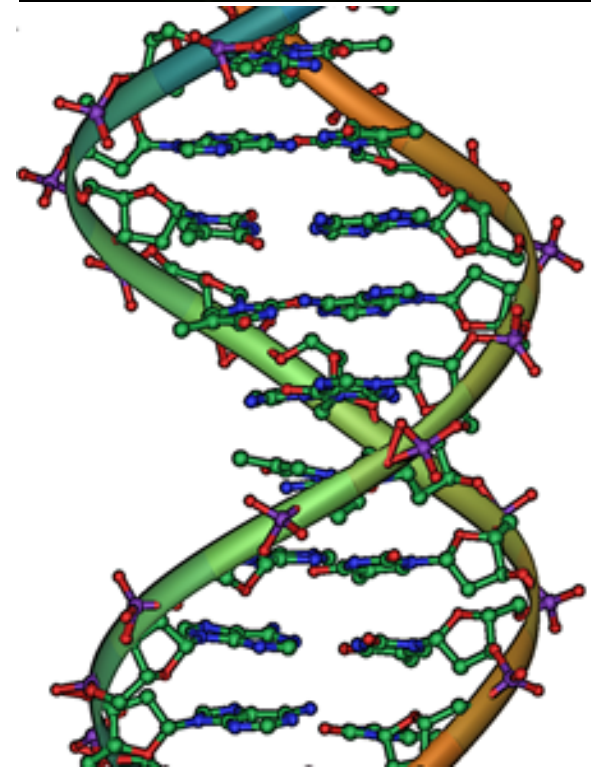
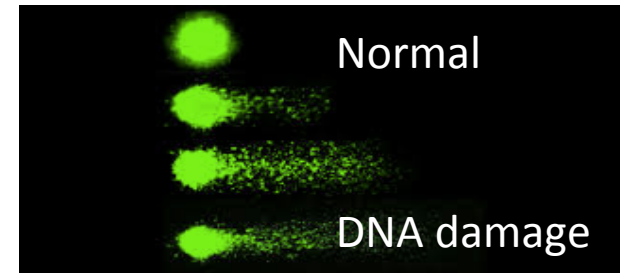
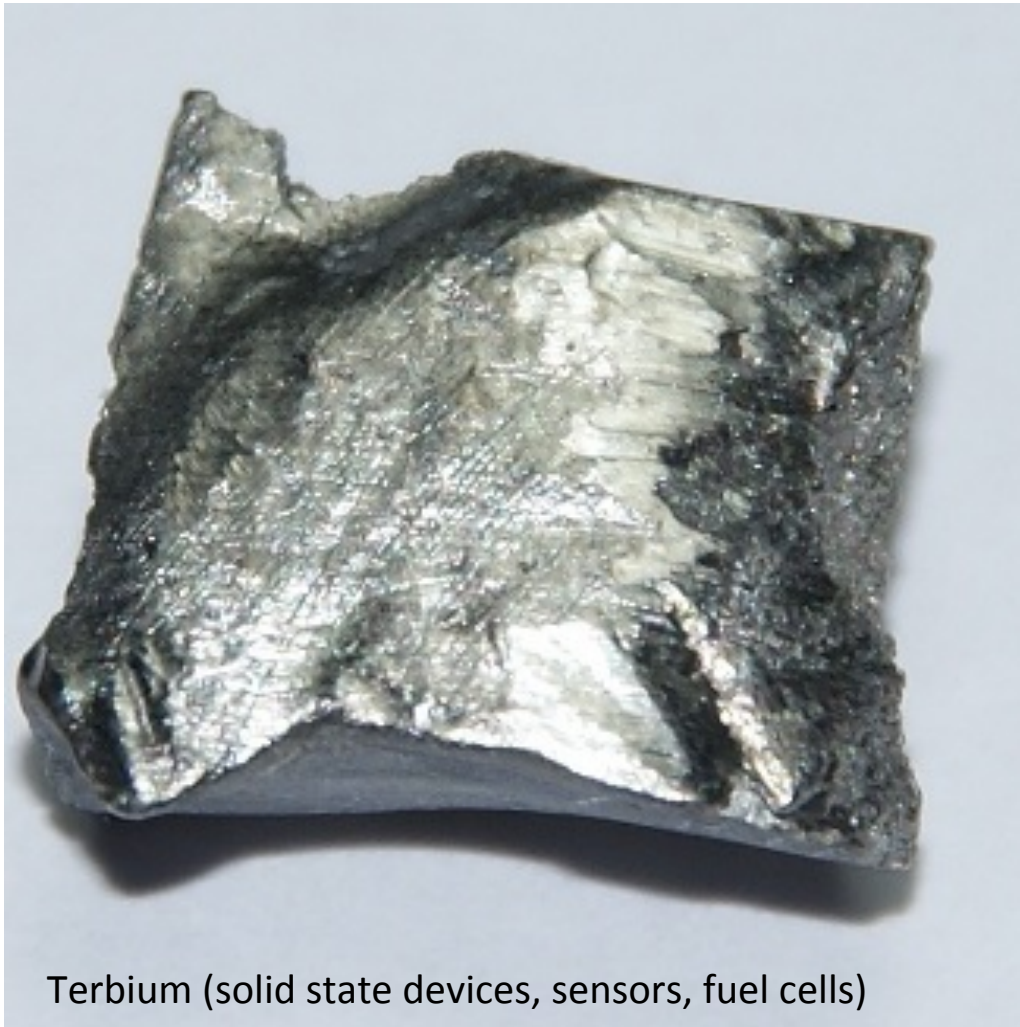


Sustainable Production and Consumption

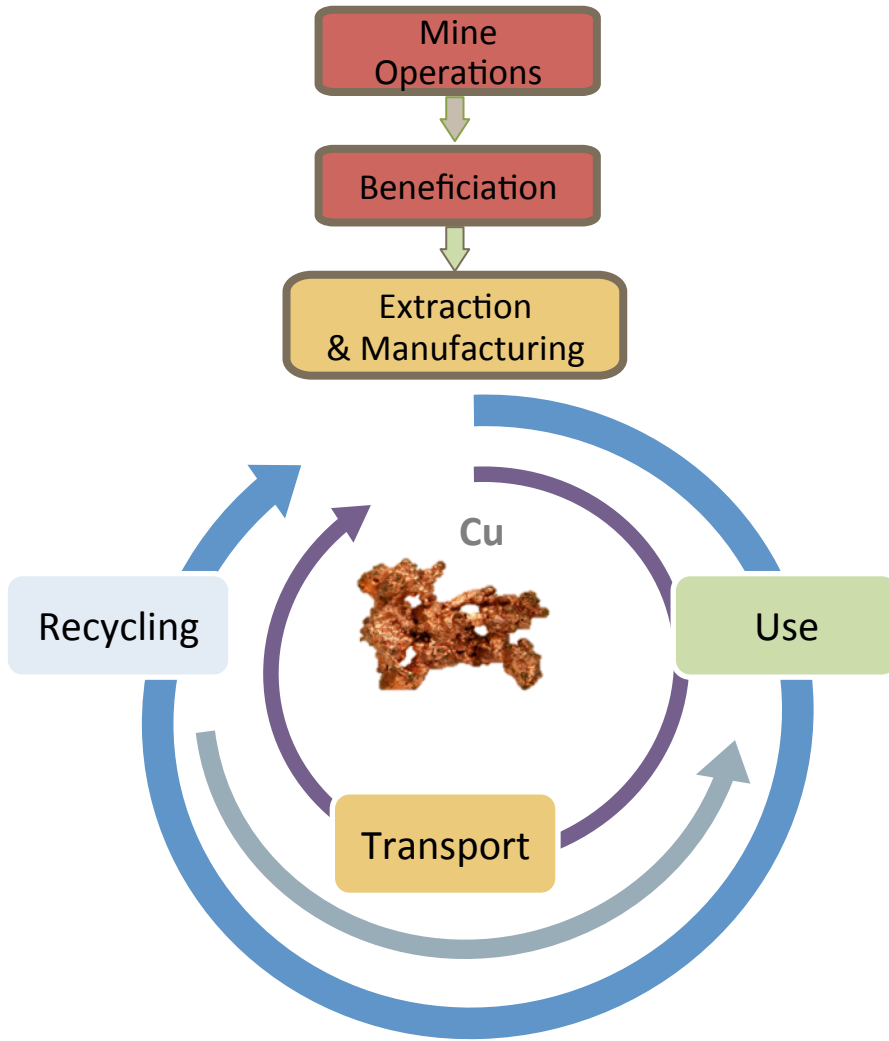
Aim: to reorient the relationship of individuals, organizations, and civil society to the environment.

- Environmentally positive resource extraction, processing, supply chains.
- Design for reuse, disassembly, material recovery.
- Regional and sub-national impacts of resource extraction on communities and cultures.
- Environmental toxicity: better understanding of diffusion, exposure, and health effects.
- Carbon pricing and/or tax.
- Cultural, behavioral, and ethical dimensions of forging a more sustainable economy.

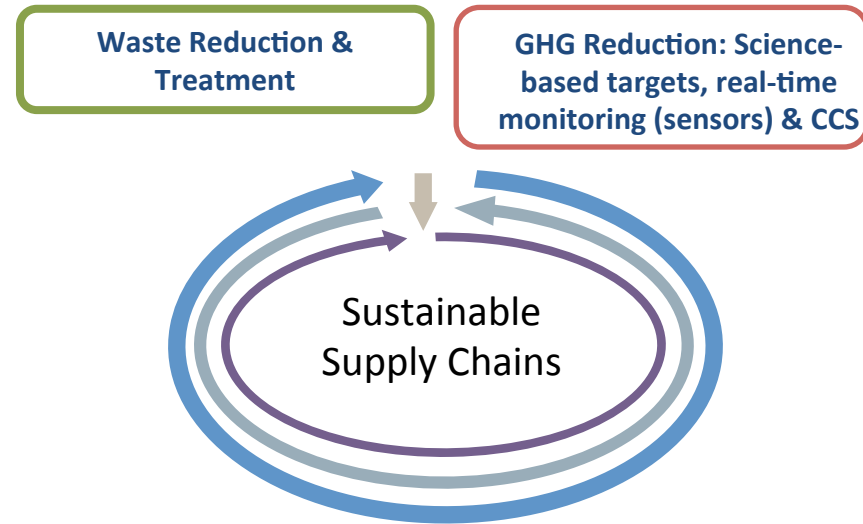
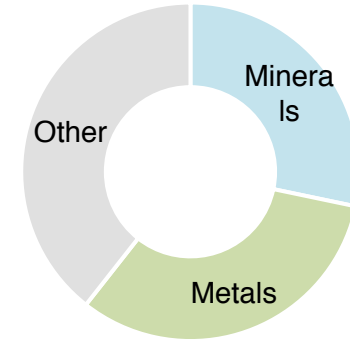
Developing solutions for human, environmental health risks created by exponentially increasing exposures to lanthanide metals



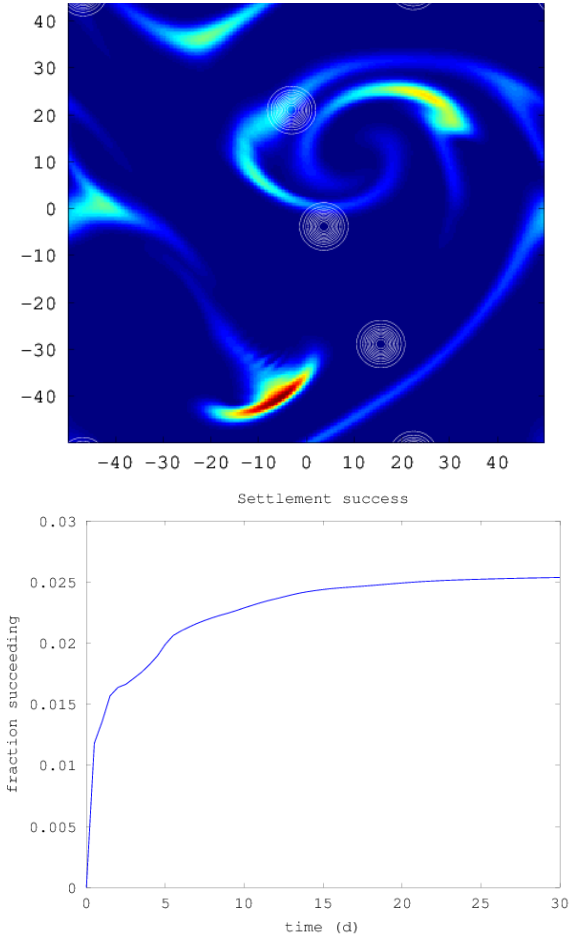
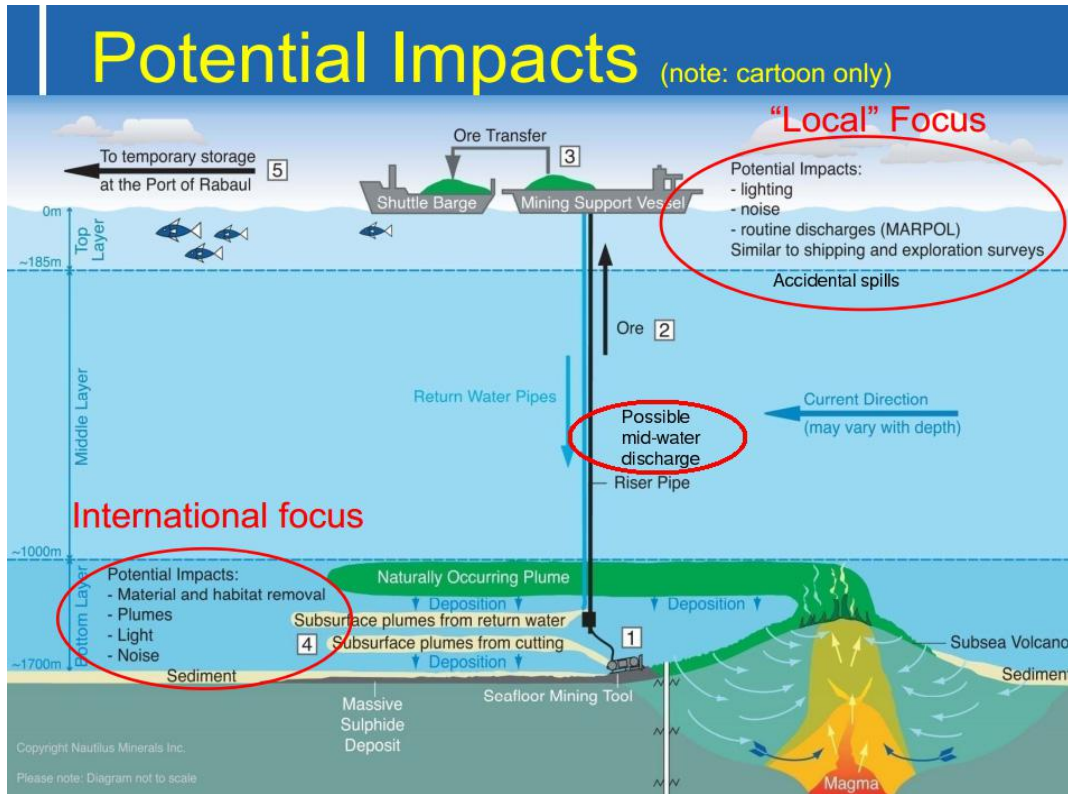
Metals & Minerals for the Environment



% GHG Emissions for US Materials



Digging Deep: An integrated approach for assessing the impacts of deep-sea mining



Simulation shows larvae released at vent sites (circles) after 3.5 days. Domain is 100km×100km. The lower plot gives the fraction settling at a vent site. Without fluid motion, it’s about an order of magnitude higher.

Improved management of common-pool resources

Project aims:

1. derive more realistic mathematical descriptions of common pool problems,
2. test these descriptions against empirical evidence, and
3. calibrate resulting predictions for optimal water management.

Current focus: Australia.

- › Traveled to Melbourne, Canberra, and Adelaide from January 7 to Feb 4
- › Met with policymakers, stakeholders, economists, scientists to gather perspectives + data



ESI Education Priorities

Environment and
Sustainability Minor

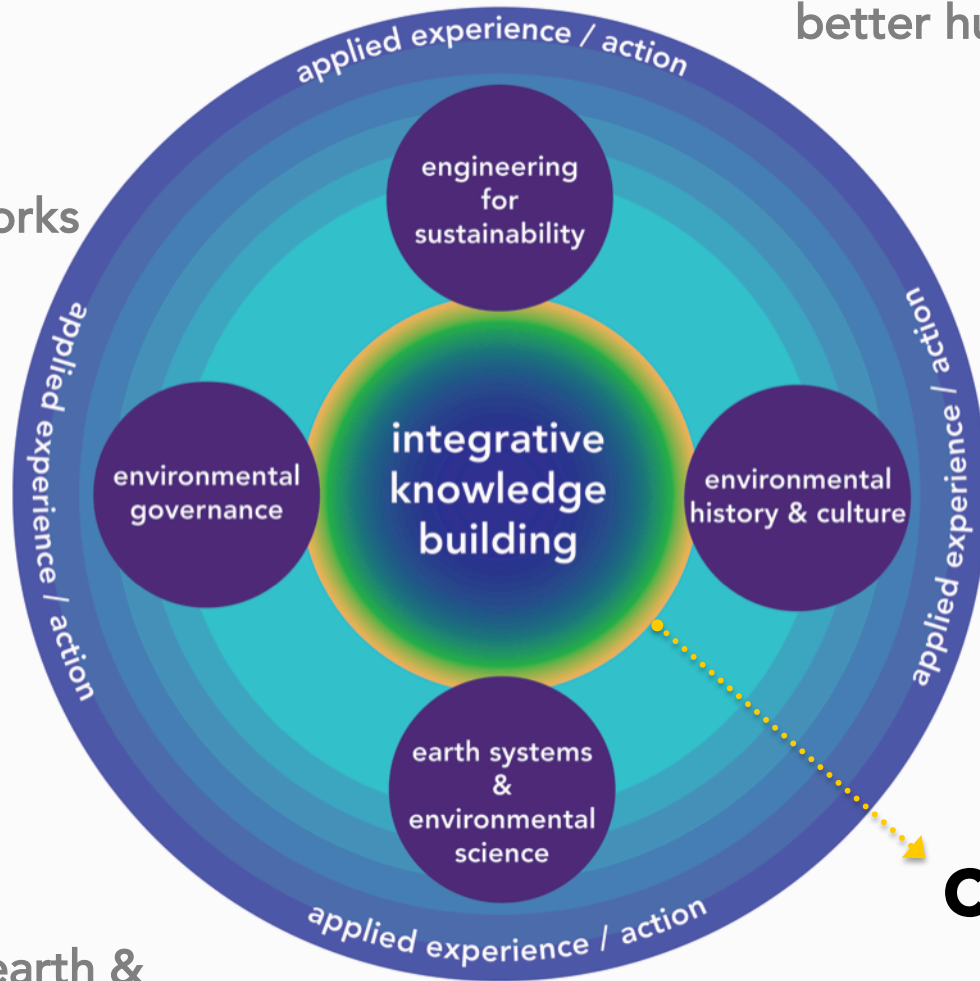
GIR Environment

Environmental
Solutions Action
Corps



How do we design technology for better human/environment futures?

What political & economic frameworks govern human/environment interaction?



What drives & inspires humanity's relationship with nature?

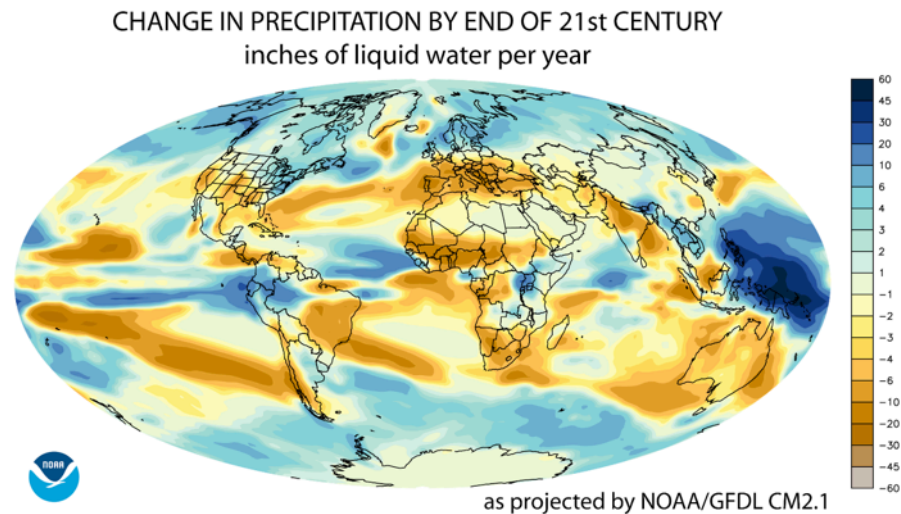
How do our earth & atmospheric systems work?

Craft pathways toward a sustainable society

ESI Convening Agenda

Multi-disciplinary research workshops, reviews, scenarios

One example:
environmental
"war games"



ESI Convening Agenda

Hackathon for Climate



MIT's Plan for Action on Climate Change



Farming Apps: From Digital Farms to Real Gardens



40 million people are monthly active users of FarmVille

43 million U.S. households have gardens

Large parts of the US can grow crops without significant water or fertilizer inputs (low carbon farming)



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