

Sustainable travel: measuring emissions and preparing for change

Bank of America 2025 Card Conference
April 29, 2025

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Outline

- Changes on the Horizon
- Understanding Climate Risk
- Understanding Reporting Climate Risk
- One Organization's Experience
- Best Practices for Emissions Accounting
- Lessons from the NC State Experience

It's all about climate risk...

Climate risk disclosure is motivated by two separate but related perspectives.

The first is information relevant to understanding the risk that climate change poses to the financial health of an individual organization.

The second is information relevant to understanding the contribution of an individual organization's activities to broader environmental, social, and governance issues of concern.

It's all about climate risk...

At the heart of climate risk is an organization's greenhouse gas emissions.

Scope 1

Sources directly
controlled by an
organization

Scope 2

Indirect emissions
from energy
purchased by an
organization

Scope 3

Indirect emissions
from activities
affected by an
organization's
value chain

Changes on the Horizon...



WTTTC (2024)

DIVE BRIEF

Scope 3 emissions reporting is a ‘when,’ not an ‘if’ for companies: Bayer, Zycus execs

ESG experts from the pharmaceutical company and procurement software provider made the case for reporting on scope 3 emissions early during a panel discussion.

Published May 28, 2024

Bhattacharyya (2024)

POLITICO

German election | War in Ukraine | Newsletters | Podcasts | Poll of Polls | Policy news | Events

NEWS > SUSTAINABILITY

Macron’s U-turn against EU green rules triggers internal revolt

The French president’s anti-regulation push has thrown his environmental legacy into doubt and angered many in his own party.

Leali (2025)

Reporting 101

Frameworks are “[a] set of principles and guidance for ‘how’ a report is structured”, while standards are “[s]pecific, replicable and detailed requirements for ‘what’ should be reported for each topic” (CDP et al., 2020; 9).

We further add regulatory requirements, which are the obligations to report imposed by a government entity

How to Report ISO 14064-1:2018	What to Disclose TCFD ISSB-IFRS S1 EO 14030 * IL 30 ILCS 238/1 * Directive 2022/2464 *	How to Calculate GHG Protocol SBTi CEQ Guidance	
	ISSB-IFRS S2 SASB ESRS *		
	GRI PRI NAIC		Where to Report
	CDP PCAF U.S. SEC * CA SB 253; SB 261 *		

Simplified conceptual overview of disclosure frameworks, standards, and requirements as reviewed in this analysis. Note: area of emphasis reflects authors’ own determination; other aspects of accounting and reporting processes might still be addressed to a lesser extent. * denotes regulatory requirements.

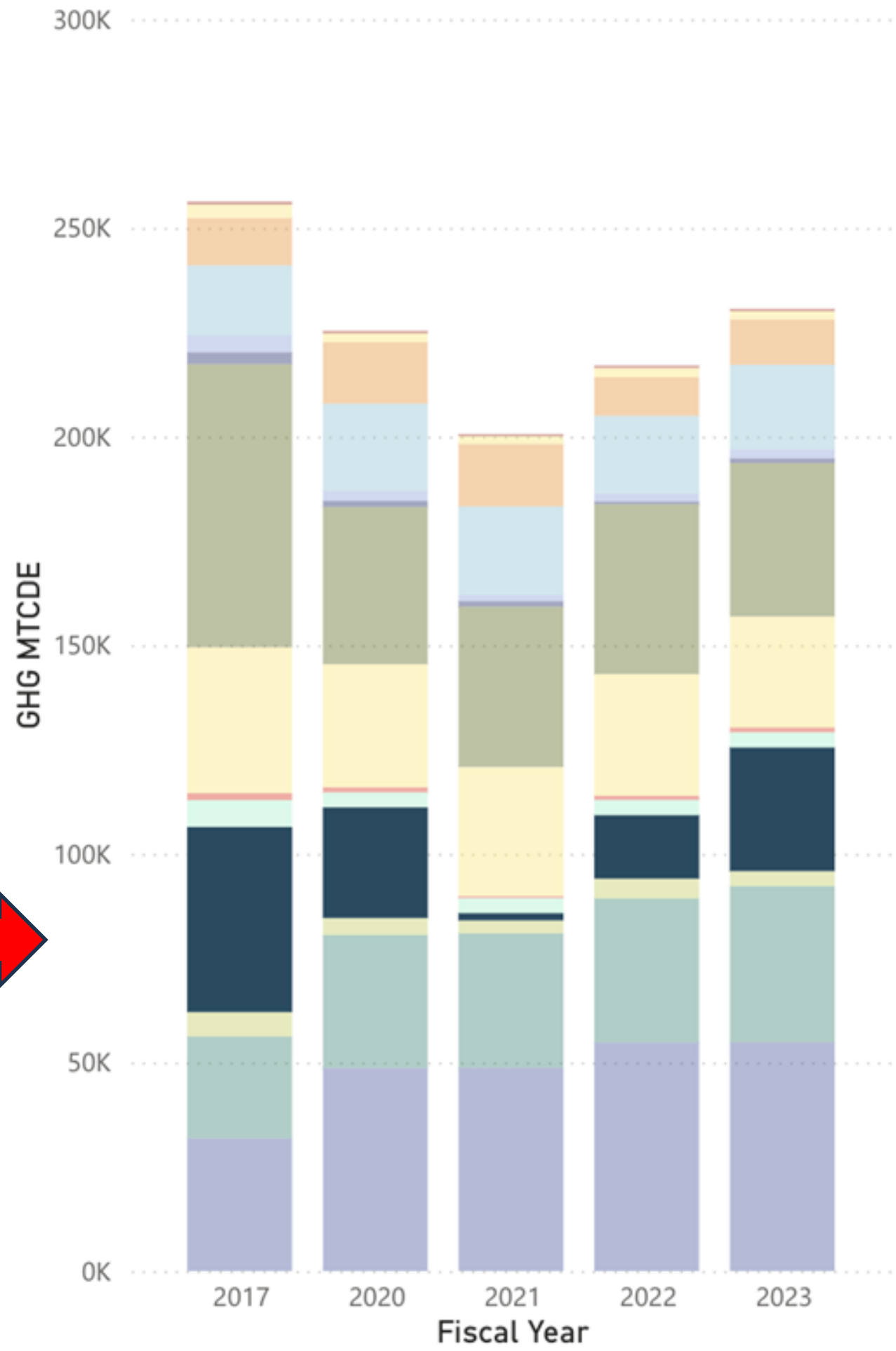
NC State University is a large organization with a substantial physical footprint:

- 49,641 students, faculty, and staff.
- Roughly 15 Million square feet of built space spread across 2,100 acres.



NC STATE UNIVERSITY

Greenhouse Gas Emissions Overview



Source

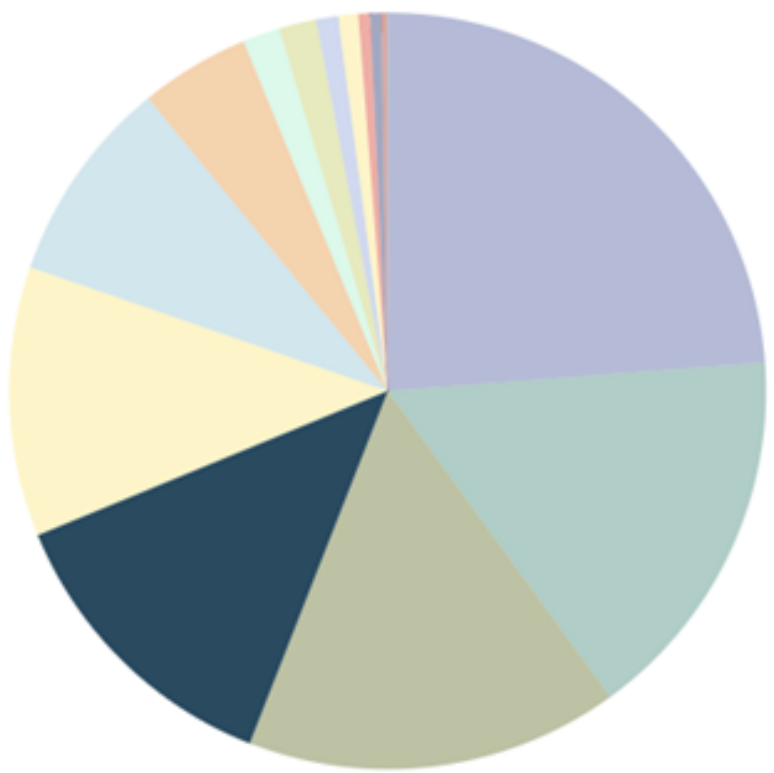


- Co-gen Electricity
- Co-gen Steam
- Direct Transportation
- Directly Financed Air Travel
- Fertilizer & Animals
- Other Directly Financed Travel
- Other On-Campus Stationary
- Paper Purchasing
- Purchased Electricity
- Refrigerants & Chemicals
- Solid Waste
- Staff Commuting
- Student Commuting
- T&D Losses
- Wastewater

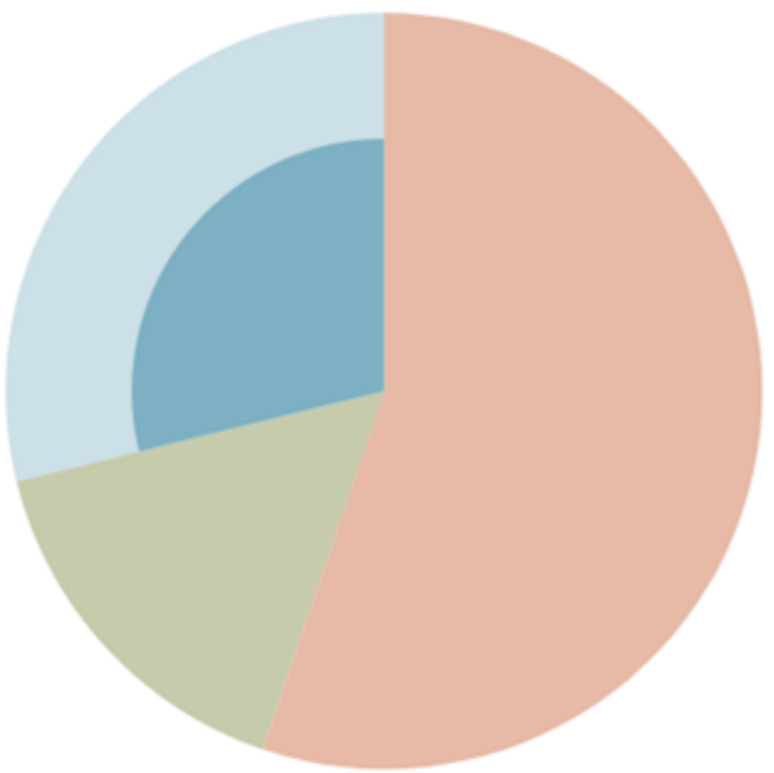
Fiscal Year

2023

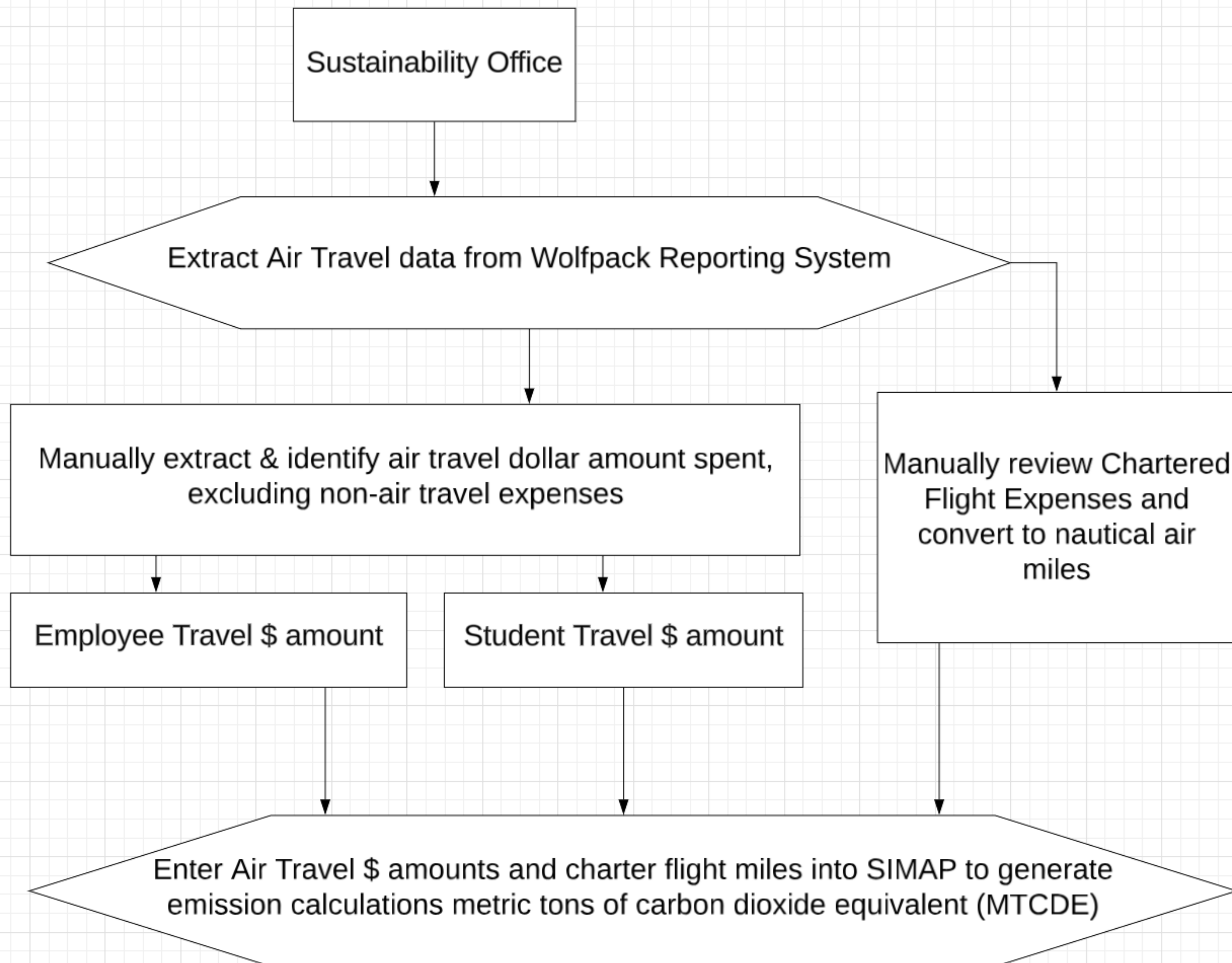
GHG Emissions by Source for 2023



GHG MTCDE by Scope for 2023



NC State Current Air Travel Emissions Calculation Process



An Efficient and Replicable Approach

Our goal in this project was to not only develop a more efficient, data-driven approach to accounting for university travel emissions, but to do so in a way that could be replicated or exported to other entities also looking to improve their travel emissions accounting and, if so desired, assist in emissions reduction efforts as well.

Data collection: Initial steps

We explored the NCSU internal WolfReports and the enhanced WolfReports datasets to identify key elements required for emission calculations.

Challenges encountered: Inconsistent airport names, Different invoice formats, Additional non-relevant charges.

Data collection: Automating invoice processing

We automated invoice processing using Optical Character Recognition (OCR) to extract text from invoices and process using ChatGPT (a Large Language Model, or LLM) to identify airport codes and other key travel-related data points.

Challenges encountered: The invoices cannot be downloaded in bulk since they are secured by a 2-factor authentication process. Downloading the invoices individually was time consuming.

Data collection: Improved datasets

From the Works and Enhanced Works datasets we were able to extract source and destination airports along with layover details for approximately two-thirds of total trips, allowing for precise emissions calculations.

We were also able to gather the NC State athletics dataset. This dataset contained layover information which was ideal for us.

Air travel emissions calculations

- Extract airport information from Works, Enhanced Works, and athletic datasets.
- Calculate distance (Great Circle Distance) between airports.
- Use IATA's fuel-based emissions calculations. This was more accurate compared to SIMAP's spend- and miles-based emissions calculations.

Custom web-based tool

Architecture components

1. Knowledge Base (PostgreSQL): Stores emissions data
2. Text-to-SQL Agent: Converts queries into structured SQL
3. LLM Recommendation Engine: Provides optimized travel suggestions
4. REST API: Handles user requests

Custom web-based tool: How it works

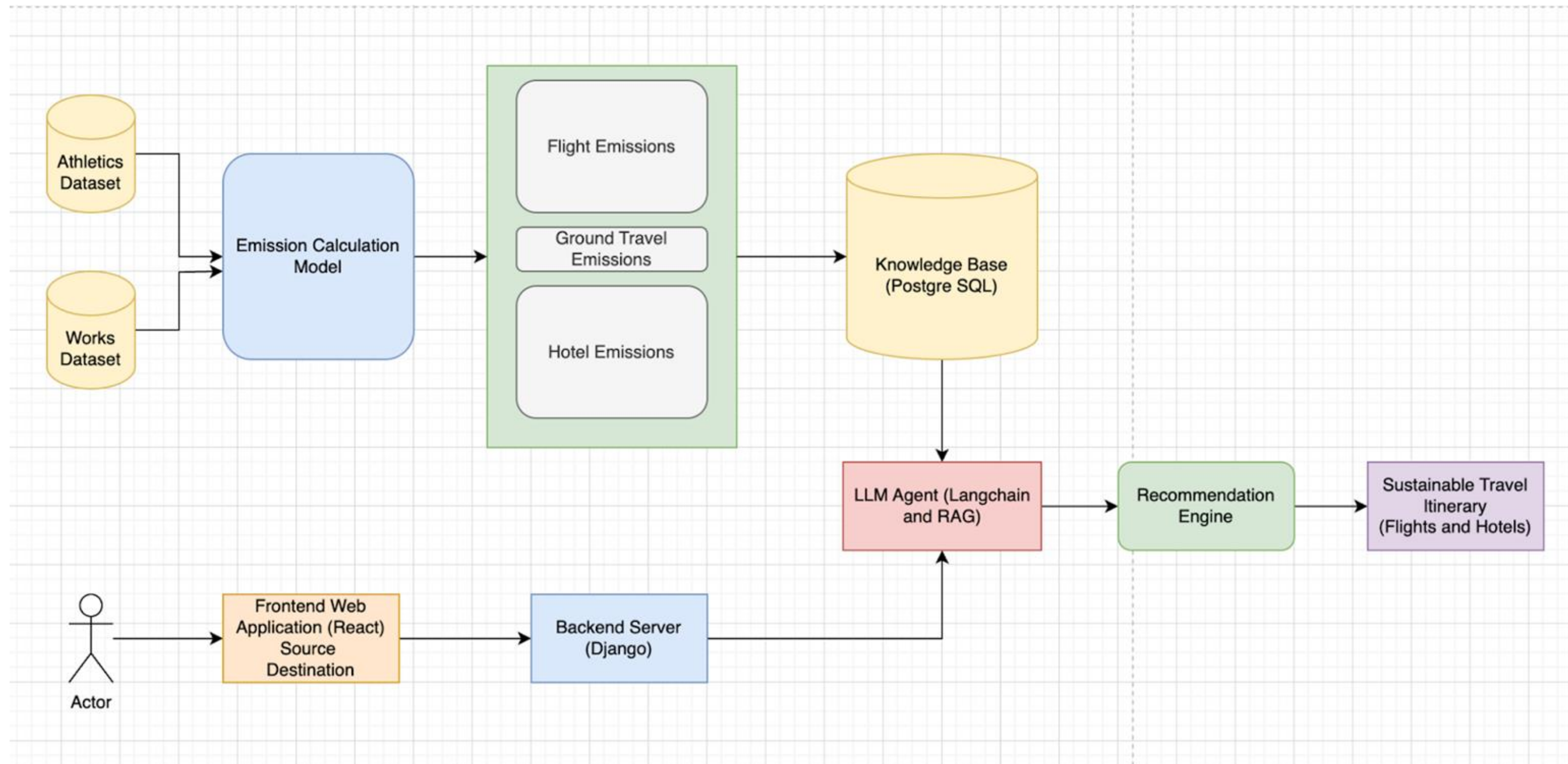
Step 1: User inputs source and destination airport codes

Step 2: AI processes data and searches for optimal routes

Step 3: System recommends sustainable flights and hotels

Step 4: If no direct flights, alternative routes suggested

Sustainable Travel Emission Calculation and Recommendation System process and information flow



Custom web-based tool: Sample output

Source airport: RDU

Destination airport: BOS

Plan Trip

Traveling from RDU to BOS

Flight Options

Most Sustainable

RDU → BOS

Airline(s): AER LINGUS

Confidence: high

Source of Route: [DB](#)

Carbon Emissions: 159.27 kg CO₂

RDU → BOS

Airline(s): AMERICAN AIRLINES

Confidence: high

Source of Route: [DB](#)

Carbon Emissions: 159.27 kg CO₂

RDU → BOS

Airline(s): DELTA

Confidence: high

Source of Route: [DB](#)

Carbon Emissions: 159.27 kg CO₂

RDU → BOS

Airline(s): DELTA AIR LINES

Confidence: high

Source of Route: [DB](#)

Carbon Emissions: 159.27 kg CO₂

Hotel Options

Most Sustainable

HI BOSTON HOSTEL

139-220

Boston

Carbon Emissions: 5.94 kg CO₂

THE VERB

Boston

Carbon Emissions: 9.38 kg CO₂

COURTYARD BOSTON LOGAN

Boston

Carbon Emissions: 9.38 kg CO₂

AC BOSTON DOWNTOWN

Boston

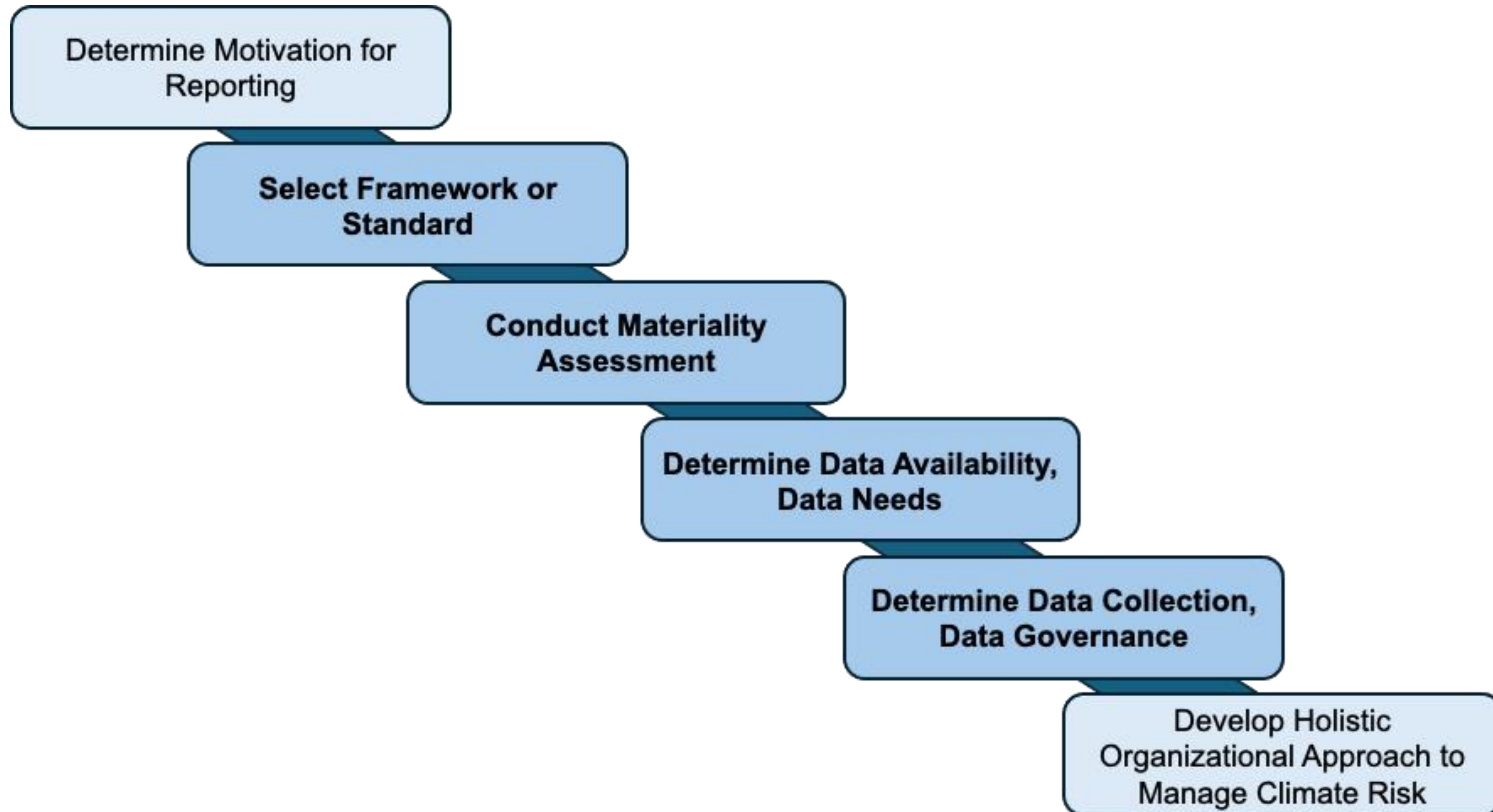
Carbon Emissions: 9.38 kg CO₂

ELEMENT BOSTON SEAPORT

Boston

Carbon Emissions: 9.38 kg CO₂

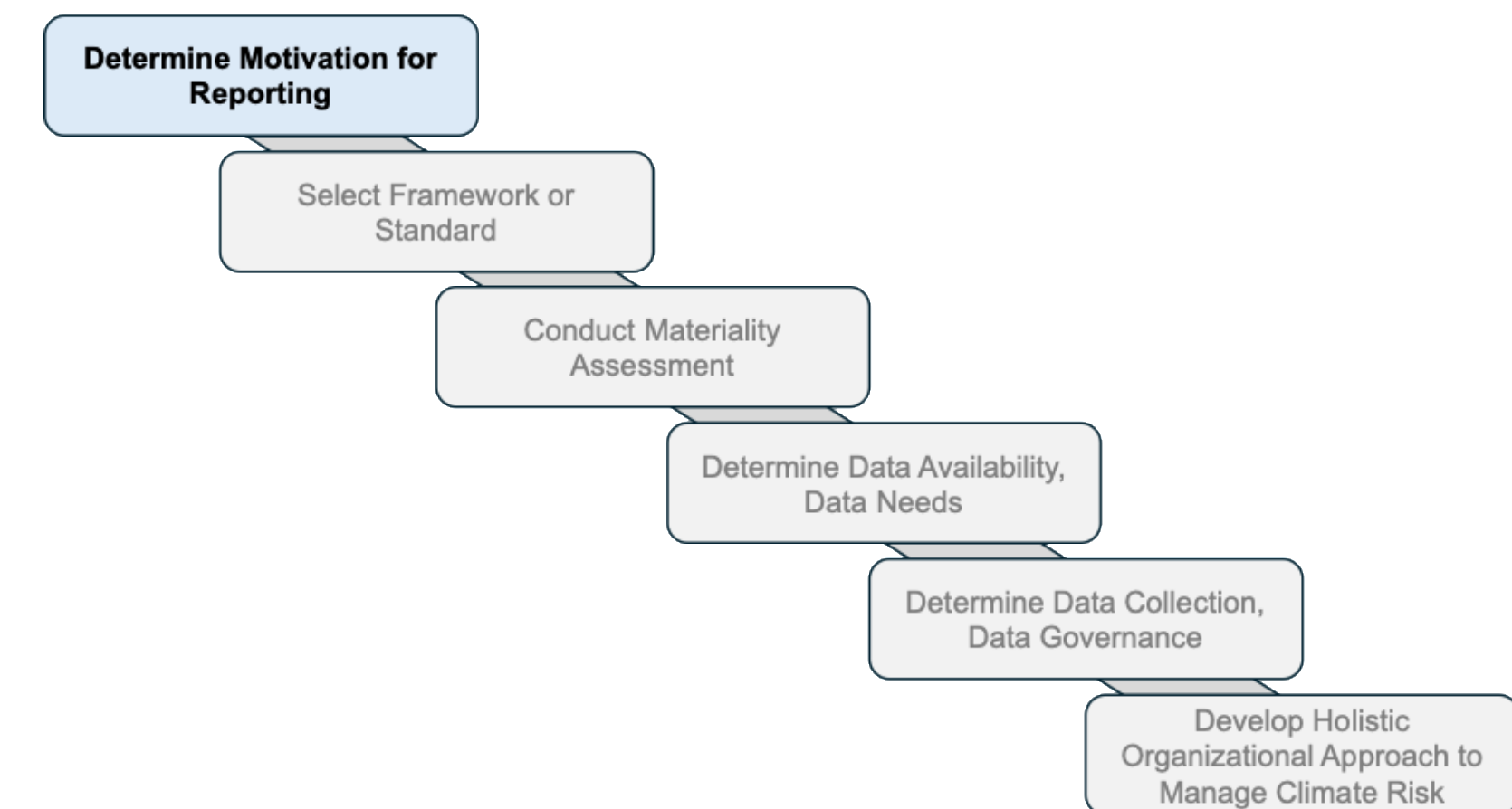
Familiarization with basic terminology, concepts, and trends is an important first step to prepare for GHG accounting. We offer the following roadmap for entities new to reporting:



Determine the motivation for reporting

Once an organization is ready to begin emissions accounting, the question moves to the reason for reporting and, relatedly, the framework or standard to report to.

Selection of a framework or standard should be motivated by both experience with reporting, as well as the motivation for reporting (e.g., transparency and stakeholder communication versus compliance preparedness).

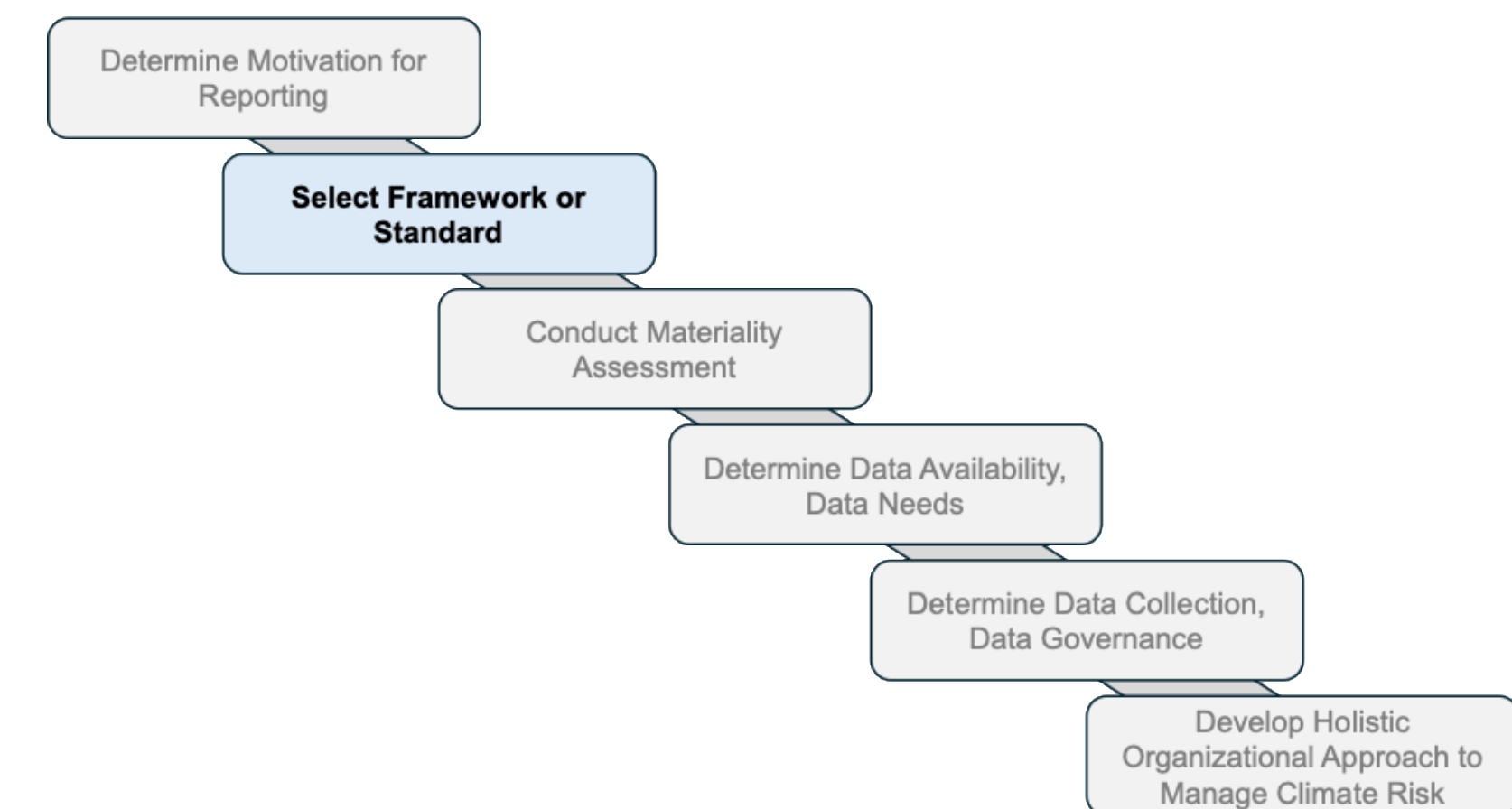


Select a framework or standard to guide the reporting process

There are a variety of third-party voluntary options to choose from, in addition to an emerging and evolving suite of regulatory requirements.

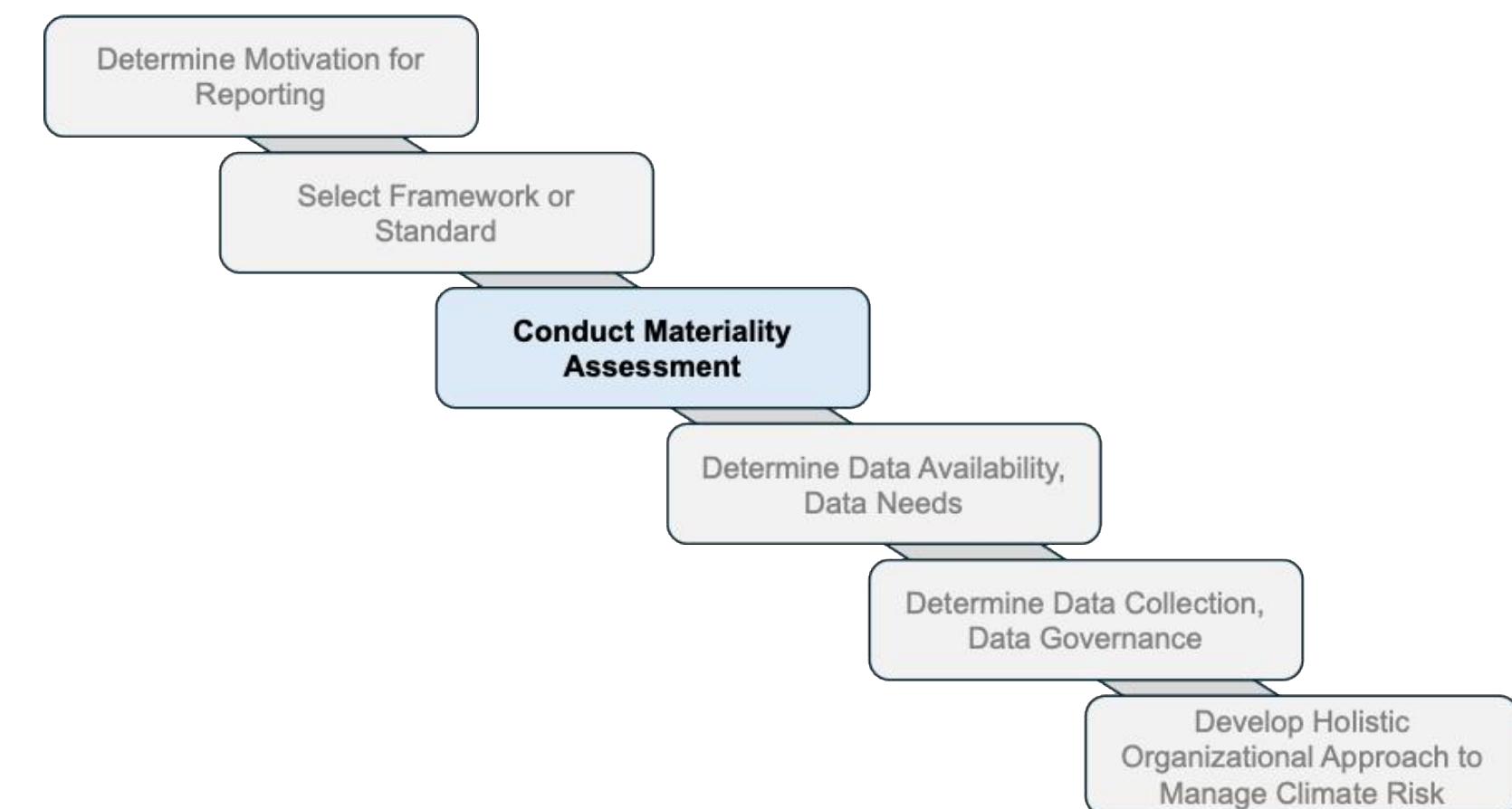
Some are industry-agnostic, others are tailored to the particulars of a specific industry. Some are GHG-specific, others are applicable to a wide variety of environmental concerns.

The GHG Protocol is among the most commonly used frameworks to guide the GHG calculation process.



Conduct a materiality assessment to identify climate risks

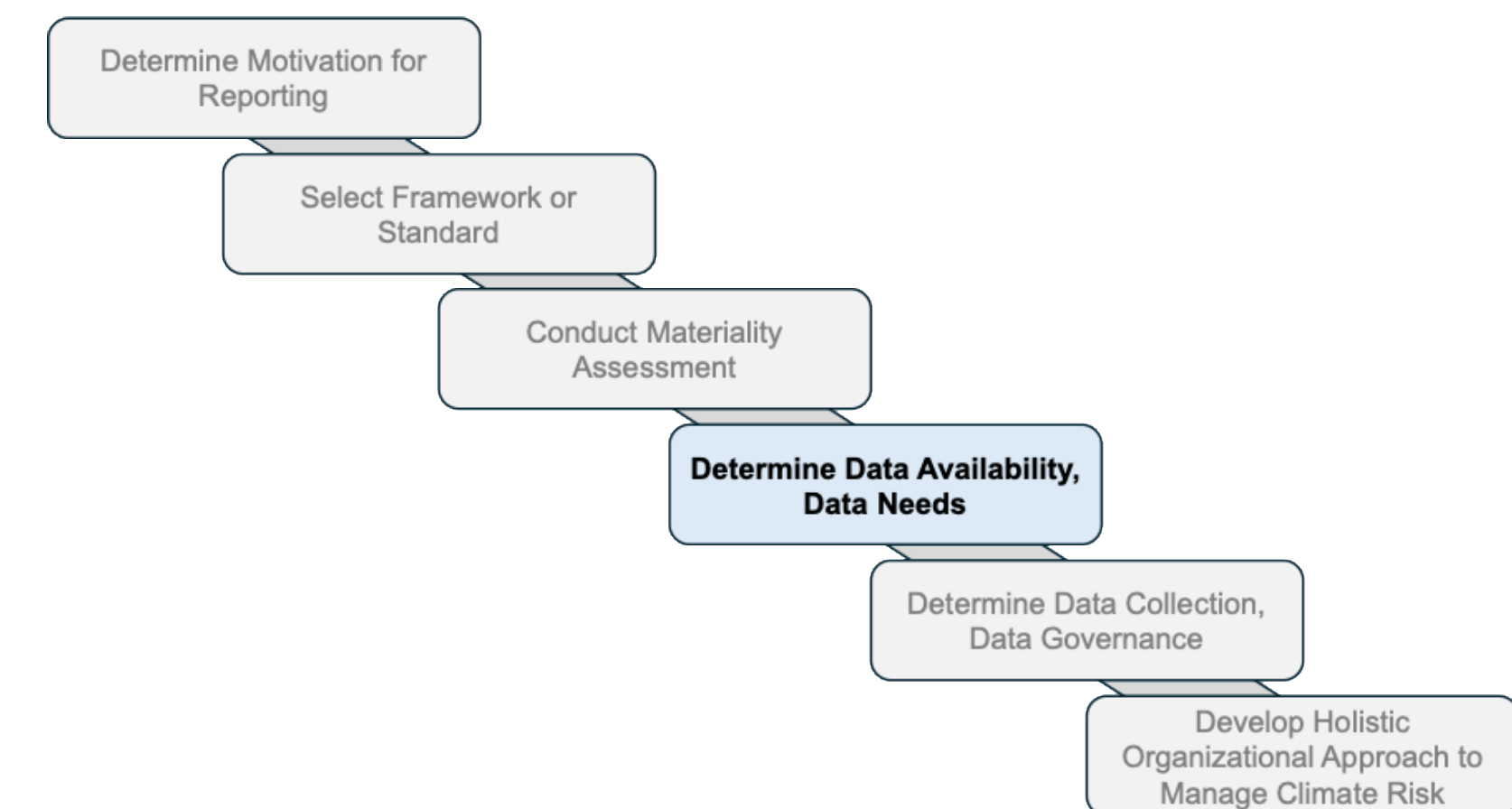
Identification of climate risks through an internal materiality assessment can help an organization determine the data that will be relevant for reporting.



Determine current data availability and future data needs

A determination of data need and availability will depend on the selected framework or standard, as well as the outcome of the materiality assessment.

Important elements are selection of base year, organizational boundaries, and the type of data (primary or secondary) that will be used.

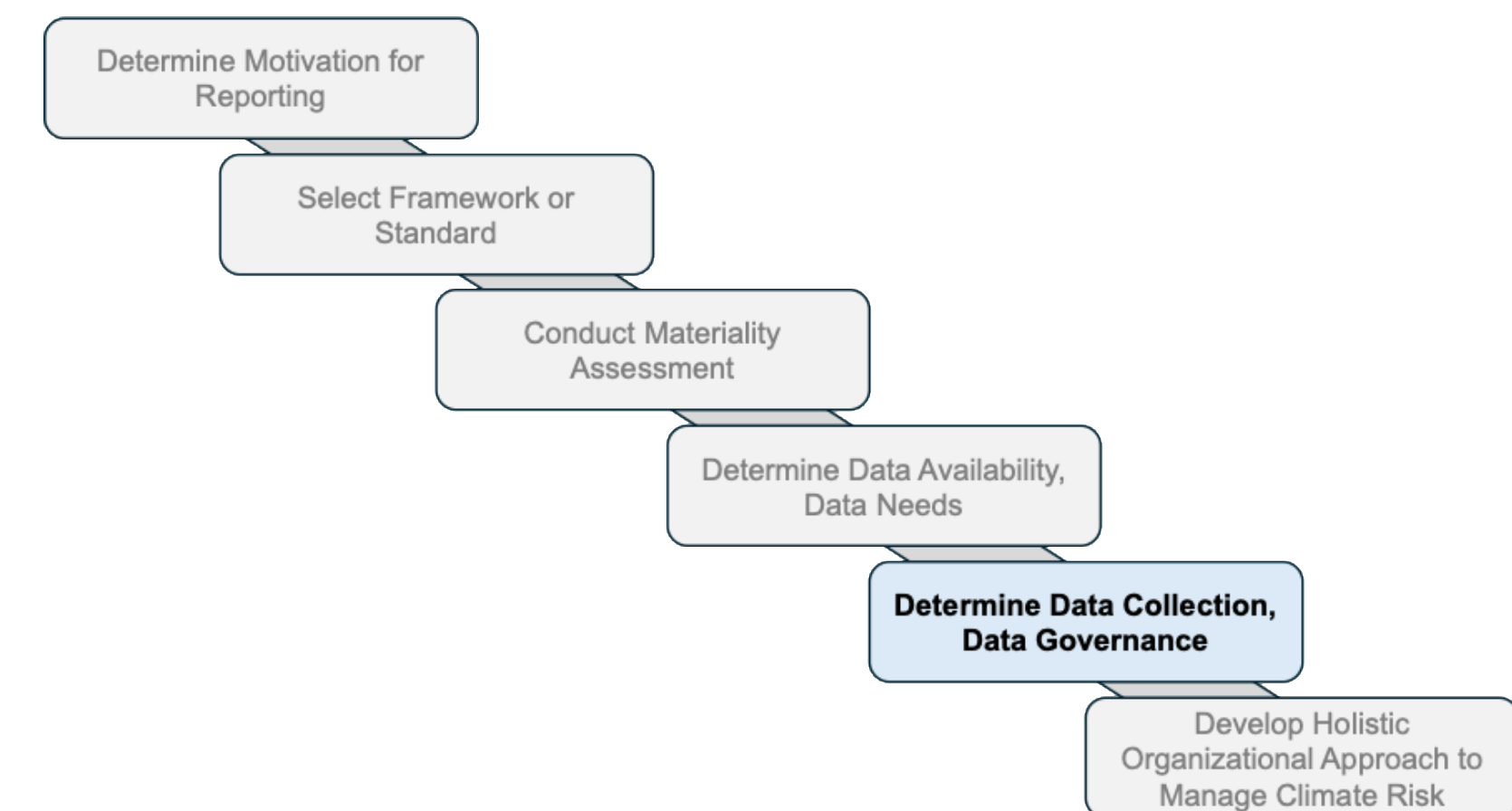


Develop data collection strategy and ownership

The process of data assessment and data collection can be complicated.

In addition to understanding where data exist and in what form, there are also decisions about data from upstream/downstream partners, who will have access/ownership of data, and how data will be managed.

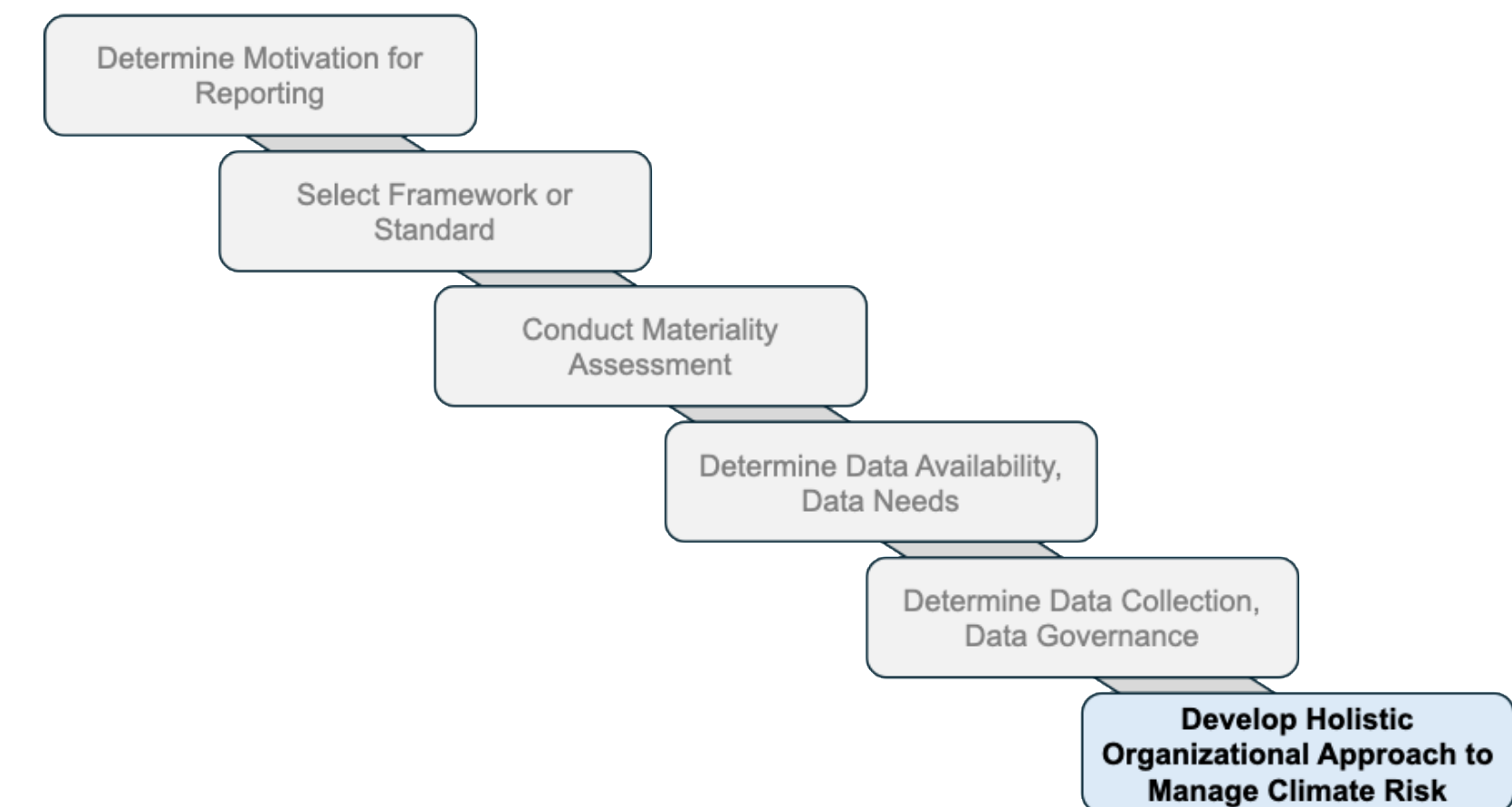
For NC State, determining a better way to process existing data reduced reported Scope 3 emissions by 5% and saved 15 hours staff time annually.

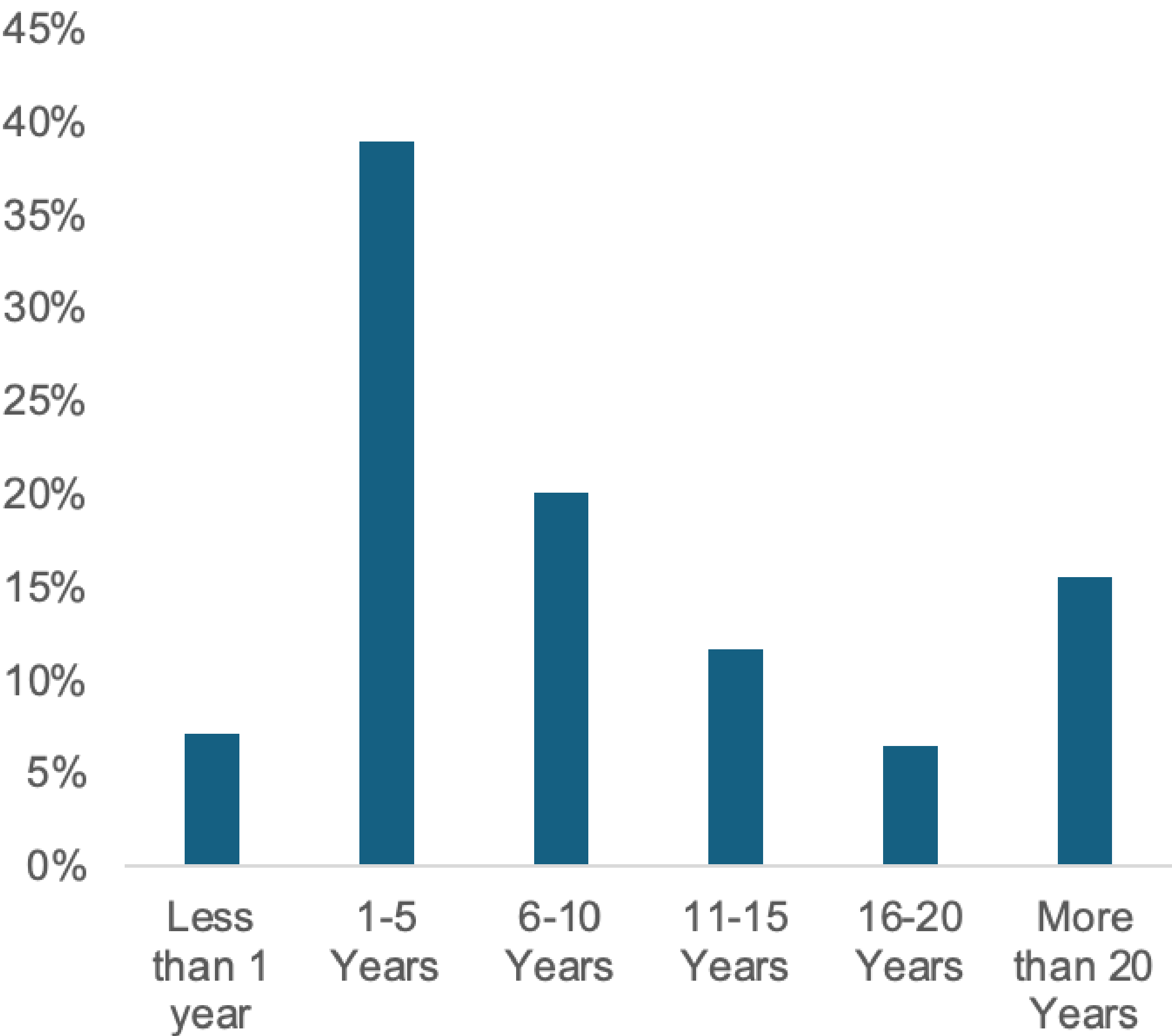


Consider a more holistic approach

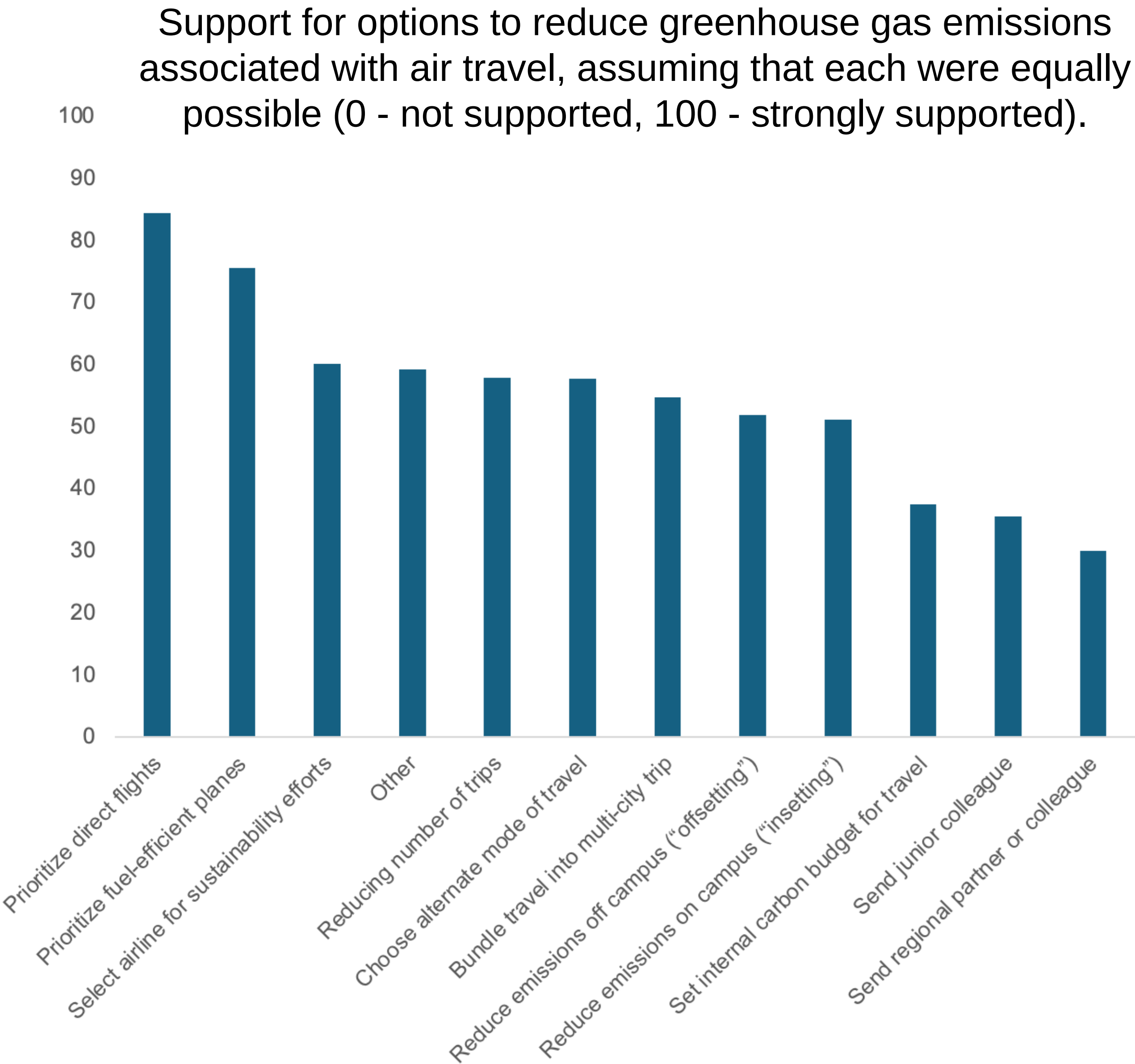
Reporting is just one part of the climate risk management process.

Addressing climate risk requires taking action to minimize that risk. This could include scenario analysis to better understand risks, development of reduction targets, transition plans, and continued reporting of progress.





Duration of time on campus for respondents reporting travel for professional reasons.



Lessons from the NC State Experience

Even with substantial experience in estimating and reporting Scope 3 emissions, NC State was able to improve its process for emissions accounting and identify possible approaches for reducing emissions in the future.

We identified multiple opportunities for improving data collection processes at the front end of the travel authorization process, changes that could increase the efficiency of the accounting process while also improving the accuracy and precision of resulting emissions estimates.

The development of a custom recommendation engine will provide the campus community additional information about lower-emission itineraries.

Additional steps, including opportunities for insetting, are being explored by the campus community as ways to further our teaching, research, and operational goals.

Thank You...

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References

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- Leali, G. (2025). Macron’s U-turn against EU green rules triggers internal revolt. Politico, 17 February 2025.
- World Travel & Tourism Council (WTTC). (2024). Navigating the Sustainability Journey: The Impact of Mandatory Reporting on Travel and Tourism. London, UK.



Frameworks, Standards, and Requirements Reviewed

Third-Party

Carbon Disclosure Project (CDP)

Global Reporting Initiative (GRI)

Greenhouse Gas Protocol

International Organization for Standardization (ISO) 14064-1:2018

International Sustainability Standards Board (ISSB) IFRS S1, General Requirements for Disclosure of Sustainability-related Financial Information

International Sustainability Standards Board (ISSB) IFRS S2, Climate-related Disclosures

Partnership for Carbon Accounting Financials (PCAF)

Principles for Responsible Investment (PRI)

Science Based Targets Initiative (SBTi)

Sustainability Accounting Standards Board (SASB) Standards

Task Force on Climate-related Financial Disclosures (FSB-TCFD)

U.S. State

2020: Illinois Sustainable Investing Act (30 ILCS 238/1)

2022: National Association of Insurance Commissioners (NAIC) Climate Risk Disclosure Survey

2023: California Climate-Related Financial Risk Act (SB 261) and Climate Corporate Data Accountability Act (SB 253)

U.S. Federal

2016: Federal GHG Reporting Program (GHGRP)

2021: Executive Order 14030, Climate-Related Financial Risk

2024: U.S. Securities and Exchange Commission, Enhancement and Standardization of Climate-Related Disclosures for Investors

International

2022: EU Corporate Sustainability Reporting Directive

2023: European Sustainability Reporting Standards (ESRS)

Various country level requirements (Australia, Brazil, Canada, France, Hong Kong, India, Japan, Malaysia, Nigeria, Singapore, Switzerland, United Kingdom)



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Flights



Hotels



Origin Airport





Destination Airport



Plan Trip

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