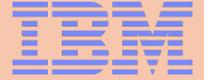# Empowering Sustainable Finance
Leveraging Large Language Models for Climate-Aware Investments

IBM

Motivation

- Increasing urgency of climate action with Paris Agreement's 1.5°C goal at risk.

- Financial sectors can significantly impact carbon emissions through sustainable lending and investments.

- However, challenges such as limited data hinder quantification of financed emission.

- There is an untapped potential of foundation models in financial supply chain emissions estimation

There is a need for LLM powered technology to measure and track financed emissions

## The GLOBAL GHG ACCOUNTING & REPORTING Standard

Developed by the The Partnership for Carbon Accounting Financials (PCAF)

Global and standardized approach to measure and report financed emissions

Provides detailed methodological guidance to measure GHG emissions associated with seven financial asset classes.
(1) Listed equity and corporate bonds (2) Business loans and unlisted equity
(3) Project finance (4) Commercial real estate (5) Mortgages
(6) Motor vehicle loans (7) Sovereign debt

Key considerations
✓ How do we classify any investment into asset classes?
✓ How do we calculate emission associated with the investment?
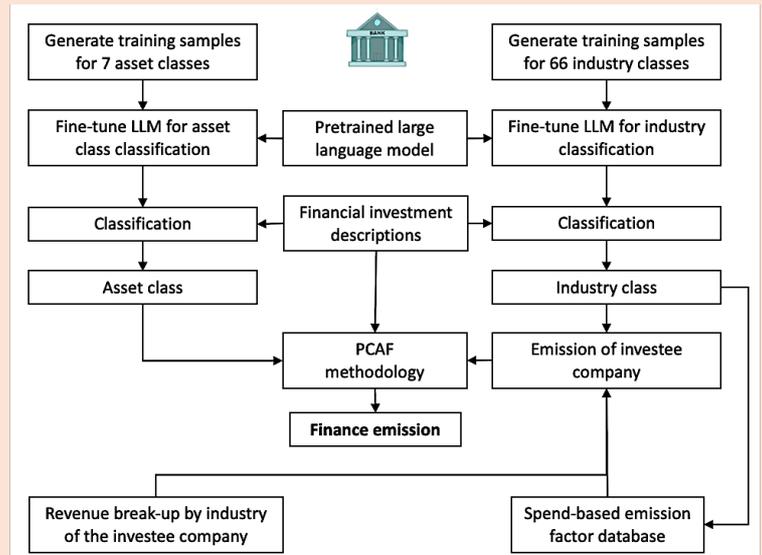✓ How to estimate emission when investee does not disclose emissions?

Business as usual approach
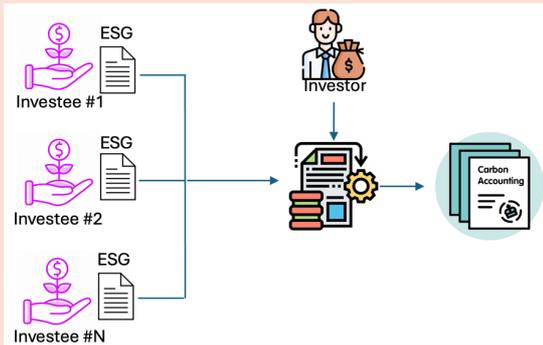
Challenges

- Comprehensive data on the carbon footprint of invested companies and projects may be limited
- Complexity associated with analyzing emissions from diverse sectors, projects, and investments

Proposed Framework

We explore different training strategies
(a) Zero-shot classification
(b) Supervised Learning using vectorization
(c) Supervised fine-tuning of pre-trained LLM

Results indicate that the LLM-based approach outperforms traditional methods in terms of accuracy and overall performance

Model	F1 (Asset)	F1 (Industry)
all-mpnet-base-v2	66.70%	21.67%
all-MiniLM-L6-v2	64.65%	20.49%
all-MiniLM-L12-v2	71.04%	21.48%

Model	F1 (Asset)	F1 (Industry)
roberta-base	98.89%	83.87%
bert-base-uncased	97.98%	82.84%

	F1 (Asset)	F1 (Industry)
TF-IDF	96%	21%
Word2Vec	95%	37%

Experimentation and Results

Sl no.	Ledger entries	Investment	Attribution	Asset	Industry	Emission factor(kg.CO_2/USD)	Final emission
1	ABC has created a well-balanced investment portfolio, directing a total of $20 million into a combination of US SEC, encompassing investment-grade corporate bonds within category D, and listed equity securities within category E	$20 million USD	15%	Listed equity and corporate bonds	Funds, trusts, and other financial vehicles	0.182	546 t.CO_2
2	Balancing social impact, Corporate Finance Ventures allocated $4.5 million for unlisted equity and granted a $3.2 million business loan to a community-based initiative in US	$7.7 million USD	30%	Business loans and unlisted equity	Social assistance	0.135	311.8 t.CO_2
3	Retail Real Estate Partners invested $12 million in the development of a new shopping center designed with experiential retail concepts.	$12 million USD	40%	Commercial real estate	Other retail	0.147	705.6 t.CO_2
4	A $310,000 mortgage loan was provided for the purchase of a duplex, allowing the buyer to live in one unit and rent out the other.	$310K USD	70%	Mortgages	Rental and leasing services and lessors of intangible assets	0.09	19.53 t.CO_2
5	Retail Ventures Inc. secured a $250,000 business auto loan to upgrade their fleet of company cars, with a 5-year term and a variable interest rate based on the prime rate.	$250K USD	80%	Motor vehicle loans	Motor vehicle and parts dealers	0.174	34.8 t.CO_2
6	Gas Power Development obtained a $105 million loan to finance the construction and operation of a combined cycle gas-fired power plant.	$105 million USD	50%	Project finance	Utilities	2.884	151410 t.CO_2
7	A federal bank purchases $2 billion worth of sovereign bonds from Country Z as part of its foreign exchange reserve strategy	$2 billion USD	5%	Sovereign debt	Federal Reserve banks, credit intermediation, and related activities	0.069	6900 t.CO_2