Building Sustainable Futures
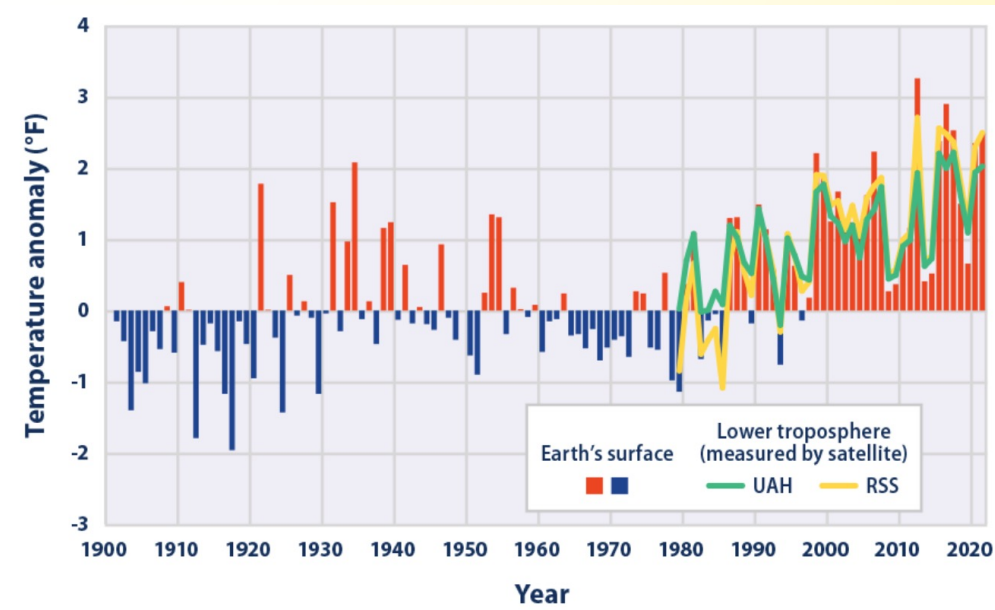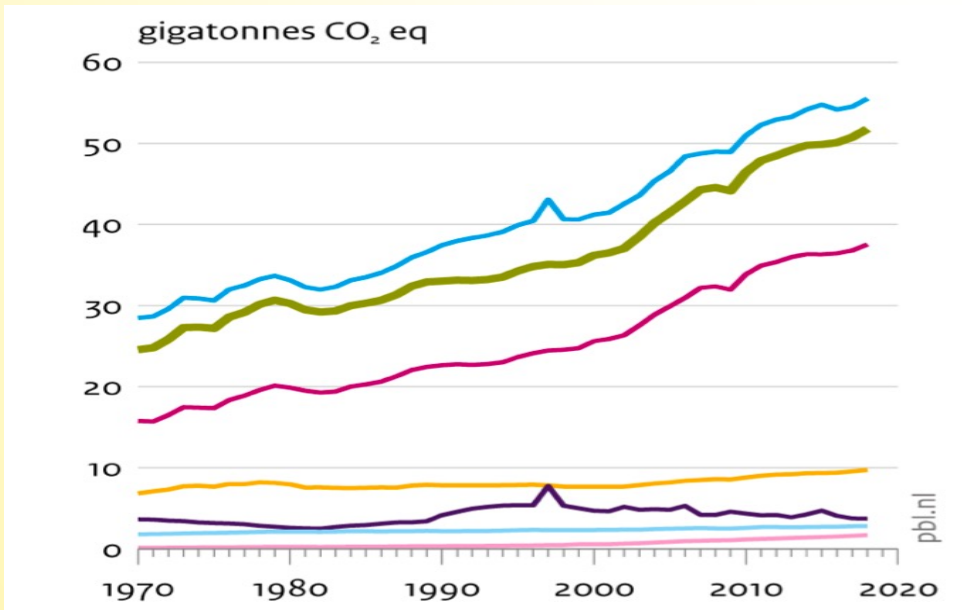
Tutorial on Carbon Footprint Analysis and Mitigation Strategies Using Counter Factual Queries
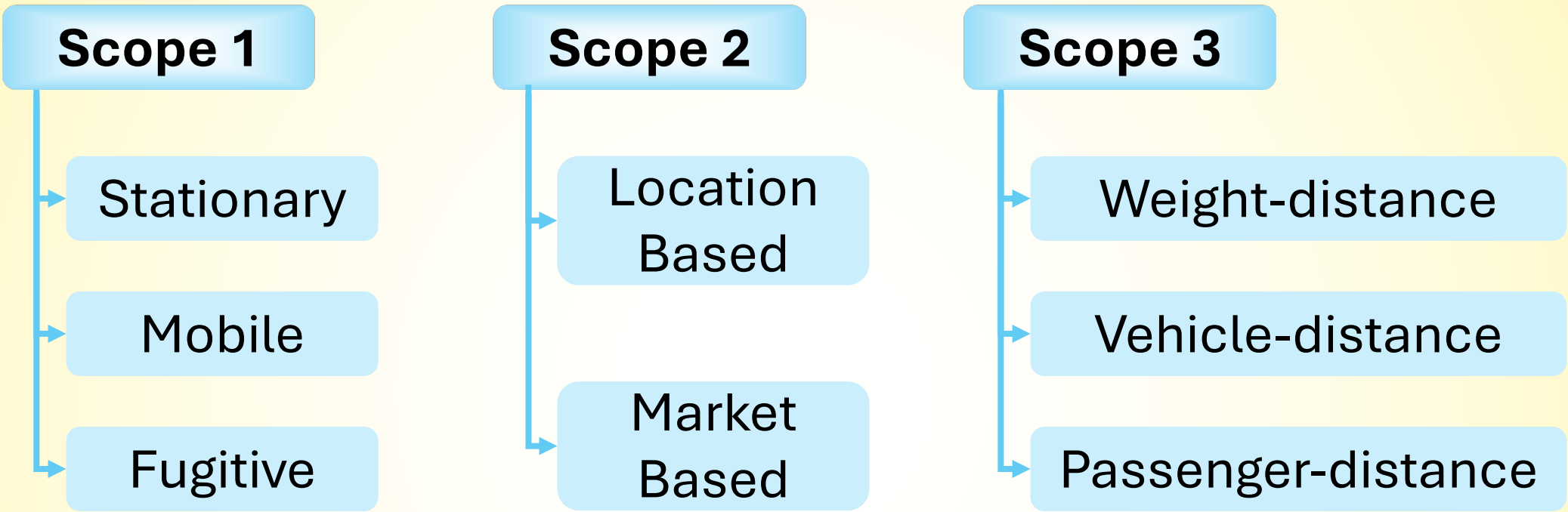
IBM

Motivation

- Enterprises under pressure to act on climate change mitigation
- Disclosing and committing to reduce their GHG emissions
- Over 20% of world's largest companies have set net-zero targets

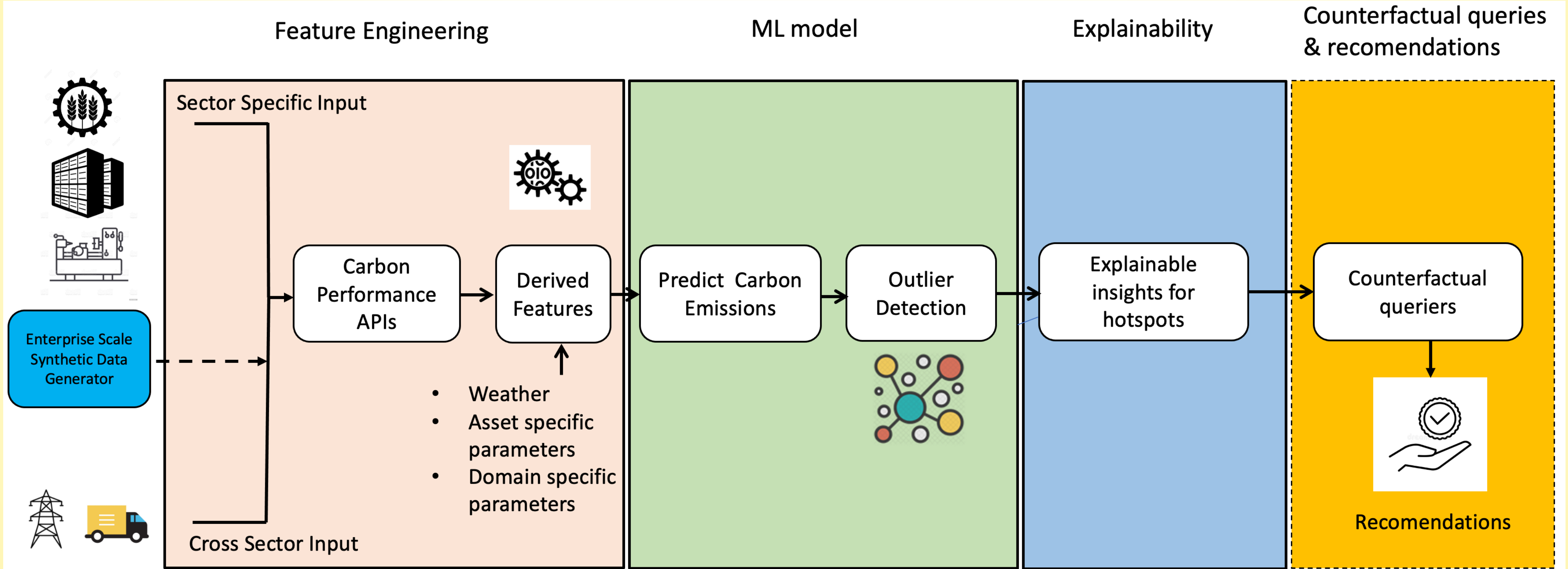**Need technology to measure, track and reduce their emissions**

Carbon Accounting

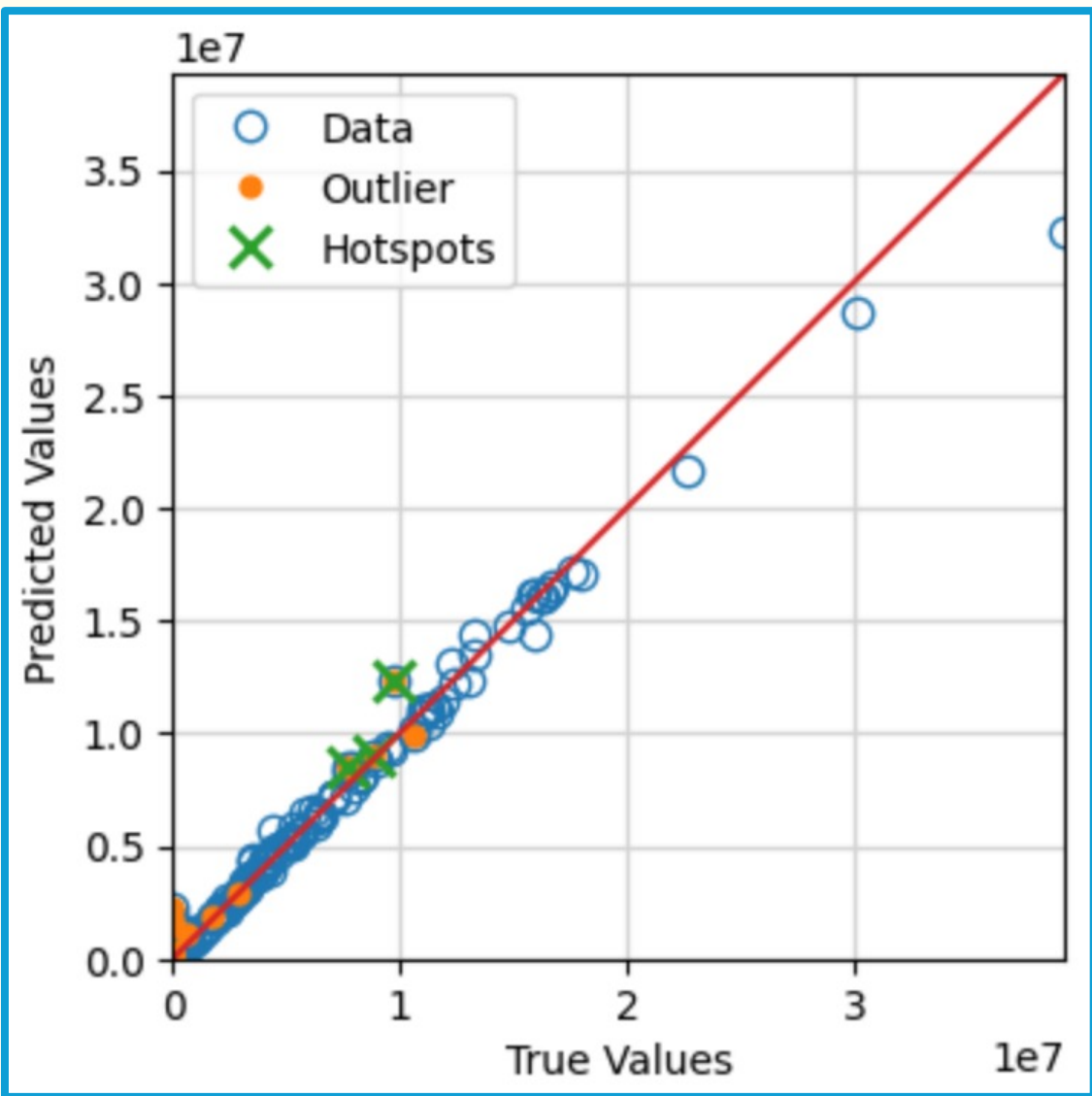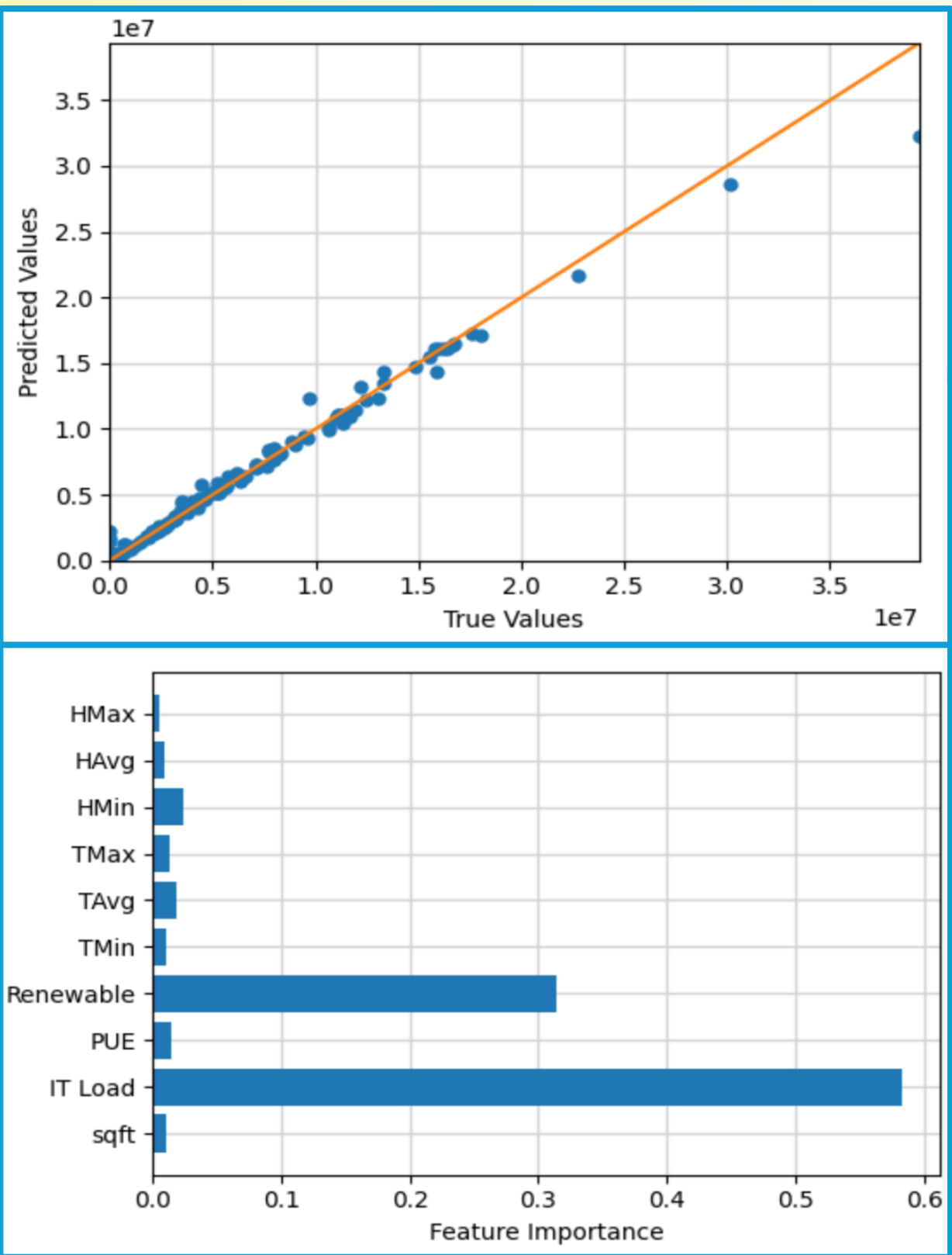| Scope 1	Scope 2	Scope 3
Stationary	Location Based	Weight-distance
Mobile	Market Based	Vehicle-distance
Fugitive		Passenger-distance

- **Scope 1:** Emissions from sources owned or controlled by a company
- **Scope 2:** Emissions from purchased energy (electricity, heat, steam)
- **Scope 3:** emissions from sources not owned or controlled by the company. i.e., from upstream and downstream of a supply chain

Proposed Framework

Feature Engineering | ML model | Explainability | Counterfactual queries & recomendations

Sector Specific Input

Enterprise Scale Synthetic Data Generator

Carbon Performance APIs → Derived Features

- Weather
- Asset specific parameters
- Domain specific parameters

Cross Sector Input

Predict Carbon Emissions → Outlier Detection

Explainable insights for hotspots

Counterfactual queriers

Recomendations

Results

IT Load	PUE	Renewable	TMin	TAvg	TMax	HMin	HAvg	HMax	CO2e (metric tonne)	Type
14462743.0	1.38	0.0	24.7	27.9	32.6	58.1	80.5	94.5	12343304.0	query
4641656.0	1.4	-	-	-	-	-	-	-	5809407.0	recommendation
5861683.0	1.4	-	-	-	-	-	-	-	7826020.0	recommendation
5992609.0	1.4	-	-	-	-	-	-	-	7830455.0	recommendation
5379207.0	1.4	-	-	-	-	-	-	-	6997716.0	recommendation
6013999.0	1.4	-	-	-	-	-	-	-	7832703.0	recommendation

IT Load	PUE	Renewable	TMin	TAvg	TMax	HMin	HAvg	HMax	CO2e (metric tonne)	Type
12701493.0	1.43	0.0	24.8	27.9	32.7	60.3	81.4	94.5	9070908.0	query
5343744.0	1.4	-	-	-	-	-	-	-	7032778.0	recommendation
5473748.0	1.5	-	-	-	-	-	-	-	7248082.0	recommendation
5849309.0	1.4	-	-	-	-	-	-	-	7716791.0	recommendation
6013999.0	1.4	-	-	-	-	-	-	-	7852515.0	recommendation
5379207.0	1.4	-	-	-	-	-	-	-	7014562.0	recommendation

higher ⇄ lower
f(x)
12343304.37

TAvg = 27.9   Renewable = 0.0   IT Load = 14462743.0   PUE = 1.37956299161231