AI in Air Quality: Current State and Future Trends

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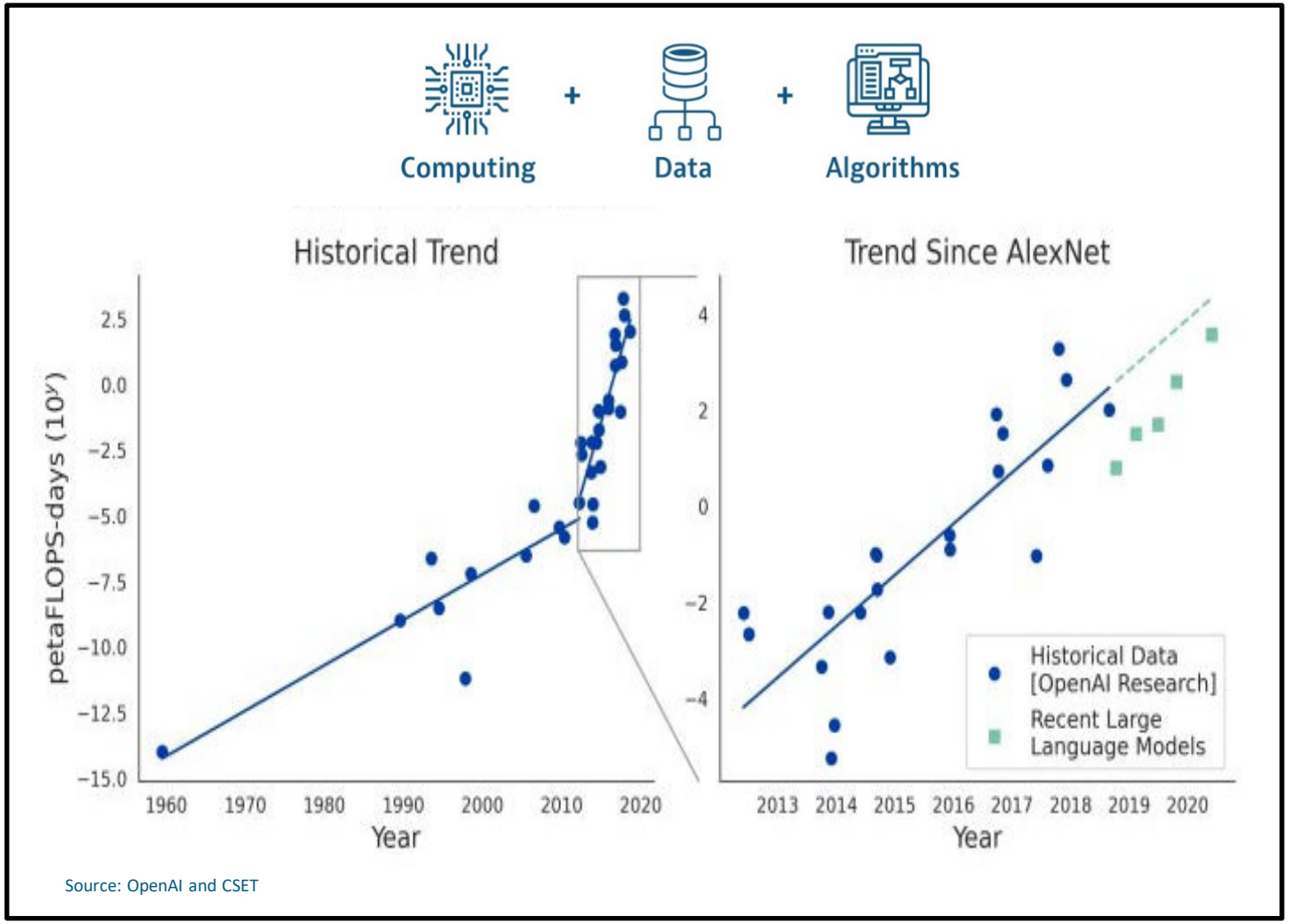
How We Got Here

- 2x compute usage every 8-12 months
- 17x air quality related publications since 2017



Source: OpenAI and CSET

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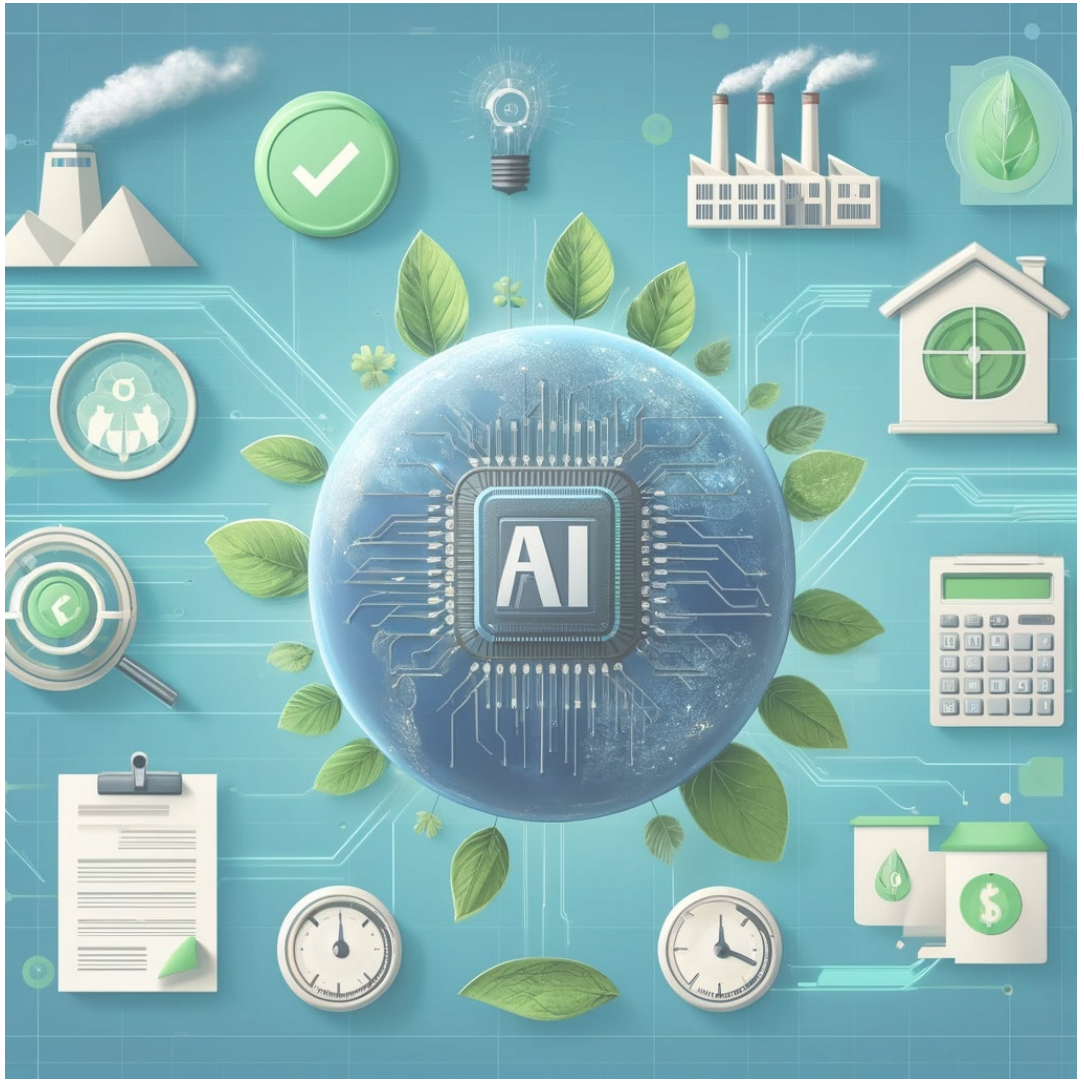
Overview

- Artificial Intelligence (AI)
- Compliance Management
- Emissions Monitoring
- Emissions Control and Reduction
- Possible Permitting Use Cases
- Concerns and Costs



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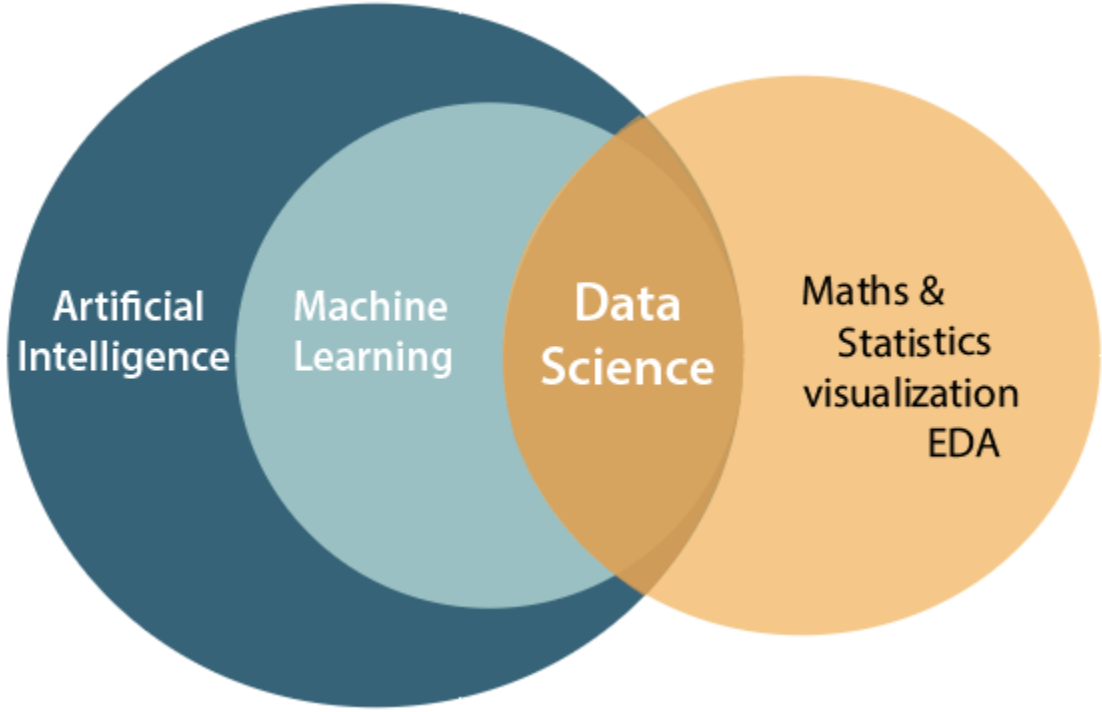
Types of AI

- Machine Learning (ML)
  - Analyzing vast datasets, identifying patterns, and predicting outcomes
- Natural Language Processing (NLP)
  - Understanding and processing human language
- Robotics / Robotic Process Automation (RPA)
  - Sampling and Inspection
  - Automating repetitive rule-based tasks
- Image Recognition
  - Identifying and classifying specific objects, people, text and actions within digital images and videos



Source: https://medium.com/@hema.sri.kovela/data-science-vs-machine-learning-1cf116a7a661

Facility Compliance Management

EHS data management

Use of AI across data management processes, including data extraction and aggregation, cleansing and quality enhancement, insight generation, trend analysis and forecasting

Workflow optimization & automation

AI use cases that streamline EHS workflows and deliver efficiency improvements or better outcomes

Regulatory compliance

AI applications linked to regulatory compliance, legal text classification and regulatory news collation

Proactive risk management

Application of AI to support the identification and mitigation of EHS risks before they materialize as events

Strategic Focus: AI And The Revolution Of EHS Compliance, Verdantix, December 2023

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Example AI (Air) Software in the Market

Software	What does it do?
ehsAI	Deconstruct permit and auto-generate tasks
Enviro.ai	AI Assistant/Chatbot to assist with permitting, compliance, regulatory, and various environmental protection & sustainability effort
Parseur	OCR to read and deconstruct utilities data, invoices, bills of lading, and reports
Visualping AI	Web-scraping to identify legislation updates, regulatory news and updates
Enablon, Cority, Benchmark	Forecast and predict the environment impacts
Power BI, Tableau, Qlik	Data modeling and trend analysis
Various Software	Suggest actions and insights based on user interactions and EHS data
Various Software	Tailor EHS training content based on job roles, performance, and trends
flare.IQ	Monitor, reduce, and control emissions associated with flaring
CMMS software, Maintenance	Real-time data analysis to identify operational anomalies and potential equipment defects; Predicts and prevents equipment and regulatory downtime
EmissionBox	Automates compliance, reporting and field services
Climatiq, Persefoni	Automates carbon emission calculations

Emissions and Process Monitoring

Current

Future

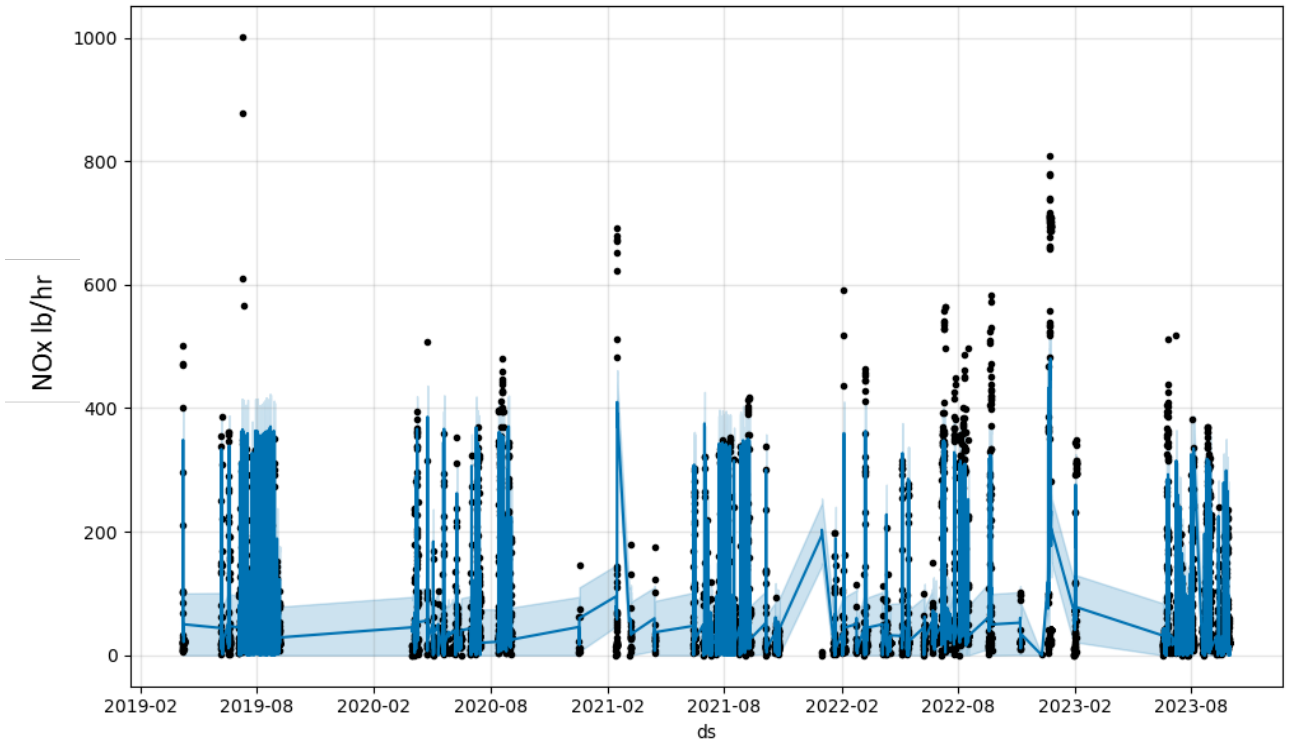
Predictive emissions

Process/equipment reliability

Computer vision + satellite

Integrated monitoring

Predictive Emissions



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Emissions Control and Reduction

Current

Operational optimization

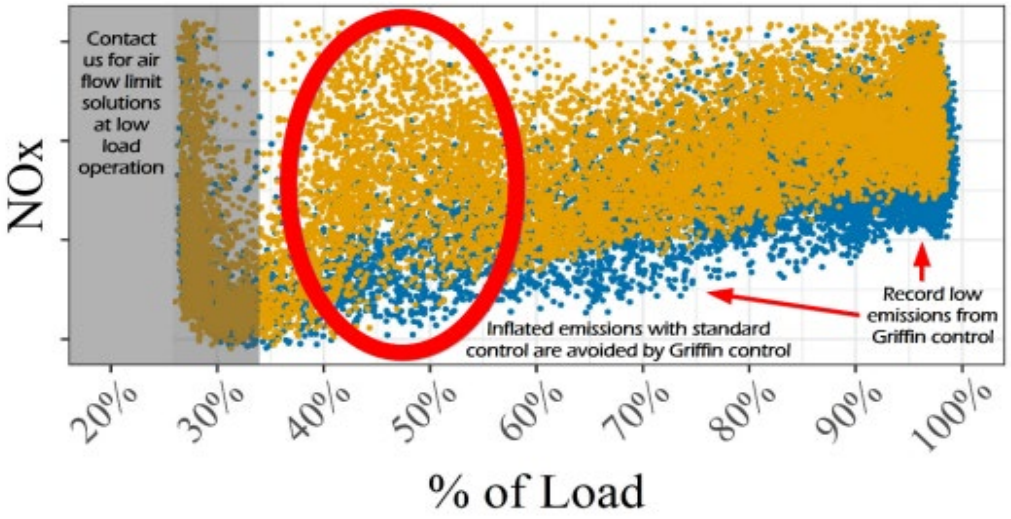
Predictive maintenance

Physics based machine learning

Digital twin

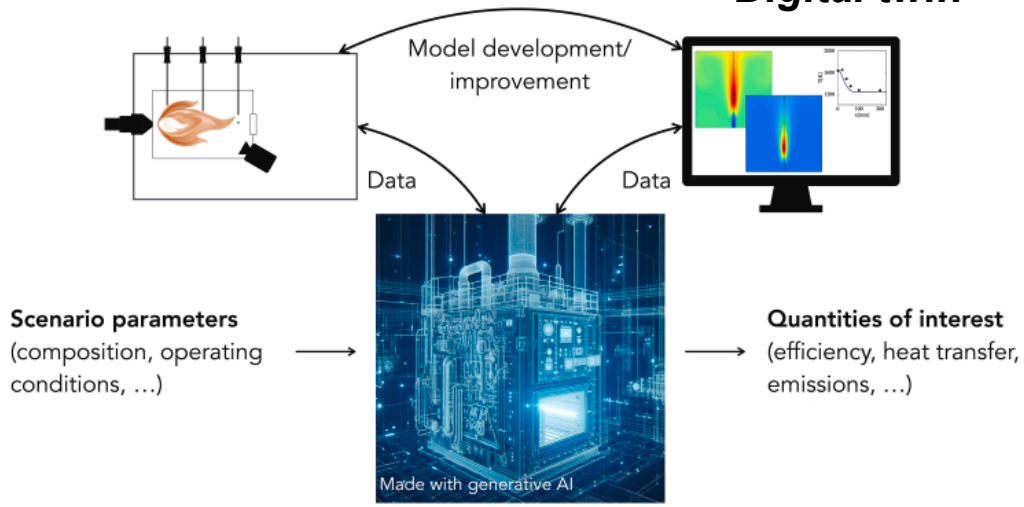
Future

Physics+AI



Source: https://www.griffinopensystems.com/wp-content/uploads/2020/06/Combustion-Optimization-With-Griffin-Open-Systems.pdf

Digital twin



Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10946323/

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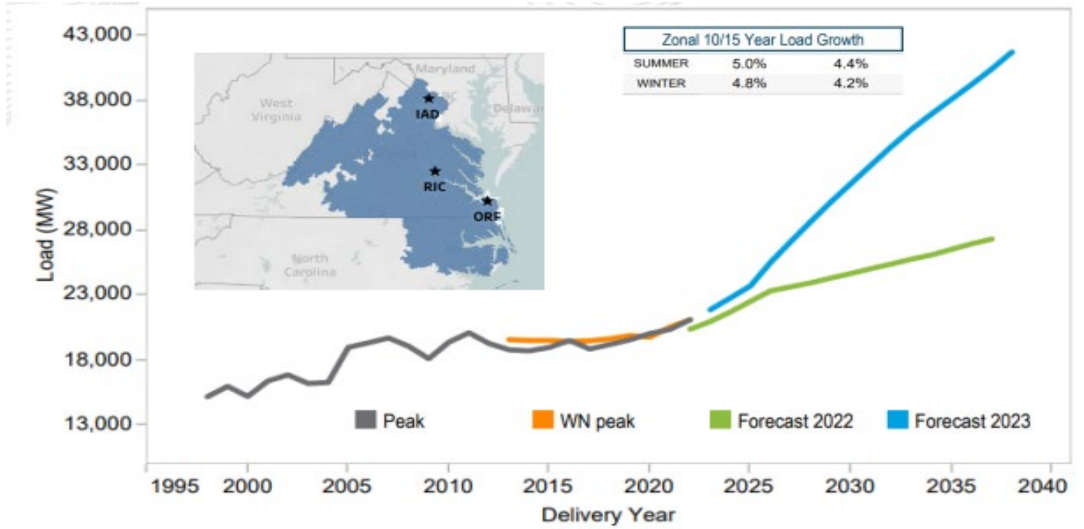
Possible Permitting Use Cases

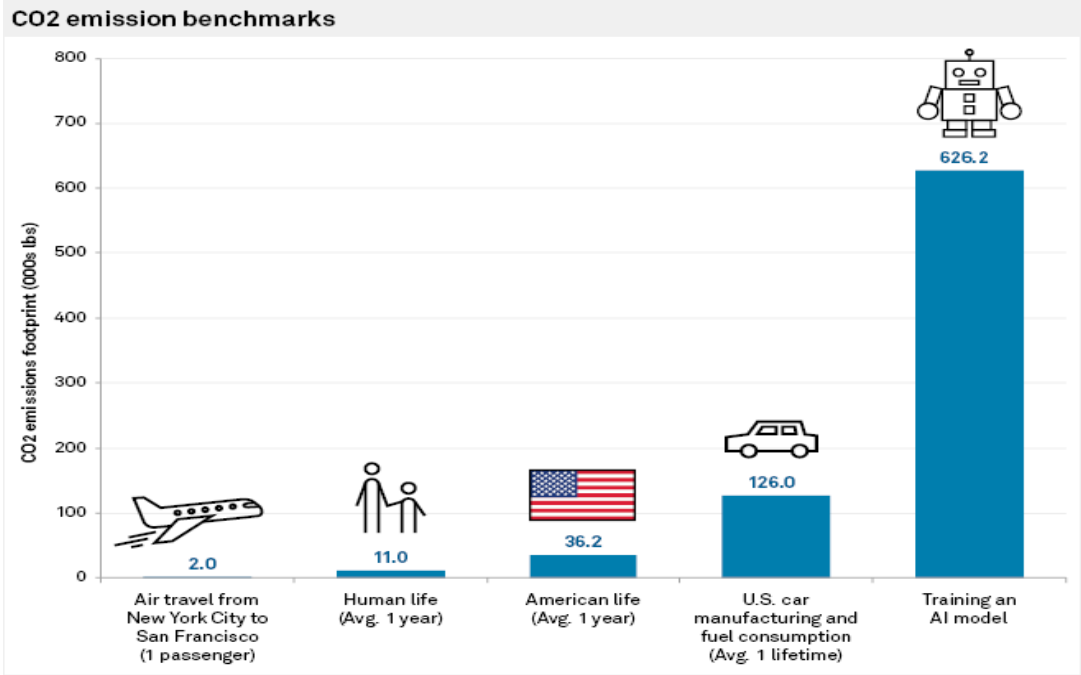
- Permitting process:
  - Information gathering and research
  - Preparing and reviewing air permit applications: Manual *vs.* AI-driven
- Determine appropriate RACT or BACT limit
- Based on actual operations *vs.* theoretical estimates or assumptions
- Identify, evaluate, and document exception events

Concerns and Costs

- Reliability and Trustworthiness
- Exponential Resource Use
  - 35 gigawatts (GW) by 2030, up from 17 GW in 2022 (McKinsey, 2023)
  - Grid and infrastructure upgrades
  - Top data center regions with <1% vacant
- Environmental Impact
  - >50% fossil fuels
  - Data center PUE has been flat
  - Rising e-waste



Source: PJM - https://pjm.com/-/media/library/reports-notices/load-forecast/2022-load-report.ashx



Source: College of Information and Computer Sciences at University of Massachusetts Amherst

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Looking Ahead (With Caution)

- Great potential, many unknowns
- Statistical patterns rather than genuine comprehension
- Narrower scope but powerful: driving efficiencies
- Broader policy and guidance
- Regulatory
  - Complex endeavor
  - ‘Adversarial examples’
  - Accountability for automated decision making

Questions?

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