Technical Board IIT GUWAHATI

BOOTCAMP 24-25

Reducing Carbon Emissions

Devising a Practical and feasible model for optimizing CO2e in a chosen supply chain.

CONTENTS

SECTOR OVERVIEW

Sector	Global Emissions Share	Key Emission Sources	Carbon Emissions (CO2e)	Potential for Reduction
E-Commerce	~2% of global emissions	Transportation, packaging, warehousing	~500 million tons CO2e	**High** (logistics optimization, renewable energy use, packaging innovations)
Healthcare	~4.4% of global emissions	Energy for facilities, medical waste, equipment	~2 gigatons CO2e	**Moderate** (energy efficiency, waste reduction, but constrained by demand)
Agriculture	20-30% of global emissions	Livestock methane, deforestation, fertilizer use	~10-12 gigatons CO2e	**Moderate to Low** (methane reduction tech, regenerative farming, but limited due to natural processes)

DETAILED BREAKDOWN

OVERVIEW

E-commerce contributes 17% of total retail sales globally, with emissions projected to rise by 30% by 2030.Carbon emissions stem mainly from transportation, packaging, and last-mile delivery inefficiencies.

MARKET GROWTH

E-commerce sales grew by 27.6% during 2023, expected to continue rising, pressuring transportation systems.

PACKING WASTE

E-commerce packaging accounts for 3.1 million tons of waste, contributing to CO_2 emissions,with plastic alone emitting 6 kg of CO_2 per 1 kg produced. Only 9% is recycled, leading to substantial landfill and incineration emissions.

CONCLUSION

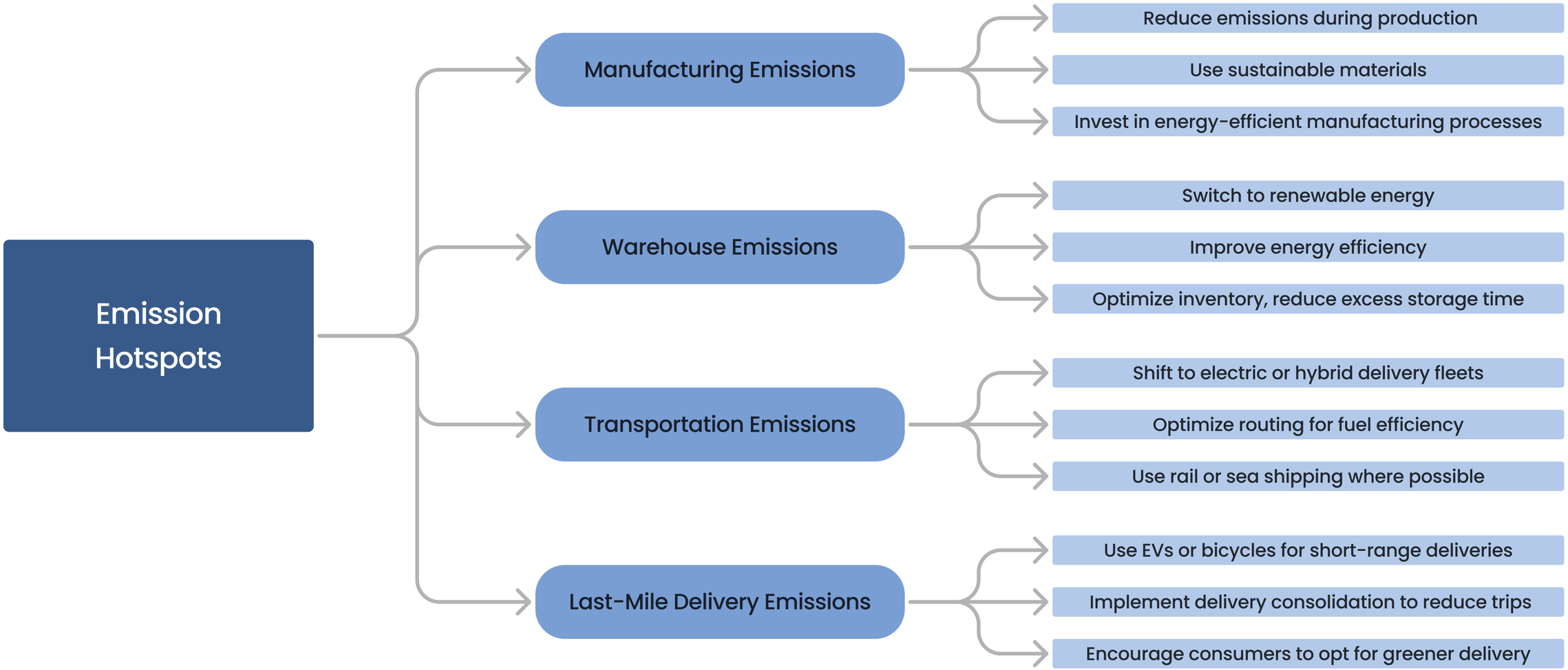
E-commerce has the smallest carbon footprint compared to healthcare and agriculture but offers the most scalable potential for rapid reductions due to technological innovation and logistical improvements.

SUPPLY CHAIN

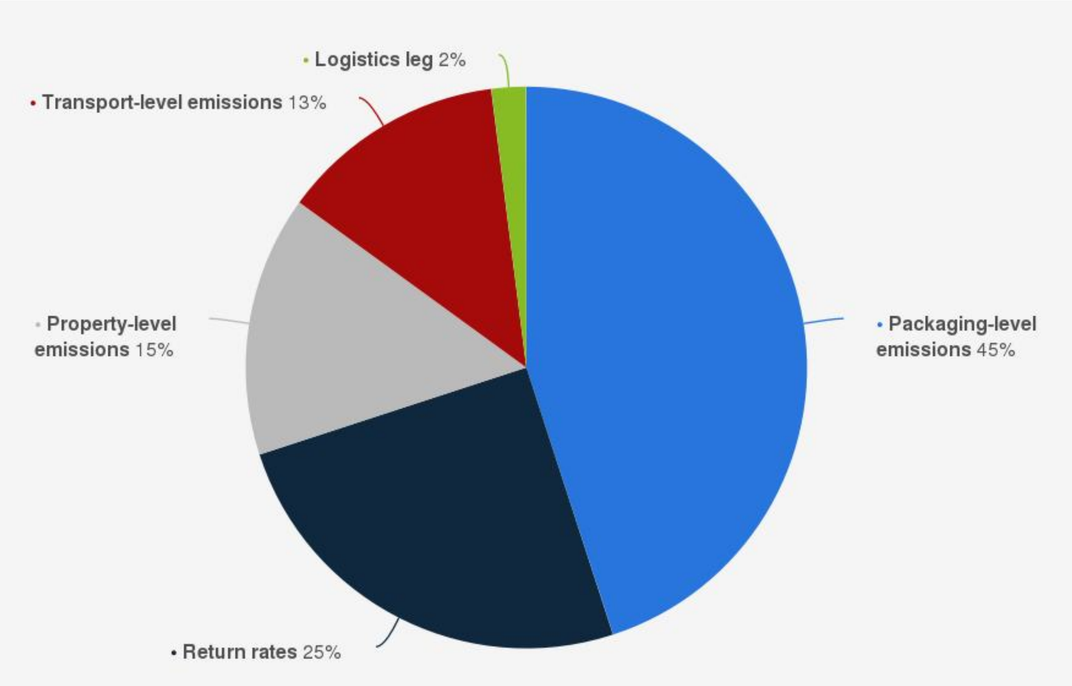
1. Product Sourcing and Procurement
2. Inventory Management
3. Order Processing
4. Warehouse Operations and Fulfillment
5. Shipping and Logistics
6. Returns and Reverse Logistics
7. Customer Service and Support
8. Data Collection and Analytics

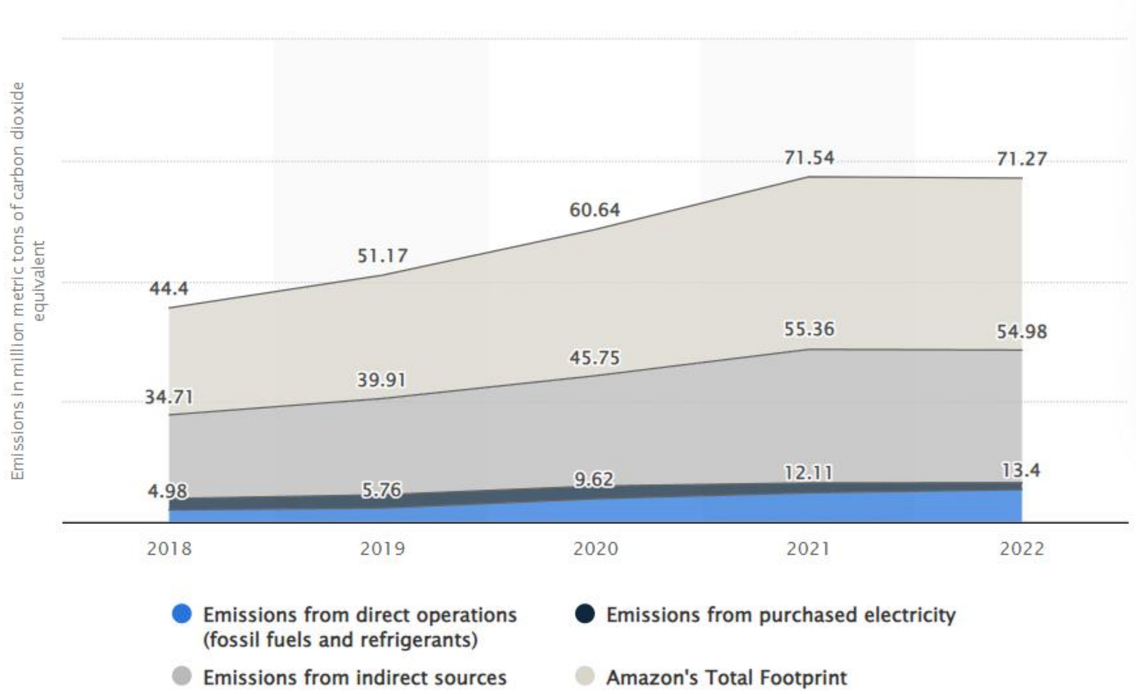
EMISSION HOTSPOTS

ISSUE TREE



EMISSION HOTSPOTS





EMISSION HOTSPOTS

GUESSTIMATE

KEY ASSUMPTIONS

Research says the average carbon emission per E-commerce order = 600g CO2e

Given the average number of E-commerce orders per day in India = 4 million

Which makes the annual number of E-commerce orders ≈ 1.5 billion

Supply Chain Breakdown:

- **Manufacturing: 10% of emissions per order (60g CO_2)**
- **Warehousing: 15% of emissions per order (90g CO_2)**
- **Transportation: 50% of emissions per order (300g CO_2)**
- **Last-mile Delivery: 25% of emissions per order (150g CO_2)**

EMISSION HOTSPOTS

GUESSTIMATE

Manufacturing Emissions

Per order: 60g CO_2

For 1.5 billion orders:

90,000metric tons CO_2

Warehousing Emissions

Per order: 90g CO_2

For 1.5 billion orders:

135,000metric tons CO_2

Transportation Emissions

Per order: 300g CO_2

For 1.5 billion orders:

450,000metric tons CO_2

Last-Mile Delivery Emissions

Per order: 150g CO_2

For 1.5 billion orders:

225,000metric tons CO_2

Total Emissions for 1.5 Billion Orders Annually:

- Manufacturing: 90,000 metric tons CO_2
- Warehousing: 135,000 metric tons CO_2
- Transportation: 450,000 metric tons CO_2
- Last-Mile Delivery: 225,000 metric tons CO_2

Grand Total:

90,000+135,000+450,000+225,000=

900,000metric tons CO_2 annually

SOLUTION AND IMPLEMENTATION

SWOT ANALYSIS FOR MINIMIZING CO2e

Strength

Availability of electric vehicles (EVs) for delivery and automated warehousing reduces emissions.
Many companies are adopting biodegradable packaging, which can reduce environmental impact.

Weakness

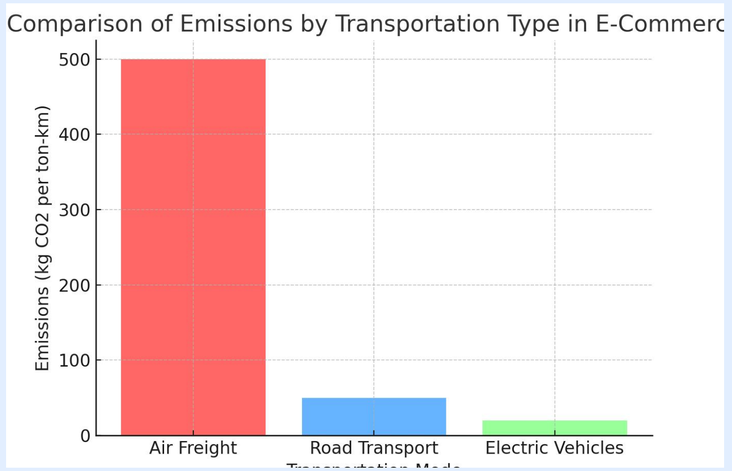
Transitioning to green technologies (e.g., EV fleets, solar-powered warehouses) requires significant upfront costs.
International shipping emissions are harder to control due to diverse regulations and less influence on shipping companies.

Opportunities

Collaborating with third-party logistics companies that offer eco-friendly options can minimize emissions.
Governments are increasingly providing subsidies or tax breaks for companies that reduce their carbon footprints.
Innovations in packaging, warehousing, and renewable energy sources offer pathways to drastically reduce carbon emissions.

Threats

Competitors who adopt greener practices faster can capture eco-conscious consumers.
Climate change itself could disrupt supply chains, making carbon reduction initiatives both necessary and challenging.

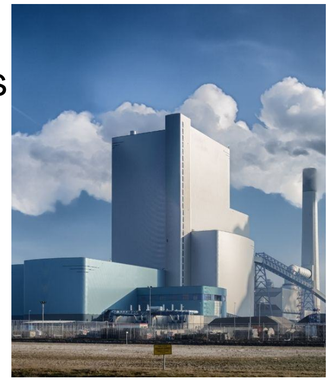


As is clearly visible in the graph the emissions by air freight is nearly 10 times as that by road and nearly 25 times by EVs

SOLUTION AND IMPLEMENTATION

MANUFACTURING EMISSION

Supply Chain Localization and Green Sourcing Solution:



- Localize production to reduce the carbon emissions associated with transportation.
- Work with suppliers who use sustainable practices and materials.

Balancing Profitability:

- Localizing production reduces shipping costs and lead times, which can improve the supply chain's efficiency and profitability.
- Green sourcing can appeal to consumers, helping to build a brand that stands out for sustainability, justifying premium pricing.
- Shorter supply chains are less vulnerable to global disruptions, potentially reducing risks and costs related to delays.

Switch to Renewable Energy Sources:

- Shift to renewable energy sources like solar, wind, or hydropower to reduce reliance on fossil fuels.
- Install solar panels or wind turbines on manufacturing facilities.

Balancing Profitability:

- Renewable energy may have higher upfront costs but leads to significant savings in energy bills in the long term.
- Energy independence from fluctuating fuel prices can stabilize costs, increasing profitability over time.
- Selling excess renewable energy back to the grid in some regions can provide an additional revenue stream.

SOLUTION AND IMPLEMENTATION

WAREHOUSING EMISSION

Optimize Warehouse Layout and Space Utilization:

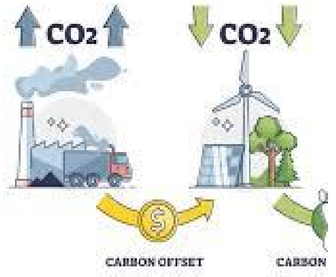
- Implement vertical storage solutions to make better use of space and reduce the warehouse footprint.
- Use WMS to optimize inventory flow and reduce the time and energy spent on moving products.

Balancing Profitability:

- Optimizing space utilization can lead to fewer or smaller warehouses, reducing operating costs (e.g., energy, rent, or mortgage).
- Faster, automated processes mean less energy is used in handling products, reducing labor and electricity costs.
- Higher inventory turnover means fewer resources are tied up in storage, improving cash flow.

On-Site Carbon Offsetting:

- Implement carbon offsetting activities such as planting trees or maintaining green spaces on warehouse grounds.
- Purchase carbon offsets for unavoidable emissions.



Balancing Profitability:

- Carbon offset programs can help a company reach carbon-neutral goals, improving brand reputation and consumer loyalty.
- These programs may also open up new revenue streams by attracting clients or partners focused on sustainability.
- While offsets do not directly increase profitability, the improved public perception can lead to increased demand, customer retention, and new business opportunities.

SOLUTION AND IMPLEMENTATION

LOGISTICS EMISSION

Optimize Delivery Routes And Implement Delivery Consolidation:

- Use route optimization software that employs real-time traffic data and advanced algorithms to plan the most fuel-efficient routes for deliveries.
- Group orders into larger, consolidated shipments to reduce the number of trips

Calculation of the carbon footprint from delivery

Balancing Profitability:

- Optimized routes mean less fuel consumption, which directly reduces operational costs.
- Reducing driving time can lead to fewer hours worked, cutting down on labor costs.
- By using fewer resources (drivers, fuel, and vehicles), consolidated deliveries improve the overall profit margin.

Transition to Electric Vehicles (EVs) and Hybrid Fleets

- Transition delivery fleets (both long-distance trucks and last-mile vans) from traditional fuel-powered vehicles to electric or hybrid vehicles.

Balancing Profitability:

- EVs have fewer moving parts, meaning less wear and tear, leading to lower maintenance costs.
- Many governments offer financial incentives or tax breaks for adopting electric vehicles, reducing upfront costs.

SOLUTION AND IMPLEMENTATION

OVERALL IMPLEMENTATION

Data Driven Demand Forecasting

- Sales history, website traffic, customer preferences, and seasonal trends need to be collected from e-commerce domains.
- Algorithms analyze data to generate insights about future demand patterns. Machine learning can refine its predictions over time by learning from past data.
- Modern forecasting models are powered by AI and machine learning, which learn from large datasets and improve their accuracy over time.
- Collaborating with 3PLs helps smaller companies leverage the same technology without having to invest heavily in their own systems.

Uses:

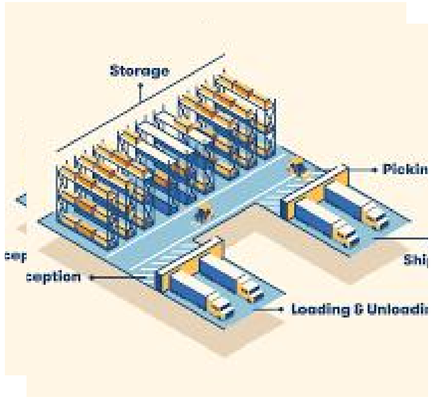
- Reduction in unnecessary deliveries.
- Strategically stock goods in warehouses closer to where demand is high.
- Allow businesses to stock the right amount of inventory at the right location.
- Plan more efficient delivery routes, overall, reducing the number of total trips needed.
- Reduce returns by predicting customer satisfaction trends and minimizing errors.

IMPACT AND RISKS

Optimizing Warehouse Layout:

Impacts:

- A well-optimized warehouse layout reduces the energy required to move goods within the facility & cuts down on lighting and HVAC needs.
- An optimized layout maximizes the use of available space, potentially reducing the need for additional warehouses.
- Streamlining the arrangement of goods improves picking, packing and overall operational efficiency



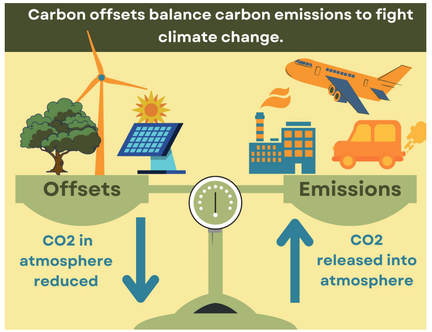
<u>Initial Disruption and Cost:</u>

Reconfiguring a warehouse layout involves upfront costs, including design, equipment rearrangement, and potential downtime during the transition.

Onsite Carbon Offsetting:

Impacts:

- Onsite carbon offsetting methods, such as tree planting, installing renewable energy infrastructure, or creating carbon capture initiatives, can directly offset CO2 emissions.
- Onsite offsetting enhances a company's image as environmentally conscious, which can attract eco-conscious consumers.



<u>Space and Resource Constraints</u>:

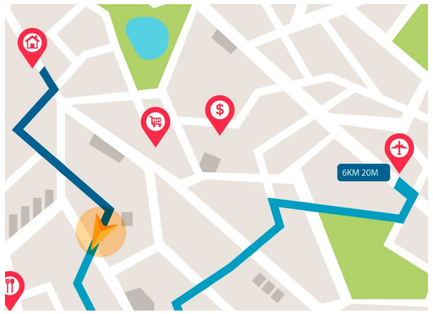
Certain onsite offsetting strategies, like planting trees or setting up renewable energy infrastructure, require space and resources that might not be available in dense urban or already developed warehouse sites.

IMPACT AND RISKS

Optimizing Delivery Routes:

Impacts:

- Using AI and GPS-based systems to optimize delivery routes reduces the distance and time that delivery vehicles need to travel, lowering fuel consumption and emissions.
- Route optimization can also improve delivery speed by avoiding traffic and minimizing detours.
- Efficient routes reduce fuel costs and vehicle wear-and-tear, which translates to lower operating expenses.



Dependence on Technology:

Route optimization heavily relies on technology such as GPS and AI systems, which could fail due to software glitches or connectivity issues.Technical failures could disrupt delivery schedules, leading to delays and customer dissatisfaction

Transition to Electric Vehicles (EVs):

Impacts:

- EVs have zero tailpipe emissions, which makes them a key tool in reducing CO2 emissions from last-mile delivery.
- A commitment to EVs enhances a company's image as a sustainability leader.
- EVs have lower fuel costs (electricity vs. gasoline/diesel) and reduced maintenance expenses since they have fewer moving parts.

High Initial Capital Investment:

The upfront cost of purchasing electric vehicles is higher tha conventional vehicles, which can strain budgets, especially fo smaller businesses.

Charging Infrastructure Limitations:

EVs require charging infrastructure, which may not be widely available or capable of handling a large fleet's needs. In region with limited infrastructure, charging could lead to delays.

Conclusions & Major Takeaways

1 **Key Insights**

E-commerce is a rapidly growing sector, contributing significantly to global retail and supply chains.Although has a smaller carbon footprint compared to sectors like healthcare and agriculture, but offers the most scalable potential for rapid emission reductions.Major emissions sources include manufacturing, warehousing, transportation.

2 **Solution And Execution**

AI-driven routing algorithms analyze traffic data, weather conditions in real-time to determine the most efficient delivery routes.It can also analyze historical sales data, and real-time inputs to predict future demand more accurately.Electric vehicle are an essential step toward sustainable logistics, offering a range of benefits from lower operating costs to zero emissions.

3 **Short And Long Term Impact**

E-commerce must adopt sustainable practices now for long-term success, with potential savings of 40-50 million tons by 2030.Profitability is maintained through long-term cost savings.Using AI for Logisticscan reduce emissions by 15-25% in a company potentially saving them millions in future.In the short term businesses may benefit from tax rebates or financial incentives provided by governments

THANK YOU!!

-NIMIT MAROO

Appendix

https://ecocart.io/reduce-business-carbon-footprint/
https://www.sciencedirect.com/science/article/pii/S0959652620354469
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