DHL Supply Chain Case Study

GROUP- 2

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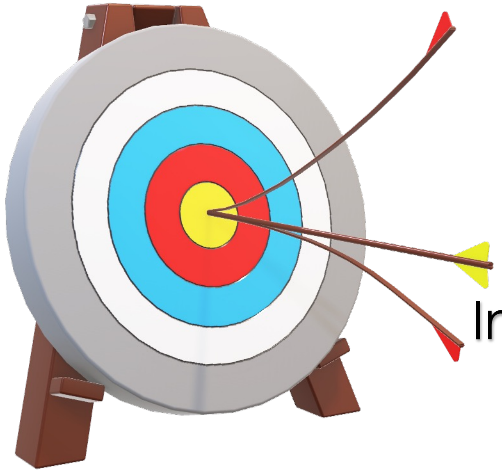
Overview

Objective:

Investigate the balance between cost efficiency and carbon emission reduction.

Importance:

Growing concerns over CO_2 emissions and environmental sustainability are driving transformations in supply chain management.



DHL’s TARGET

Improve it’s CO2 efficiency by 30% compared to it’s 2007 baseline levels

Approach

Model Overview

Comparative Analysis Between Different Supply Chain Models

Model 1: Aims to minimizes total cost without considering CO_2 emissions, focusing on cost-effective sourcing strategies.

Model 2: Aims to minimize CO_2 emissions within a 3 billion CNY budget, prioritizing environmental sustainability.

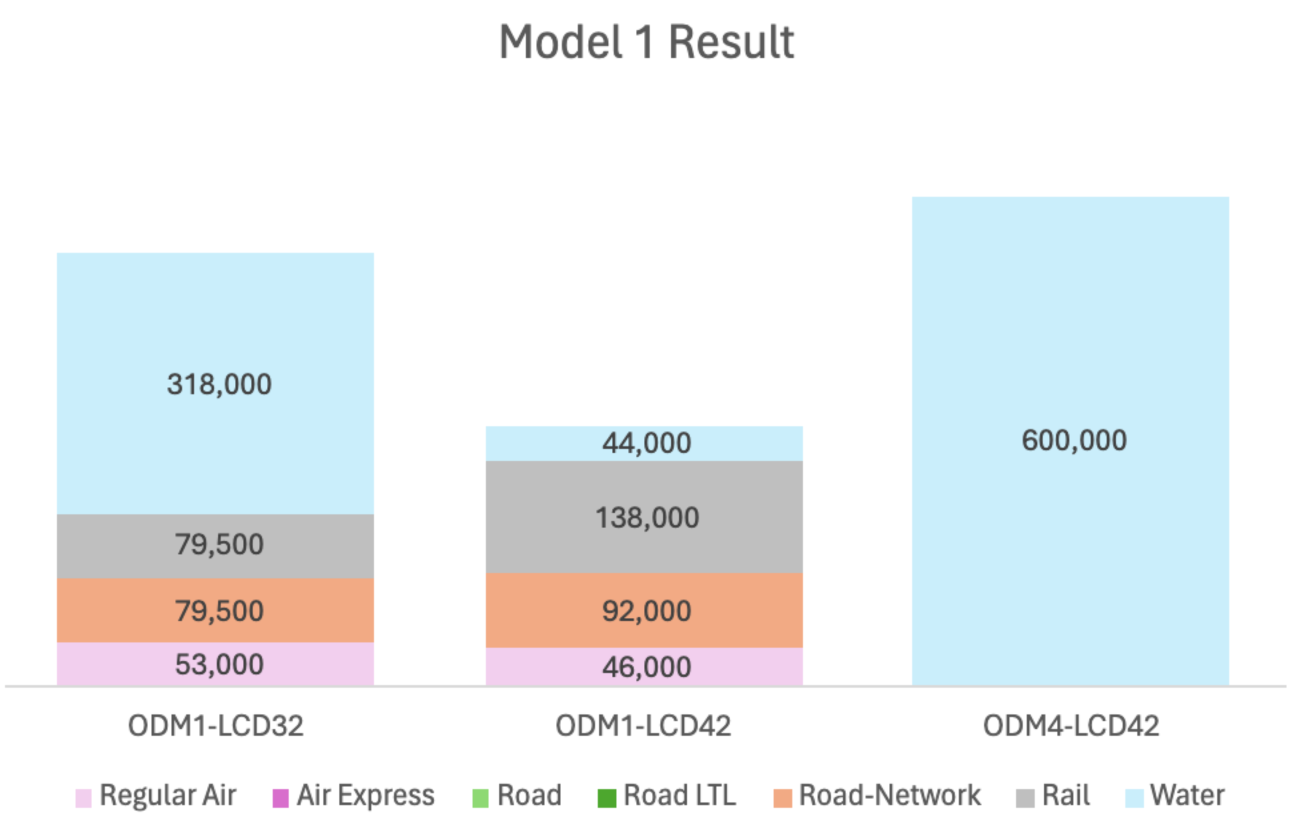
Objective Of Comparative Analysis: Analyzing the trade-offs between profitability and environmental sustainability under different operational conditions.

Model 1 – Minimizing The Total Cost

Results

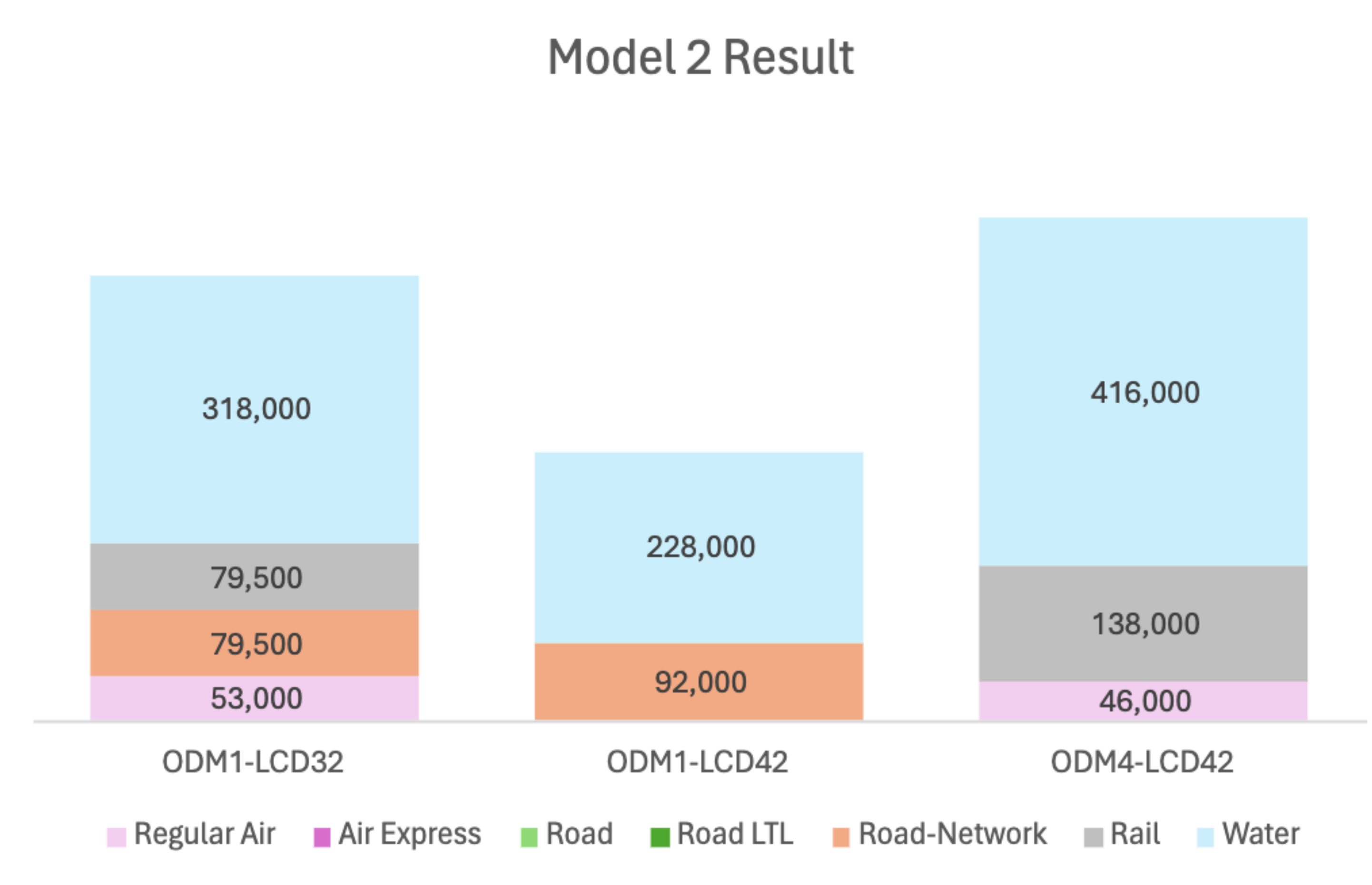
Best Sourcing Strategy

To achieve an optimum solution with minimized cost it is recommend to use ODM 1 and ODM 4 for production along with a combination of transport modes.



Model 1 Outcome	
Total Cost (CNY)	2,999,985,597.10
Total CO2 Emission (KG)	7,944,511.03

Model 2- Minimizing CO2 Emissions



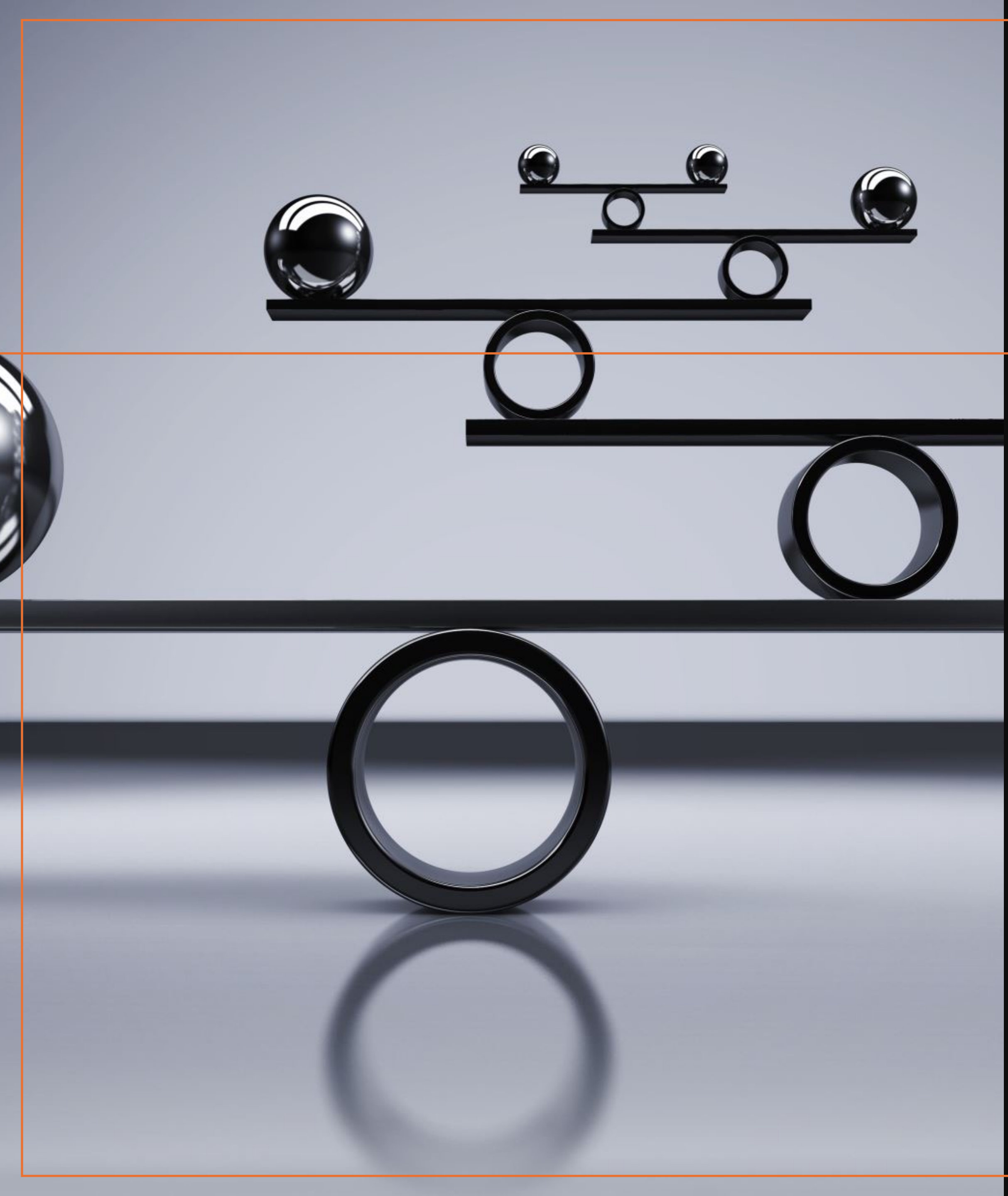
Results

Best Sourcing Strategy

To achieve an optimum solution with minimized CO_2 emissions it is recommend to use ODM 1 and ODM 4 for production along with a different combination of transport modes as compared to Model 1

Model 2 Outcome

Total Cost (CNY)	**2,999,985,597.10**
Total CO2 Emission (KG)	**7,401,972.77**



Comparison Overview

- **Different Focus, Common Goal**
- **Quantitative Comparison**

  Both models resulted in the same total cost (~2.99 billion CNY), but Model 1 has 7.33% higher CO_2 emissions than Model 2.
- **Trade-off between Cost and CO_2 Emissions**
- **Effect of Budget on CO_2 Emissions**

COST ANALYSIS

TOTAL COST

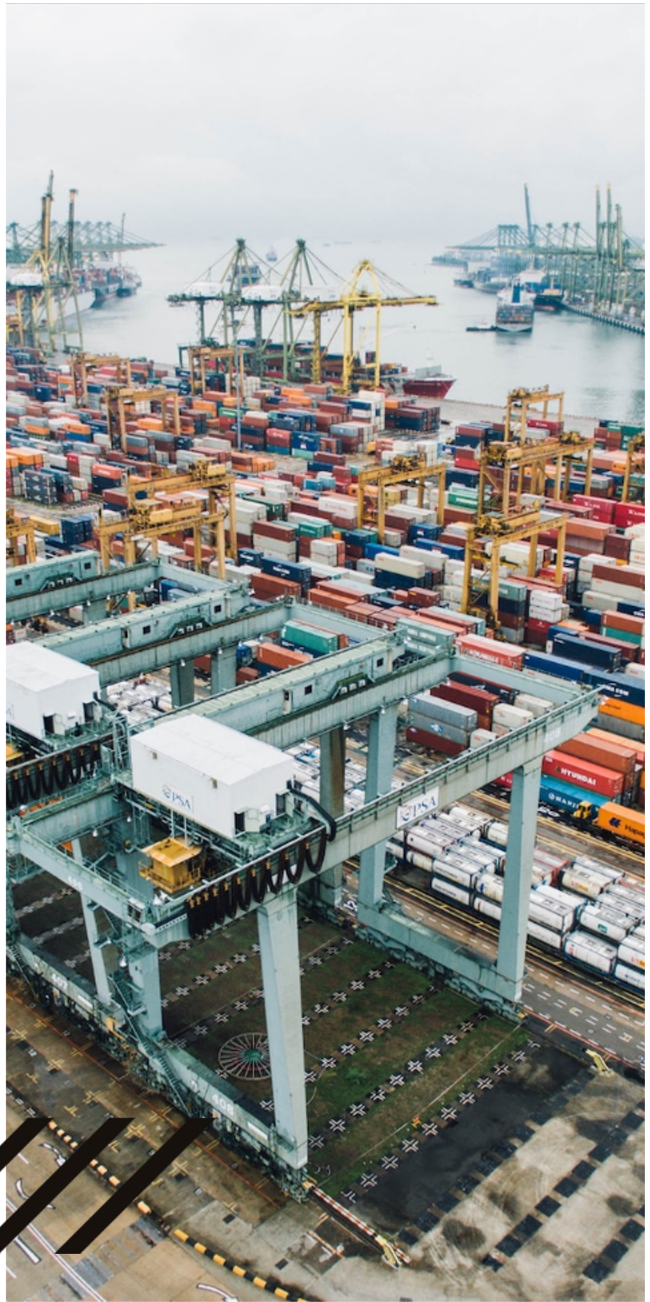
Both models resulted in an identical total cost of approximately 2.99 billion CNY.

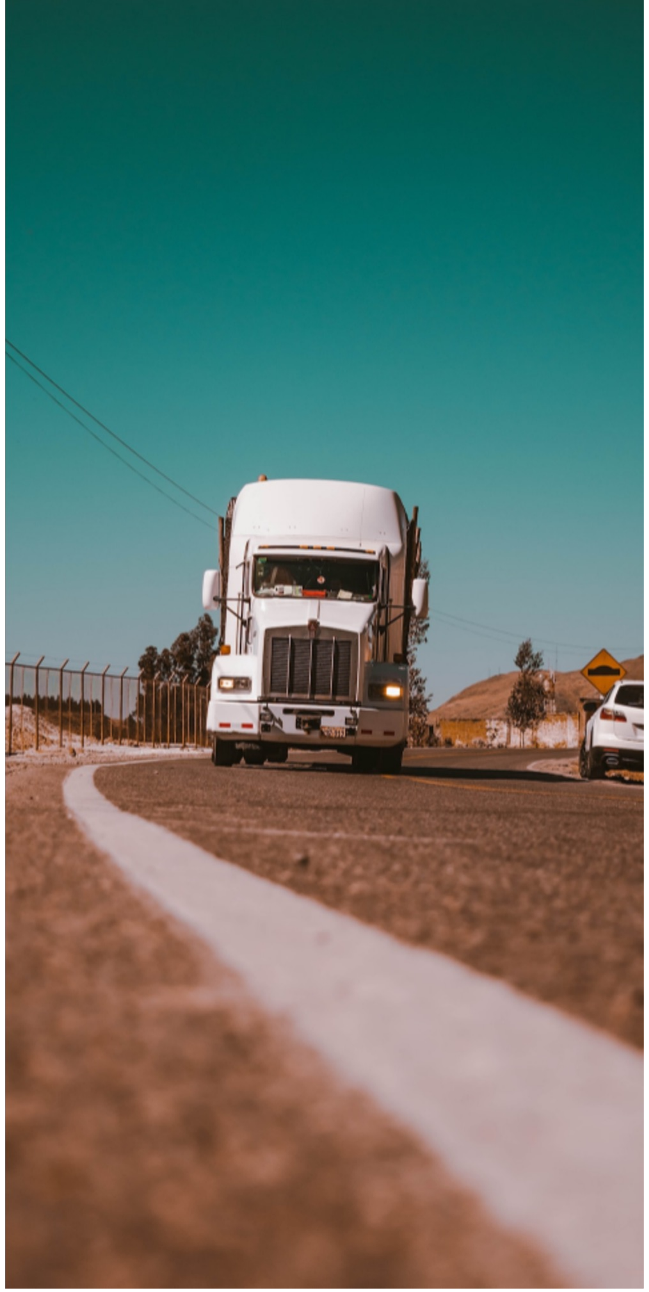
COST EFFICIENCY

Model 1 and Model 2 demonstrate cost-effectiveness by maintaining operational costs within the projected budget.

CONCLUSION

The identical cost outcomes highlight the feasibility of achieving environmental goals without compromising on cost efficiency.





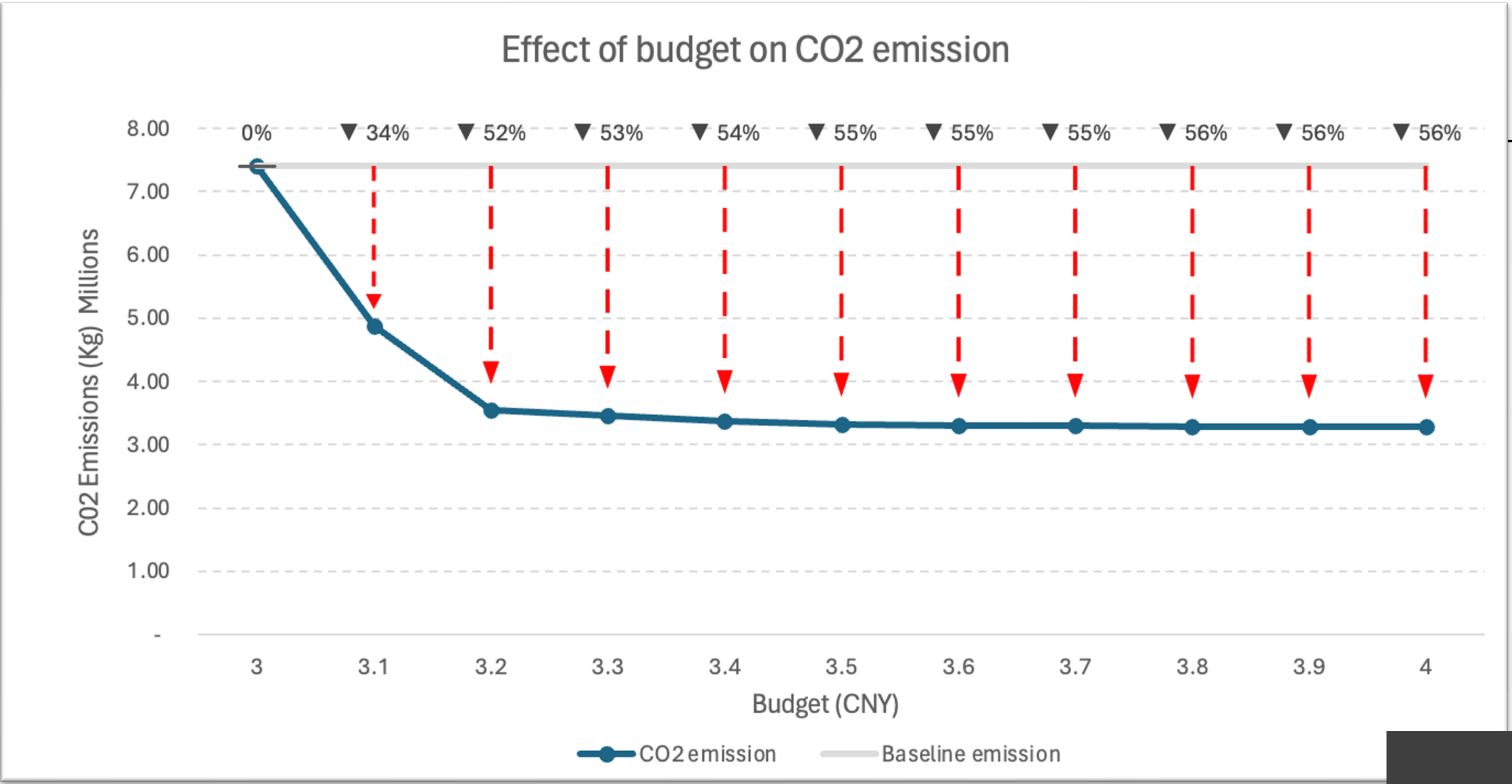
Carbon Emissions Analysis

Total CO_2 Emissions: Model 2 resulted in lower CO_2 emissions (7.40 million KG) compared to Model 1 (7.94 million KG).

Emission Reduction: *Model 2 successfully reduced CO_2 emissions by 7.33% compared to Model 1*, aligning with environmental sustainability goals.

Environmental Significance: This comparison between the 2 models underscores the potential of operational strategies to significantly impact CO_2 emissions without compromising financial goals.

Effect Of Budget On Carbon Emissions



Note- Baseline Levels correspond to the emission levels when the budget is 3 billion CNY

Model 3: Aims to Minimize CO2 Emissions considering a budget of 3.3 Billion CNY

Conclusion: There is a significant drop of 53% in the CO2 emission levels as compared to the baseline emissions . This implies that the amount of CO2 Emissions are directly proportional to the Budget

Model 3 Outcome

Total Cost (CNY)	3299999771.71
Total CO2 Emission (KG)	3470066.471

Assumptions and Simplifications

- The current data we have is historical information and with an increasing awareness about environmental sustainability demand, fuel prices and other variables will fluctuate
- Transportation Costs, Demand and Supply are consistent

- Government Legislations
- Environmental Policies
- Reductions in CO_2 emissions without additional costs could potentially increase the supply chain budget by 10%.

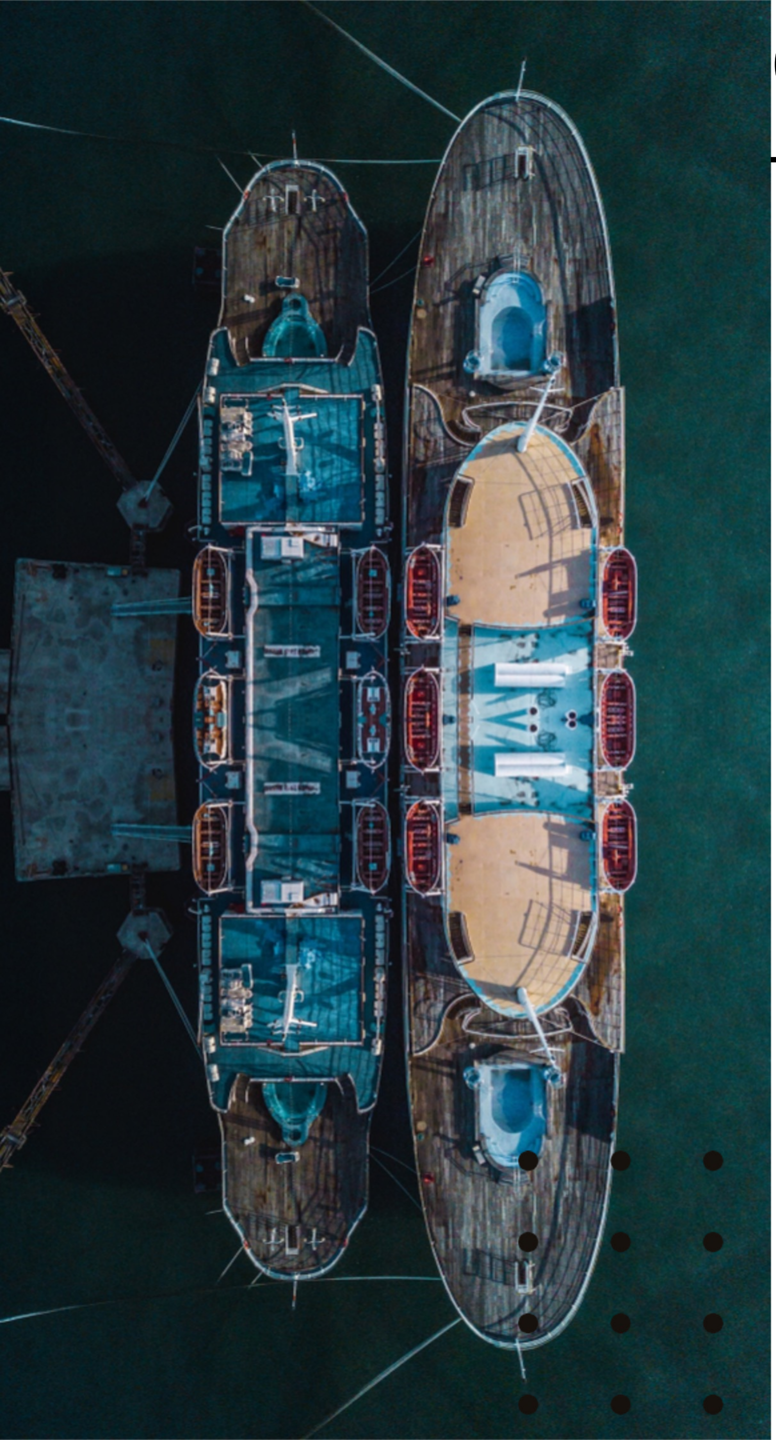
- At least one mode of transportation (air, road, rail, water) is used for each product regardless of the ODM in the supply chain.
- Economies of scale are leveraged, by ensuring the minimum production for any LCD is 200,000 units per contracted ODM

IMPACT OF TRANSPORT MODES ON SAFETY STOCK LEVELS

Unpredictable risks associated with some transport modes enhances the need for a higher safety stock level

Lower lead times and predictable schedules reduce the need for higher safety stock levels

Sudden demand surges will deplete safety stock levels and lead to a shortage. This increases the need to have optimum safety stock levels



Conclusion/ Recommendations

1

-The ideal solution is trade-off between Cost and CO_2 Emissions.
-Therefore, if DHL has the required budget it can aim for Model 3 as it's the ideal solution to obtain operational efficiency by focusing more on reducing CO_2 emissions.

2

- Using this approach DHL can leverage technology to strategically align with it's target goal of improving CO_2 efficiency by 30% while simultaneously achieving operational efficiency

3

- Optimize Transport Modes
- Engage in Policy Dialogue
- Invest in Renewable Energy

4

- Future Trends: Increasing government regulations and consumer demand for sustainable products are likely to drive further innovations in supply chain sustainability

THANK YOU !!

Appendix

Model 1- Formulation

Objective

$\text{Min} \sum_{i=0}^{1} \sum_{j=0}^{6} ProductionCost(i,j) \times \sum_{k=0}^{6} q(i,j,k) + \sum_{i=0}^{1} \sum_{j=0}^{6} \sum_{k=0}^{6} q(i,j,k) \times ShippingCost(i,j,k) \times weight(i)$

1. **Shipping Constraints:** for i, j, k ∈ ValidCombination: q(i, j, k)≥ $MinimumUnitsMode(i,j,k) \times z(i,j,k)$ and $q(i,j,k) \le MinimumUnitsMode(i,j,k) \times z(i,j,k)$
2. **EnforceUsage Constraint**: $for\ i \in$ I, c ∈ C:$\sum_{j=0}^{6} \sum_{k=0}^{krange} z(i,j,k) \ge 1$
3. **Production constraints:** $for\ j \in$ J: $\sum_{i=0}^{1} \sum_{k=0}^{6} q(i,j,k) \ge MinProduction \times y(j)$ and $\sum_{i=0}^{1} \sum_{k=0}^{6} q(i,j,k) \le MaxProduction \times y(j)$
4. **Demand Constraints**: for i ∈ I: $\sum_{j=0}^{6} \sum_{k=0}^{6} TotalDemand(i)$

Decision variables:

1. **q (i, j, k):** the quantities of product i (i=0, LCD42; i=1, LCD32) being shipped from ODM j (j=0, ODM1, ...,j=6, ODM7) via mode k (k=0, Air; k=1, Air Express; k=2, Road; k=3, Road LTL; k=4, Road Network; k=5, Rail; k=6, Water).
2. **y (j):** binary variable, whether ODM j is producing, =1: produce, =0: not produce
3. **z (i, j, k):** binary variable, whether mode k from ODM j for product i is used to ship goods, =1 used, =0 not used.

Parameters:

1. **weight (i)** : weights of LCD42 and LCD32
2. **distance (i, j)** : distances between ODM j and DC
3. **mode_category (c)** : a list of categories including air, road, rail, water
4. **f_shipping_cost (i, j, k):** shipping costs of product i being shipped from ODM j via mode k
5. **f_min_units_mode (i, j, k):** the minimum units to be shipped of product i via mode category c
6. **f_production_cost (i, j):** production cost for product i in ODM j
7. **f_emission (k):** emission(kg) released per km per ton for mode k
8. **total_demand (i):** demand for product i
9. **min_production:** at least 200000 units to be produced at any ODM, for LCD42 and LCD32 combined
10. **max_production**: at most 600000 units to be produced at any ODM except ODM 1 and 2, for LCD42 and LCD32 combined
11. **valid_combinations:** valid (i, j, k) in f_shipping_cost array

Model 2- Formulation

Objective

$\text{Min}\sum_{i=0}^{1}\sum_{j=0}^{6}\sum_{k=0}^{6} distance(i,j)\times weight(i)\times q(i,j,k)\times emissioncost(k)$

1. **Shipping Constraints:** for i,j,k∈ ValidCombination: q(i,j,k)≥ $ShippingCost(i,j,k)\times z(i,j,k)$ $and\ q(i,j,k) \leq M\times z(i,j,k)$
2. **EnforceUsage Constraint**: $for\ i$ ∈ I, c ∈ C:$\sum_{j=0}^{6}\sum_{k=0}^{krange} z(i,j,k) \geq 1$
3. **Production constraints:** $for\ j$ ∈ J: $\sum_{i=0}^{1}\sum_{k=0}^{6} q(i,j,k) \geq MinProduction\times y(j)\ and\ \sum_{i=0}^{1}\sum_{k=0}^{6} q(i,j,k) \leq MaxProduction\times y(j)$
4. **Demand Constraints:** for i ∈ I: $\sum_{j=0}^{6}\sum_{k=0}^{6} TotalDemand(i)$
5. **CostConstarint**: $\sum_{i=0}^{1}\sum_{j=0}^{6} ProductionCost(i,j)\times\sum_{k=0}^{6} q(i,j,k) + \sum_{i=0}^{1}\sum_{j=0}^{6}\sum_{k=0}^{6} q(i,j,k)\times ShippingCost(i,j,k)\times weight(i) \leq$ 3000000000

Decision variables:

1. **q (i, j, k):** the quantities of product i (i=0, LCD42; i=1, LCD32) being shipped from ODM j (j=0, ODM1, ...,j=6, ODM7) via mode k (k=0, Air; k=1, Air Express; k=2, Road; k=3, Road LTL; k=4, Road Network; k=5, Rail; k=6, Water).
2. **y (j):** binary variable, whether ODM j is producing, =1: produce, =0: not produce
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