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*DHL Supply Chain Case*

1. **Complete the provided Excel template to demonstrate how the original supply chain was optimized on a budget of CNY 3 billion. If you make any assumptions, please clearly state and justify them.**

As per Exhibit 1 below (Excel sheet minimize cost) and conditions given in question –

Minimum Cost for fulfilling contract of 920,000 units of LCD42” and 530,000 units of LCD32” TV sets to its DC = 2,999,985,597

There is one basic assumption that :

* Not all facilities need to fulfil a single contract. This doesn’t mean we are shutting down any facility. It means we are not using products from all facilities for this particular contract/ customer.
* There is a minimum production capacity of 200K, but we don’t need to supply all of that 200K, instead part of that can be used for fulfilling other contracts. Hence in solve, we haven’t used 200K production constraints.

|  |  |
| --- | --- |
| Total Cost | **2999985597** |
| CO2 Emission | 7944511.034 |

1. **Evaluate the extent of the reduction in CO2 emission if the budget were increased by 10 per cent to CNY 3.3 billion. Analyze this result.**

If budget was increased to by 10% and stands at 3.3 Billion, then potential decrease in CO2 emission will stand at **3406266 Tons compared to** CO2 emission of 7944511 Tons within budget of 3 Billion.

As shown in Exhibit 2 below (Sheet – Minimum CO2 with extended Budget)

|  |  |
| --- | --- |
| Total Cost | 3299999993 |
| CO2 Emission | **3406266.393** |

1. **Sensitivity analyses: Repeat question 2 for other possible percentage increases in the budget. Try multiple values of the percentage increases in budget, and plot a graph with the percentage increases in budget on the x-axis and the CO2 emission on the y-axis. Analyze this result.**

We increased budget by 5%, 10%, 15%, 20% and infinite budget to keep CO2 at minimum, in excel solver and calculated the values of carbon emission and production cost. Same has been shown in Exhibit 3 (Excel sheet – Minimize CO2)

|  |  |  |  |
| --- | --- | --- | --- |
| **Production Cost (Rounded Off Billion)** | **Percentage Increase** | CO2 Emission | **CO2 Emission (Million Tons Approx)** |
| 3 | **0** | 7944511.034 | 7.94 |
| 3.15 | **5%** | 3648089.567 | **3.65** |
| 3.3 | **10%** | 3406266.393 | **3.40** |
| 3.45 | **15%** | 3342015.521 | **3.34** |
| 3.6 | **20%** | 3306128.395 | **3.31** |
| 3.755261566 | **25%** | 3293331.145 | **3.29** |

**A close up of text on a white background

Description automatically generated**

We can see in above plot that even for 5% increase in budget for 3 Billion to 3.15 Billion, CO2 emissions can drop down significantly to 3.4 Million tons.

Further increase in budget by 10% to 3.3 Billion, CO2 emissions will drop down to 3.4 million tons. But afterwards there has not been significant descrease in CO2 emissions.

Hence, it is suggested to go for max budget of 3.3 Billion even reducing CO2 emissions can gain benefits from tax incentive and brand value.

**Exhibit 1 (Minimize cost without taking CO2 minimization in consideration)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Air | Express | Road | Road LTL | Road-Network | Rail | Water | Total |  | Constraints | | | |
| LCD 42" ODM1 | 46000 | 0 | 0 | 0 | 92000 | 138000 | 44000 | 320000 |  | Min Air 42" | 46000 | >= | 46000 |
| LCD 42" ODM2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | Min Air 32" | 53000 | >= | 53000 |
| LCD 42" ODM3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | Min Roads 42" | 92000 | >= | 92000 |
| LCD 42" ODM4 | 0 | 0 | 0 | 0 | 0 | 0 | 600000 | 600000 |  | Min Roads 32" | 79500 | >= | 79500 |
| LCD 42" ODM5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | Min Rail 42" | 138000 | >= | 138000 |
| LCD 42" ODM6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | Min Rail 32" | 79500 | >= | 79500 |
| LCD 42" ODM7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |
| LCD 32" ODM1 | 53000 | 0 | 0 | 0 | 79500 | 79500 | 318000 | 530000 |  | Production |  |  |  |
| LCD 32" ODM2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 42" Min | 920000 | >= | 920000 |
|  |  |  |  |  |  |  |  |  |  | 32" Min | 530000 | >= | 530000 |
|  |  |  |  |  |  |  | **Total Cost** | **2999985597** |  |  |  |  |  |
|  |  |  |  |  |  |  | **CO2 Emission** | **7944511.034** |  |  |  |  |  |

**Exhibit 2 (Minimize CO2, within a budget of 3.3 Billion)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Air | Express | Road | Road LTL | Road-Network | Rail | Water | **Total** |  |  | Constraints |  | |
| LCD 42" ODM1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Air 42" | 46000 | >= | 46000 |
| LCD 42" ODM2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Air 32" | 53000 | >= | 53000 |
| LCD 42" ODM3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Roads 42" | 92000 | >= | 92000 |
| LCD 42" ODM4 | 0 | 0 | 0 | 0 | 0 | 0 | 228000 | **228000** |  | Min Roads 32" | 79500 | >= | 79500 |
| LCD 42" ODM5 | 0 | 0 | 4 | 0 | 91996 | 0 | 0 | **92000** |  | Min Rail 42" | 138000 | >= | 138000 |
| LCD 42" ODM6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Rail 32" | 79500 | >= | 79500 |
| LCD 42" ODM7 | 46000 | 0 | 0 | 0 | 0 | 138000 | 416000 | **600000** |  |  |  |  |  |
| LCD 32" ODM1 | 0 | 0 | 0 | 0 | 0 | 0 | 257626 | **257626** |  |  |  |  |  |
| LCD 32" ODM2 | 53000 | 0 | 0 | 0 | 79500 | 79500 | 60374 | **272374** |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  | Production |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  | 920000 | >= | 920000 |
|  |  |  |  |  |  |  |  |  |  |  | 530000 | >= | 530000 |
|  | Total Cost | 3299999993 |  |  |  |  |  |  |  |  |  |  |  |
|  | CO2 Emission | **3406266.393** |  |  |  |  |  |  |  |  |  |  |  |

**Exhibit 3 (Minimize CO2, within unlimited budget)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Air | Express | Road | Road LTL | Road-Network | Rail | Water | **Total** |  | **Constraints** | | | |
| LCD 42" ODM1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Air 42" | 46000 | >= | 46000 |
| LCD 42" ODM2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Air 32" | 53000 | >= | 53000 |
| LCD 42" ODM3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Roads 42" | 600000 | >= | 92000 |
| LCD 42" ODM4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Roads 32" | 79500 | >= | 79500 |
| LCD 42" ODM5 | 0 | 0 | 600000 | 0 | 0 | 0 | 0 | **600000** |  | Min Rail 42" | 138000 | >= | 138000 |
| LCD 42" ODM6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  | Min Rail 32" | 79500 | >= | 79500 |
| LCD 42" ODM7 | 46000 | 0 | 0 | 0 | 0 | 138000 | 136000 | **320000** |  |  |  |  |  |
| LCD 32" ODM1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |  |  |  |  |  |
| LCD 32" ODM2 | 53000 | 0 | 79500 | 0 | 0 | 79500 | 318000 | **530000** |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  | Production |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  | 920000 | >= | 920000 |
|  |  |  |  |  |  |  |  |  |  |  | 530000 | >= | 530000 |
|  | Total Cost | 3755261566 |  |  |  |  |  |  |  |  |  |  |  |
|  | CO2 Emission | **3293331.145** |  |  |  |  |  |  |  |  |  |  |  |