



Changing the rules of business

# Value Proposition for Reducing the Carbon Footprint



25th November 2008

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# What We'll Cover ...



Changing the rules of business

- Introduction
- Green Campaign
- Network Planning
- Demonstration
- Wrap-up

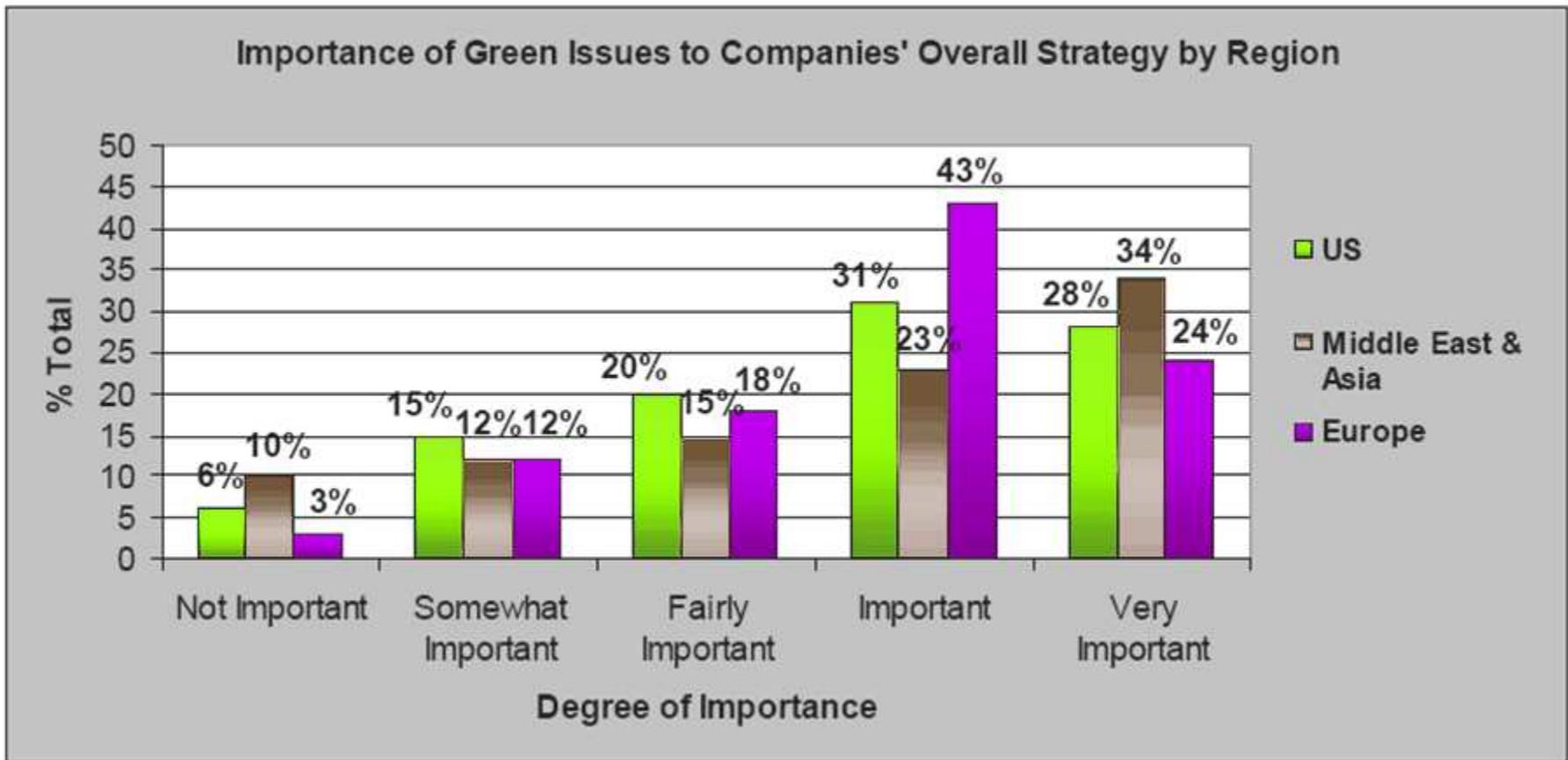


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# Green SC: Executives are Concerned



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Eye for Transport Survey, Nov. 2007

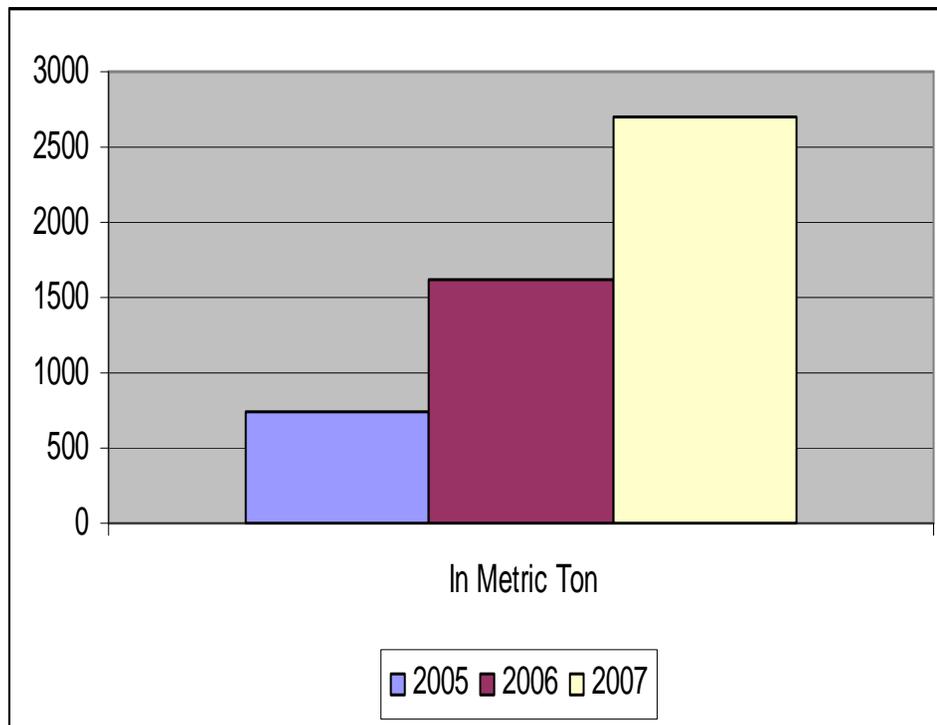
- Growing pressure on companies
  - Consumers, B2B customers, Employees, Banks, Insurance companies
- Regulation & Financial Incentives
  - Kyoto agreement established carbon emission limits
  - European Emission Trading Scheme
  - Future legislations in the US: Various proposals in US senate
- Supply chain efficiency
  - High energy costs
  - Wal-Mart initiative to “boost energy efficiency, cut down on waste and reduce greenhouse gases emissions”

# WW Market in Carbon Emission Permits

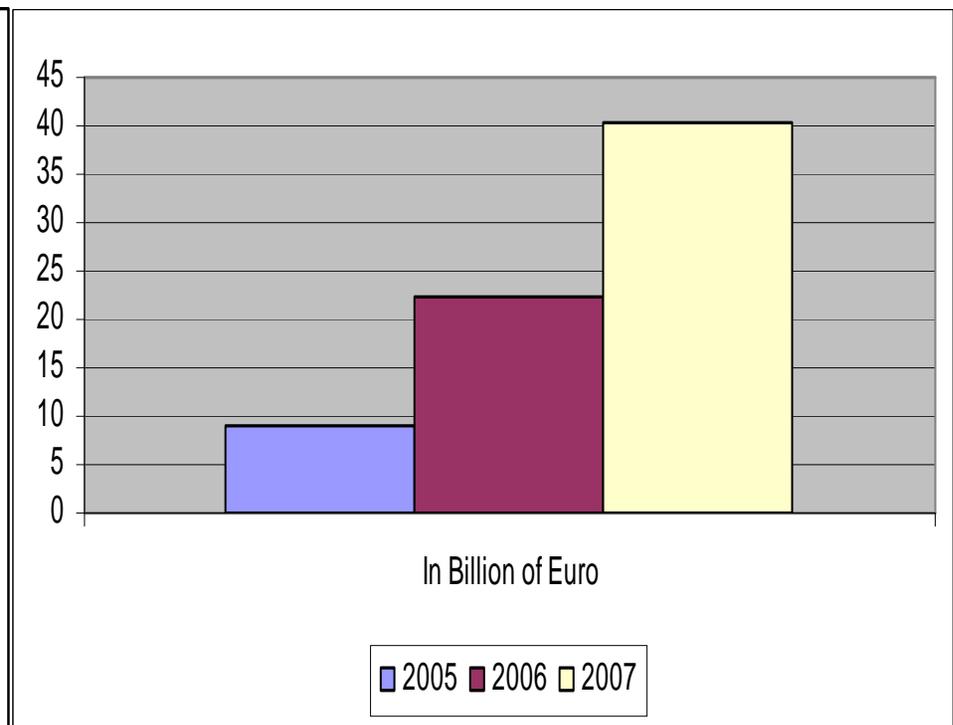


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## Volume



## Value



- A carbon permit allows a company to omit one metric ton of carbon dioxide into air
- Companies that can reduce their carbon emissions earn credits that can be sold or traded

Source: WSJ, January, 18-20, 2008

- Growing pressure on companies
  - Consumers, B2B customers, Employees, Banks, Insurance companies
- Regulation & Financial Incentives
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- Wal-Mart requires its supply chain service providers to reduce their carbon footprint.
  - Starting Oct 07, the retail giant will rate its providers' performance on an environmental scorecard that includes fuel use, facilities, and equipment.



- Wal-Mart's 3PL provider in Canada has done the following
  - Changed the way it ships products to 10 stores in Nova Scotia and Prince Edward Island from road to rail which led to reduction of carbon emissions by 2,600 tons.
  - In addition, the 3PL provider converted 20 truck generators to electric power, saving about 10,000 gallons of fuel.
  - These two measures combined are expected to yield more than \$2 million in annual cost savings.
- Wal-Mart switched from cardboard shipping crates to reusable plastic.
  - This change allows boxes to be used about 60 times instead of just once. Adoption of plastic crates is expected to save \$4.5 million and reduce waste by more than 1,400 tons annually.

- **Change transportation mode from air to ground**
  - Air transportation generates seven time higher carbon emission level than ground transportation
  - Use of network optimization tool
- **Increase success of first time delivery**
  - Reduce transportation cost (the need for a re-visit) and carbon emission
- **Use modern packaging technology**
  - Reduce damaged shipments and therefore returns
  - Maximize space utilization in every shipment

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- **Network Planning**
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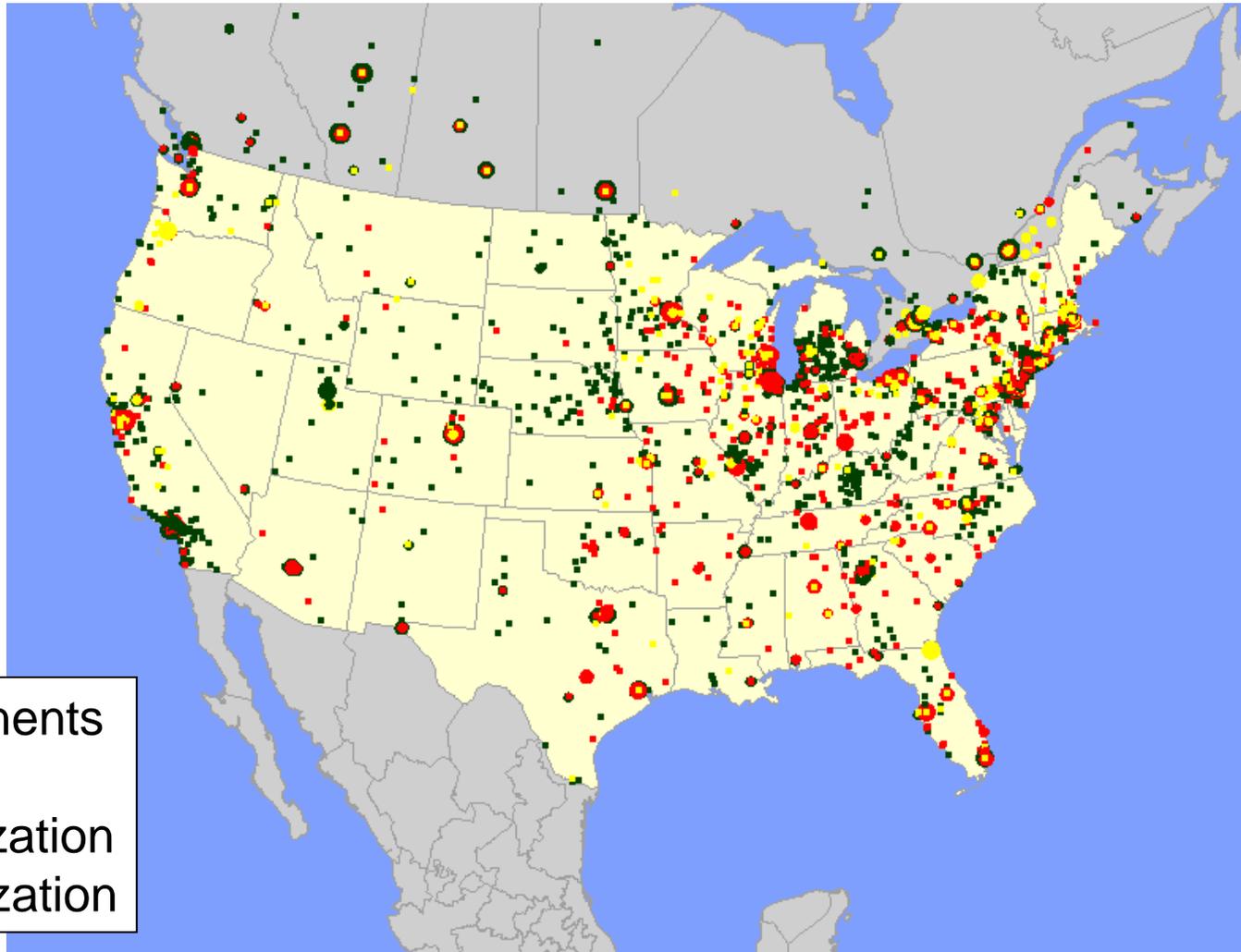


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# Network Design Introduction



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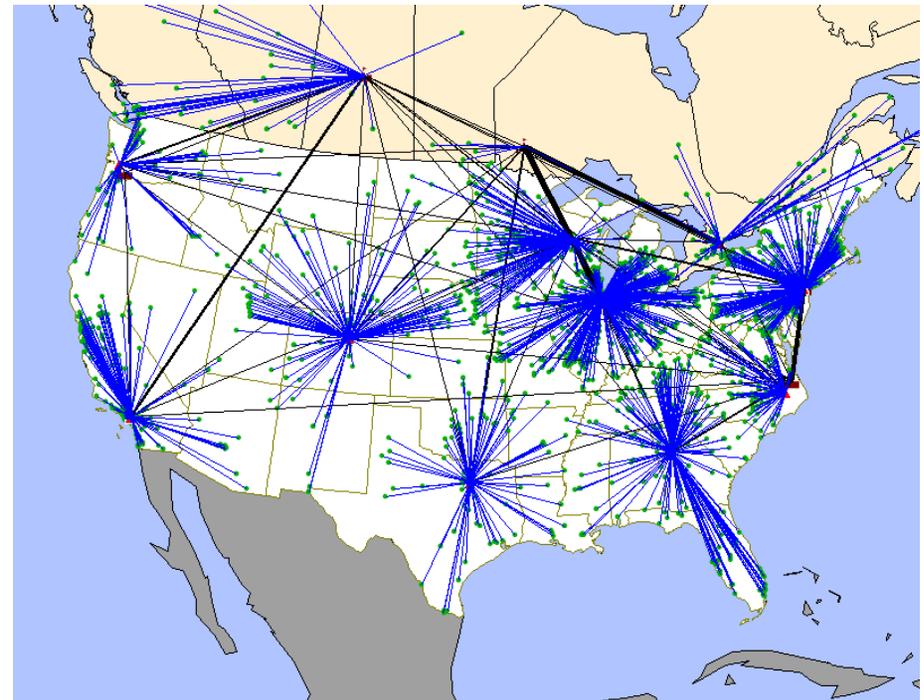
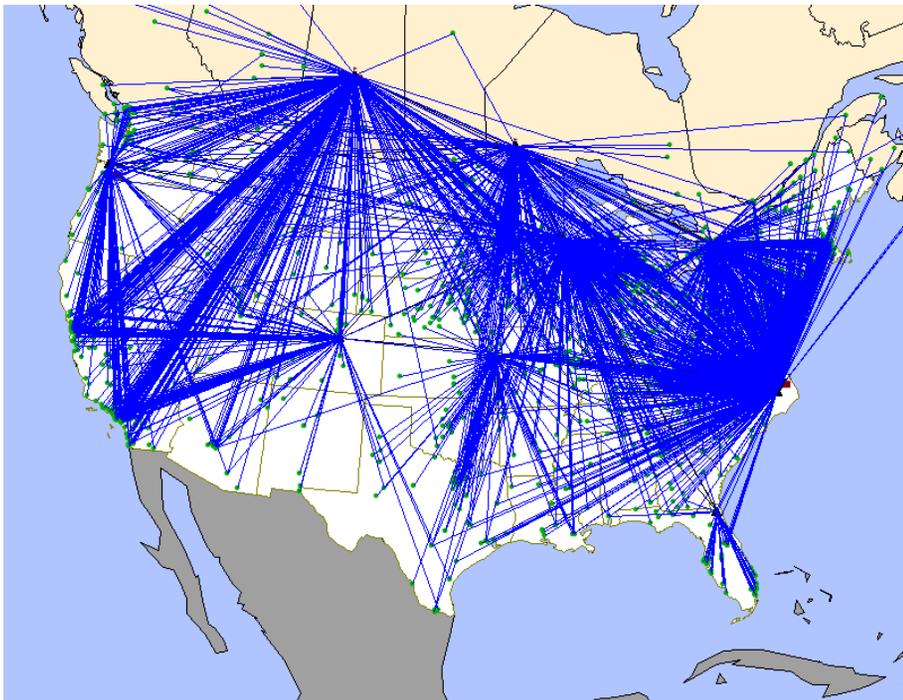


- Components
- Data
  - Optimization
  - Visualization

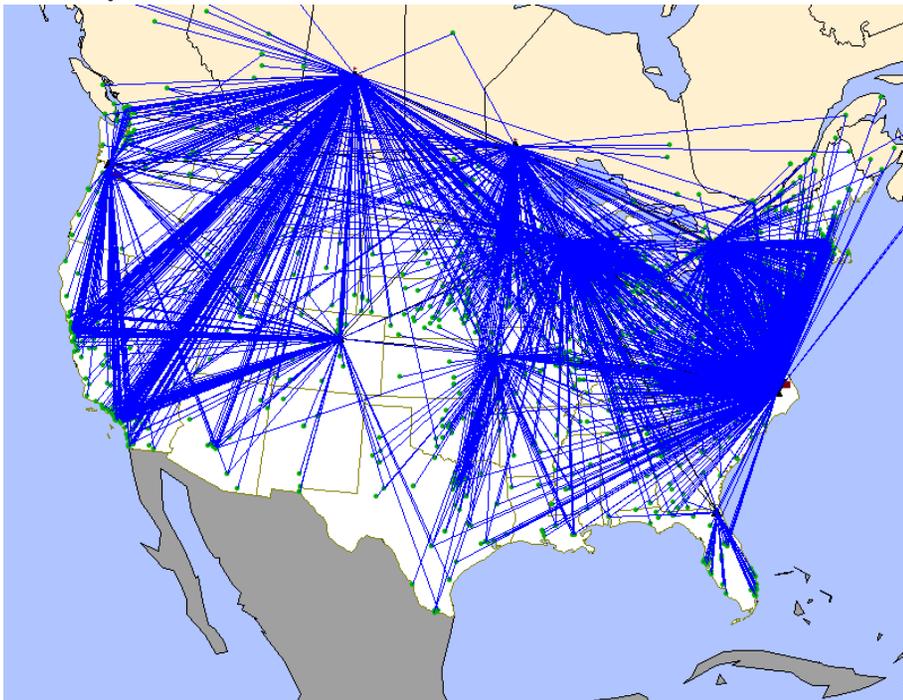
# Solution Comparison



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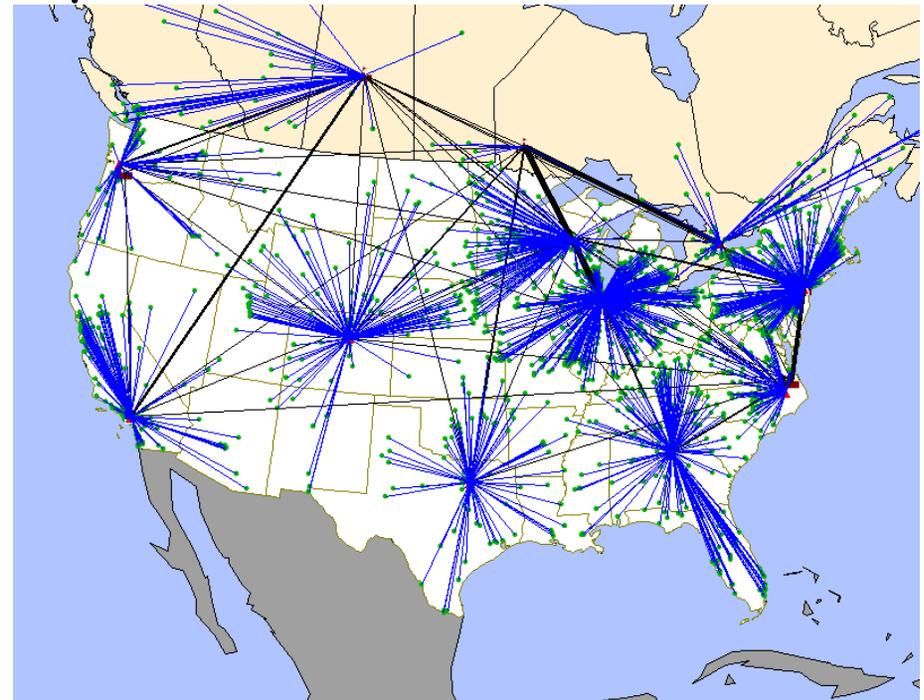


## Optimal Network For Cost



Savings: \$6 million  
Service: 40% next day

## Optimal Network For Service



Savings: \$3 million  
Service: 80% next day

**Which is Better?**



- Mergers and Acquisitions
- Consolidations, cost reduction and plant rationalization
- Transportation costs
- Production sourcing
- Risk Management
- Carbon emission footprint

- Lack of standardized, comprehensive and up-to-date data
- Industry is struggling to find the right trade-off between “green” and “lean”
- No major software vendor controls the space



## Reporting

- User enters various factors used to calculate CO<sub>2</sub> emissions associated with various supply chain activities.
- LogicNet Plus optimizes the supply chain for lowest total cost, or maximum total profit.
- LogicNet Plus reports total Carbon Footprint to be used as an additional factor in decision making.

## As a Constraint

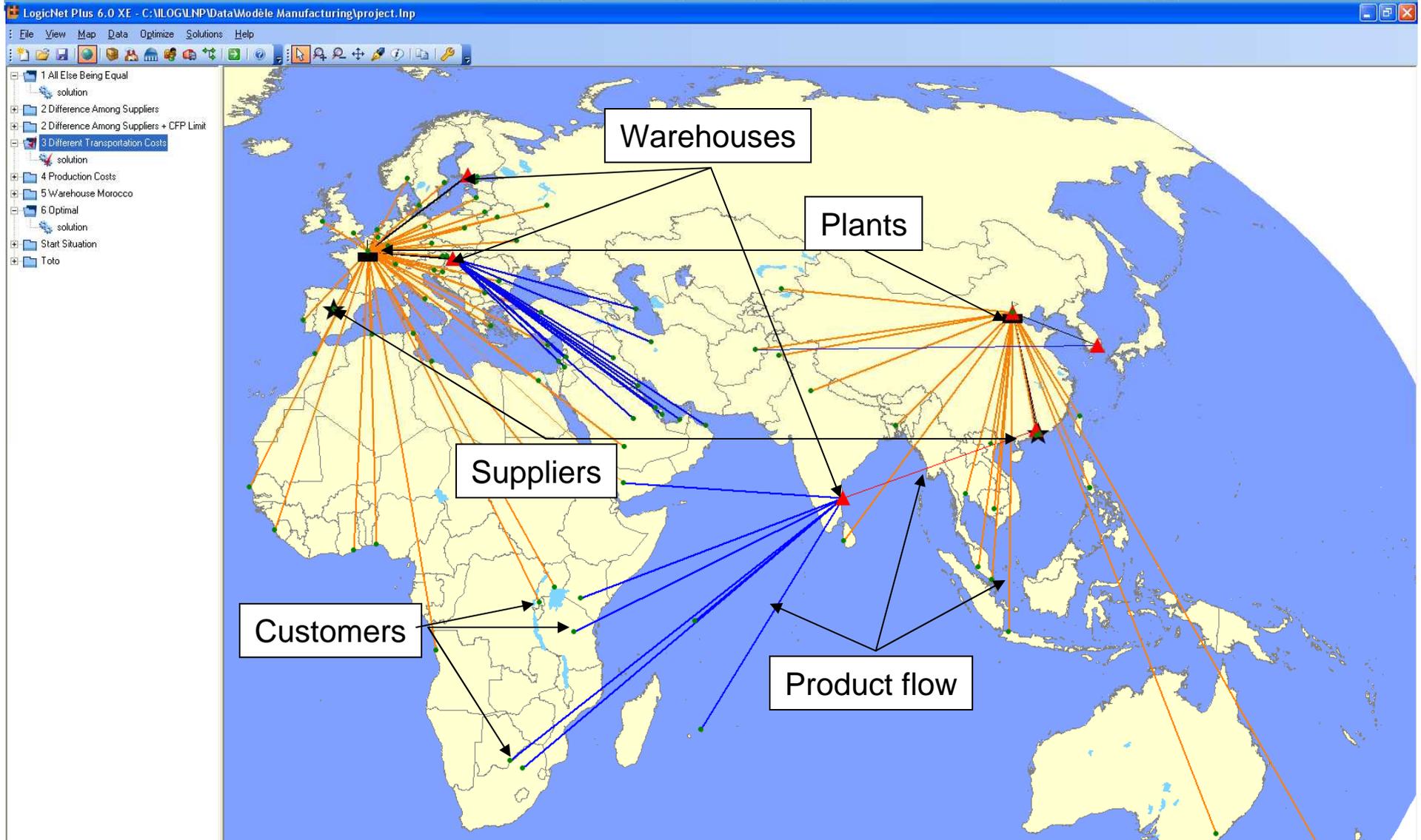
- User enters various factors used to calculate CO<sub>2</sub> emissions associated with various supply chain activities.
- User enters a maximum total Carbon Footprint (in metric tons) the supply chain is not to exceed.
- LogicNet Plus optimizes the supply chain for lowest total cost, or maximum total profit while adhering to the constraint on Carbon Footprint.

Supply Chain Activity	Data Required
Transportation	By carrier in the model, the user either enters the Fuel Efficiency (e.g. miles per gallon) and Carbon Conversion factor (kg CO <sub>2</sub> per gallon) <b>or</b> CO <sub>2</sub> per Freight (kg CO <sub>2</sub> per ton-mile)
Warehouses	By warehouse location, the user enters the Energy Consumption (e.g. kWh per sq. ft.), the Carbon Conversion Factor (kg CO <sub>2</sub> per kWh) and the Area to Apply (entire size of whse, or avg. inventory volume)
Plants	By plant location, the user enters the Energy Consumption per Space (e.g. kWh per sq. ft.), the Energy Consumption per Capacity (e.g. kWh per production hr) and a Carbon Conversion Factor (kg CO <sub>2</sub> per kWh).
Production	By product, the user enters the Energy Consumptions associated with the production of that product, as well as any materials used in that product (kWh per unit) and a Carbon Conversion Factor (kg CO <sub>2</sub> per kWh).

# Strategic Network Design



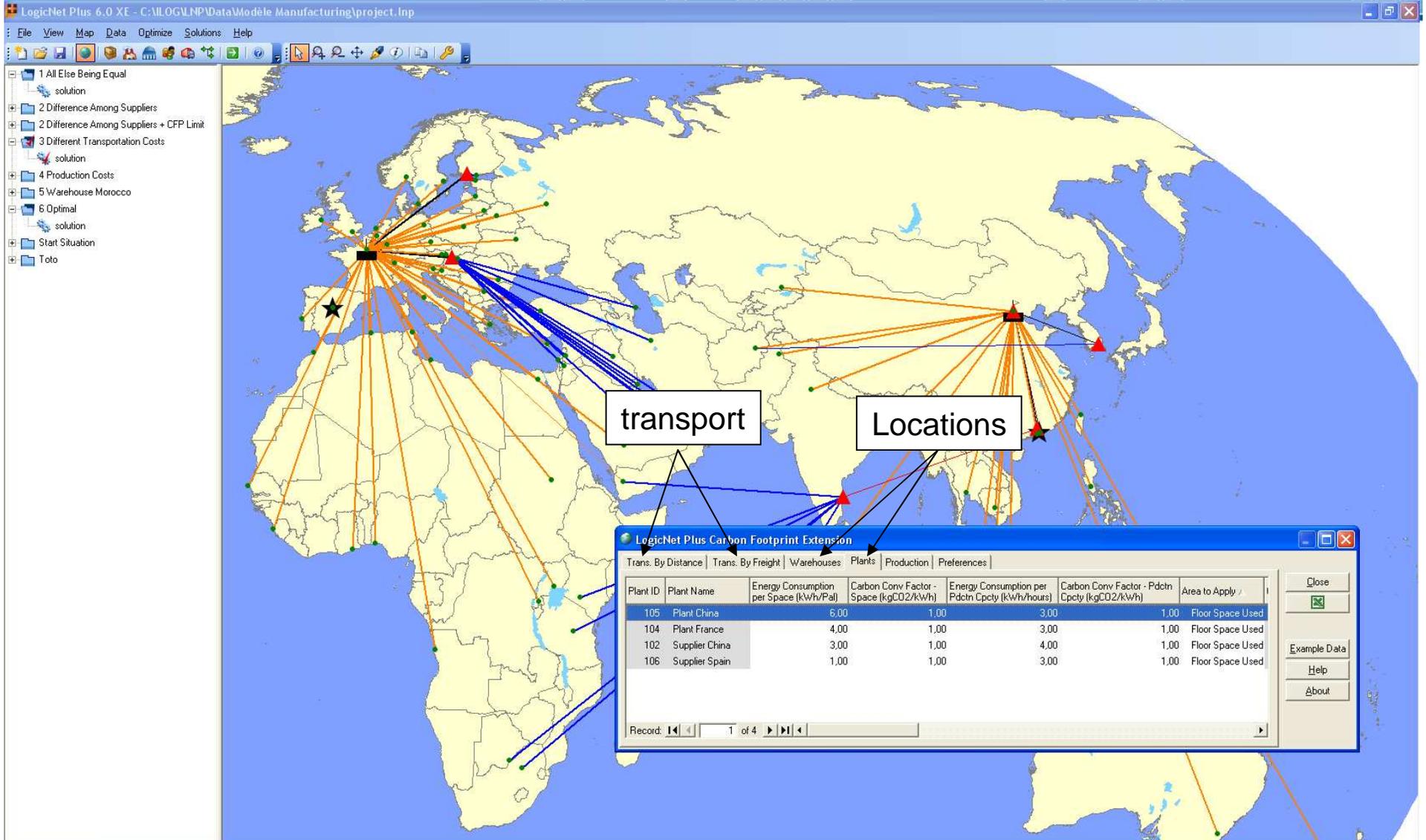
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# Carbon Footprint



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8.0 Click here to begin 9432015601862

# Carbon Footprint



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LogicNet Plus 6.0 XE - C:\ILOG\NP\Data\Modele Manufacturing\project.Inp

File View Map Data Optimize Solutions Help

1 All Else Being Equal solution  
 2 Difference Among Suppliers  
 2 Difference Among Suppliers + CFP Limit  
 3 Different Transportation Costs solution  
 4 Production Costs  
 5 Warehouse Morocco  
 6 Optimal solution

Microsoft Excel - rad2259B.tmp

File Edit View Insert Format Tools Data Window Help

Type a question for help

A2 Next CBECs will be conducted in 2007

1 Released: Dec 2006  
 2 Next CBECs will be conducted in 2007

Table C14. Electricity Consumption and Expenditure Intensities for Non-Mall Buildings,

	Electricity Consumption			Distribution of Building-Level Intensities (kWh/square foot)			Electricity Expenditures			
	per Building (thousand kWh)	per Square Foot (kWh)	per Worker (thousand kWh)	25th Percentile	Median	75th Percentile	per Building (thousand dollars)	per Square Foot (dollars)	per kWh (dollars)	
All Buildings*	202	14.1	12.2	3.6	8.2	17.1	15.7	1.09	0.078	
<b>Building Floorspace (Square Feet)</b>										
1,001 to 5,000	47	17.8	11.4	3.8	8.9	20.3	4.3	1.63	0.092	
5,001 to 10,000	92	12.4	10.3	3.8	7.4	14.5	8.7	1.18	0.095	
10,001 to 25,000	164	10.5	11.1	2.9	6.3	13.4	13.8	0.88	0.084	
25,001 to 50,000	439	12.2	11.6	3.8	8.8	16.2	33.6	0.94	0.077	
50,001 to 100,000	927	13.1	14.1	4.5	9.9	17	68	0.97	0.073	
100,001 to 200,000	2,181	15.7	12.2	5.3	13	23.4	146.4	1.05	0.067	
200,001 to 500,000	4,347	15	15.4	5.8	12.1	20.7	301	1.04	0.069	
Over 500,000	17,034	19	12.8	10	16.6	25.2	1209.8	1.35	0.071	
<b>Principal Building Activity</b>										
Education	283	11	8.7	4.9	8.9	13.6	21.1	0.82	0.075	
Food Sales	276	49.4	43	33.4	48	77	20.9	3.74	0.076	
Food Service	213	38.4	20.3	18.8	37.4	70.3	17.4	3.13	0.082	
Health Care	564	22.9	11.5	6.1	12	18.4	37.9	1.54	0.067	

LogicNet Plus Carbon Footprint Extension

Trans. By Distance | Trans. By Freight | Warehouses | Plants | Production | Preferences

Plant ID	Plant Name	Energy Consumption per Space (kWh/Pal)	Carbon Conv Factor - Space (kgCO2/kWh)	Energy Consumption per Pdcn Cpcly (kWh/hours)	Carbon Conv F: Cpcly (kgCO2/)
105	Plant China	6.00	1.00	3.00	
104	Plant France	4.00	1.00	3.00	
102	Supplier China	3.00	1.00	4.00	
106	Supplier Spain	1.00	1.00	3.00	

Record: 1 of 4

Example Data

8.02875833786159, 65.9432015601862

# Carbon Footprint Reporting



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LogicNet Plus 6.0 XE - C:\ILOG\I\NP\Data\Modèle Manufacturing\project.Inp

File View Map Data Optimize Solutions Help

1 All Else Being Equal  
 solution  
 2 Difference Among Suppliers  
 2 Difference Among Suppliers + CFP Limit  
 3 Different Transportation Costs  
 solution  
 4 Production Costs  
 5 Warehouse Morocco  
 6 Optimal  
 solution  
 Start Situation  
 Toto

**LogicNet Plus Carbon Footprint Extension**

Trans. By Distance | Trans. By Freight | Warehouses | Plants | Production | Summary

Carbon Emissions	Total (mtCO2)
Transportation (Total Distance)	1 149.57
Transportation (Total Freight)	16.63
Warehouses	78.68
Plants (Floor Space)	0.24
Plants (Production Capacity)	1 180.40
Production (By Unit)	74.88
Production (By Materials)	112.32
<b>Total</b>	<b>2 612.71</b>

Record: 1 of 8

**Summary Reports**

Cost Summary | Warehouses | Plants | Lines | Products | Time Periods | Customers | Diagnostics

**Overview**

Solution Type: Minimize Cost  
 Solver Run Time: 00:00:34  
 Optimization Gap: 0.00%  
 % Demand Met: 100.00%  
 % Safety Stock Met: 100.00%  
 Error Count: 0  
 Warning Count: 0

**Manufacturing Cost Details**

Tooling (€): 0  
 Setup (€): 0  
 Production (€): 243 620  
 Line Item (€): 5 616  
 Tank (€): 0

**Financial Summary**

Revenue (€): 7 395 000,00  
 Total Cost (€): 7 598 381,00  
 Profit (€): -203 381,00

**Cost Totals**

Plant Fixed (€): 4 367 601  
 Line Fixed (€): 240 000  
 Manufacturing (€): 249 236  
 Transportation (€): 250 939  
 Warehouse Fixed (€): 2 480 000  
 Variable (€): 10 605  
 Holding (€): 0

**Transportation Summary**

	Cost (€)	Wtd Avg Distance
Plant to Plant:	14 643	1 564 km
Plant to Warehouse:	4 526	1 719 km
Plant to Customer:	132 388	3 210 km
Warehouse to Plant:	0	0 km
Warehouse to Warehouse:	27 923	4 363 km
Warehouse to Customer:	71 459	3 738 km
Duty Tariff:	0	

**Variable Cost Details**

Warehouse Inbound (€): 0  
 Warehouse Outbound (€): 6 098  
 Warehouse Storage (€): 4 507

**Holding Cost Details**

Warehouse Inventory (€): 0  
 Customer Inventory (€): 0  
 In-Transit (€): 0

**TOTAL COST (€): 7 598 381**

63.6648758755108, 14.6574219963914

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# Carbon Footprint as a constraint



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LogicNet Plus 6.0 XE - C:\ILOG\LNPlus\Data\Modele Manufacturing\project.lnp

File View Map Data Optimize Solutions Help

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 6 Optimal solution  
 Start Situation  
 Toto

**Summary Reports**

Cost Summary | Warehouses | Plants | Lines | Products | Time Periods | Customers | Diagnostics

**Overview**

Solution Type:	Minimize Cost
Solver Run Time:	00:00:36
Optimization Gap:	0.08%
% Demand Met:	100.00%
% Safety Stock Met:	100.00%
Error Count:	0
Warning Count:	0

**Manufacturing Cost Details**

Tooling (€):	0
Setup (€):	0
Production (€):	248 170
Line Item (€):	5 616
Tank (€):	0

**Transportation Summary**

	Cost (€)	Wld Avg Distance
Plant to Plant:	14 276	1 525 km
Plant to Warehouse:	19 494	2 407 km
Plant to Customer:	183 541	3 354 km
Warehouse to Plant:	0	0 km
Warehouse to Warehouse:	0	0 km
Warehouse to Customer:	42 970	4 448 km
Duty Tariff:	0	

**Financial Summary**

Revenue (€):	7 395 000,00
Total Cost (€):	7 607 209,00
Profit (€):	-212 209,00

**Cost Totals**

Plant Fixed (€):	4 367 601
Line Fixed (€):	240 000
Manufacturing (€):	253 786
Transportation (€):	260 281
Warehouse Fixed (€):	2 480 000
Variable (€):	5 540
Holding (€):	0
<b>TOTAL COST (€):</b>	<b>7 607 209</b>

**Variable Cost Details**

Warehouse Inbound (€):	0
Warehouse Outbound (€):	3 320
Warehouse Storage (€):	2 220

**Holding Cost Details**

Warehouse Inventory (€):	0
Customer Inventory (€):	0
In Transit (€):	0

**LogicNet Plus Carbon Footprint Extension**

Trans. By Distance | Trans. By Freight | Warehouses | Plants | Production | Summary

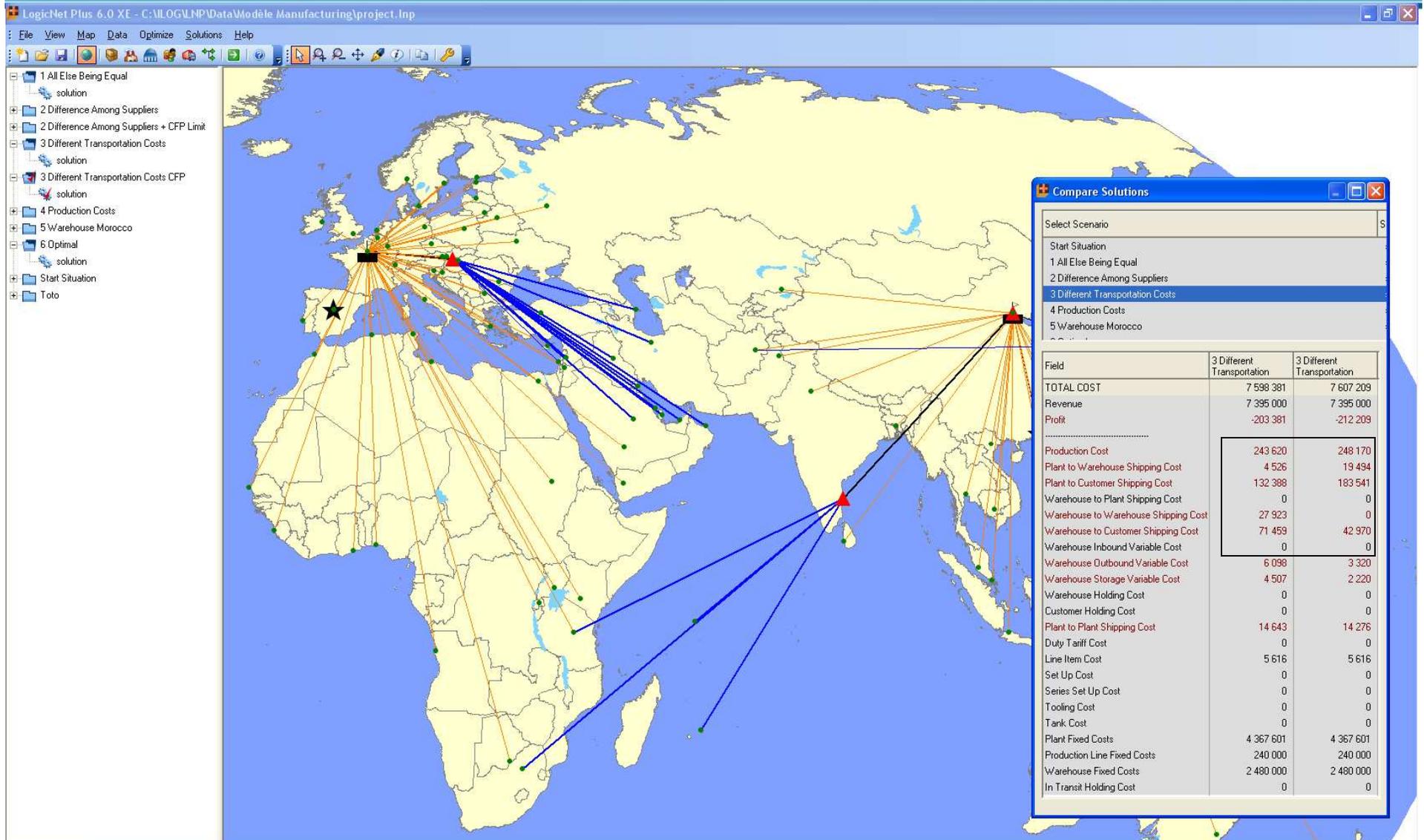
Carbon Emissions	Total (mtCO2)
Transportation (Total Distance)	1 107,04
Transportation (Total Freight)	15,52
Warehouses	16,60
Plants (Floor Space)	0,24
Plants (Production Capacity)	1 173,40
Production (By Unit)	74,88
Production (By Materials)	112,32
<b>Total</b>	<b>2 500,00</b>

Record: 1 of 8

# Solution Comparison



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Click here to begin | 18.4068049948666

- To aid the user, example data is provided
  - US Government sources and the World Resources Institute.
- Data includes:
  - Carbon emissions by fuel type
  - Average fuel efficiency values
  - Carbon-Freight factors for waterborne and rail
  - Electricity emissions factors by US State, and country
  - Electricity consumption by building characteristic

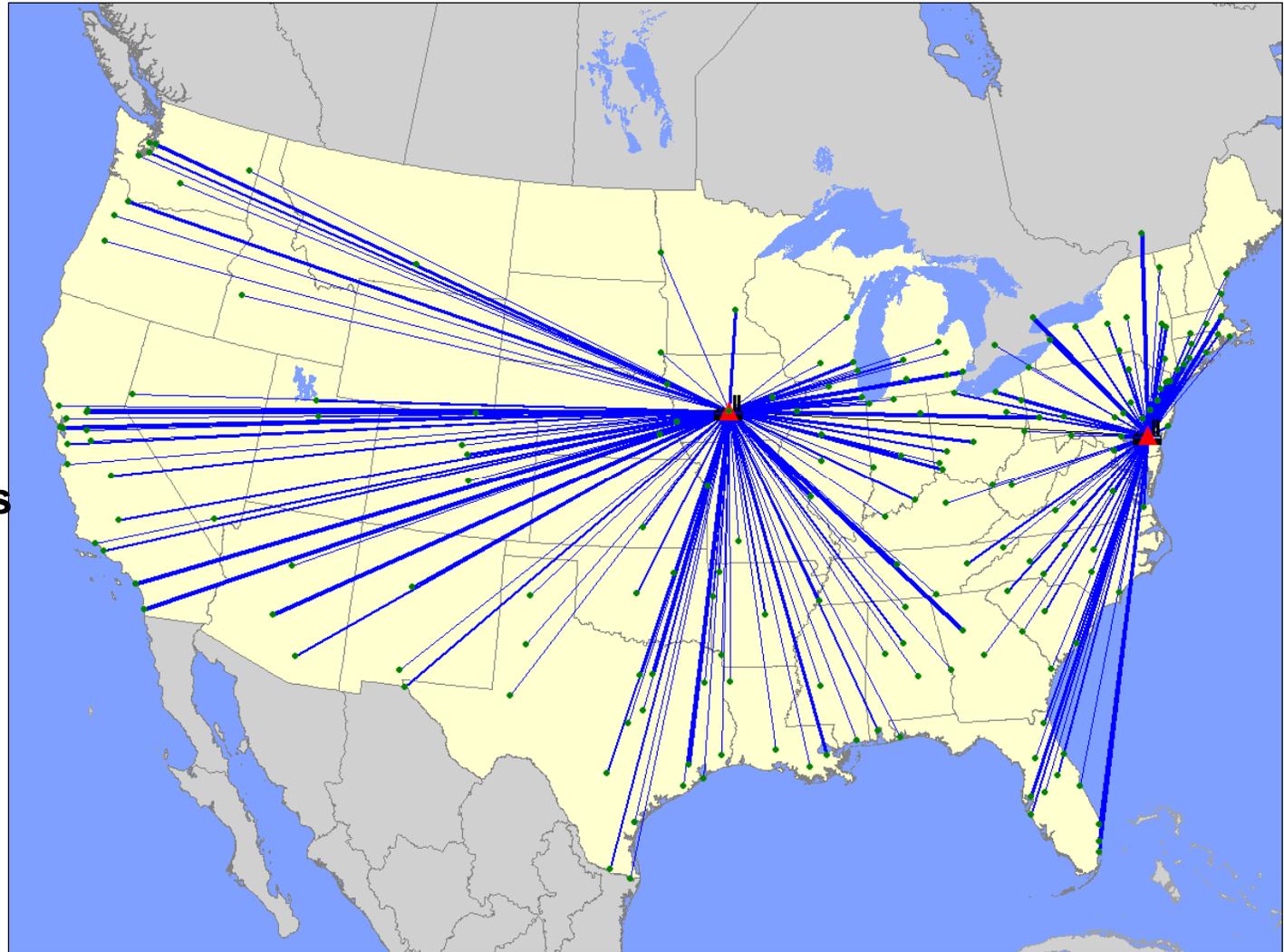
- Manufacturer of Office Furniture
  - Steel Cabinets
- US based manufacturing & distribution network
  - Manufacturing and distributions from 2 sites- Des Moines, IA and Dover, DE
- Two objectives:
  - Redesign distribution network to reduce costs and improve customer service
  - Reduce Carbon Footprint to align with corporate environmental objectives
- The challenge: Find the appropriate trade-off between reducing cost and reducing Carbon Footprint

# Office Furniture Manufacturer Distribution Study



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**2 Plants**  
**2 Existing DC's**  
**58 Potential DC's**  
**200 Customers**  
**11 Product Families**

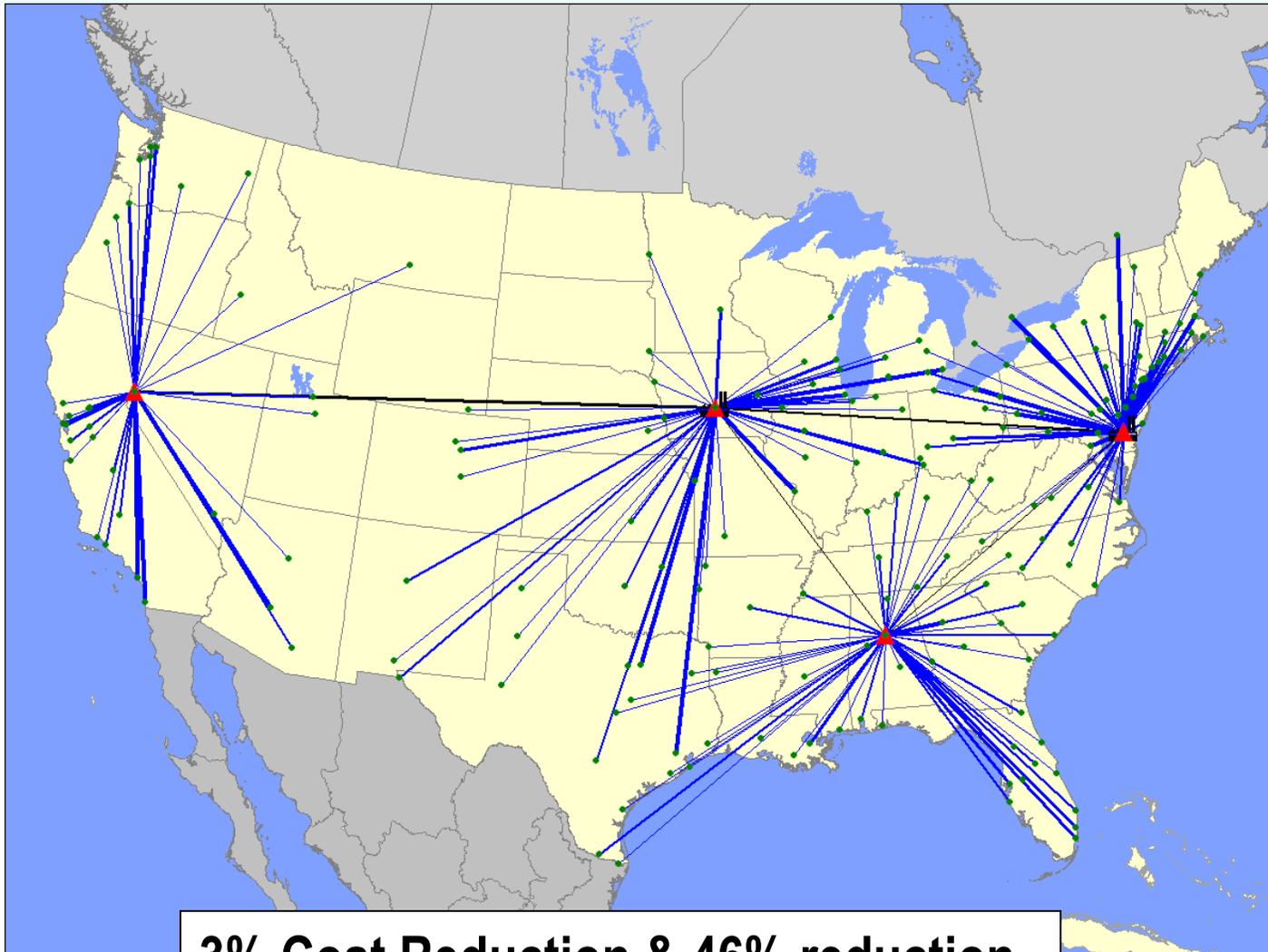


- Apply network modeling to design a distribution network that satisfies customer demand at the lowest possible cost, while considering the Carbon Footprint of the new network
- Consider all logistics costs as well as carbon emission from **plants, DCs, and the various modes of transportation.**
  - Carbon emission per kWh is different from state to state due to different power generation technology
    - Grid Electricity, Natural Gas, Diesel, Petrol, Coal, etc.

# Optimized Network



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**3% Cost Reduction & 46% reduction  
in average distance to customer**

- As additional DCs enter the network, the following occur:
  - DC Fixed Costs increase
  - Outbound Transportation Costs decrease
  - Average distances to customer decrease
  - Carbon Footprint tends to decrease
    - Why?
      - Inbound transportation is mostly rail which has less environmental impact than truck
      - As DC's increase, a greater proportion of total freight is plant-warehouse transportation (rail)
      - Increased CO2 from more facilities does not outweigh reduction in transportation CO2 emissions

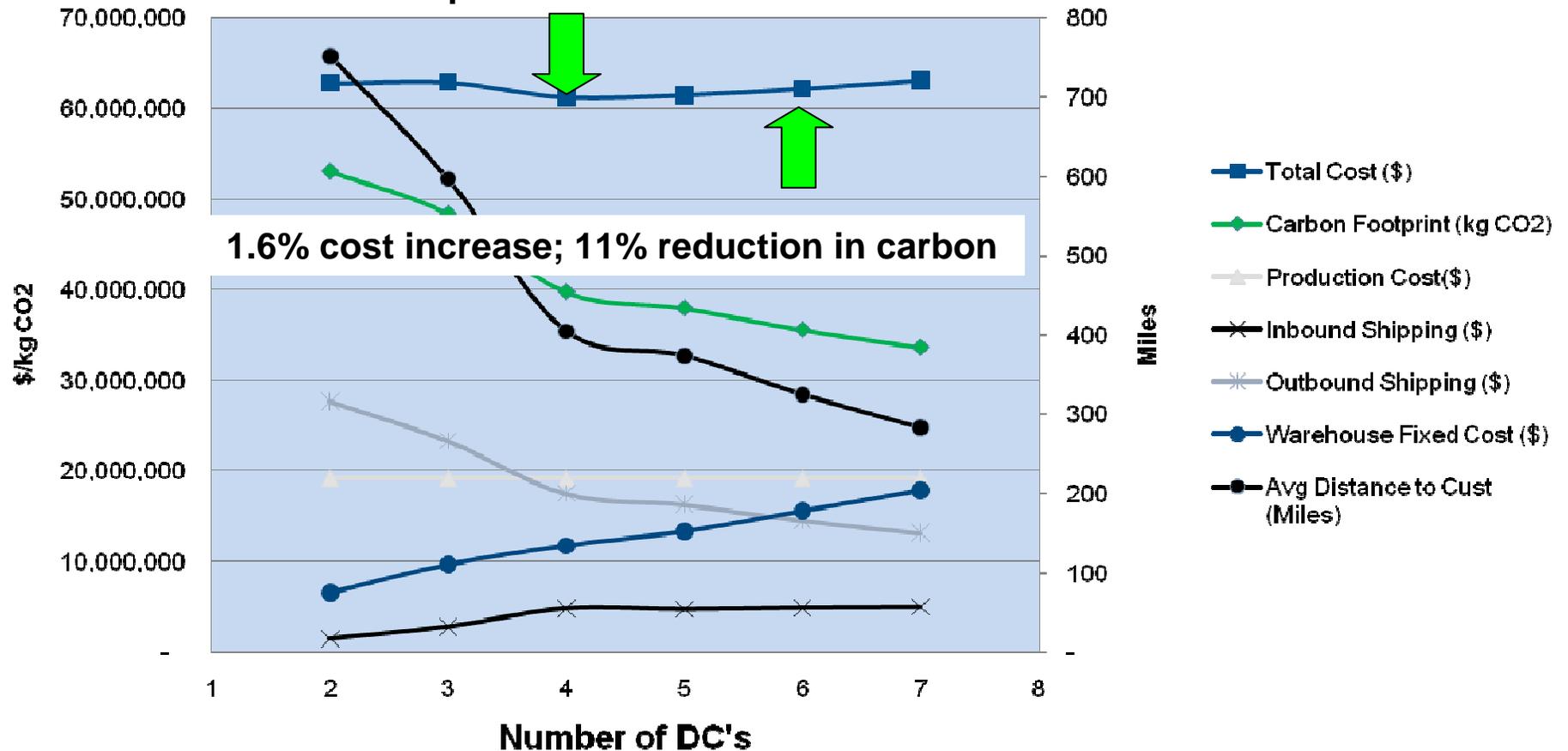
# Trade-Off Curve Between Number of DC's, Costs, Service and Carbon Footprint



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## Distribution Network with 2-7 DC Locations

### Optimal Solution



# What We'll Cover ...



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- Network Planning
- Demonstration
- **Wrap-up**



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# Key Points to Take Home



Changing the rules of business

- Growing pressure to become more green
  - Regulation
  - Consumer and customer pressure
  - Waste reduction
- LogicNet Plus provides real value
  - Accurate supply chain assessment
    - Network modeling for cost, service *and carbon emissions*
  - Optimization for better investment decisions
    - ILOG, a leader in optimization for 20 years

<http://www.ilog.com/products/supplychain/>



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THANK YOU