Impact of Crude Oil Volatility on Network Design

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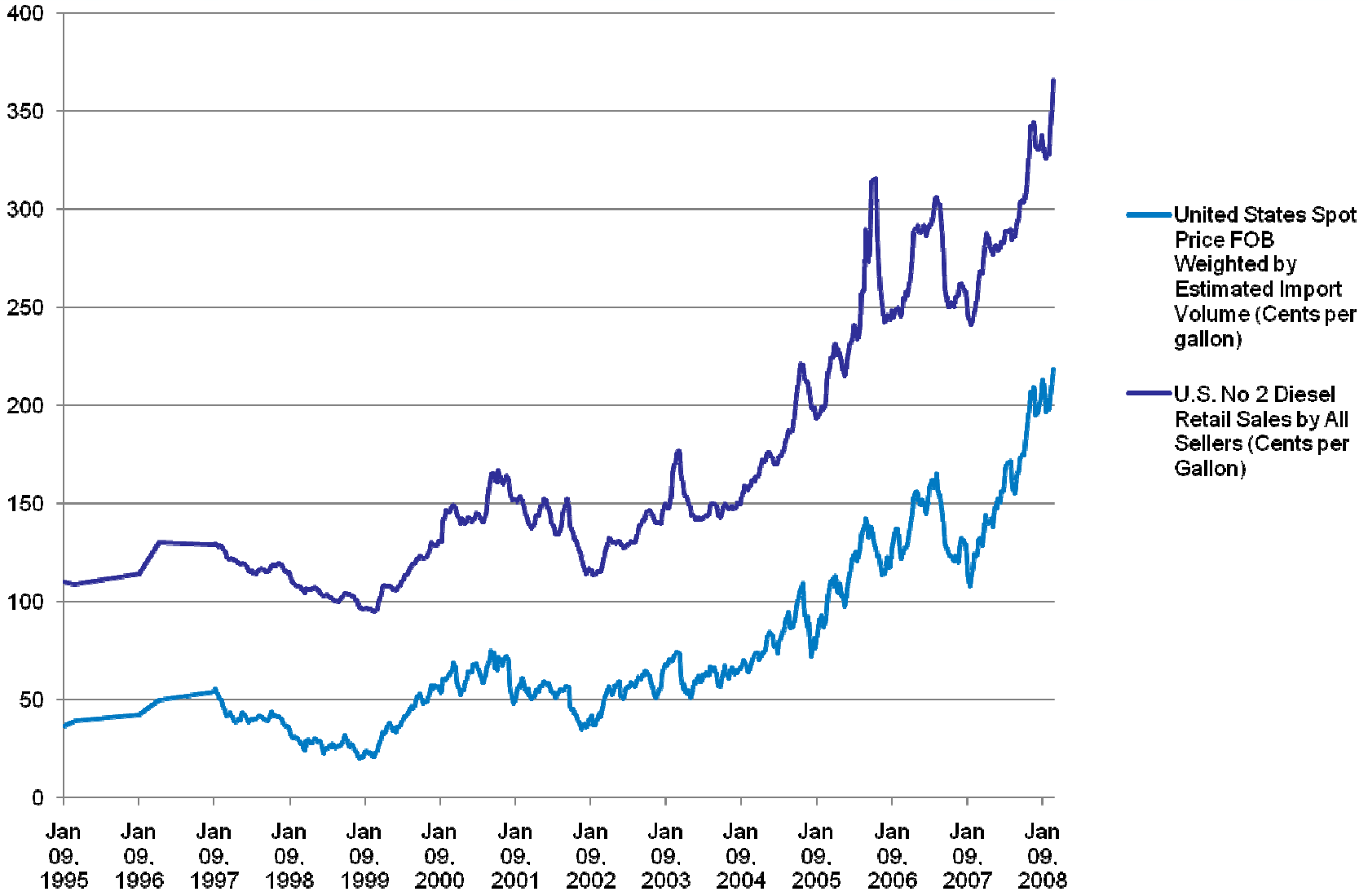
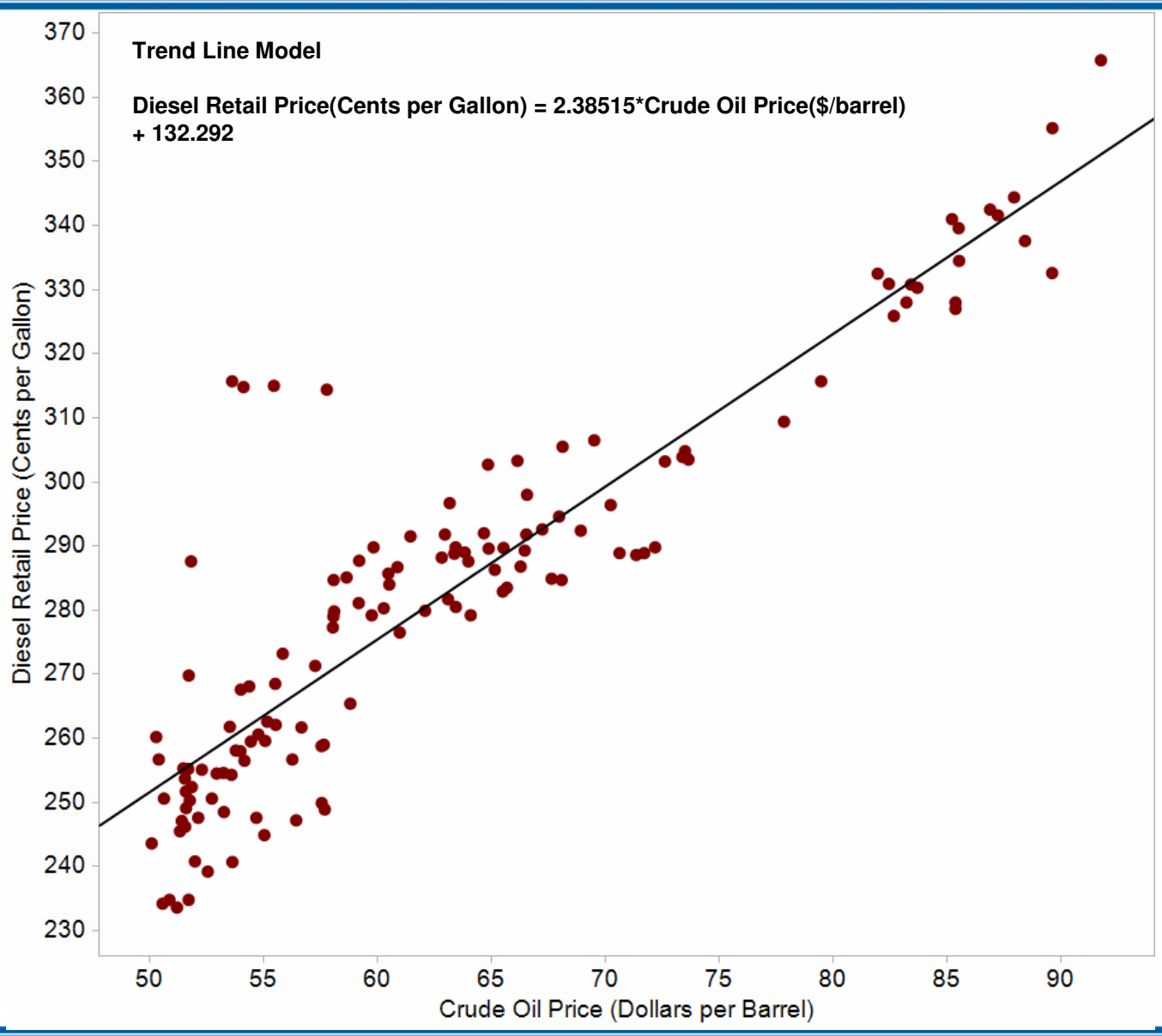
US Diesel and Crude Oil Prices over time



Relationship between Crude Oil price and Diesel Fuel Price



Implications on crude oil price to transportation rates

- Given the relationship in the previous slide, we see that a $10/barrel increase in crude oil will result in ~$0.24/gallon increase in diesel fuel
- Standard fuel surcharge methodology is to increase surcharge $0.01/mile for every $0.06 increase in diesel fuel
- We conclude that for every $10 increase per barrel of crude oil price, we have an additional $0.04/mile increase in transportation rates.

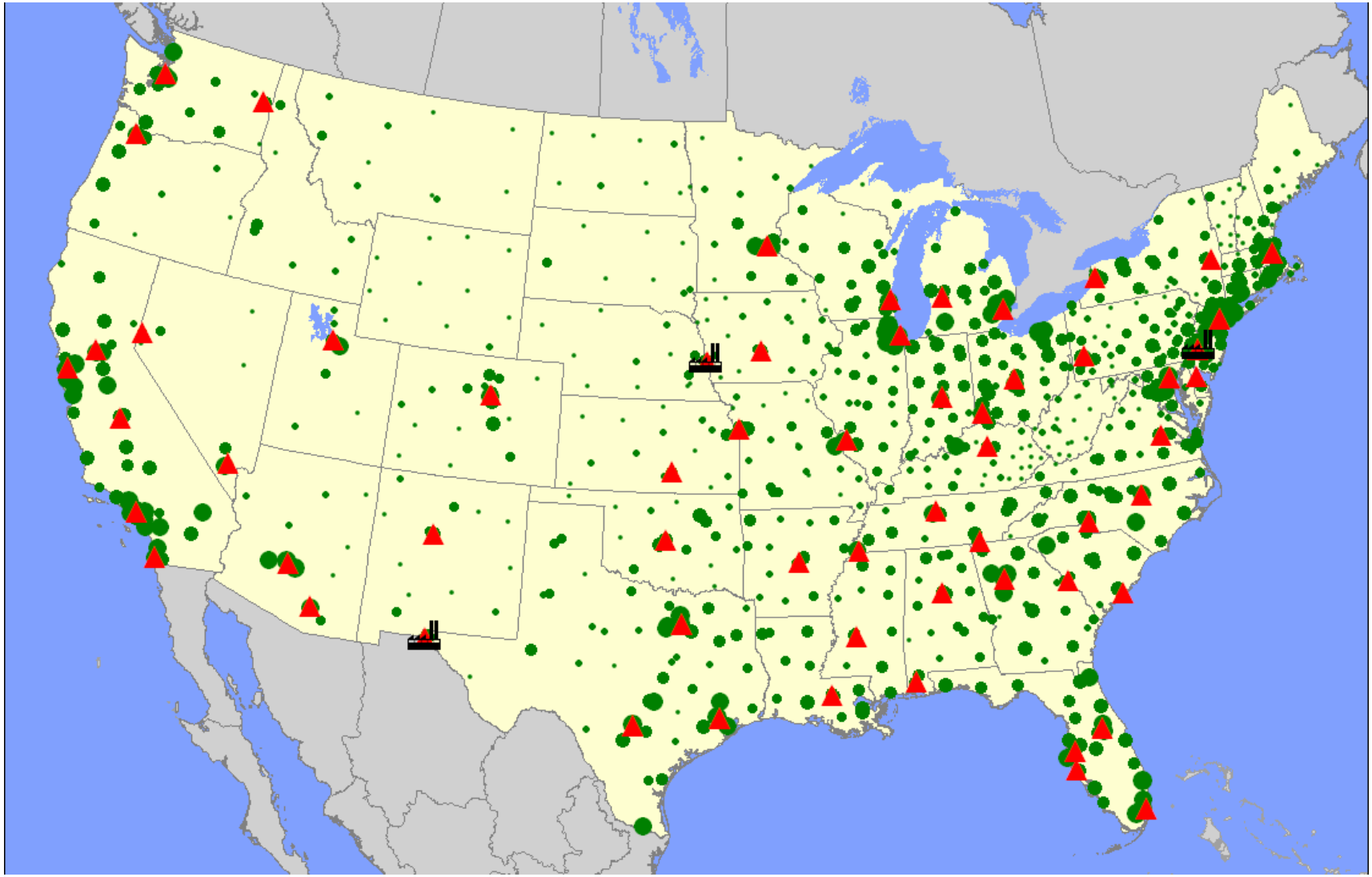
Case Study: Oil Prices and the Logistics Network

- Manufacturer of consumer packaged goods
- Manufacturing is possible in three locations:
  - Philadelphia- Highest production cost
  - Omaha-
  - Juarez, Mexico- Lowest production cost
- 60 potential DC locations
- 888 aggregated customers
- Inbound transportation uses commercial TL carriers
  - TL averages 40,000 lbs/shipment
- Outbound transportation uses a private fleet
  - Private fleet averages 20,000 lbs/shipment

Case Study - Objectives

- Determine the best number and location of distribution centers, as well assignment of customers to DC's.
- Determine the best allocation of production to their manufacturing locations.
- Understand how the optimal network would change as oil prices fluctuate
  - Roughly 25% of the supply chain costs are in transportation

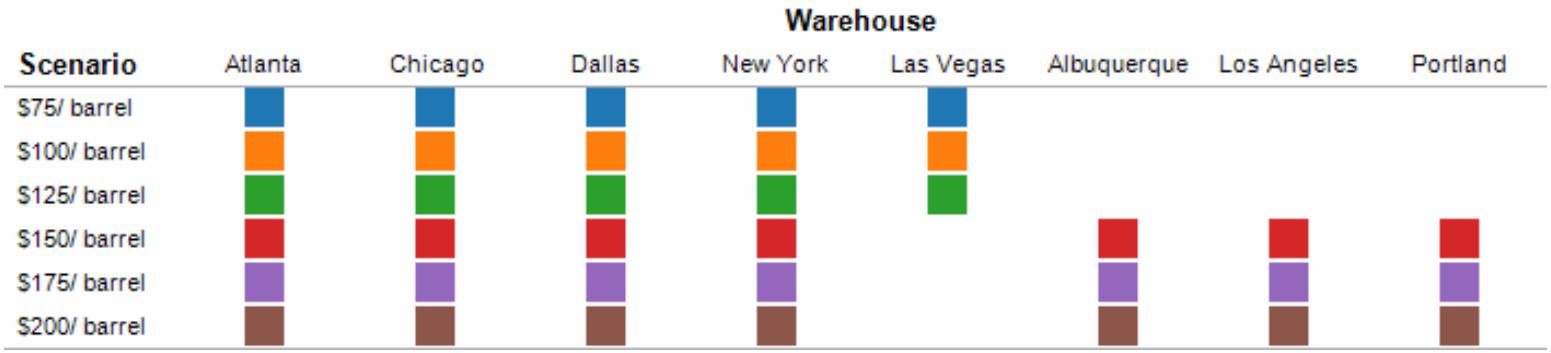
Network Visualization



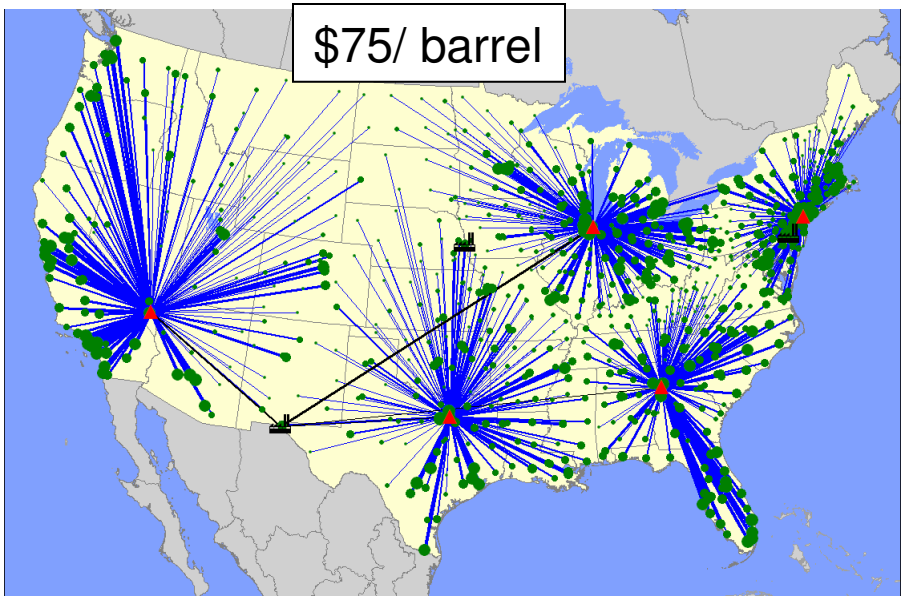
Discussion of Tradeoffs

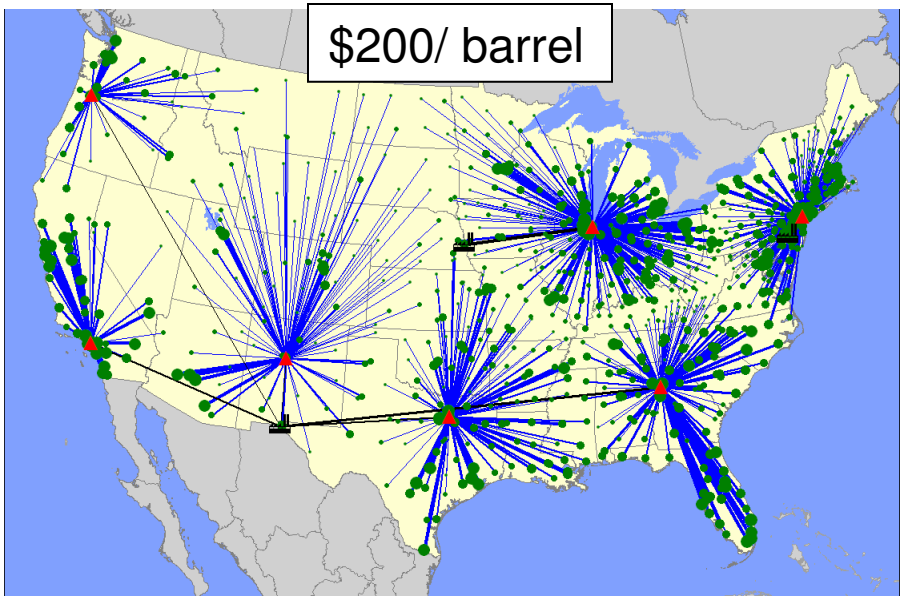
- As crude oil price increases, transportation costs become more important relative to production and facility fixed costs. We expect:
  - Production moves nearer to demand.
    - Cheaper manufacturing in Mexico is offset by higher transportation costs.
  - Additional DC's are more attractive.
    - As outbound transportation becomes more expensive, it becomes increasing important to minimize the distance of the final leg.

Impact on Warehouse Locations



Moving from $125/ barrel to $150/ barrel changes the optimal number of DC's from 5 to 7. In particular, you can think of Las Vegas being replaced by Los Angeles, Albuquerque, and Portland.

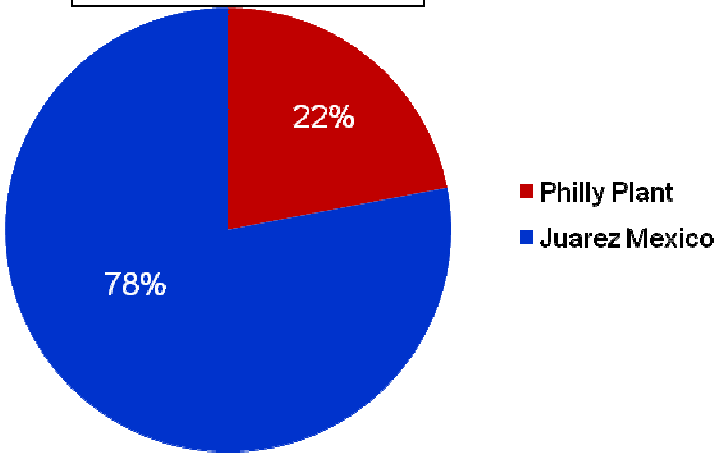




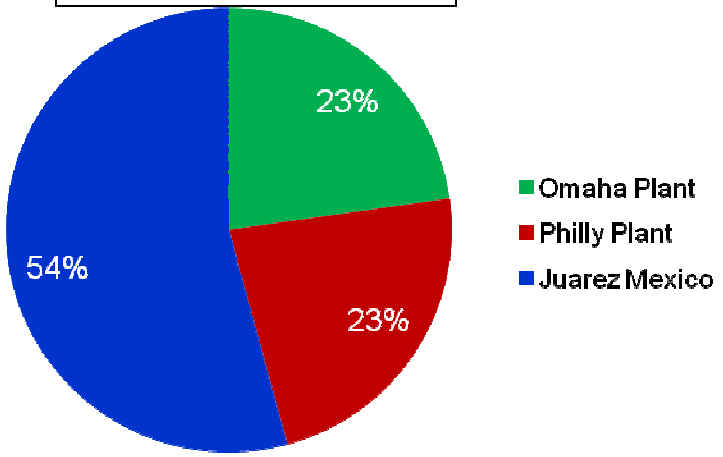
Impact on Production Sourcing

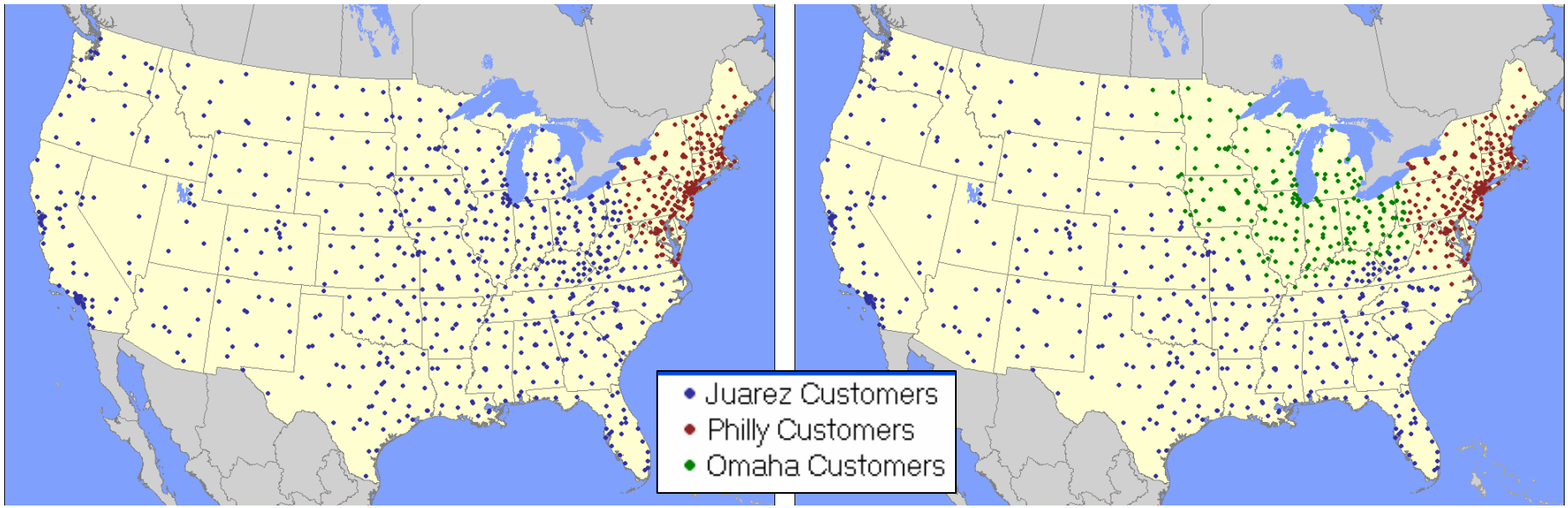
ILOG
Changing the rules of business

$75/ barrel



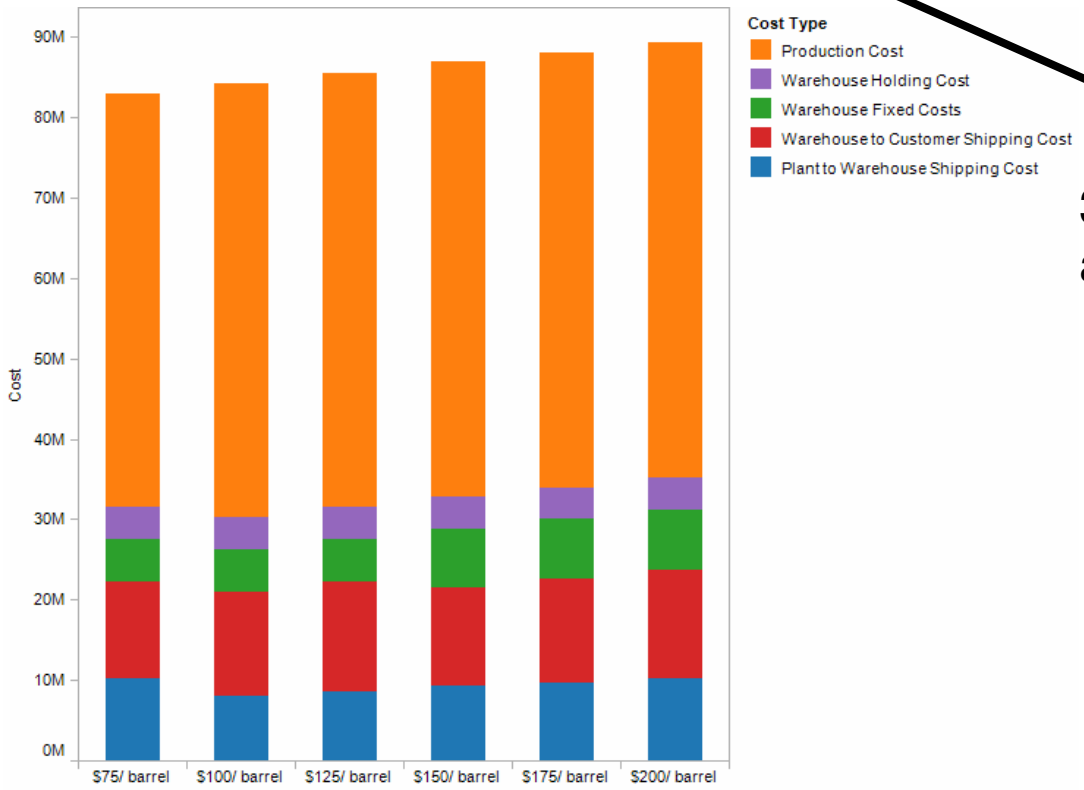
$200/ barrel





Total Cost Comparison

Cost Type	$75/ barrel	$100/ barrel	$125/ barrel	$150/ barrel	$175/ barrel	$200/ barrel
Production Cost	51,352,370	53,978,928	54,034,995	54,032,003	54,071,680	54,149,335
Warehouse Holding Cost	3,994,055	3,994,055	3,994,055	3,994,055	3,994,055	3,994,055
Warehouse Fixed Costs	5,250,000	5,250,000	5,250,000	7,350,000	7,350,000	7,350,000
Warehouse to Customer Shipping ..	12,138,280	12,951,623	13,796,249	12,205,702	12,913,436	13,598,938
Plant to Warehouse Shipping Cost	10,179,282	8,083,064	8,502,896	9,287,443	9,730,287	10,155,038
TOTAL COST	82,913,987	84,257,670	85,578,194	86,869,203	88,059,459	89,247,365



3% increase in total cost
as the price of a barrel
increases from $100 to $150