Supply Chain Consulting Services

# Path to Societal and Green SCM

Visit and contact us at http://www.teknokret.com for more assistance with this.

Carbon

# Objectives

- **Green Supply Chain Discussion**
  - **The Why?**
  - **The How?**
    - **Section 1**
      - Where to Start? How to Quantify the Opportunity?
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      - How to go about analyzing the supply chain carbon footprint?
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      - Some Quantitative Scenarios
      - Some Qualitative Scenarios
- **Final Thoughts**

# The business issues presented by carbon management are truly enterprise wide…

**Carbon should be managed in an integrated way with business variables - not as a separate "side issue"**

**Strategy**
- Where should we focus our carbon reduction efforts?
- How integrated is our carbon strategy with our business strategy?
- Do we have an integrated programme of action?
- How do we finance our carbon programme?

**Customer and product**
- How do we communicate our green credentials to our customers?
- What are the new green market opportunities and how do we exploit them?
- How can we design our products to be more carbon-friendly?
- How do we optimise these benefits throughout the full product lifecycle?

**Supply chain**
- How can we make our end-to-end operations more carbon-friendly:
  - Manufacturing?
  - Logistics?
  - Procurement?

**People**
- How do we establish and implement effective green HR policies:
  - Strategy?
  - Travel?
  - Home working?
- How do we engage with our employees on the green agenda?
- How do we enable and sustain behaviour change across our organisation?

**IT**
- How do we reduce carbon in our IT:
  - Data centres?
  - Distributed IT?
- How do we optimise to get more IT capacity for less carbon?
- How do we address immediate capacity/power issues?
- How can we manage IT to minimise energy consumption?

**Property**
- How do we reduce carbon in our:
  - Buildings and offices?
  - Production plant?
  - Distribution centres?
- How does the property portfolio contribute to our carbon footprint and how can we improve it?
- How do we work towards a more sustainable property portfolio?

**Information**
- How do we measure and monitor information on carbon consistently and efficiently?
- How do we demonstrate regulatory and policy compliance?
- Do we have a carbon scorecard and key performance measures?

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# Economic and regulatory forces make carbon management a matter of competitive advantage

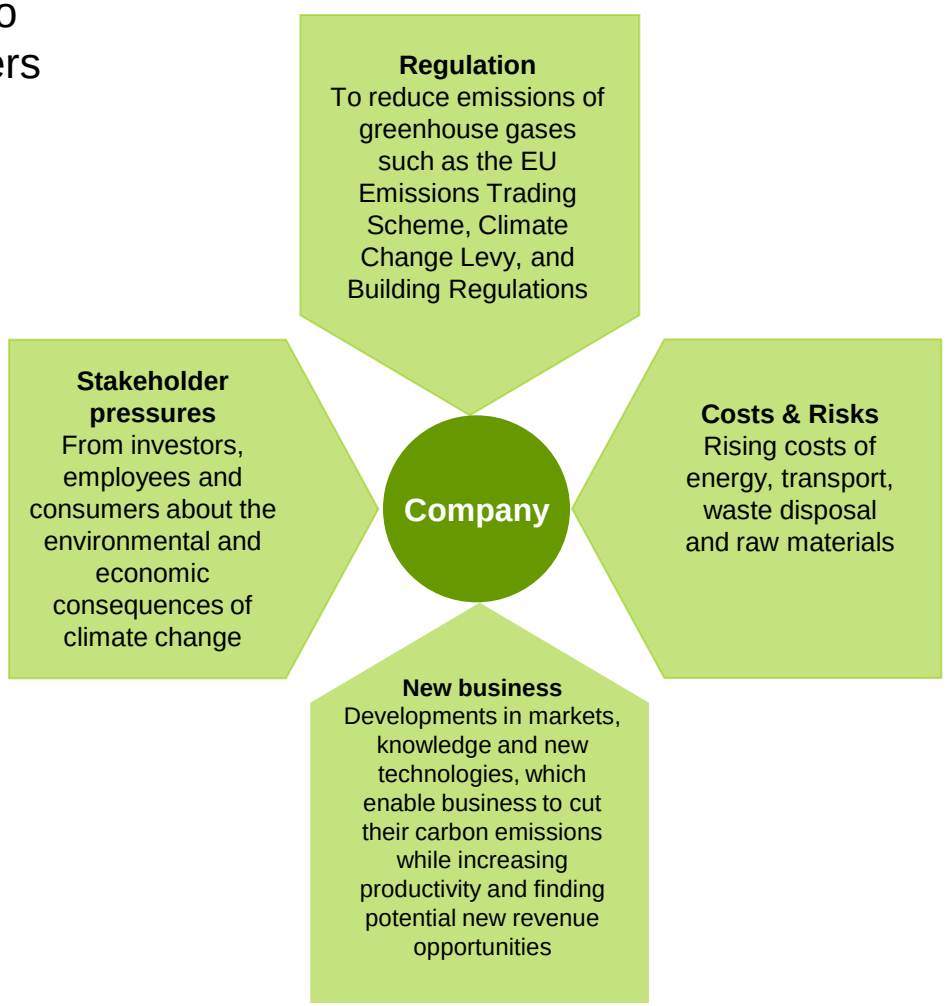
The business opportunities and risks related to climate change have several interrelated drivers

1. Costs & Other Risks
   - High & Volatile energy prices
   - Security of energy supply concerns
   - Scarcity of water supply
   - Threats to competitiveness
   - Physical risks (extreme weather)
   - Litigation

2. New Business: Product & Service Opportunities
   - Customers "voting with their wallets"
   - Operational Efficiencies

3. Reputation: Stakeholders Pressures
   - Investors (Disclosure)
   - Brand/Customers (PR, Social Responsibility)
   - Employee/ Talent Management

4. Regulation & Legislation



# Making the Case for a Proactive Carbon Management Strategy

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

## The Wall Street Factor


Merrill Lynch

**Launching the ML Carbon Leaders Europe Index**

**8 reasons to invest in Carbon Leaders**

1. Quality – delivery of shareholder value
2. Carbon is quantifiable, valuation driver
3. Better cost control
4. Environmental reputational gain potential
5. Wider reduction measures implemented
6. Climate change to remain in media
7. Invoking behavioural change, low cost solution
8. Reduces investor carbon footprint

BMW, RENAULT, SyV, ferrovial, Travis Perkins

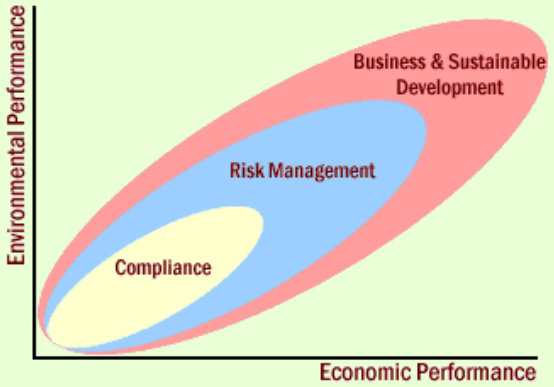
## Industry Momentum

- Many Global 500 companies are pursuing various green initiatives ranging in scope and depth
- Various analysts predict that the combination of $100+ oil prices and rising Carbon index will lead to carbon tariff that will put China manufacturing at risk and would fundamentally alter the global outsourcing landscape

United Technologies, ALCAN, xstrata, posco, ROLLS ROYCE, SHARP, Rockwell Collins, BOMBARDIER, BOEING

## Regulatory Environment

- Changing market dynamics are driving companies to be more accountable for corporate social responsibility means that simply complying with regulations is no longer sufficient – longer term sustainable development is required



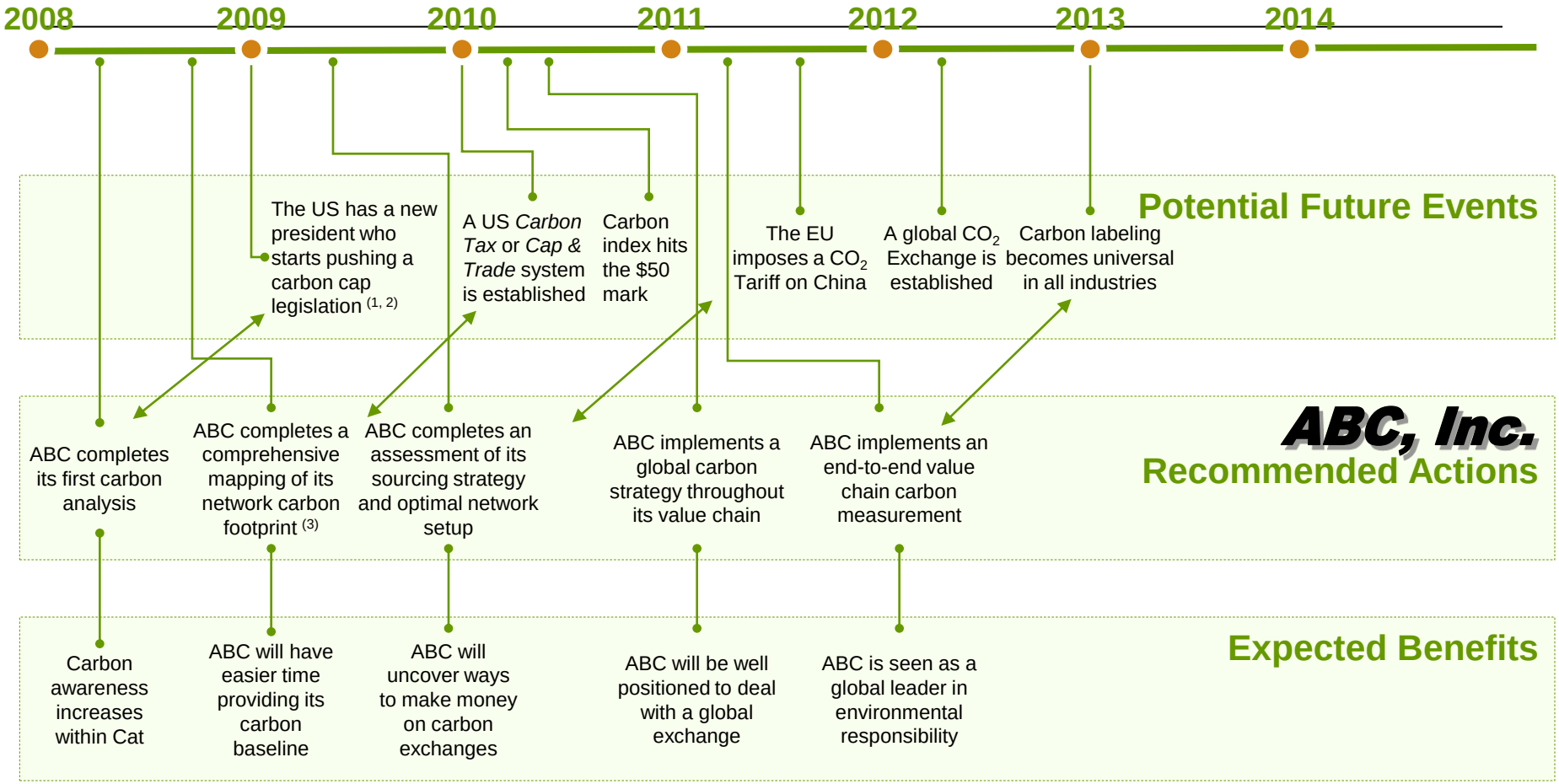

**ABC, Inc. needs to approach carbon management with a strategic mindset by defining a comprehensive strategy to prepare its supply chain to fully exploit this new environment**

CIBC Report

Merrill Lynch Carbon Leaders

# What Should ABC, Inc. Expect?

*One Speculative Version of the Near Future (where unlike today, Carbon is Not Free)*

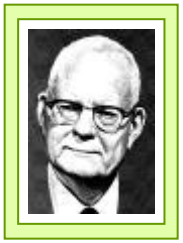



**Notes**

1) The McCain-Lieberman Act of 2005 would limit, originally with a start in 2010, total GHG emissions from the U.S. electricity generation, transportation, industrial and commercial sectors to the amounts emitted in 2000
2) Obama and Clinton are promoting a national cap on carbon emissions, which by 2050 would be reduced to 80 percent below the levels in 1990
3) The first 2 actions will put ABC, Inc. in position to be GHG SCOPE 3 compliant

# Why Should ABC, Inc. Move Now?

*Because history tells us of other business concepts that were either dismissed or not embraced because of their lack of business case (e.g. the Story of TQM)*



## 1940's

US Manufacturers discount Juran's and Deming's efforts to promote Total Quality Management

## 1950

The Union of Japanese Scientists and Engineers invites Dr. Deming to Japan to teach TQM

## 1960's

US Manufacturers continue to resist quality and claim that there is no business case for it as it will be expensive to implement without clear benefits

## 1970's

The "Made in Japan" brand starts establishing itself as a global symbol of products with superior quality and competitive pricing

## 1980

**"If Japan Can... Why Can't We?"** an NBC White Paper is credited with beginning the Quality Revolution and introducing Dr. Deming TQM techniques to American managers

## 1990's

## 2000's

The US Big 3 Automakers struggle to regain lost ground and fall behind Japanese automakers.

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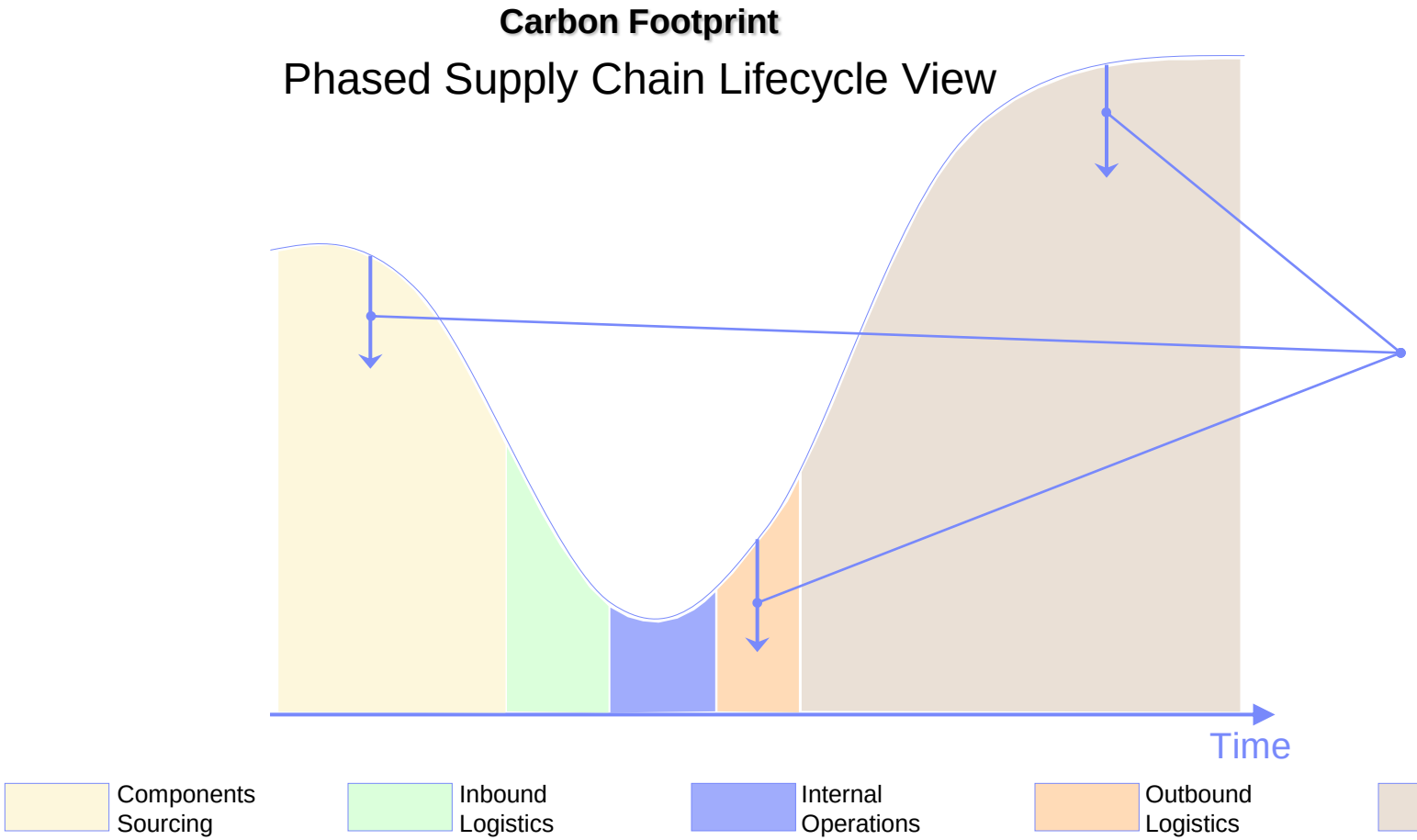
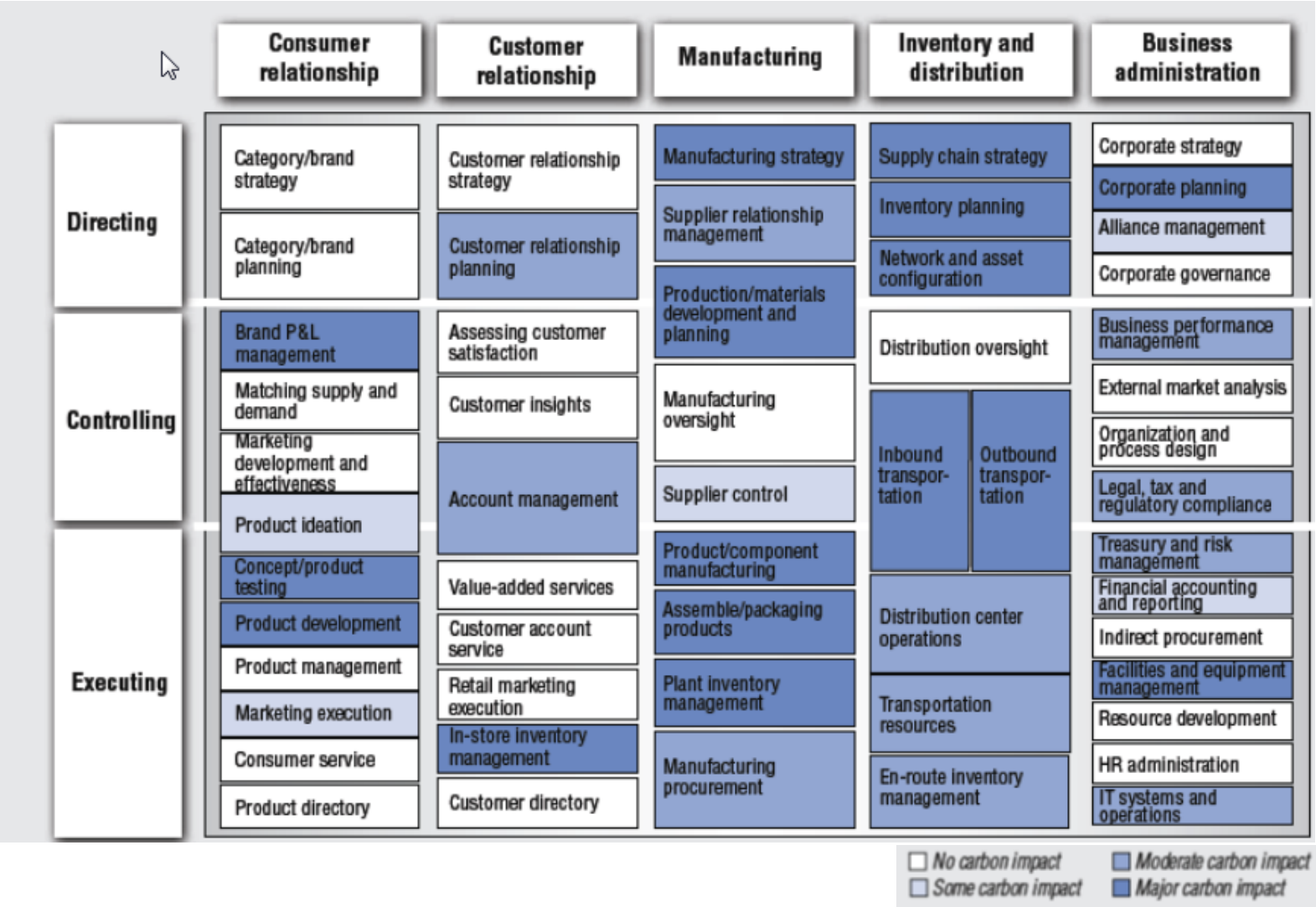
# Carbon Analysis needs to be seen from a total Product Lifecycle View

*As a general guideline, carbon reduction analysis needs to be driven by the size of the opportunity and its potential for change*



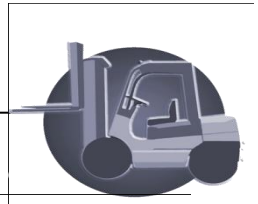

Our goal can be formulated rather simply: **Lower the outer edge**

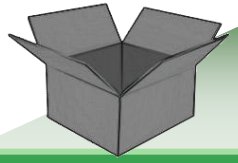
# A heat-map of carbon emissions helps to assess the carbon footprint and set priorities for action.



# Supply Chain activities create significant carbon emissions, making supply chain an important focus for companies seeking to reduce their carbon footprint

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN





Flows: Product, Process, Information, Cash

| Design | Plan | Source | Make | Deliver | Service & End-of-Life |
|---|---|---|---|---|---|
| PLM | SC Strategy | Procurement | Integrated Ops | Logistics | Integrated Ops |
| • How can product design make better trade-offs between design requirements, including carbon footprint?<br>• What tools & practices should be employed by co's wanting to establish leadership?<br>• What are the carbon impacts throughout the product's lifecycle, and how can they be minimized upfront through smart design? | • How can the total network be optimized considering service, cost, "green" tradeoffs<br>• What CO2 impact is there from various inventory concepts & planning methodologies<br>• Are there opportunities to reduce cost and carbon emission at the same time? | • How can we best measure a supplier's carbon impact (product, packaging, upstream logistics) and ultimately compliance with carbon reduction requirement?<br>• What sourcing strategies will result in a better trade-off of cost, service levels, carbon emission?<br>• How should we evaluate carbon offsets? | • What operations strategy (facility location, operating model) provides the best trade-off between cost, service, carbon?<br>• Is there a role for sustainable factory / facility mgmt?<br>• Can lean manufacturing and 6-sigma approaches be used to manage carbon?<br>• Is there a role for Manufacturing Execution Software in the mgmt of carbon? | • What distribution network strategy (facility locations, sizes, transport modes) provides the best tradeoff of cost, service and carbon?<br>• How can packaging be reduced and recycled?<br>• What is the impact of increased load consolidation, and is this practical?<br>• What role can alternative fuel or power sources play? | • How can field service operations reduce carbon footprint with better routing and parts inventory tracking?<br>• Is there a mechanism to drive continuous design improvement from service back to product design and engineering?<br>• Are all strategies being employed to reduce landfilled materials: reuse, refurbishing, recycling, secondary markets? |

## Asset Management

Sustainable facilities management: Green building & renewable energy; carbon footprint asset management; Asset utilization (Real-time data on energy usage; Carbon dashboard)

## Finance

Paperwork Reduction; Environmental Cost Accounting; Environmental Tax Benefits Tracking

# For each supply chain function there are specific questions and measures for carbon management

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

**Strategy**
Setting goals, integrating with business strategy, focus areas, policies, funding

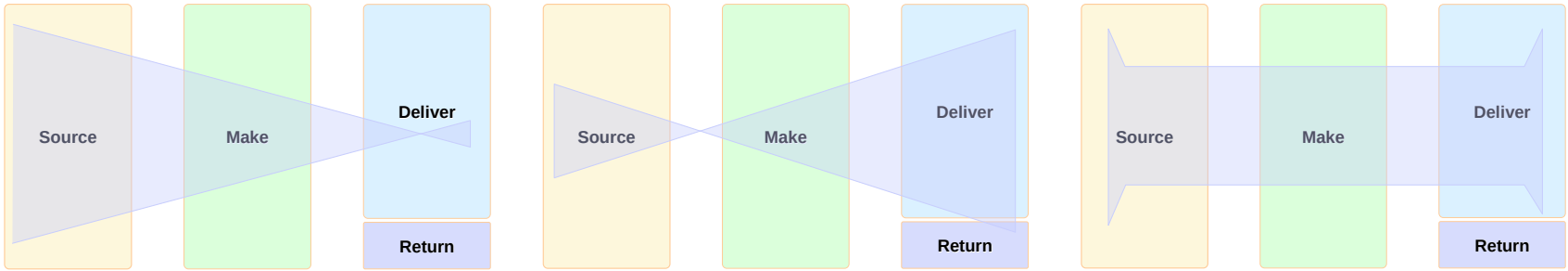
| Product design | Planning | Sourcing | Production | Logistics | Service and end-of-life |
|---|---|---|---|---|---|
| • How can product design make better trade-offs between design requirements, including carbon footprint?<br>• What tools and practices should be employed by companies wanting to establish leadership?<br>• What are the carbon impacts throughout the product's lifecycle, and how can they be minimized upfront through smart design? | • How can the total network be optimized, considering service, cost, "green" trade-offs?<br>• What is the $CO_2$ impact from various inventory concepts and planning methodologies?<br>• Are there opportunities to reduce cost and carbon emission at the same time? | • How can we best measure a supplier's carbon impact (product, packaging, upstream logistics) and ultimately comply with carbon reduction requirements?<br>• What sourcing strategies will result in a better trade-off of cost, service level, quality, carbon emission?<br>• How should we evaluate carbon offsets? | • What operations strategy (facility location, operating model) provides the best trade-off between cost, service, carbon?<br>• Is there a role for sustainable factory/facility management?<br>• Can lean manufacturing and Six Sigma approaches be used to manage carbon?<br>• Is there a role for manufacturing execution software in the management of carbon? | • What distribution network strategy (facility locations, sizes, transport modes) provides the best trade-off of cost, service and carbon?<br>• How can packaging be reduced and recycled?<br>• What is the impact of increased load consolidation, and is this practical?<br>• What role can alternative fuel or power sources play? | • How can field service operations reduce carbon footprint with better routing and parts inventory tracking?<br>• Is there a mechanism to drive continuous design improvement from service back to product design and engineering?<br>• Are all strategies employed to reduce landfilled materials: reuse, refurbishing, recycling, secondary markets? |

**Asset management**
Sustainable facilities management; green building and energy carbon footprint asset management; asset utilization (Realtime data on energy usage, i.e., carbon dashboard)

**Finance**
Paperwork reduction; environmental cost accounting; environmental tax benefits tracking

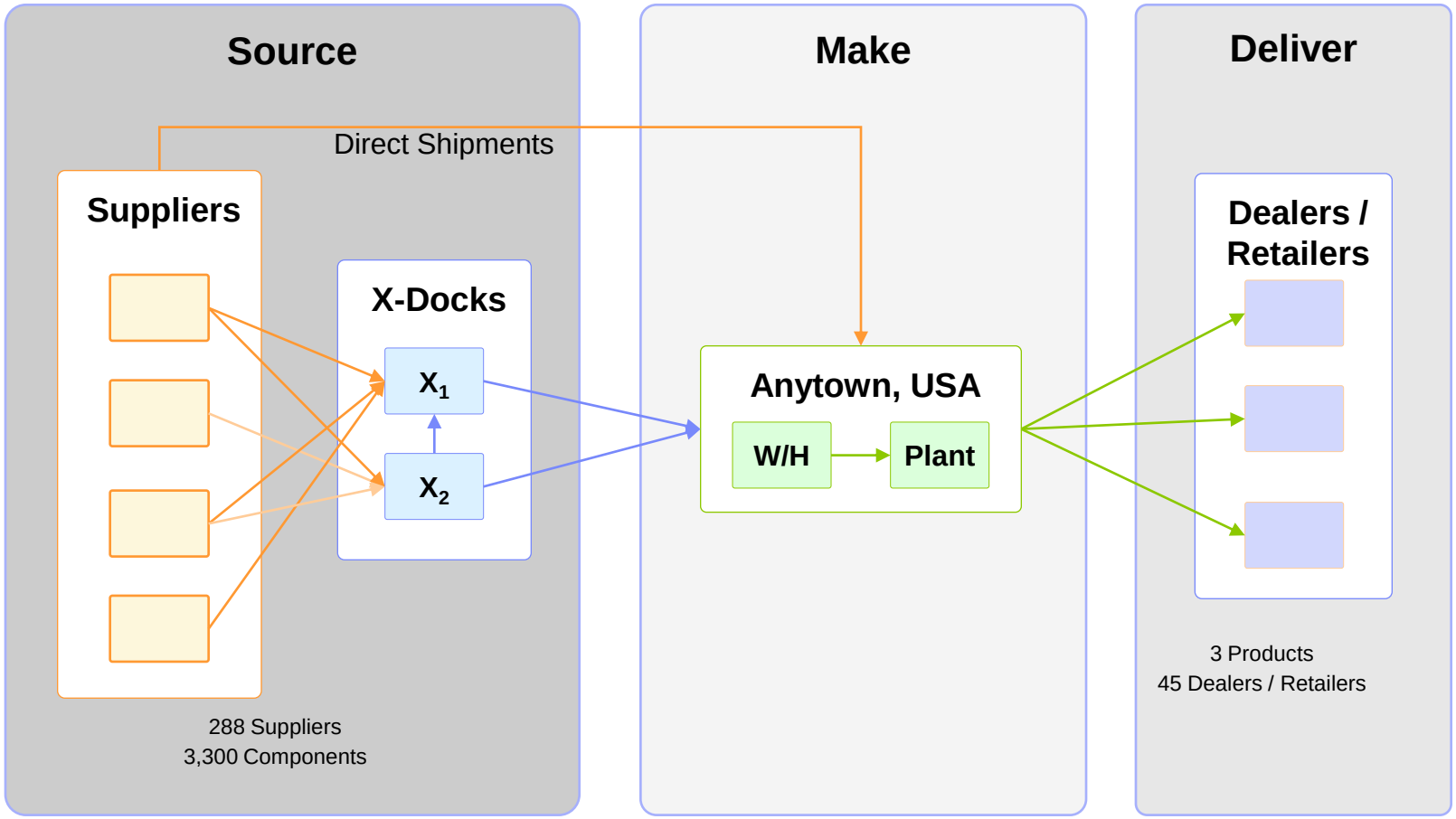
# Determining our Focus Area

- A-Shaped – primarily an assembly operation (e.g. an assembly shop where most of the core machining is done by contractors) and where the focus of the analysis should be on the “Source” side
- V-Shaped – primarily a distribution operation (e.g. amazon.com receiving items in pallets and shipping them in units) and where the focus of the analysis should be on the “Deliver” side
- I-Shaped – classic manufacturing environment with a large number of sourced components and finished product configurations and where all processes need to be analyzed with particular focus on the “Make” process (e.g. process industry, chemicals, discrete manufacturing, etc.)

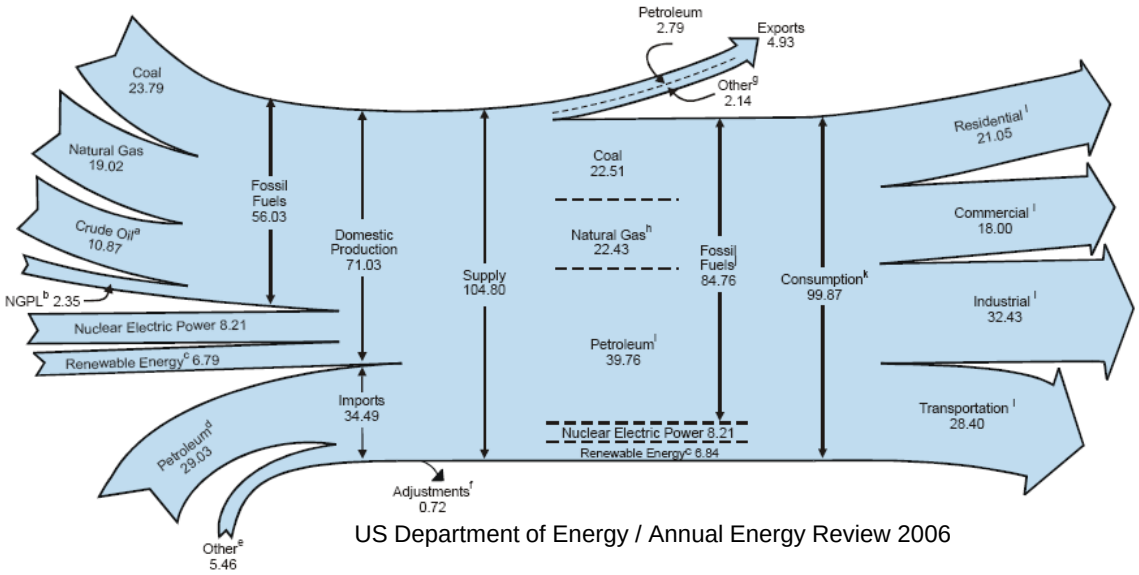


# Applying the Framework

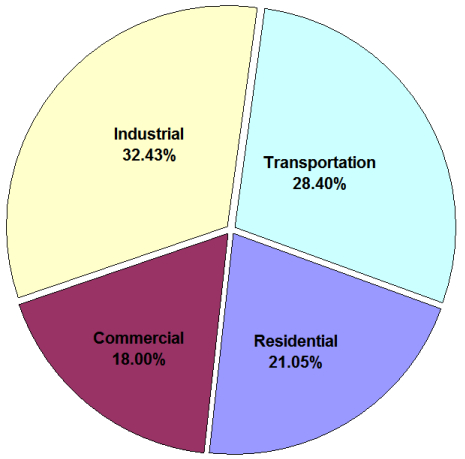
*We worked with the division of a leading Fortune 500 company to determine our focus area and ended up settling on the sourcing side of their supply chain*



# Sizing Up the Overall Situation – Quick Top Down Analysis



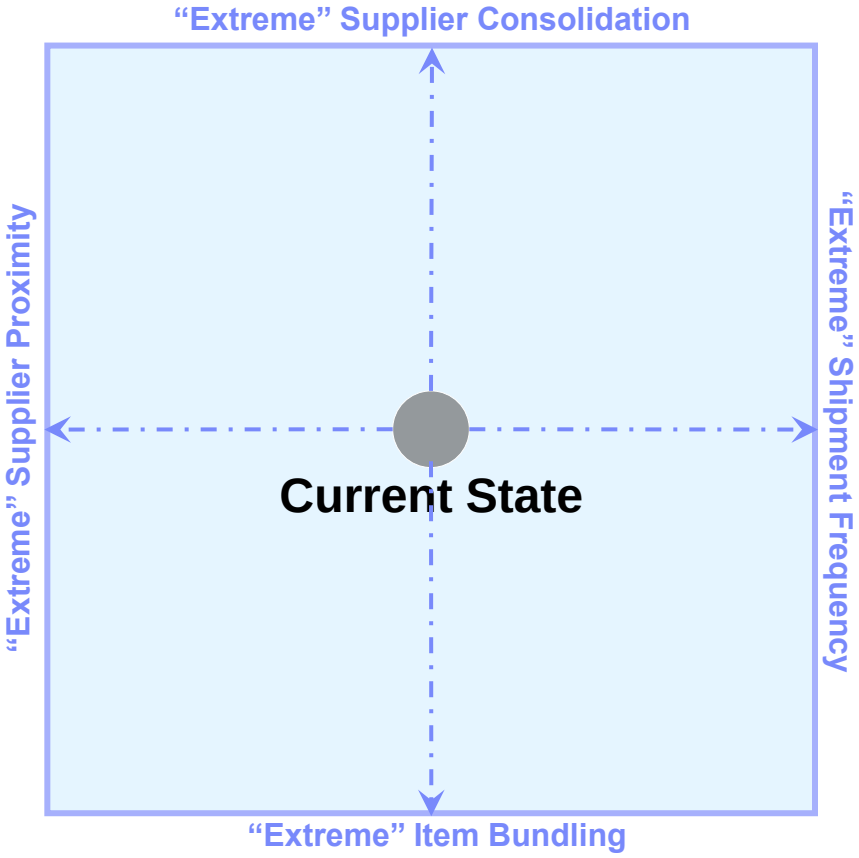

US Department of Energy / Annual Energy Review 2006




**2B Tons x 61% x 0.34% = 4.13M Tons x $36 = $149M x 0.68% = $1.02M**

| US Share of World Carbon Emissions | Industrial and Transportation | Company A revenue as a % of US GDP | | Company A Total Potential Estimate | Division revenue as a % of Total A | Preliminary Potential Estimate |
|---|---|---|---|---|---|---|

# Defining the Boundaries of Our Analysis – "Extreme" Modeling




**To assess the Carbon Reduction potential, we will start by building scenarios based on some extreme assumptions**

- What if all items were sourced from the same supplier?
- What if all suppliers were within a "walking" distance?
- What if all items were heavily bundled?
- What if all shipments were consolidated?
- What if all trucks used hybrid fuel? **ETC**

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# Primary Supply Chain Levers with Carbon as a New Variable

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

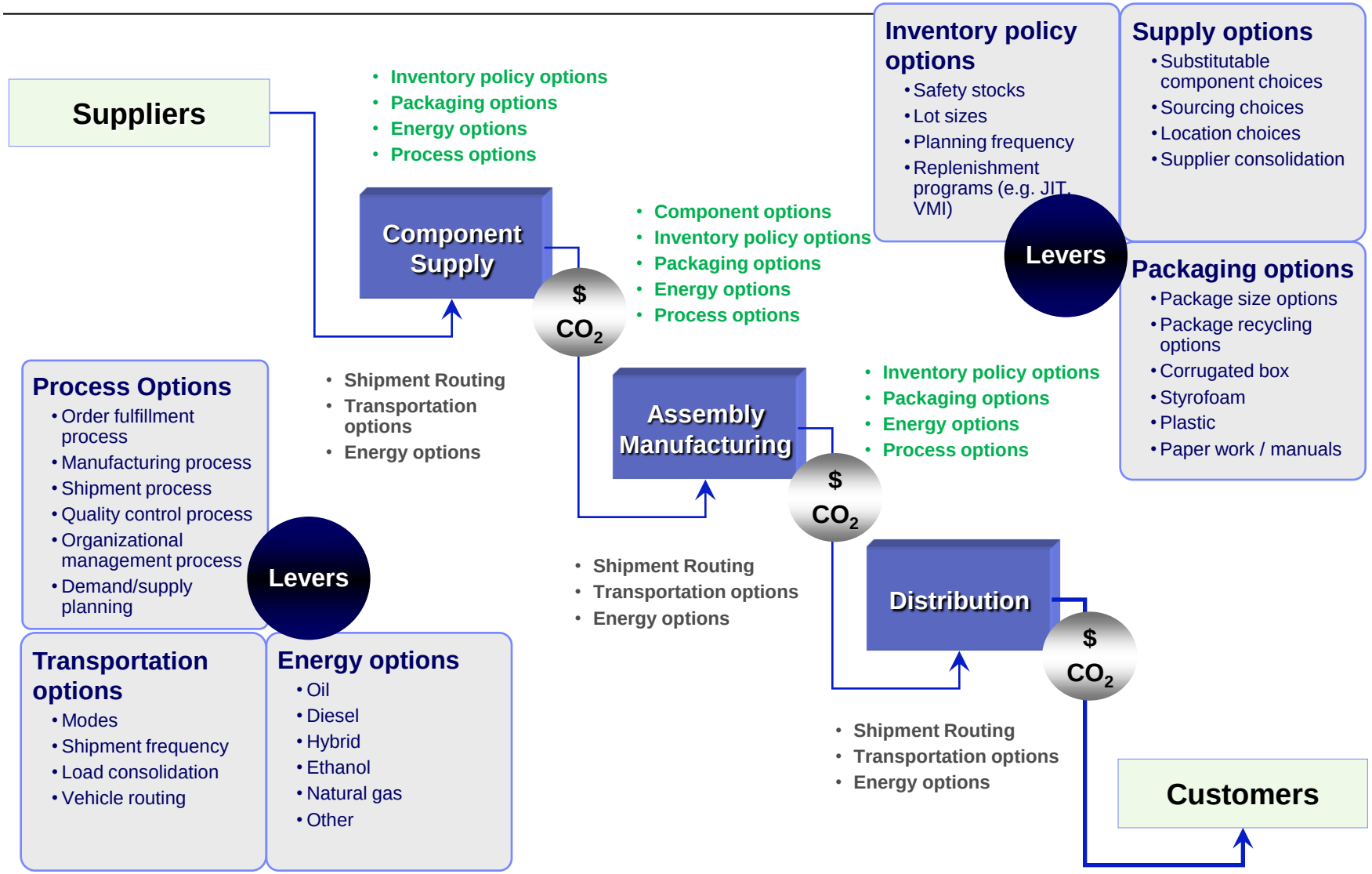
- Typical supply chain optimization only considers the direct monetary costs
- Inventory and supply policies can be significantly different with the inclusion of broader environmental costs, and constraints
- A good model can quantify both the cost and the carbon impact of various supply chain policies.
- A comprehensive model can identify areas where carbon and cost reduction can be achieved simultaneously (e.g. minimization of wastage, rework etc)

# Any Supply Chain Carbon View will have to be Multi-Dimensional in Nature

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

| | Packaging Options | Transportation Options | Energy Options | Inventory Policy Options | Process Options | Supply Options |
|---|---|---|---|---|---|---|
| Shrinkage ($, $CO_2$ cost) | ♦ | ♦ | | ♦ | | |
| Breakage ($, $CO_2$ cost) | ♦ | ♦ | | ♦ | | |
| Real Estate ($ cost) | ♦ | | | ♦ | ♦ | |
| Handling ($, $CO_2$ cost) | ♦ | ♦ | | ♦ | ♦ | |
| Transportation ($, $CO_2$ cost) | ♦ | ♦ | | ♦ | ♦ | ♦ |
| Utilities ($, $CO_2$ cost) | | | ♦ | ♦ | | |
| Manufacturing ($, $CO_2$ cost) | | | | | ♦ | ♦ |
| Component Supply ($, $CO_2$ cost) | | | | | ♦ | ♦ |

# Various Operational and Financial Tradeoffs will present themselves as a product travels throughout the supply chain



# Green Supply Chain Analysis Tool will model the impact of six key levers and provide insights for carbon management

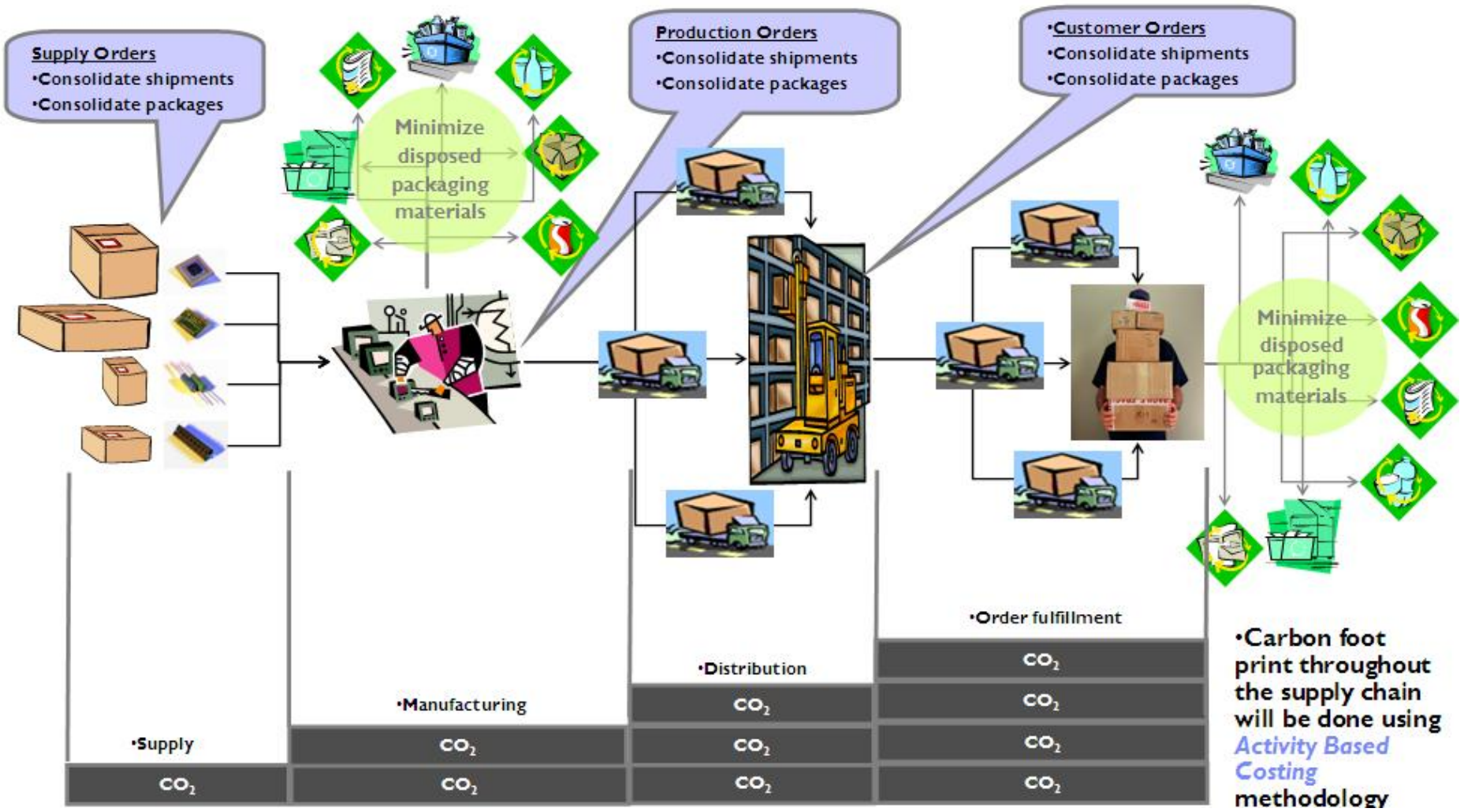
TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

1. Packaging options
2. Process options
3. Transportation options
4. Energy options
5. Inventory policy options
6. Supply options

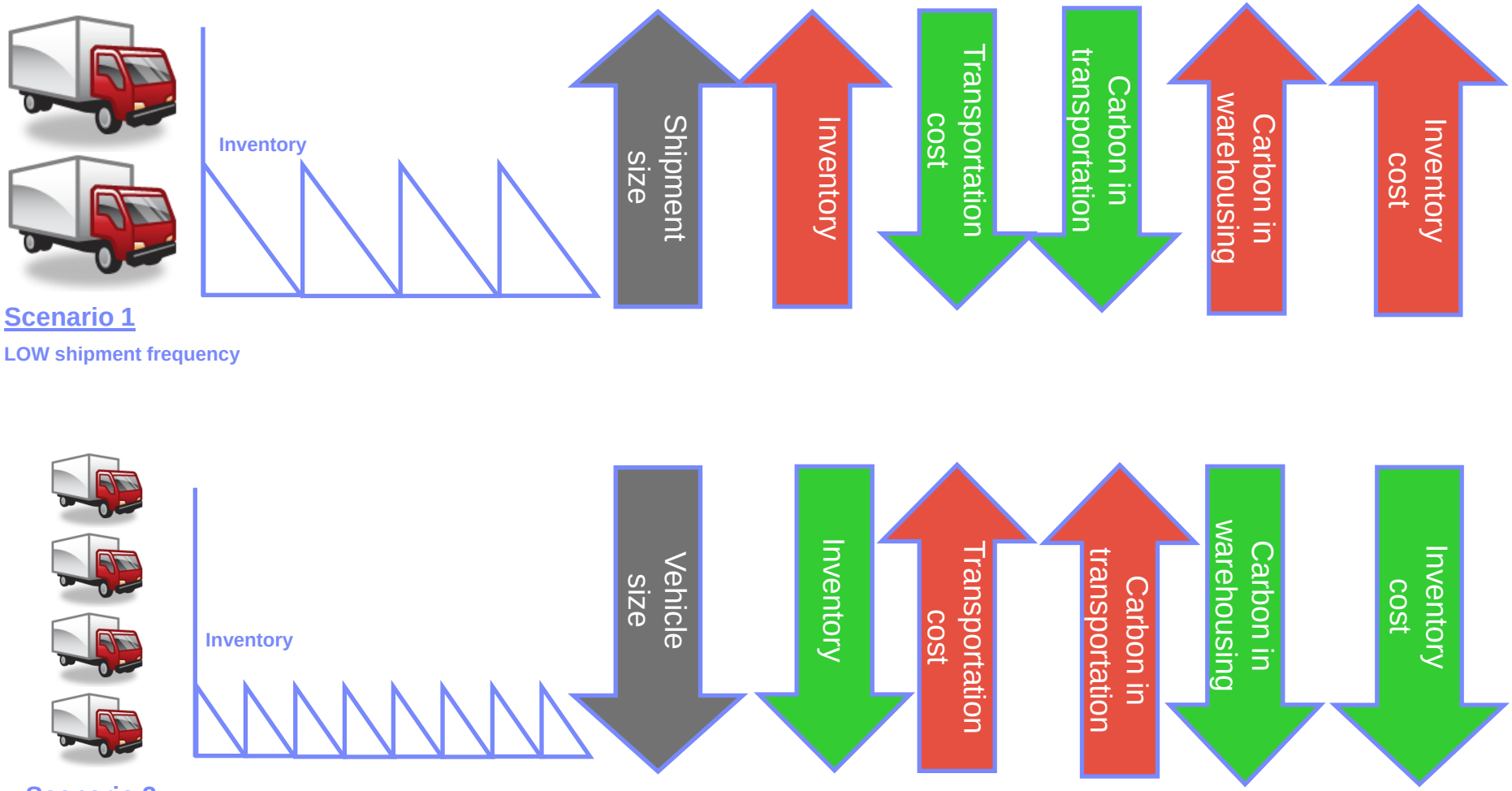
- Examples of questions that will be addressed by the tool:
  - What is the impact on cost and carbon emission if I change **package sizes and/or packaging materials**
  - What is the impact of **manufacturing lot sizes** on supply transportation requirements and therefore the cost and carbon.
  - How can I evaluate **alternative supply sources** in terms of cost and carbon contribution on the supply chain?
  - How do my **inventory replenishment practices** influence my current carbon print and how can I change it?
  - How much does ability to **consolidate orders** reduce my carbon footprint?
  - What is the carbon footprint of my current distribution requirements planning (**DRP**) and how does it change if I change the plan.
  - Does **component commonality** help reduce carbon footprint and if so how much?
  - **Which components** contribute more than others to my carbon footprint?
  - Etc., etc.

# Shipment and package consolidation is one of the major opportunities to reduce carbon foot print

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN



# Quantifying the impact of shipment frequency on cost and carbon can help establish a *greener* inventory replenishment policy



# Supplier choice can impact component cost, carbon emission, and inventory all of which can be quantified to support a green procurement strategy

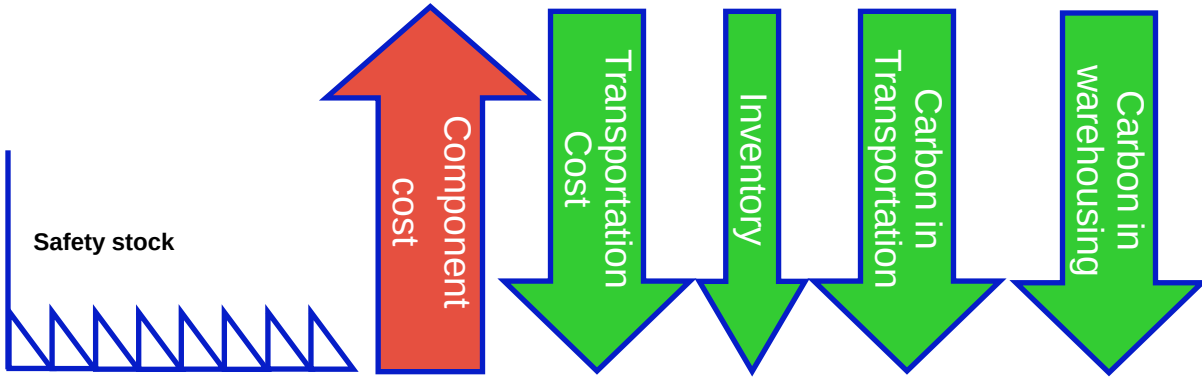
TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

**Supplier 1**

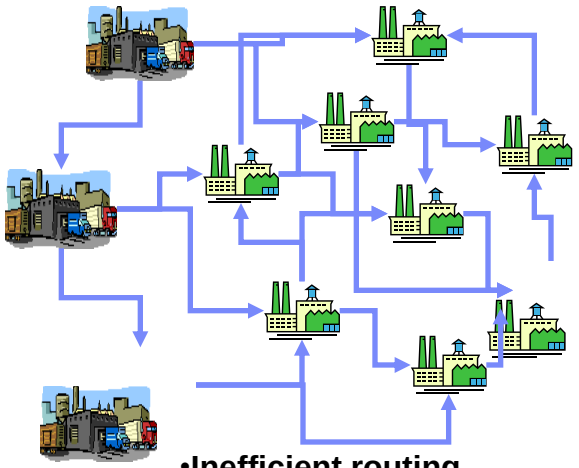
- LOW price
- LONG distance


**Supplier 2**

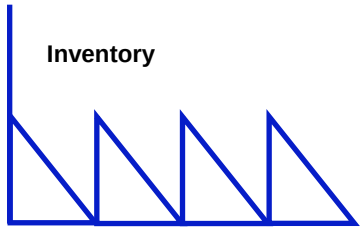
- HIGH price
- SHORT distance

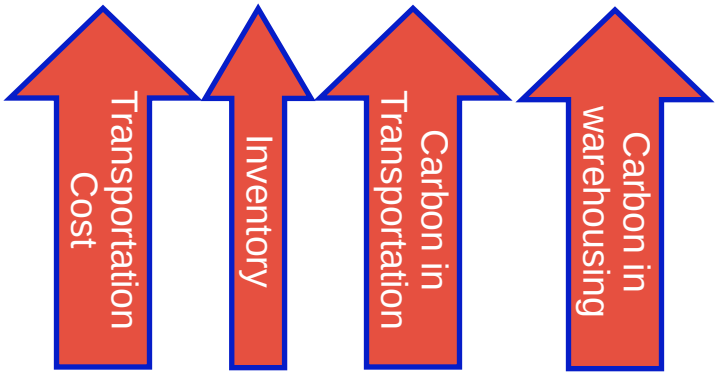


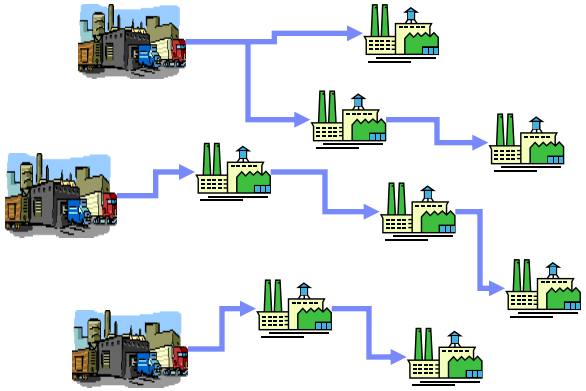
# Some levers such as better routing can create a win-win case for both reducing carbon and cost in the supply chain



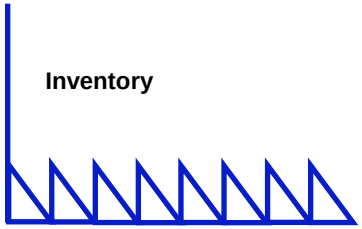
•**Inefficient routing**

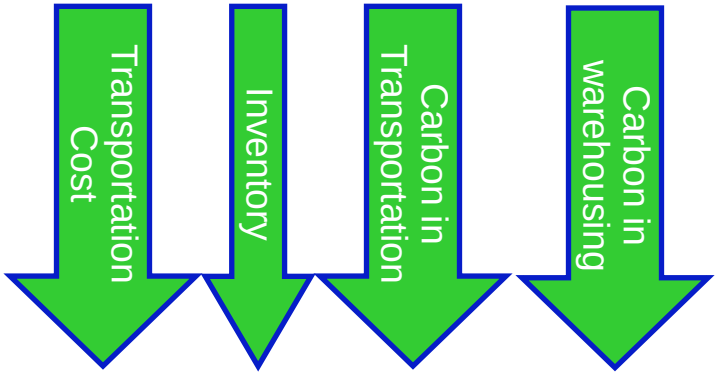


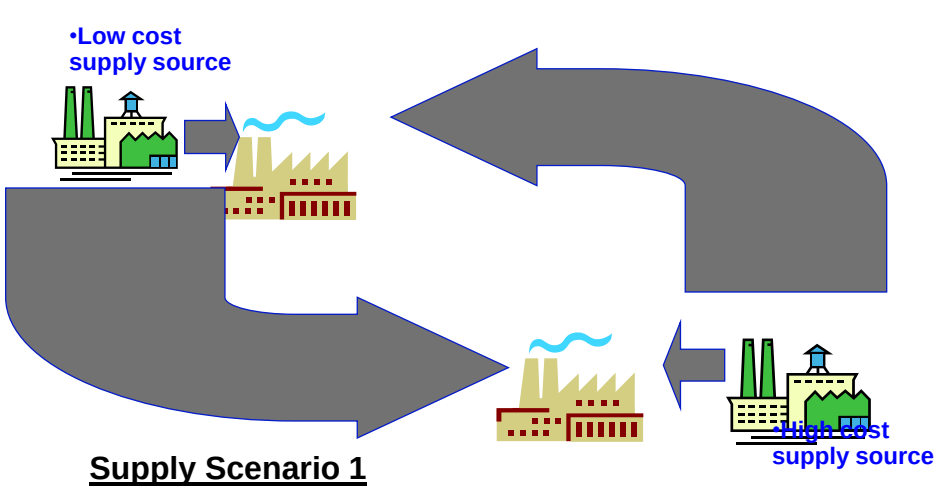
•**Efficient routing**



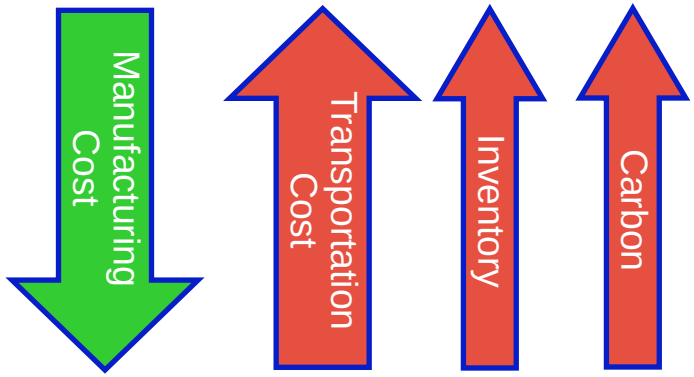



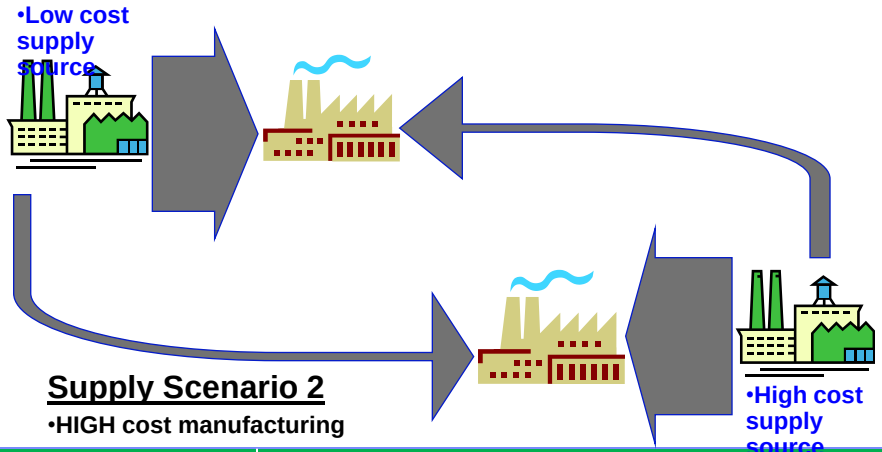
# Quantifying the cost and carbon impact of alternative supply sourcing plans can help in the greening decisions

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

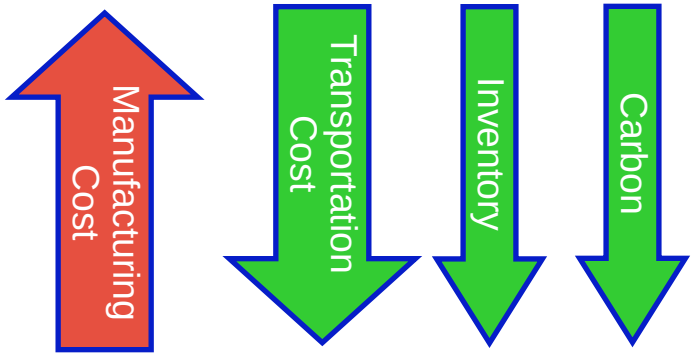



**Supply Scenario 1**
•LOW cost manufacturing

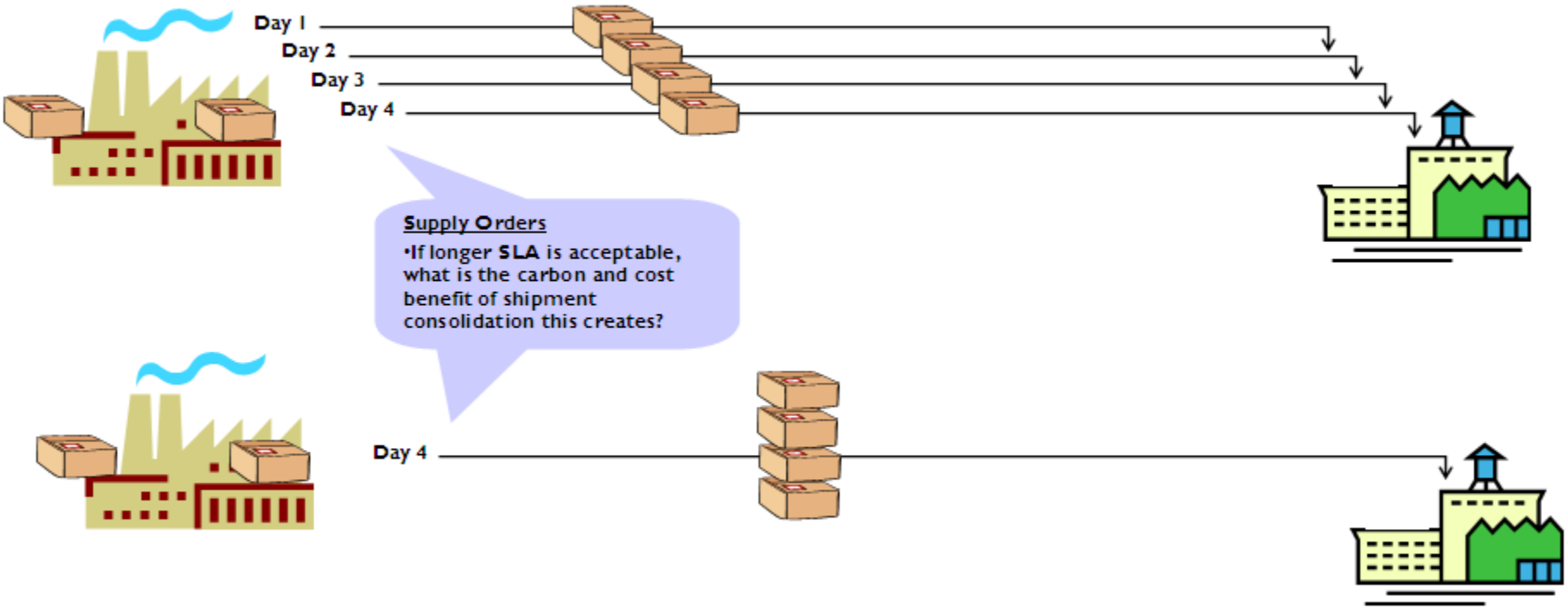


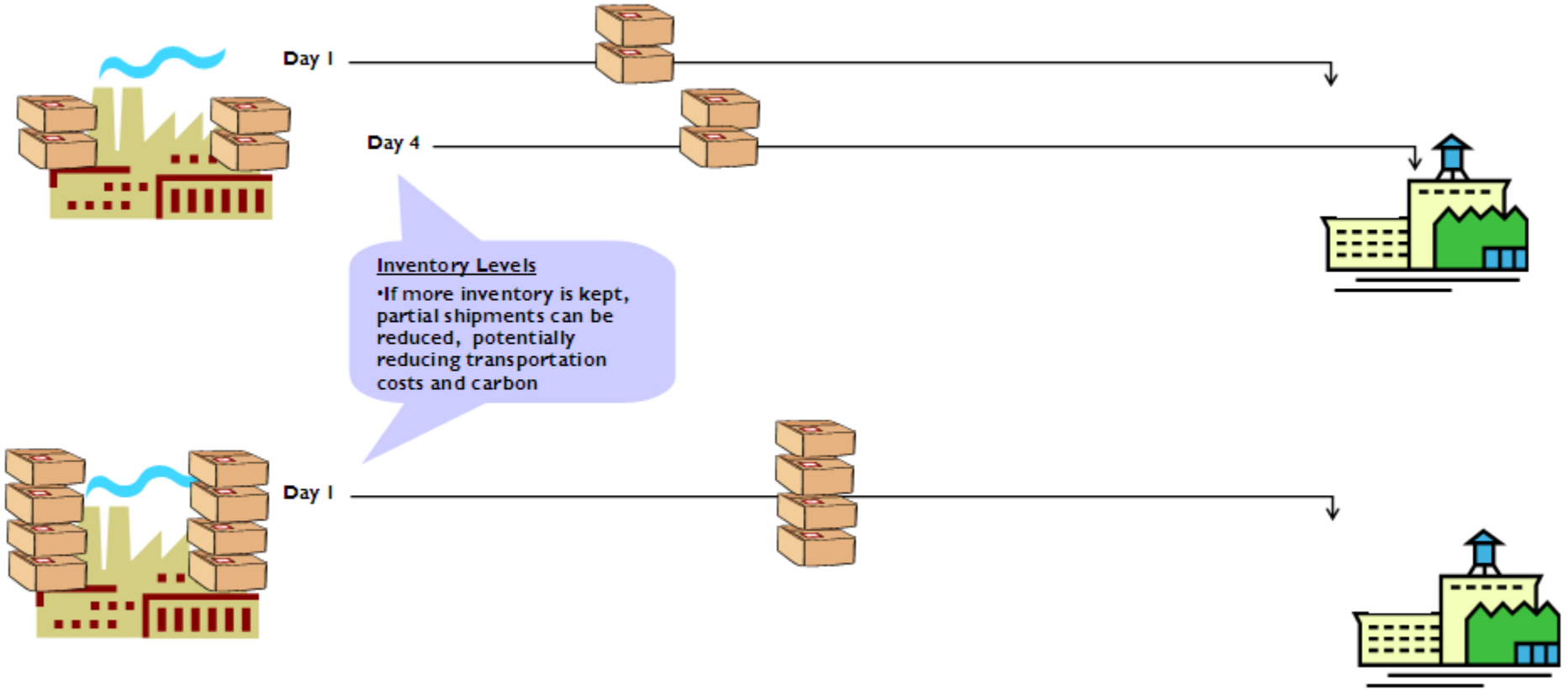

**Supply Scenario 2**
•HIGH cost manufacturing



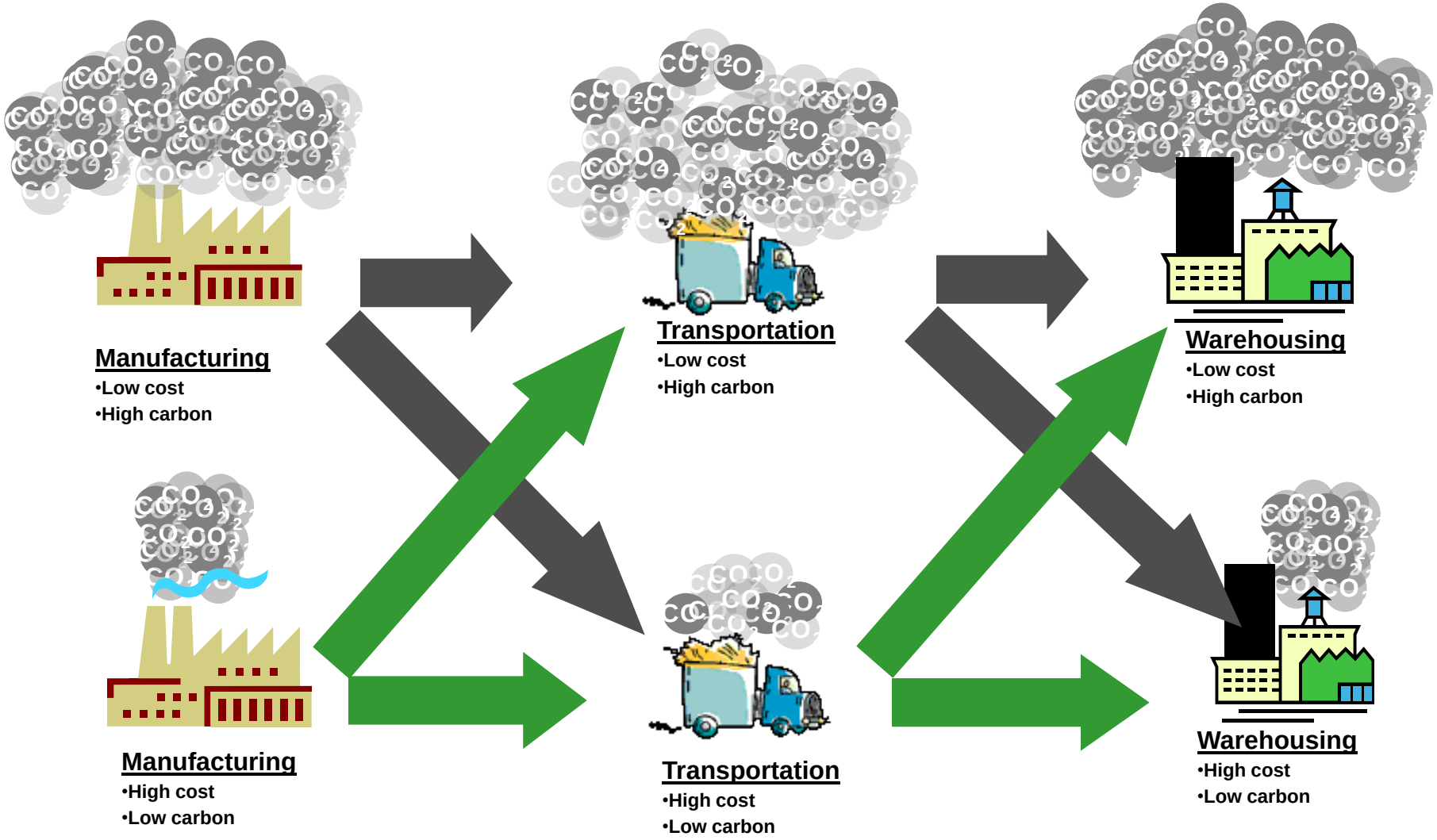
# If better service level agreements can be negotiated, carbon and cost can be reduced through shipment consolidation.



# Inventory policies can also impact transportation costs and carbon footprint.



# Quantification of cost and carbon makes it possible to identify minimum-cost-path of getting the product to the customer with maximum carbon reduction potential

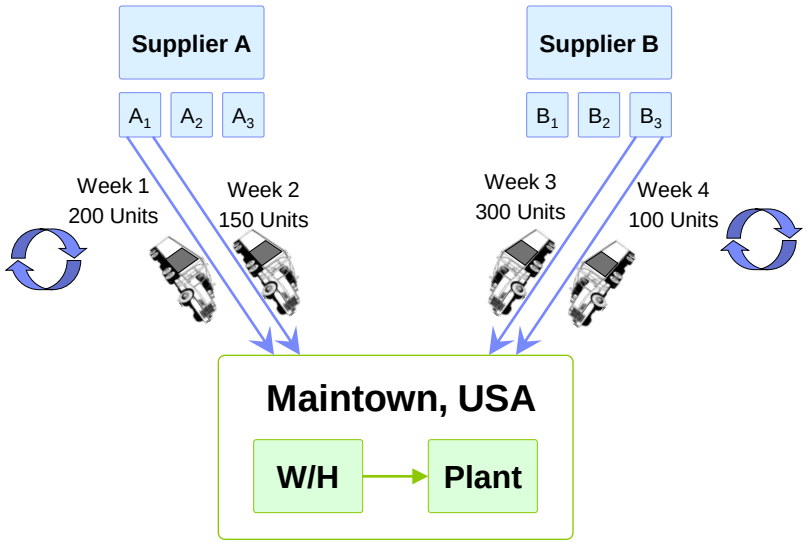


# Objectives

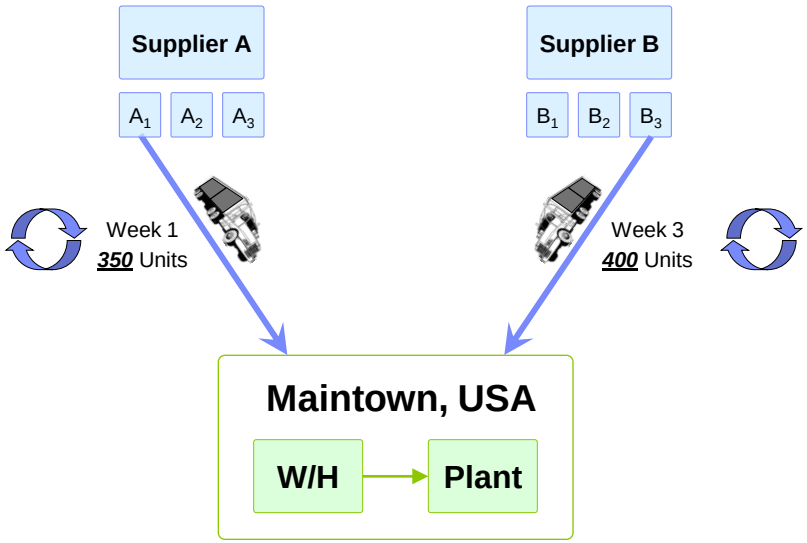
- **Green Supply Chain Discussion**
  - **The Why?**
  - **The How?**
    - **Section 1**
      - Where to Start? How to Quantify the Opportunity?
    - **Section 2**
      - How to go about analyzing the supply chain carbon footprint?
    - **Section 3**
      - Some Quantitative Scenarios
      - Some Qualitative Scenarios
- **Final Thoughts**

# Sample Scenario # 1 – Same Supplier / Same Item (less miles)

## As-Is




## To-Be




## Description

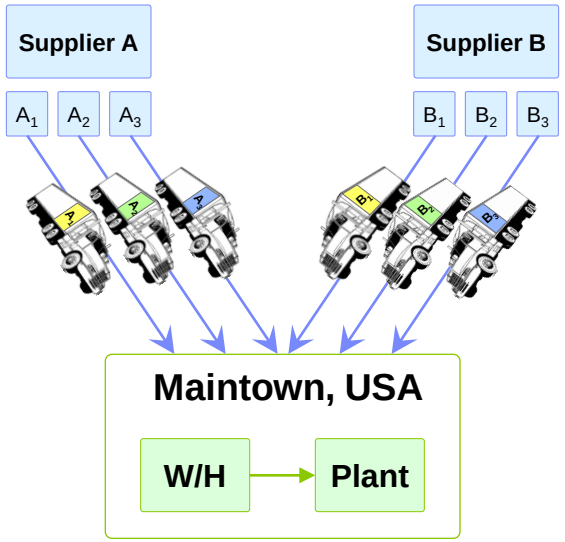
- Combine 2 consecutive weekly shipments of item $A_1$ from Supplier A in a bi-weekly shipment of the combined quantities

## Preliminary Analysis

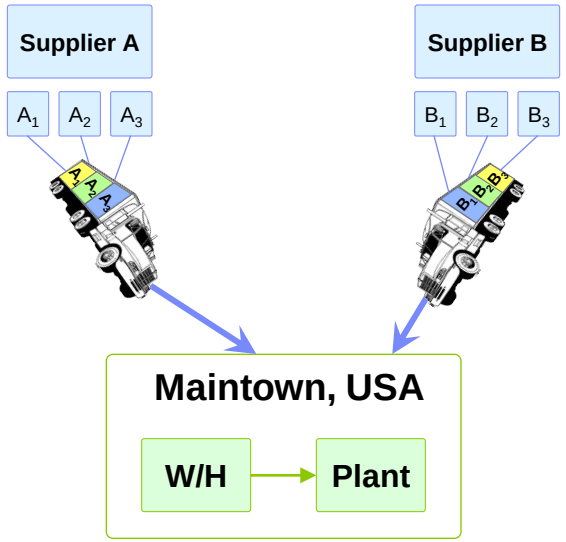
- This setup will reduce carbon footprint
- This setup will reduce transportation cost
- This setup will reduce miles traveled but increase average inventory

# Sample Scenario # 2 – Same Supplier / Many Items (less miles)

## As-Is




## To-Be




## Description

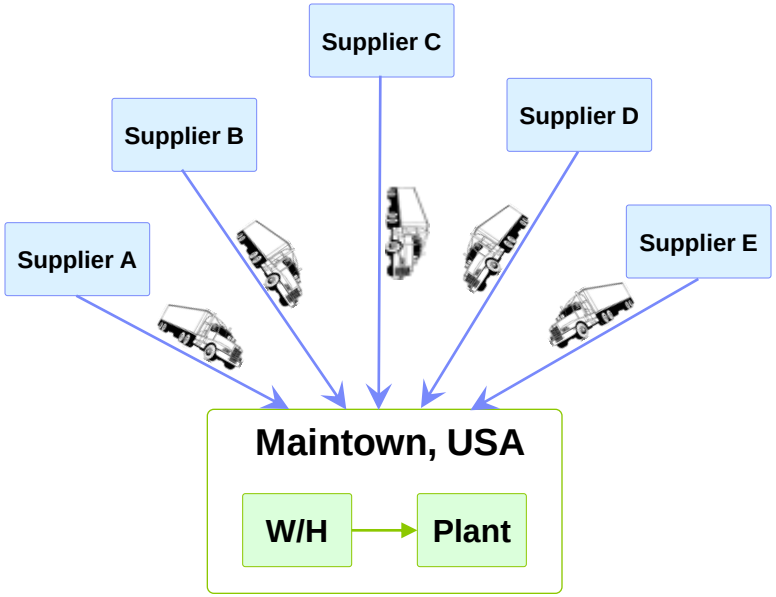
- Consolidate partial shipments of various items from a particular supplier in a single shipment

## Preliminary Analysis

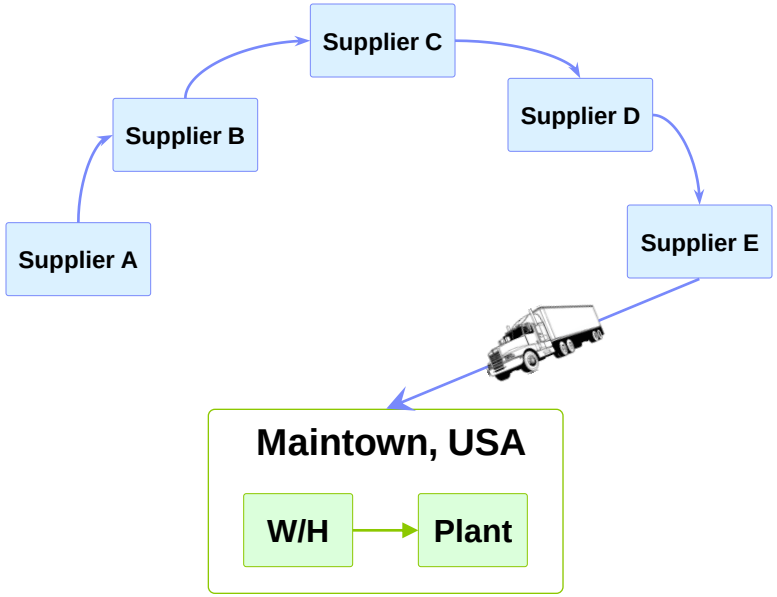
- This setup will reduce carbon footprint
- This setup will reduce transportation cost
- Average inventory will increase if different shipments dates are combined

# Sample Scenario # 3 – Many Suppliers / Many Items

## As-Is




## To-Be



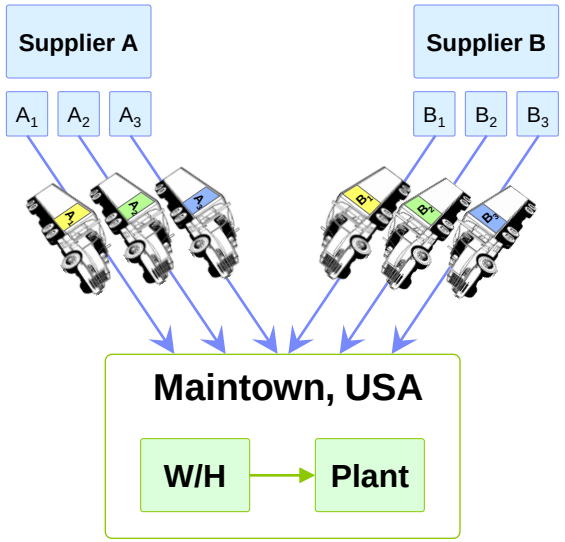
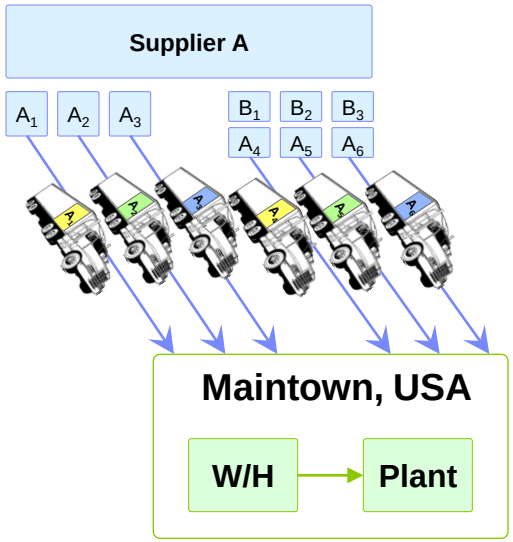

## Description

- Consolidate shipments from various suppliers using a Milkrun approach (applied to logical supplier locations)

## Preliminary Analysis

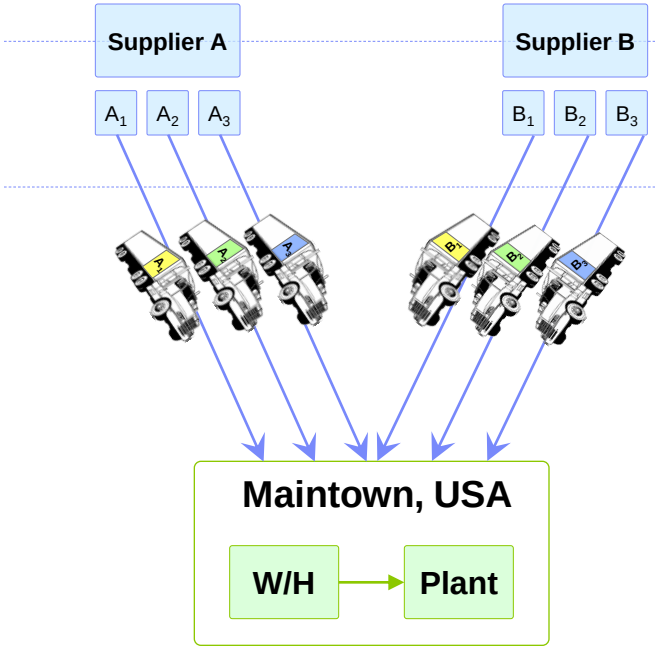
- This setup is likely to reduce total miles traveled
- This setup will reduce carbon footprint and transportation cost
- Average inventory will increase if different shipments dates are combined

# Sample Scenario # 4 – Same Supplier / More Items

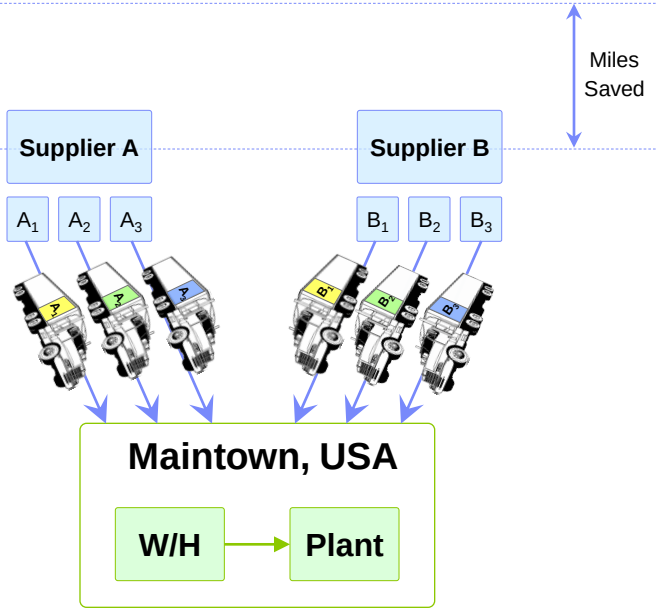
| As-Is | To-Be |
|---|---|
|  |  |
| **Description** | **Preliminary Analysis** |
| ▪ Consolidate the supplier network by shifting some items to some select suppliers | ▪ This setup is likely to reduce carbon footprint<br>▪ This setup is likely to reduce total miles traveled<br>▪ This setup is likely to reduce transportation cost as more opportunities to combine items and shipments will arise |

# Sample Scenario # 5 – Many Supplier / Less Distance

## As-Is




## To-Be




## Description

- Develop (or shift items to) suppliers that are close to the plant (effort already initiated) with the goal of reducing distance and lead time

## Preliminary Analysis

- This setup will reduce carbon footprint
- This setup will to reduce total miles traveled

# Qualitative Scenario Analysis Template

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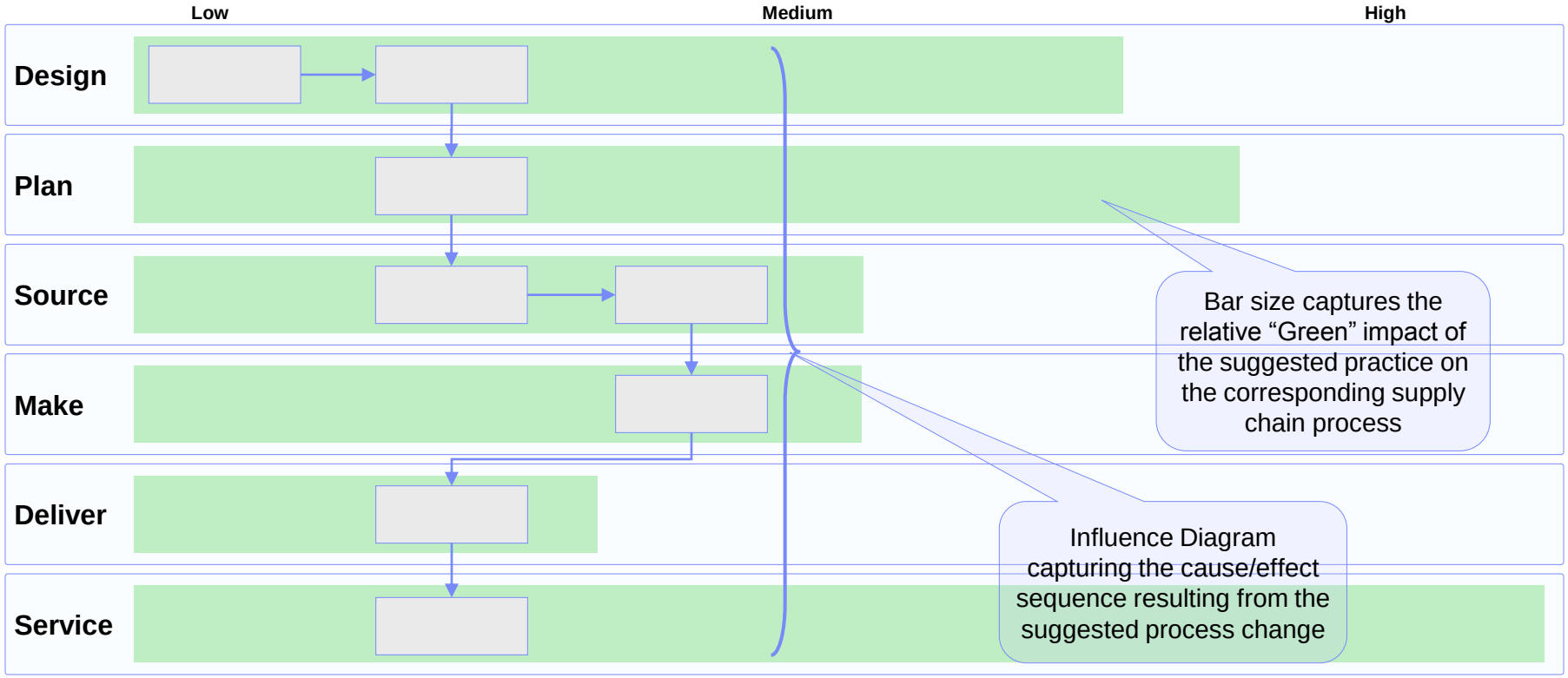
THINK OUT OF THE SUPPLY CHAIN

## Qualitative Scenario – {Title}

| Description | Impact Factors | Complexity Factors |
|---|---|---|
| Description | ▪ Impact Factor 1<br>▪ Impact Factor 2<br>▪ Et Cetera | ▪ Complexity Factor 1<br>▪ Complexity Factor 2<br>▪ Et Cetera |

**Influence Diagram**

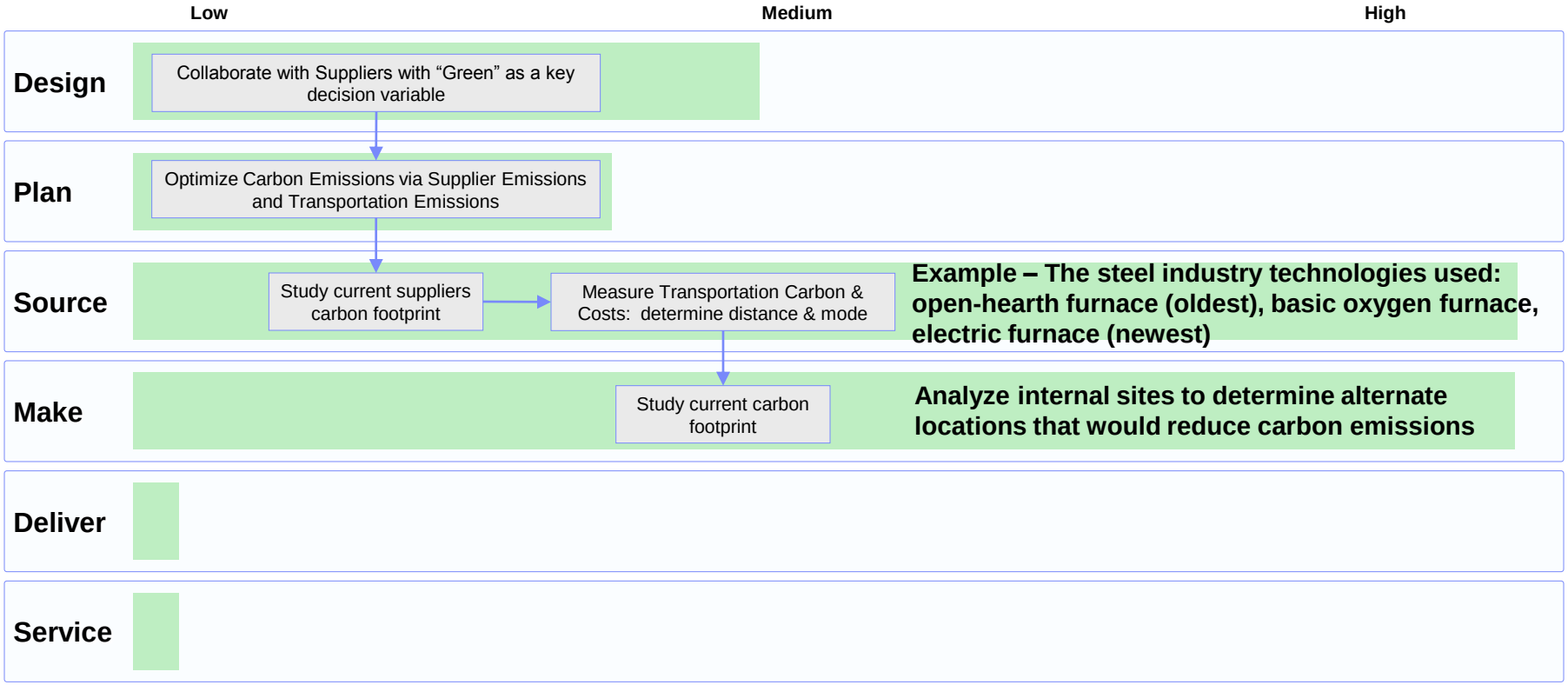


# Sustainable Supplier Strategy

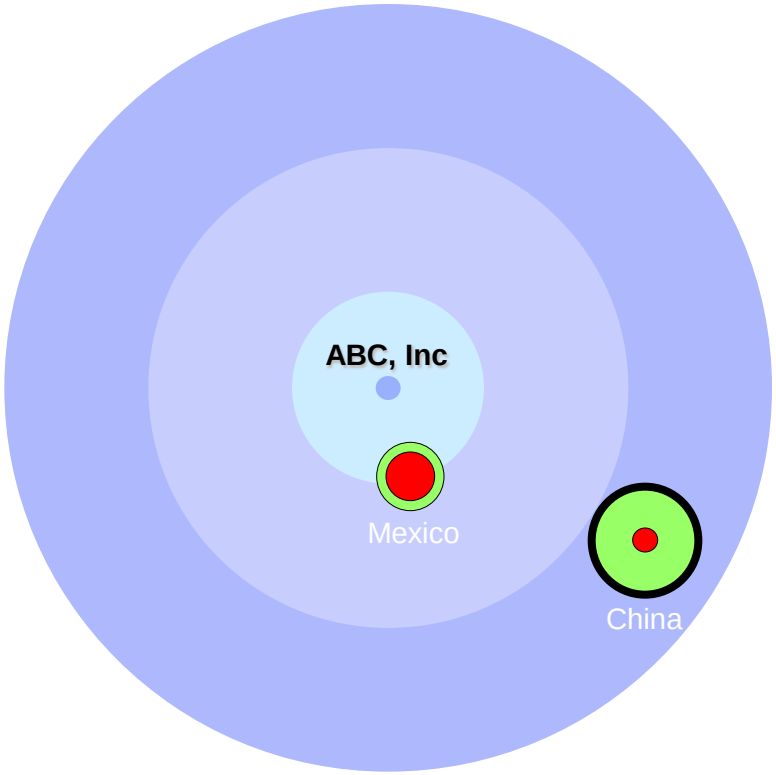
## Qualitative Scenario – Sustainable Supplier Strategy

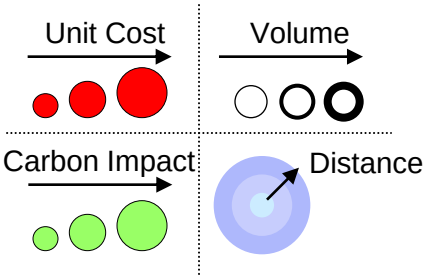
| Description | Impact Factors | Complexity Factors |
|---|---|---|
| Examine current and potential future suppliers' carbon creation based on steel making technologies in conjunction with their distance of delivery | ▪ Reduced carbon emissions for the company and the globe<br>▪ Reduced transportation cost<br>▪ Quicker response time | ▪ Purchase costs of supplier that produces less carbon is high<br>▪ Difficulty in finding capacity in locations with limited carbon footprint |

**Influence Diagram**



# Sustainable Supplier Strategy Development

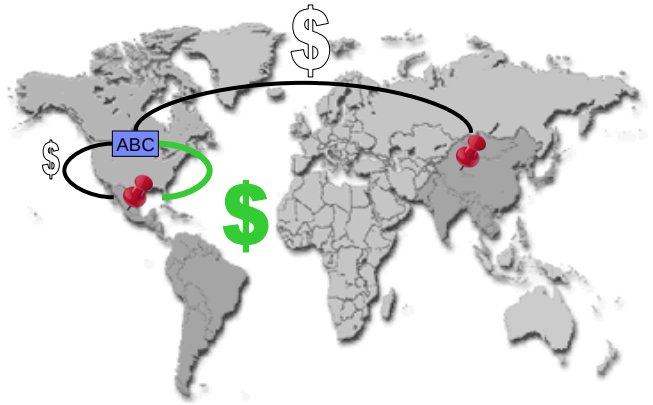



## As-Is


**Classic Value Equation =**
Least Production Cost *despite* the Transportation Cost

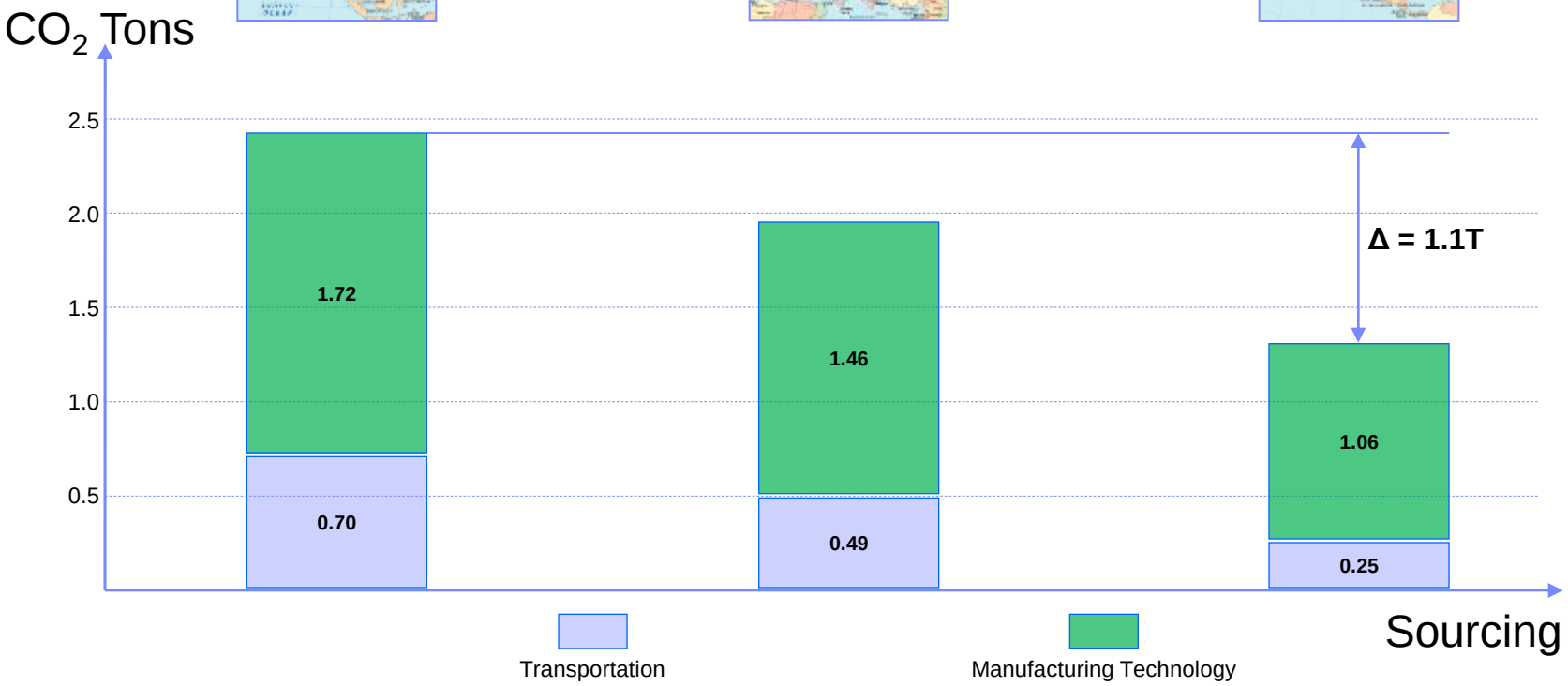
## To-Be




***New "Green"* Value Equation =**
Actual Cost (Production + Transportation) **+** Corresponding Carbon Cost

# The Sourcing Strategy Articulation – Carbon, Technology & Distance

*Tons of $CO_2$ per 1 Ton of Steel sourced from various locations / manufacturing technologies*



# Network Optimization Strategy

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THINK OUT OF THE SUPPLY CHAIN

Market Demand


Potential DC Locations


**Classic Optimization Approach**

Minimize Total Cost – select DC's so as to minimize the total DC and transportation costs of meeting demands

**VS.**

***Green*** **Optimization Approach**

Minimize $CO_2$ Emissions – objective function changes from minimization of total cost to minimization of total $CO_2$ emissions (equivalently, total miles traveled)

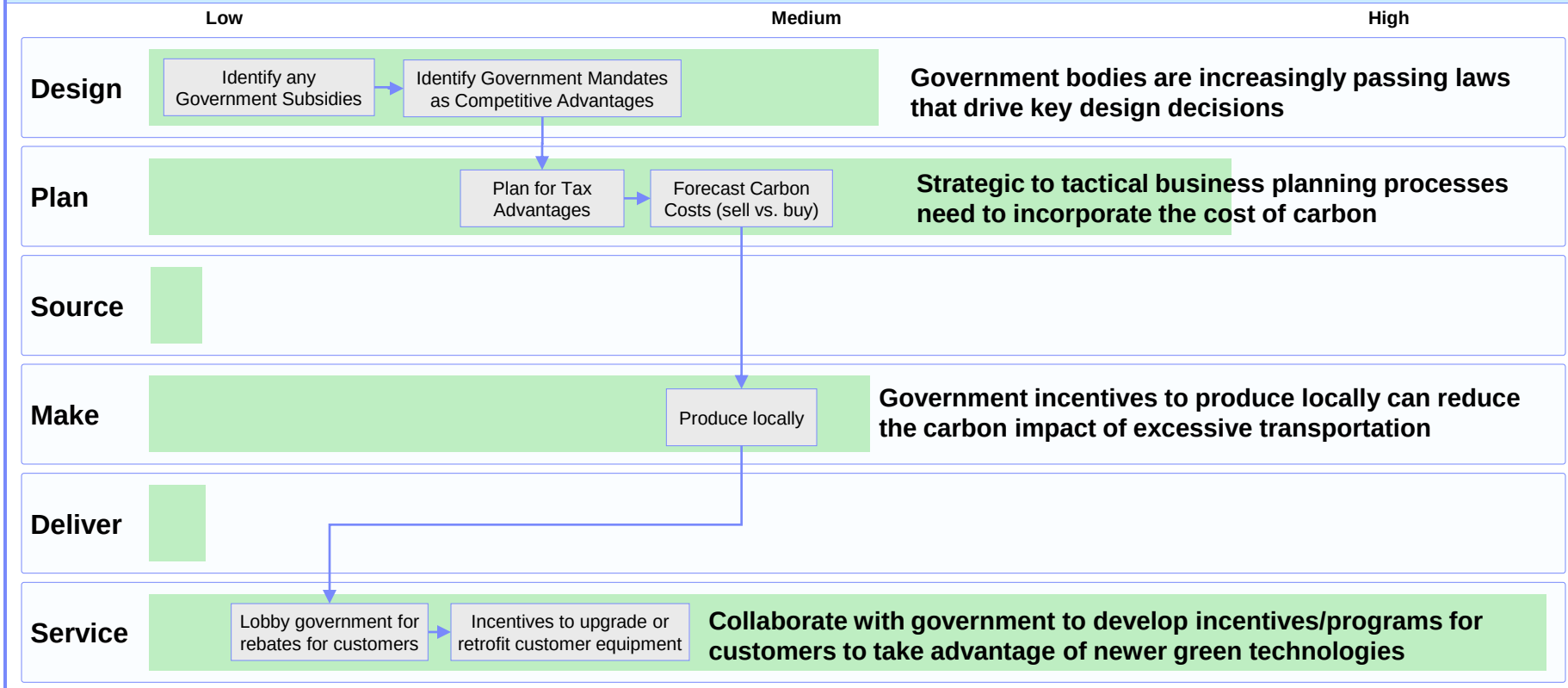
# Green Based Tax Planning and Strategies

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

## Qualitative Scenario – Green Tax Planning and Strategies

| Description | Impact Factors | Complexity Factors |
|---|---|---|
| The recent focus by regulatory bodies to influence industry led efforts promote green initiatives presents a great opportunity to change/re-evaluate tax incentives based on a green supply chain | ▪ Accelerate the rate of green technologies adoption<br>▪ Predict and profit from the expanding carbon trading scheme | ▪ Working with the government can be needlessly slow and expensive<br>▪ Emerging markets maybe too small to support investment |

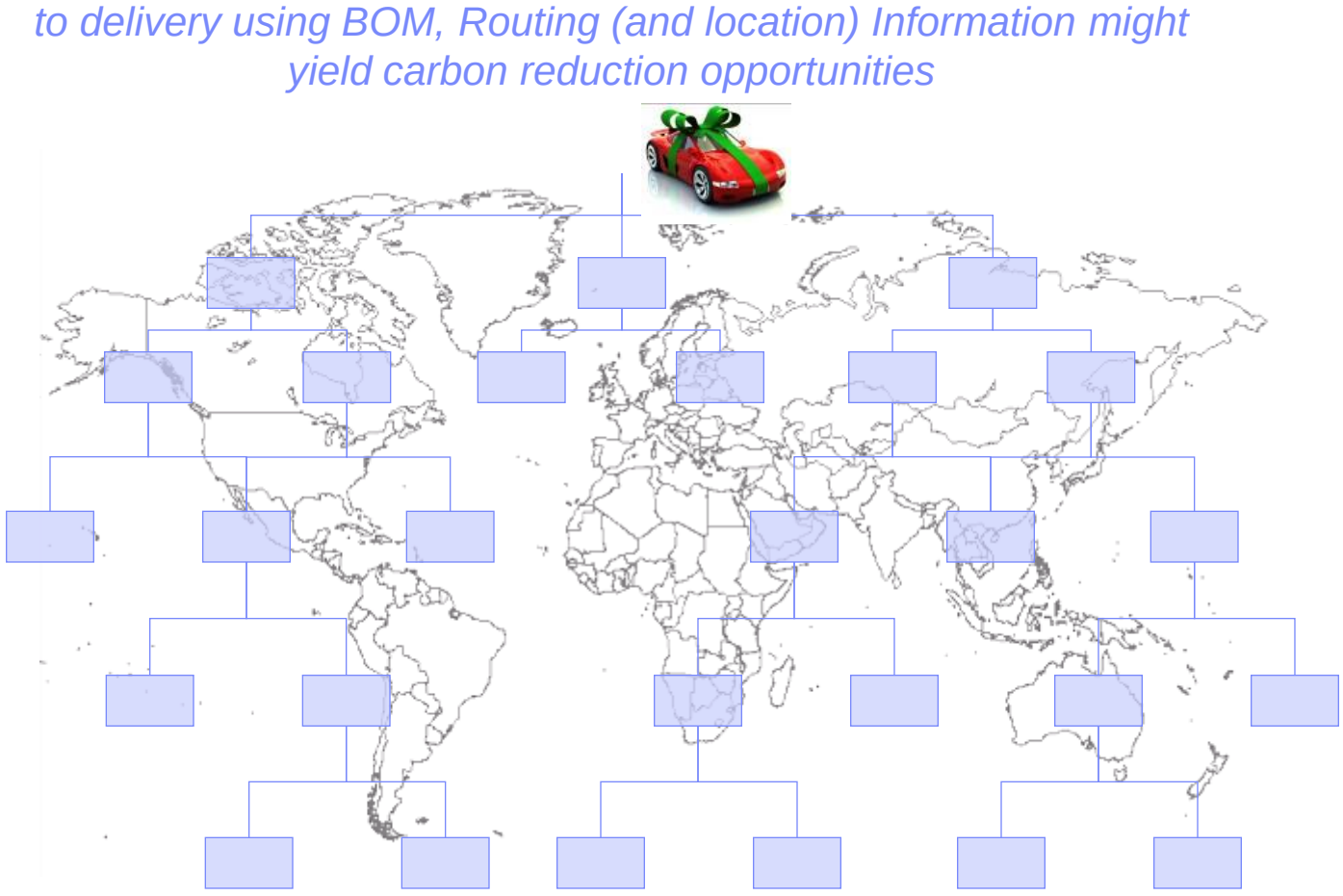
**Influence Diagram**



# Green Based Tax Planning and Strategies

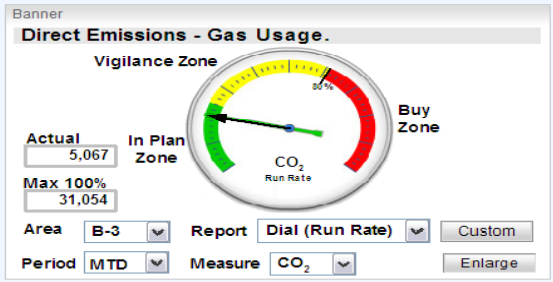
TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

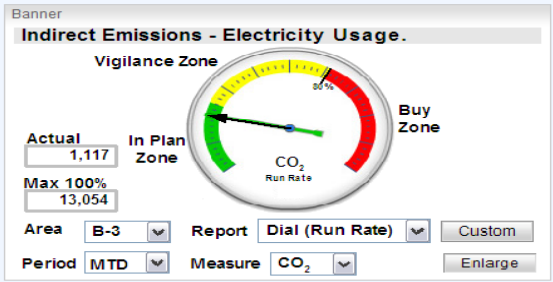
*A comprehensive look at a global product journey from inception to delivery using BOM, Routing (and location) Information might yield carbon reduction opportunities*

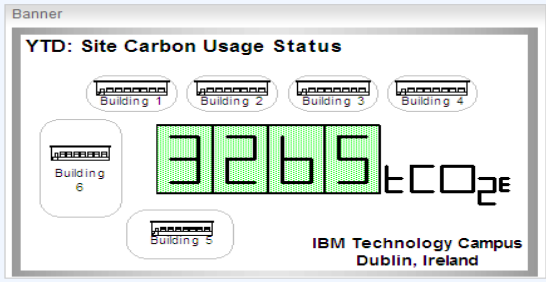


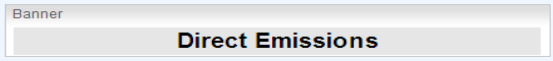
# Green Sigma™ – Carbon Management Dashboard

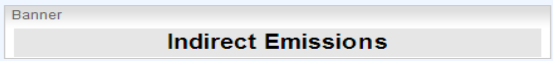
TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

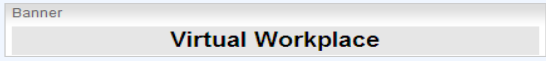


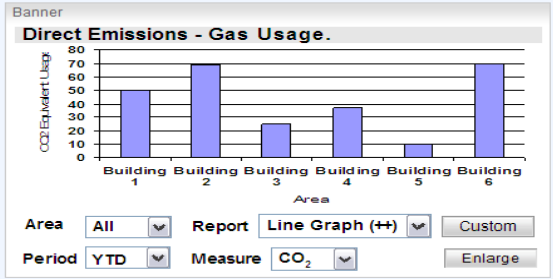



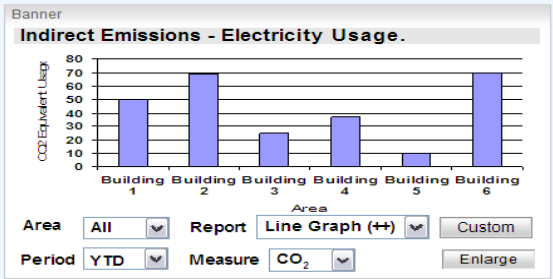



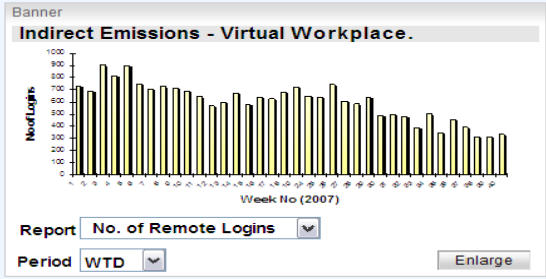



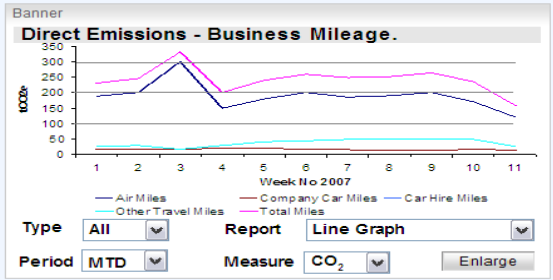



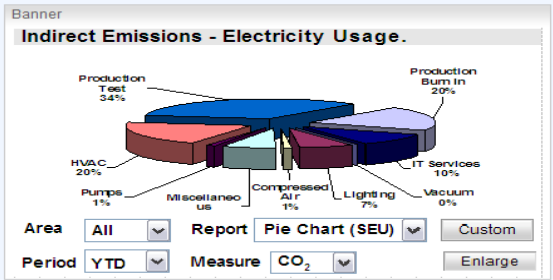



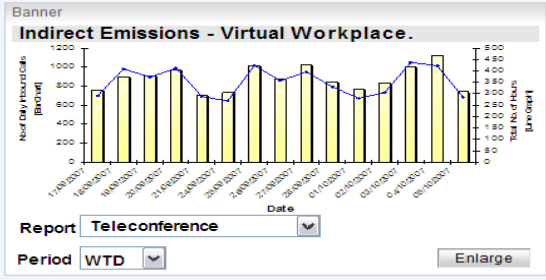



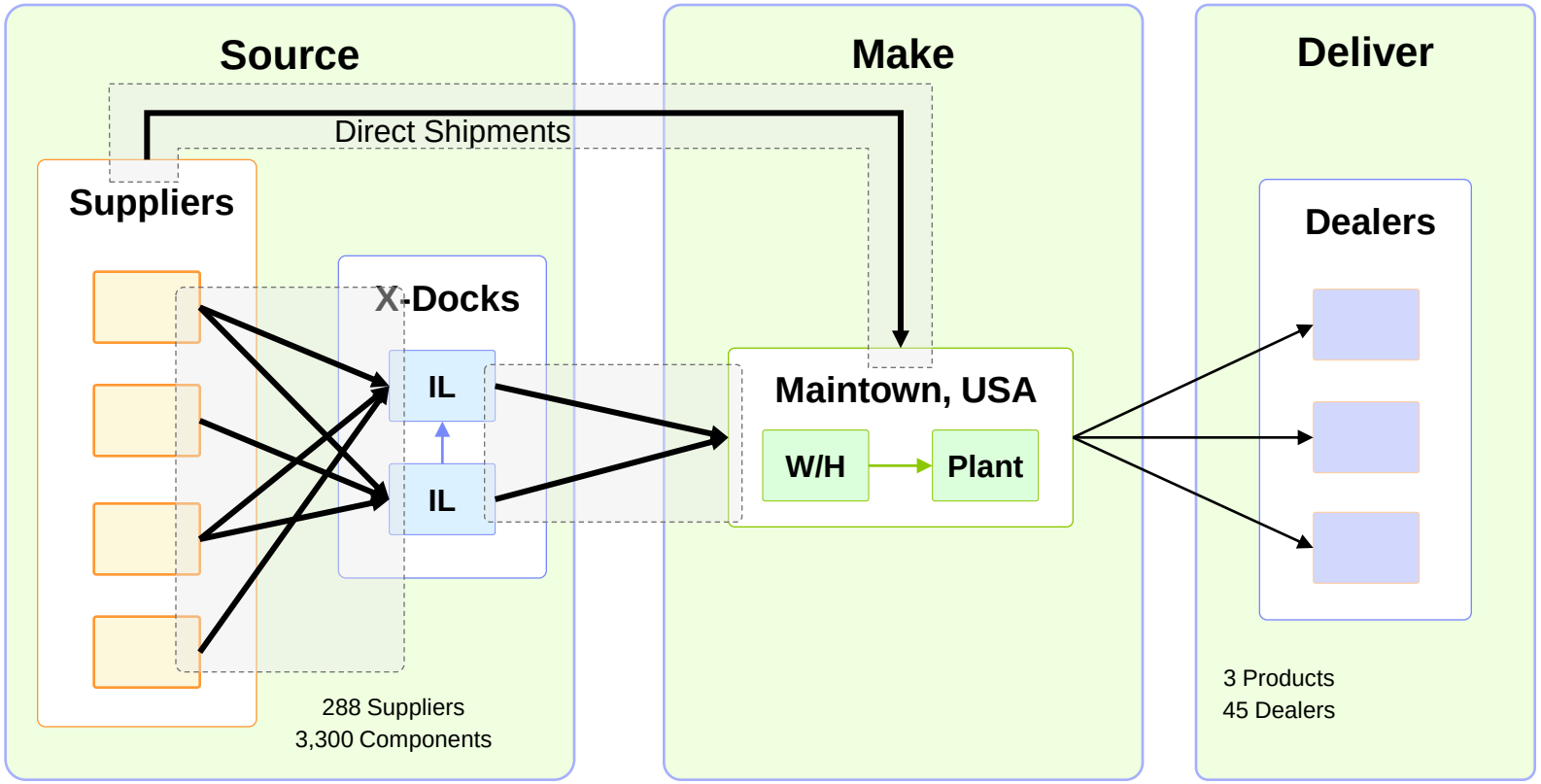



# Carbon Analyzer tool



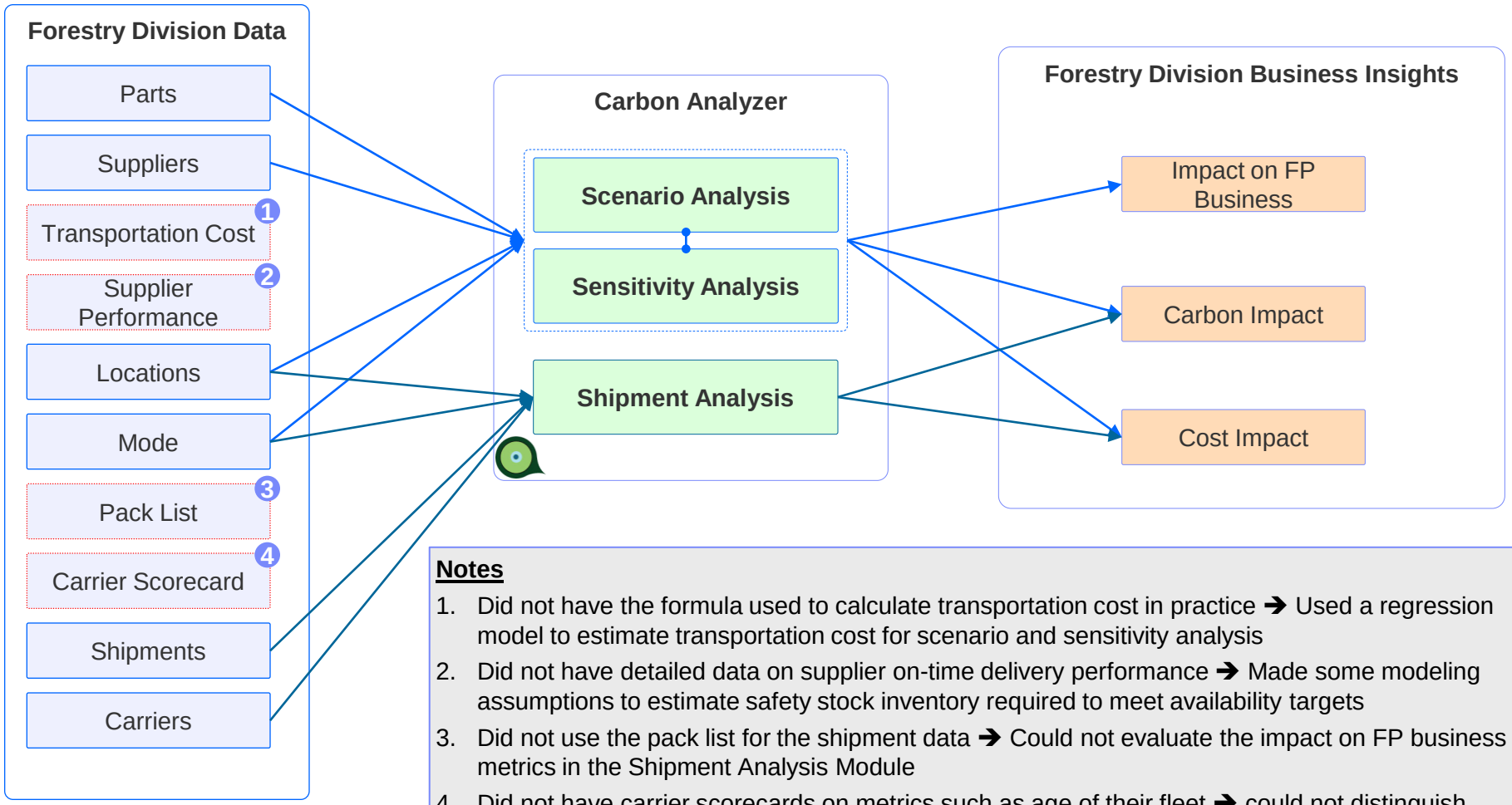

**Assumptions (data approximations):**

1. Did not have the formula used to calculate transportation cost in practice ➔ Used a regression model to estimate transportation cost for scenario and sensitivity analysis
2. Transportation cost does not change with change in fuel type
3. Carbon emission by mode type is proportional to variable shipping cost

Flow attributes modeled:

- $CO_2$ emissions
- Transportation
  - Cost ($)
  - Fuel Type
  - Mode
  - Consolidation
- Various inventory metrics

# Carbon Analyzer Summary View




**Notes**

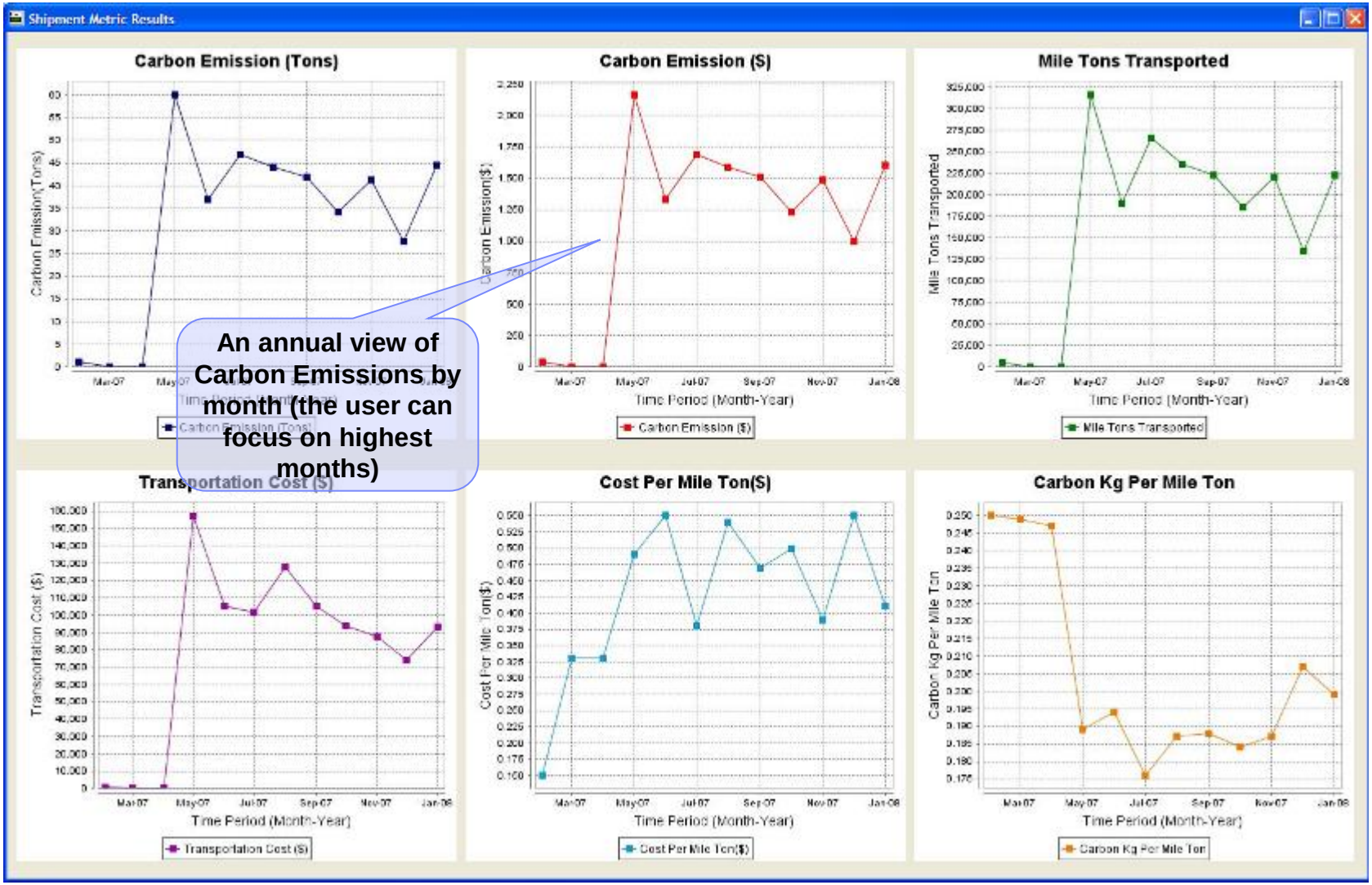
1. Did not have the formula used to calculate transportation cost in practice ➔ Used a regression model to estimate transportation cost for scenario and sensitivity analysis
2. Did not have detailed data on supplier on-time delivery performance ➔ Made some modeling assumptions to estimate safety stock inventory required to meet availability targets
3. Did not use the pack list for the shipment data ➔ Could not evaluate the impact on FP business metrics in the Shipment Analysis Module
4. Did not have carrier scorecards on metrics such as age of their fleet ➔ could not distinguish between carriers operating a given mode in terms of their carbon impact

# Quantitative Analysis & Business Insights

*Some Insights from the Carbon Analyzer tool using the* ***Shipment*** *Analysis Module*

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

**A Summary View at Inbound Logistics History**



# Quantitative Analysis & Business Insights

*Some Insights from the Carbon Analyzer tool using the **Shipment** Analysis Module*

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

## Shipment Analysis

ABC, Inc. has the opportunity to cut its carbon emissions by exploring some options provided by the tool (e.g. fuel type, shipment mode, etc.) at minimum or no incurred cost

Data Granularity: Low → High

| | |
|---|---|
| **If ABC, Inc. wants to decrease carbon emissions by 20%** | **Transition 8 states to Natural Gas, or<br>Transition 5 states to TL, or<br>Transition 3 states to Natural Gas and TL, or<br>Transition 2 carriers to Natural Gas & TL** |
| What if ABC, Inc. transitioned three top carriers to natural gas?<br>(Roadway, ATS Specialized Inc., Star Transport Inc.) | **Total carbon emissions would go down by 10%** |
| What if ABC, Inc. transitioned its three top states to 100% natural gas?<br>(IL, TX., GA) | **Total carbon emissions would go down by 11%** |
| What if ABC, Inc. transitioned its six top cities to 100% natural gas?<br>(La Grange, GA; Laredo, TX; Morton, IL; Gurley, NE; Brownsville, TX; Siler City, NC) | **Total carbon emissions would go down by 10%** |
| What if ABC, Inc. transitioned just one Roadway route to TL from LTL? And switched this route to Natural Gas<br>(supplier X5906U0 from Brownsville, TX to La Grange, GA) | **Total carbon emissions would go down by 2.6%, and another 0.7% for second route<br>Total transportation costs would increase by 0.96%*** |

*Based on data that TL rate is more expensive than LTL rate

# Quantitative Analysis & Business Insights

*Some Insights from the Carbon Analyzer tool using the **Shipment** Analysis Module*

TEKNOKRET
THINK OUT OF THE SUPPLY CHAIN

Carrier Level

| % CU... | % CU... | RANKING | CARBON_E... | TRANSPOR... | FUEL | FUELMIX | TLSHIPME... | CARRIER_... | CARBON_E... | TRANSPOR... | C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Natural Gas | 100 | 0 | | | | |
| 6.29 | 0.00 | 1 | 6.29 | 0.00 | Natural Gas | 100 | 0 | ROADWAY ... | 74.43 | 146,363.75 | |
| 8.16 | 0.00 | 6 | 1.87 | 0.00 | Natural Gas | 100 | 0 | ATS SPECIA... | 22.19 | 112,026.91 | |
| 9.96 | 0.00 | 7 | 1.80 | 0.00 | Natural Gas | 100 | 0 | STAR TRAN... | 21.29 | 45,042.85 | |
| 11.75 | 0.00 | 8 | 1.79 | 0.00 | Natural Gas | 100 | 0 | AVERITT E... | 21.20 | 40,982.65 | |
| 13.14 | 0.00 | 10 | 1.39 | 0.00 | Natural Gas | 100 | 0 | MAVERICK ... | 16.45 | 28,778.90 | |
| 14.22 | 0.00 | 12 | 1.08 | 0.00 | Natural Gas | 100 | 0 | AIR-LAND ... | 12.78 | 30,848.51 | |
| 15.26 | 0.00 | 13 | 1.04 | 0.00 | Natural Gas | 100 | 0 | WARREN T... | 12.31 | 74,271.70 | |
| 16.20 | 0.00 | 15 | 0.94 | 0.00 | Natural Gas | 100 | 0 | BRUBAKER ... | 11.09 | 72,381.79 | |
| 16.91 | 0.00 | 17 | 0.71 | 0.00 | Natural Gas | 100 | 0 | LONE STAR... | 8.41 | 25,624.37 | |
| 17.23 | 0.00 | 21 | 0.32 | 0.00 | Natural Gas | 100 | 0 | TRACK XPR... | 3.86 | 17,932.80 | |
| 17.45 | 0.00 | 22 | 0.22 | 0.00 | Natural Gas | 100 | 0 | ALLISON T... | 2.57 | 38,600.00 | |
| 17.59 | 0.00 | 24 | 0.14 | 0.00 | Natural Gas | 100 | 0 | SHARKEY T... | 1.69 | 1,244.54 | |
| 17.73 | 0.00 | 25 | 0.14 | 0.00 | Natural Gas | 100 | 0 | PROVINCIA... | 1.63 | 2,202.28 | |
| 17.85 | 0.00 | 26 | 0.12 | 0.00 | Natural Gas | 100 | 0 | G & D TRA... | 1.49 | 3,374.06 | |
| 17.97 | 0.00 | 27 | 0.12 | 0.00 | Natural Gas | 100 | 0 | FOX TRAN... | 1.45 | 11,466.76 | |
| 18.06 | 0.00 | 30 | 0.09 | 0.00 | Natural Gas | 100 | 0 | RICHMAN... | 1.11 | 877.45 | |
| 18.13 | 0.00 | 33 | 0.07 | 0.00 | Natural Gas | 100 | 0 | LANDSTAR ... | 0.79 | 2,200.00 | |
| 18.17 | 0.00 | 34 | 0.04 | 0.00 | Natural Gas | 100 | 0 | SUN BELT T... | 0.50 | 1,706.40 | |
| 18.21 | 0.00 | 35 | 0.04 | 0.00 | Natural Gas | 100 | 0 | ROWE MAC... | 0.47 | 10,531.34 | |
| 18.24 | 0.00 | 37 | 0.03 | 0.00 | Natural Gas | 100 | 0 | DHL GLOB... | 0.32 | 10,968.84 | |
| 18.26 | 0.00 | 39 | 0.02 | 0.00 | Natural Gas | 100 | 0 | PAYNE TRA... | 0.24 | 2,257.97 | |
| 18.26 | 0.00 | 44 | 0.00 | 0.00 | Natural Gas | 100 | 0 | NUSSBAUM... | 0.04 | 39.57 | |
| 19.14 | 0.00 | 999999 | 0.88 | 0.00 | Natural Gas | 100 | 0 | TRI-STATE ... | 10.44 | 20,609.76 | |
| 19.32 | 0.00 | 999999 | 0.18 | 0.00 | Natural Gas | 100 | 0 | UPS SUPPL... | 0.06 | 1,364.76 | |
| 19.45 | 0.00 | 999999 | 0.13 | 0.00 | Natural Gas | 100 | 0 | WERNER E... | 2.11 | 1,471.33 | |
| 19.65 | 0.00 | 999999 | 0.20 | 0.00 | Natural Gas | 100 | 0 | UPS [illegible] | 1.50 | 089.56 | |
| 20.45 | 0.00 | 999999 | 0.80 | 0.00 | Natural Gas | 100 | 0 | [illegible] | 2.39 | [illegible] | |
| 20.85 | 0.00 | 999999 | 0.40 | 0.00 | Natural Gas | 100 | 0 | DOHR[illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Natural Gas | 100 | 0 | T C F I[illegible] | [illegible] | [illegible] | |
| 21.50 | 0.00 | 999999 | 0.65 | 0.00 | Natural Gas | 100 | 0 | VITRA[illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Natural Gas | 100 | 0 | YELLO[illegible] | [illegible] | [illegible] | |
| 21.51 | 0.00 | [illegible] | [illegible] | [illegible] | Natural Gas | 100 | 0 | R & L C[illegible] | 0.00 | 159.42 | |
| 21.59 | 0.00 | 999999 | 0.08 | 0.00 | Natural Gas | 100 | 0 | USF HOLLA... | 0.97 | 2,436.97 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Natural Gas | 100 | 0 | BILL THOM... | 11.43 | 31,005.53 | |

1 Switching the top 3 Carriers to 100% Natural Gas would cut Carbon by 10%

2 Switching the top 7 Carriers to 100% Natural Gas would achieve that goal

**1** What if ABC, Inc. transitioned three top carriers to 100% natural gas?
(Roadway, ATS Specialized Inc., Star Transport Inc.)

**2** What if ABC, Inc. is asked to cut its carbon emissions by 15%?

# Quantitative Analysis & Business Insights

*Some Insights from the Carbon Analyzer tool using the **Scenario Analysis Module***

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## Scenario Analysis

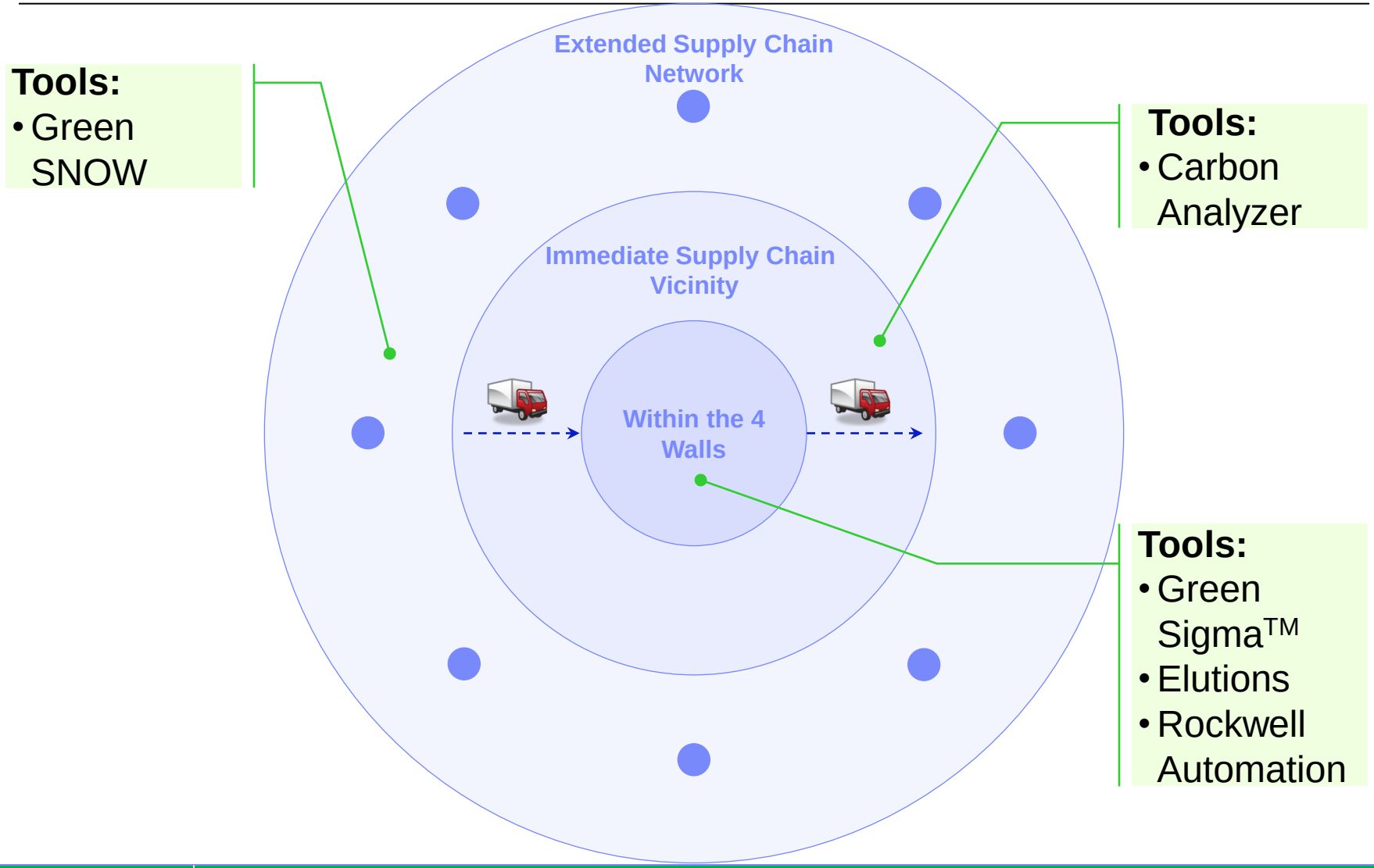
| | |
|---|---|
| What if ABC, Inc. transitioned all carriers to Natural Gas? | **Total carbon emissions would go down by 23%** |
| What if ABC, Inc. improves supplier reliability from 70% to 90% in order to make inventory availability to manufacturing 99%? | **Inventory turns increase by 13%<br>Inventory liability decreases by 37%** |
| If ABC, Inc. demand doubled, by what % would carbon costs increase? by what % would transportation costs increase? | **Total carbon costs increase by 73%<br>Total transportation costs increase by 64%** |
| What if a new regulatory environment pushed the $CO_2$ ton from $5 (current Chicago pricing) to $80 | **Total cost goes up by 4%<br>(i.e. inventory carrying charge + transportation cost + carbon cost)** |

# Objectives

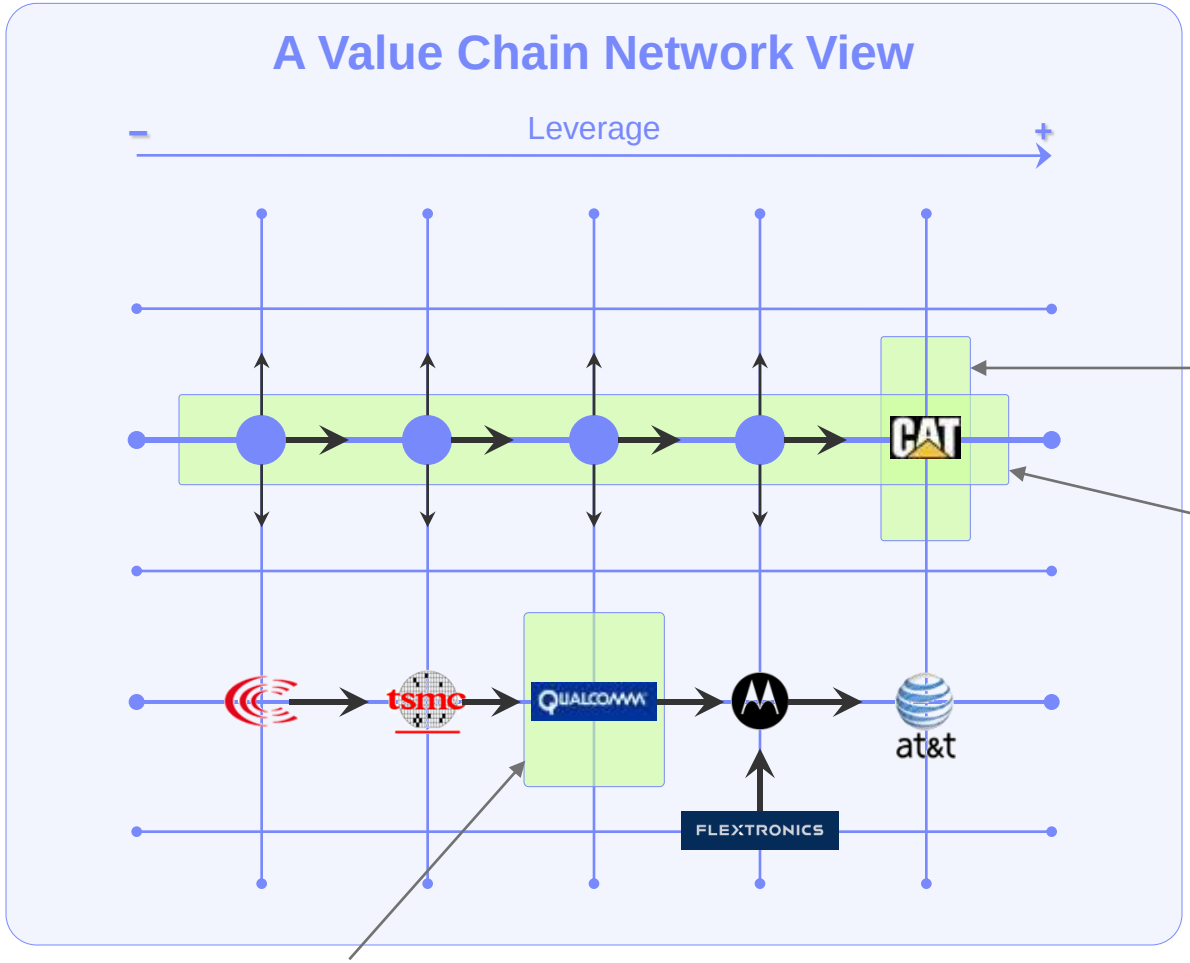
- **Green Supply Chain Discussion**
  - **The Why?**
  - **The How?**
    - **Section 1**
      - **Where to Start? How to Quantify the Opportunity?**
    - **Section 2**
      - How to go about analyzing the supply chain carbon footprint?
    - **Section 3**
      - Some Quantitative Scenarios
      - Some Qualitative Scenarios
- **Final Thoughts**

# The Inside-Out Strategy

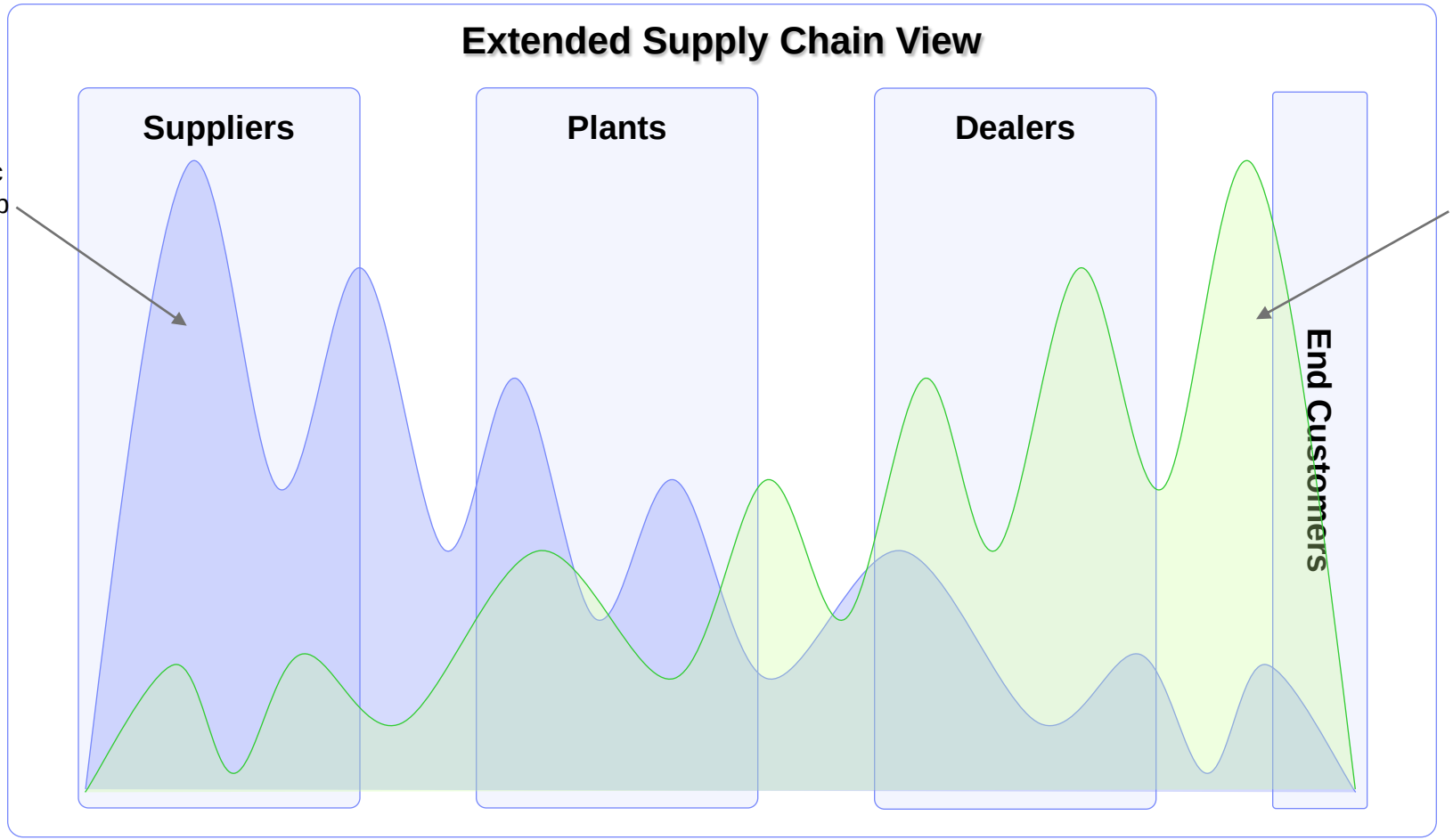
*A Summary of Our Thinking and Tools at Our Disposal*



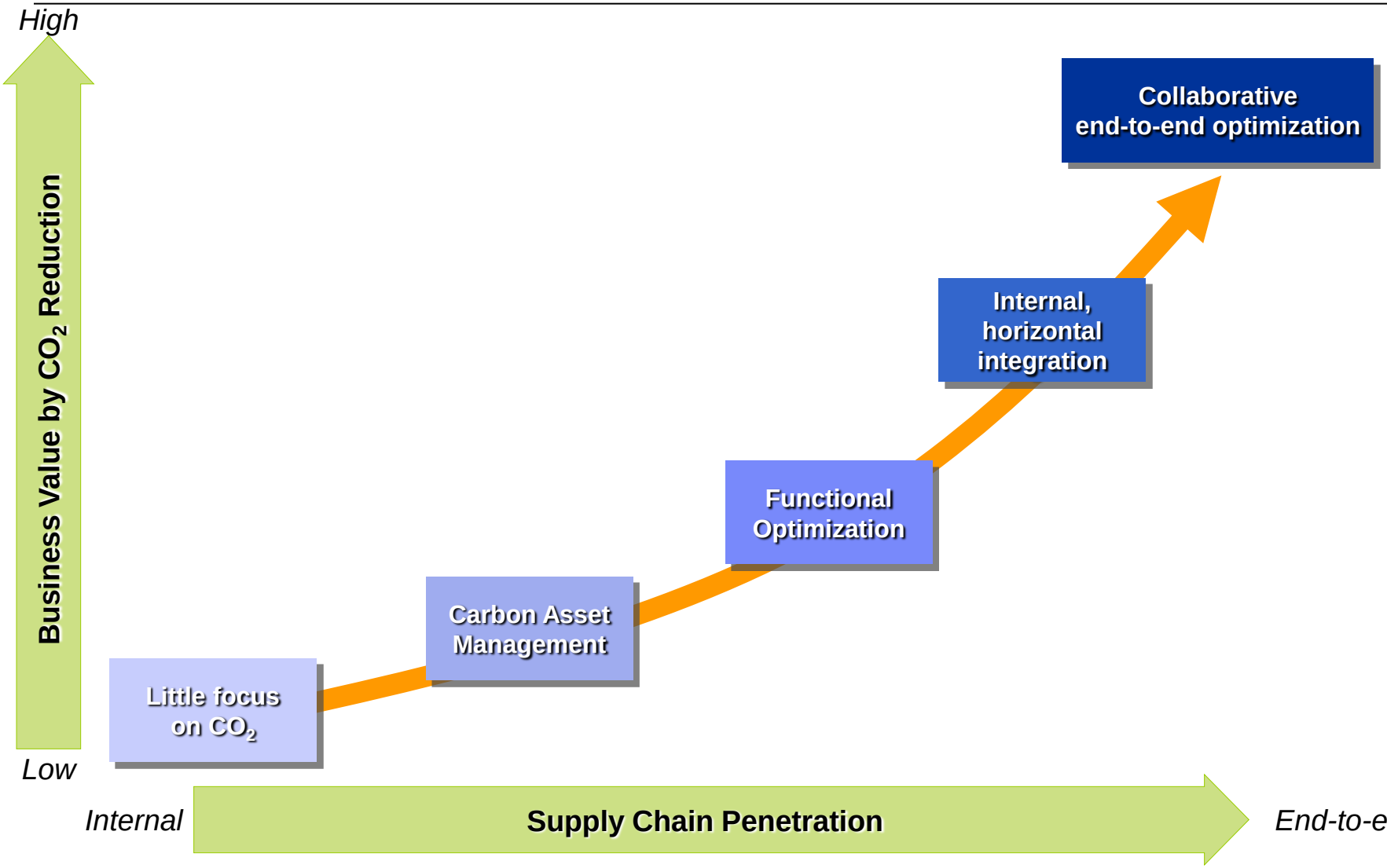
# Carbon Reduction Needs to be a Value Chain Affair



# Carbon Buildup Effect



# Supply Chain Carbon Mastery Model



# Borrowing a Line from Gartner's Hype Cycle – Where Are We?

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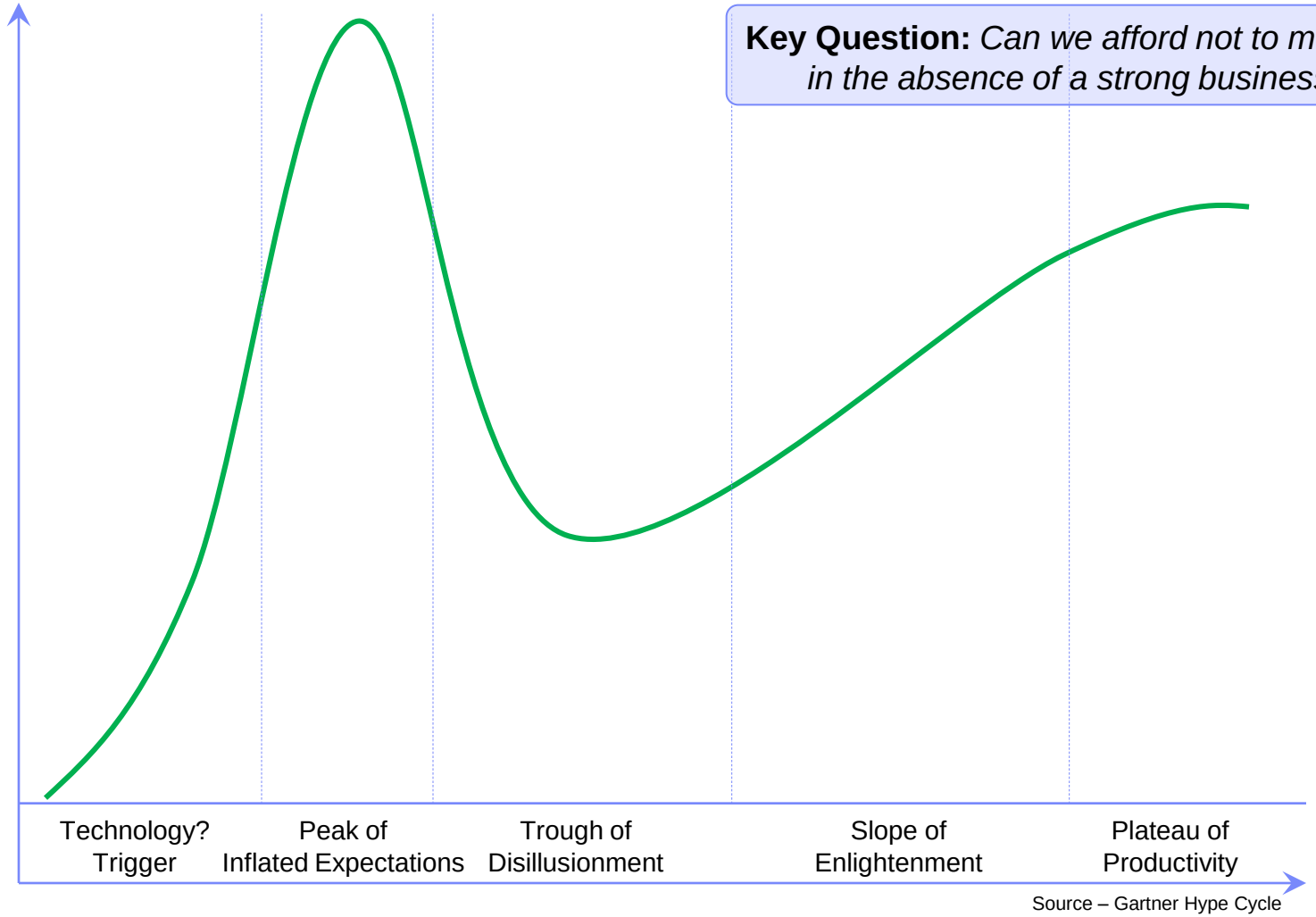
**Key Question:** *Can we afford not to move forward in the absence of a strong business case?*




Source – Gartner Hype Cycle

# Does the Technology Adoption Life Cycle Apply Here?

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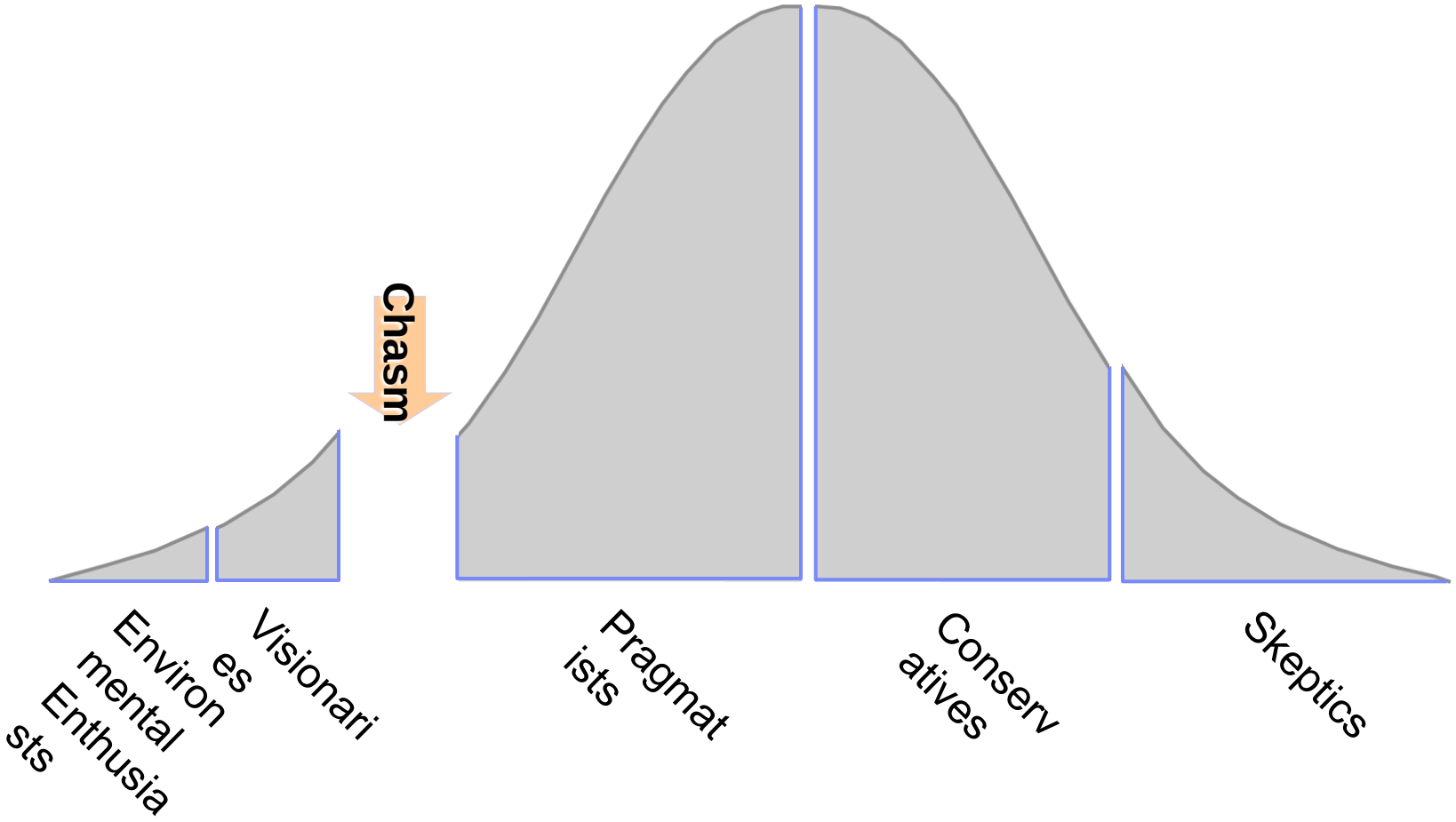
**Key Question:** *Does the work of the few make a real difference?*



# Our Supply Chain Consulting Practice Offerings

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***Our depth and breadth of capabilities make us uniquely positioned to help our clients with every facet of their Supply Chain needs***

# Thank You

**Visit and contact us at http://www.teknokret.com for more assistance with this.**