

# Freight Demand Management: Role in Sustainable Urban Freight Systems

**José Holguín-Veras,**

**William H. Hart Professor**

**Director of the VREF Center of Excellence  
for Sustainable Urban Freight Systems**

**[jhv@rpi.edu](mailto:jhv@rpi.edu)**

# The Challenge



## ❖ Economic Globalization

## ❖ Urbanization:

- ❖ World's population: 7+ billion people, 9 billion by 2045
- ❖ In 2010, for the first time, 50% of world population is urban, by 2050, 70% of the world population will be urban
- ❖ In US/Canada/Europe, the future is here: +80% urban

## ❖ Impacts of the Internet on Supply Chains:

- ❖ Millions of citizens expect fast and inexpensive deliveries
- ❖ The diminished importance of proximity to customers as a competitive advantage, together with anti-freight attitudes and policies, leads to logistical sprawl

## ❖ Increased Citizen Expectations



This is what we all want...







**This is what we need to change...**

# Who needs to change behavior??

- ❖ Not only the freight carriers → entire supply chains need to change behavior...




# The Urban Freight System



# The Freight System

- ❖ The conglomerate of all the economic entities involved in the generation, transportation, consumption, and transformation of cargo
- ❖ Key agents:
  - ❖ Producers, the ones that manufacture/produce the goods
  - ❖ Shippers, the ones that send the goods
  - ❖ Receivers, the ones that use the goods transported
  - ❖ Carriers, the ones that transport the goods
  - ❖ Ancillary functions: warehouses, distribution centers, etc.
- ❖ The typical power relations:
  - ❖ Shippers have power over Carriers
  - ❖ Receivers have power over Shippers

These are key to  
behavior change





# Inter-linkages among freight agents

## ❖ Key insights

- ❖ The carriers cannot unilaterally change operations, they are the weakest element of the chain
- ❖ Although the carriers are the ones that produce the externalities, the actual source of the problem is the demand
- ❖ In most cases, the carriers have no choice...

## ❖ Due to competitive market forces:

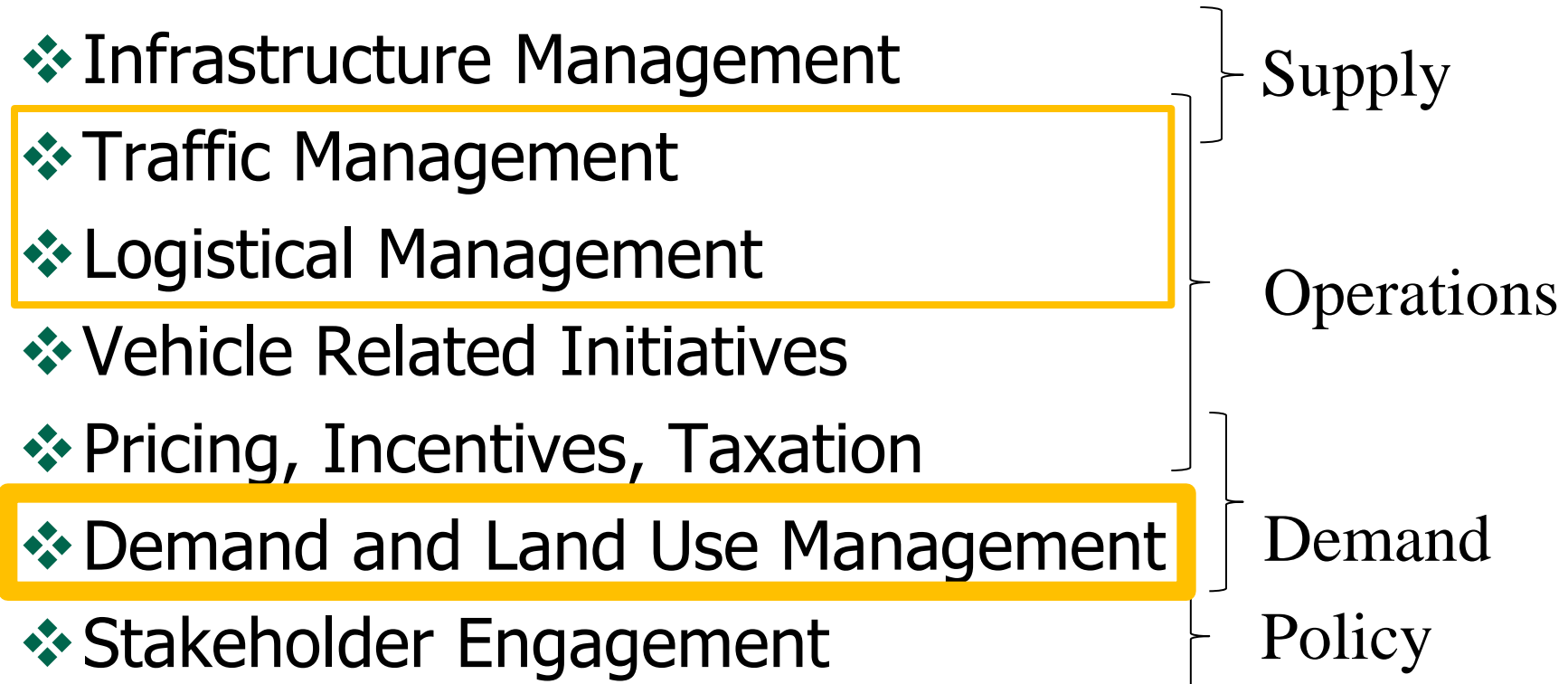
- ❖ Carriers are very efficient from the private point of view, not necessarily efficient from the social point of view
- ❖ In many instances, if carriers could freely decide how to do things (without constraints), private optimal solutions would coincide with social optimal
- ❖ The solution: modify the markets thru policy interventions

# What Could Be Done To Foster Sustainable Urban Freight Systems?

Based on the research conducted as part of NCFRP 38  
“Improving Freight System Performance in Metropolitan Areas”



# Groups of Public Sector Interventions



**For a comprehensive Initiative Selector, see:**  
**<http://transp.rpi.edu/~NCFRP38PG/assessment.htm>**





# Freight Demand Management: The Next Frontier



# Freight Demand Management

- ❖ It focuses on inducing changes in demand, by influencing the economic agent(s) that generate the demand for freight...
- ❖ Holds great potential because these agents have a great deal of power over supply chains...using this power could transform supply chains for the better
- ❖ Examples:
  - ❖ Off-hour deliveries
  - ❖ Retiming of deliveries
  - ❖ Receiver-led consolidation programs
  - ❖ Transport for London took advantage of the four Rs (Retime, Reduce, Re-route, Revise mode) during the London Olympics achieving a 10% reduction in large truck traffic

# Off-Hour Delivery Programs





# A project that has been, at times...

- ❖ A science mystery
- ❖ A political thriller
- ❖ A melodrama
- ❖ A comedy
- ❖ A Greek tragedy
- ❖ A good drama with a happy ending...



# Voluntary Off-Hour Delivery Programs

- ❖ Induce a shift to deliveries made during the off-hours (7PM to 6AM), by providing incentives to receivers for their commitment to accept off-hours deliveries (OHD)
- ❖ Purpose: reduce congestion and pollution during daytime hours
- ❖ Could switch to off-hours 20-40% of delivery traffic

## Examples:

- ❖ PierPass Program, California
- ❖ OHD, New York City



# 1st Phase: Pilot Test

17

- ❖ At the beginning, nobody wanted to participate... the obstacles were perceived to be unsurmountable... biggest challenge → need for multi-party cooperation
- ❖ Three separate one-month stages:
  - ❖ Foot Locker (ten stores)/NDL
  - ❖ Whole Foods (four stores)
  - ❖ Sysco (twenty one stores)
- ❖ About 35 receivers, 20 trucks/vendors
  - ❖ Half doing staffed OHD
  - ❖ Half doing unassisted OHD





# Regular vs. Off-Hour Deliveries



# Regular vs. Off-Hour Deliveries

19



# Results From Satisfaction Surveys

**Scale: 1= Very favorable,  
5= Very unfavorable**

❖ Carriers/Vendors: 1.55

❖ Drivers:

❖ Travel speeds = 1.33

❖ Parking = 1.11

❖ Time to deliver = 1.38

❖ Time to complete the route = 1.44

Congestion = 1.11

Stress levels = 1.11

Feeling of safety = 1.86

❖ Receivers:

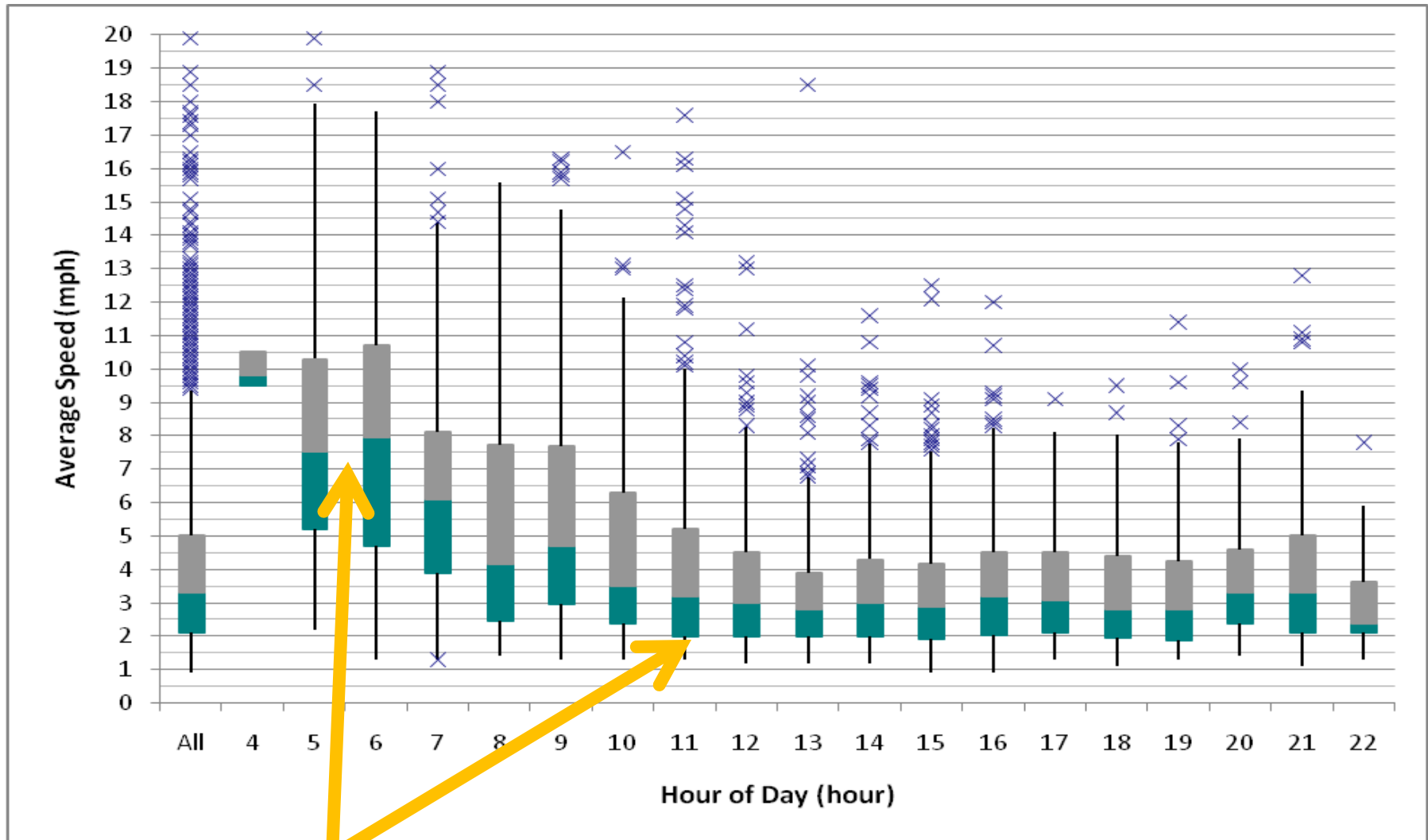
❖ Impression of off-hour deliveries = 1.50

❖ How likely are you to off-hour deliveries = 1.42

❖ If all liability issues were addressed, would you be interested in receiving unassisted OHD? = 2.17

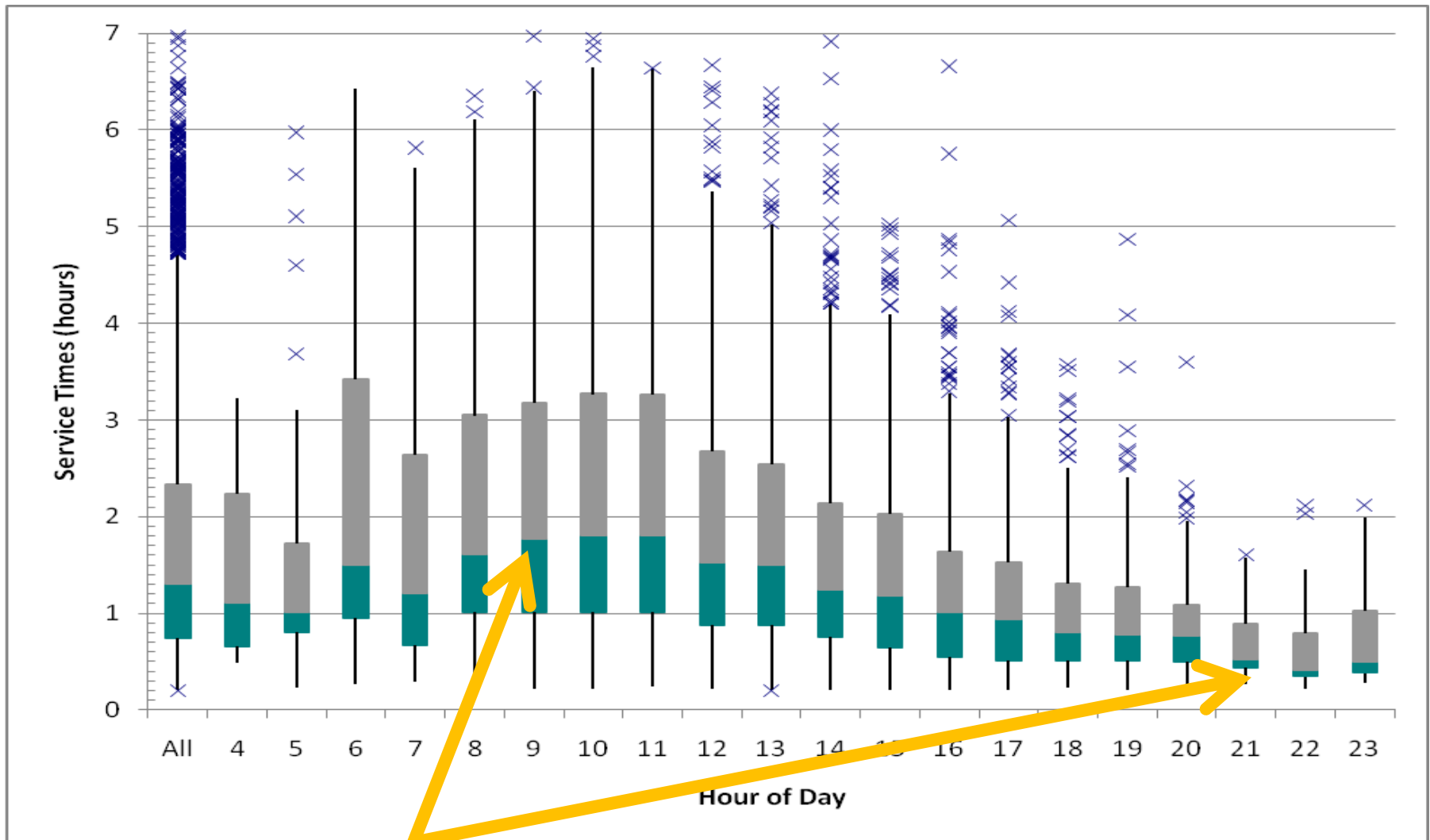


# Average Space Mean Speeds



**More than twice as fast**

# Average Service Times



**More than three times as fast**

# After the End of the Pilot

- ❖ All of the receivers doing staffed OHD reverted back to the regular hours
- ❖ Almost all the receivers doing unassisted OHD remained in the off-hours
  - ❖ The reason: reliability of OHD
  - ❖ “Our locations will continue to receive ‘night drops’ even though this program has ended as our managers now favor the dependability of night drops vs. late day time deliveries. Thanks again for the program.”  
Nick Kenner, Managing Partner, Just Salad LLC
- ❖ **Key lesson:** Unassisted OHD work for large numbers of receivers, and do not require on-going incentives

## 2<sup>nd</sup> phase: Unassisted OHD

- ❖ Main focus of the 2<sup>nd</sup> phase of the OHD project
  - ❖ Unassisted OHD:
    - ❖ Only a one-time-incentive is needed
    - ❖ Once they try it and like it, receivers stay in the off-hours
  - ❖ Large Traffic Generators (large buildings/establishments)
- ❖ Research was conducted to find out how to:
  - ❖ Foster:
    - ❖ Unassisted OHD at businesses establishments (retail and the food sector are the top priority)
    - ❖ OHD at Large Traffic Generators
  - ❖ Use technology to:
    - ❖ Reduce noise during OHD
    - ❖ Facilitate Unassisted OHD

## ❖ Key determinants in OHD participation:

- ❖ One-Time-Incentive (financial)
- ❖ Discounts from vendors (financial)
- ❖ Business Support Services to participants
- ❖ Public Recognition to participants
- ❖ Trusted Vendor Certification programs

## ❖ Suggestions:

- ❖ Public → Incentives, Business Support, Public Recognition
- ❖ Carriers/vendors → Shipping discounts
- ❖ Business groups → Create a “Trusted Vendor” program

## ❖ Re-align federal/state incentive programs:

- ❖ Environmental, economic, etc. to support OHD
- ❖ Require recipients to accept OHD

# Current Status...

- ❖ Key participants (+400 companies):
  - ❖ Sysco: 31 OHD routes/week (18% of their routes, 171) delivering to 140 unassisted off-hour delivery customers
  - ❖ Wakefern: 5 OHD routes/day (25% of their total)
  - ❖ Duane Reade: Approximately 120 of their 160 Manhattan stores receive OHD on a regular basis
  - ❖ Dunkin Donuts: 72 stores out of 121 in Manhattan
  - ❖ Beverage Works (Red Bull) has approximately 130 routes in the NY Metro, 22% are OHD
  - ❖ Waldorf Astoria





- ❖ Implementing various forms of off-hour delivery policies in Manhattan leads to:
  - ❖ Travel time savings to all highway users of about 3-5 minutes per trip
  - ❖ Travel time savings to carriers that switch to the off-hours of about 48 minutes per delivery tour
  - ❖ Savings in service times (per tour) could be up to 1-3 hours
- ❖ Depending on the extent of the implementation, economic savings are between \$100 and \$200 million/year in travel time savings and pollution reductions



# Environmental Pollution Reductions

28

<b>TOTAL/YEAR</b>				
<b>Scenario % OHD</b>	<b>CO (tonnes)</b>	<b>HC (tonnes)</b>	<b>NOx (tonnes)</b>	<b>PM<sub>10</sub> (kg)</b>
6.49%	101.20	24.05	3.00	20.29
14.10%	169.58	28.53	8.22	48.81
20.90%	202.75	39.97	11.82	69.99
25.34%	253.14	56.56	15.04	90.09
29.07%	383.81	55.76	26.33	149.86

## PER RECEIVER/YEAR

<b>% OHD</b>	<b>VMT (veh-mi)</b>	<b>VHT (veh-hrs)</b>	<b>CO (kg)</b>	<b>HC (kg)</b>	<b>NOx (kg)</b>	<b>PM10 (kg)</b>
6.49%	348.93	438.20	19.56	3.19	0.58	0.0039
14.10%	549.40	207.09	14.90	1.81	0.72	0.0043
20.90%	551.69	195.51	12.05	1.88	0.70	0.0042
25.34%	542.89	233.92	12.41	2.12	0.74	0.0044
29.07%	1,052.06	244.31	16.40	1.41	1.13	0.0064

# Average CO<sub>2</sub> Emissions

- ❖ Estimated using truck GPS data and the Comprehensive Modal Emission Model

Road type	Segment	Off-hours	Regular hours	Difference
<b>Highway (grams/mile)</b>	#1	2566.2	2636.8	-2.70%
	#2	1496.2	2408.0	-37.90%
	#3	2225.4	3365.9	-33.90%
<b>Toll Road (grams/mile)</b>	#1	2232.4	4006.4	-44.30%
	#2	2899.6	3607.9	-19.60%
	#3	2286.8	3660.0	-37.50%
<b>Manhattan (grams/mile)</b>	#1	1921.5	7747.8	-75.20%
	#2	4028.8	7036.3	-42.70%
	#3	2160.5	8458.7	-74.50%

# Noise



## ❖ 1<sup>st</sup> Layer: Commitment

- ❖ Code of conduct / Training
- ❖ Low noise strategies / tech.

## ❖ 2<sup>nd</sup> Layer: Training

- ❖ Driver behavior
- ❖ Low cost measures – noise absorbing materials
- ❖ Low noise trucks/equipment

## ❖ 3<sup>rd</sup> Layer: Enforcement

- ❖ NYC Depts. of Transportation and Environmental Protection monitor, investigate violations and enforce compliance



Rensselaer



### Code of Conduct and Standards for Participants in the NYC deliverEASE Program

The success of this program depends on an honest business relationship between carriers and receivers. Drivers, fleet managers and receiving companies participating in the NYC deliverEASE program must adhere to the following code of conduct:

#### COMMITMENT TO MAINTAIN A GOOD RELATIONSHIP WITH FELLOW CARRIERS AND RECEIVERS

**Receivers:** A receiving business shall ensure that anyone delivering to the location will have a safe and healthy work environment. The driver shall have no obstacles when delivering in the off-hours. Receivers will help identify strategies to accommodate unassisted deliveries if staff is not available.

**Carriers:** If needed a carrier will identify technologies and suggest changes to driver behavior for drivers to reduce any noise resulting from deliveries. If unassisted deliveries are taking place, the driver will ensure that the receiver's property is not damaged in any way and that the products being delivered are handled appropriately.

#### COMMITMENT TO THE COMMUNITY

**Health and Safety:** Participants shall ensure that food is handled safely and that food deliveries and storage adhere to the NYC Health Code.

**Quiet Neighbor:** In order to remain a quiet neighbor and respect the local community, receivers and carriers must ensure that the building and commercial vehicle infrastructure is designed to be as quiet as possible. All participants in NYC deliverEASE are encouraged to attend a free noise webinar to learn how to improve both infrastructure and behavior in order to make quiet deliveries in the off-hours and abide by the NYC Noise Code.

#### PARTICIPANTS SHALL MAKE EFFORTS TO MINIMIZE NOISE THEY PRODUCE WHILE MAKING DELIVERIES

##### Changes to driver behavior:

- Do not slam truck doors or lift gates (into truck or sidewalk)
- Do not shout
- Turn off the radio
- Reduce engine idling (3 minutes or less unless vehicle is used to operate equipment)
- Use equipment quietly and gently as to reduce noise

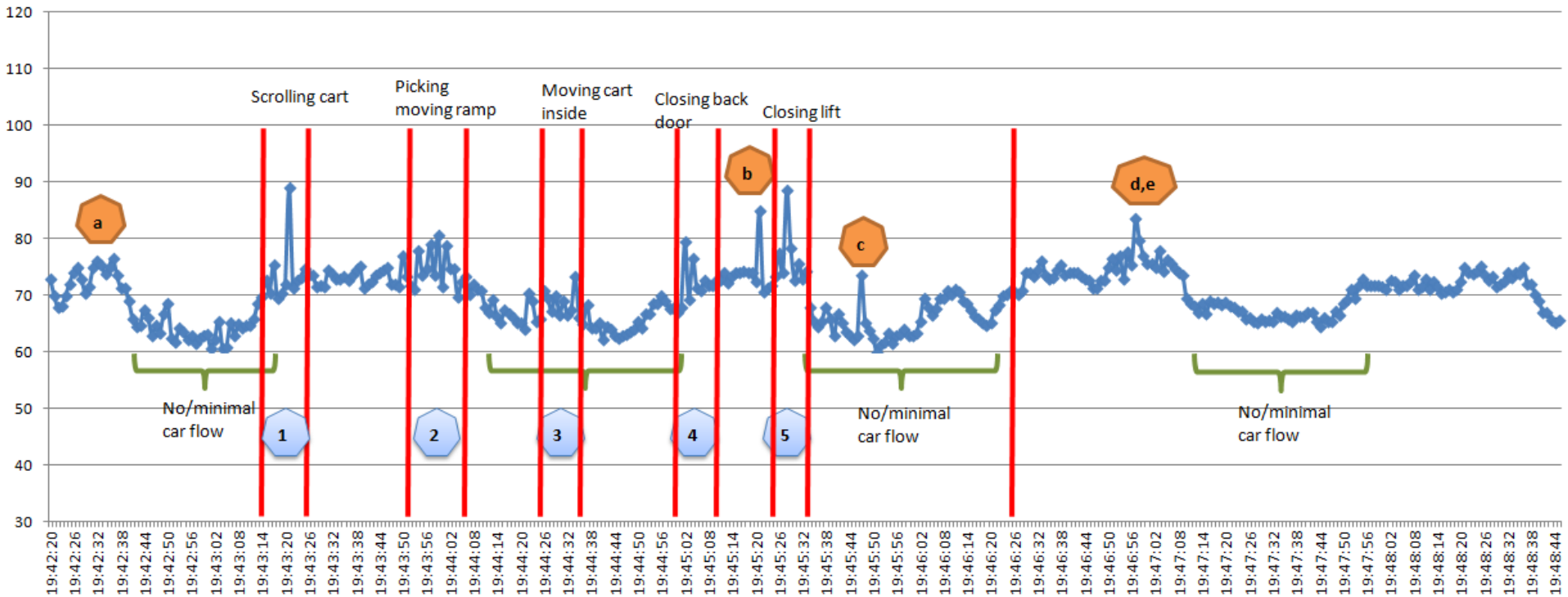
##### Physical changes for both carrier and receiver:

- As needed, provide retrofits for vehicles, store and equipment to reduce noise

The OHD team will provide information on how to make changes to driver behavior and what technologies can be used for retrofits to both reduce noise and support unassisted deliveries.

NYC DOT and Rensselaer Polytechnic Institute are committed to the highest standards of business conduct and require all participants to treat employees fairly and all employees to perform their job with the utmost level of professionalism.

# Noise Profile of a Delivery Truck





# There is Public Support...as Reflected by Media

**THE WALL STREET JOURNAL**  
U.S. EDITION Thursday, July 1, 2010

Home World U.S. New York Business Tech Markets  
News Sports Culture Real Estate

TOP STORIES IN New York

NEW YORK | July 1, 2010

## Congestion R


Article

By ANDREW GROSSMAN

New York City wants to sneakers to make more

Twenty-five businesses deliveries after 7 p.m. a program that offers inc Positioning Systems so

The truckers saw benefit usage. All of the particip program ended in Januar Sadik-Khan.



Bridge Image

Avenue from New Jersey take an hour and a half

"It's physics. The only way have the space. We have

But residents expect street and retailers frequently said she thinks residents

## Fleets Say They Discovered Through New York's N

By Michele Fuetsch  
Staff Reporter

When Joe Killen heard that New York City needed participants for its trial off-hours delivery program, he did more than volunteer his Kearny, N.J., trucking firm, New Deal Logistics.

Killen persuaded eight Foot Locker stores he supplies in Manhattan to volunteer, which meant the retail outlets agreed to substitute night deliveries for the daytime shoe shuttles New Deal normally

runs under the

"Instead, 7 o'clock is spending an to get through, [trucks side... in said of the n

For carriage, which 2009 through results were OFF-hour average travel as 75%, according submitted to

**10 BIG IDEAS** TRANSPORTATION

## DELIVER A FIX FOR TRAFFIC JAMS

BY JOSH SANBURN

**THE NEXT TIME YOU'RE STUCK** in traffic, blame all that stuff you buy online.

E-commerce sales jumped 15% last year, to \$186 billion in the U.S., and the daily volume of shipments for FedEx and UPS has grown every year since 2009. Moreover, to keep pace with demand for faster deliveries, many of the rigs dispatched by Amazon, eBay and Fresh Direct leave before they're fully stocked.

In other words, there are now more trucks, and more traffic, than ever. That increase helps explain why urban commuters waste at least 52 hours each year in stop-and-go jams, according to the Texas Transportation Institute.

There are a number of ways to address this problem, including a push for off-peak

delivery (see sidebar). But one of the most promising new solutions is actually an old idea: bikes. In recent years, a growing number of cities have welcomed such services, partly to help the environment and partly to skirt—and alleviate—congestion. For example, B-Line, based in Portland, Ore., works with companies like Office Depot to transport parcels via electric tricycles, which can carry up to 600 lb. (270 kg) of freight at a time. CEO Franklin Jones says his six-bike, 15-person company has replaced 20,000 truck and van deliveries since it started in 2009, and B-Line plans to expand to Seattle later this year. Similar companies have launched in Boston, Vancouver and London, where bike deliveries from UPS were essential during the

crush of the 2012 Olympics.

The most inventive option, however, comes from Brussels. Last September, courier TNT Express loaded packages into a mobile trailer during the middle of the night, then towed it to a place near a populated area (but out of traffic zones). Come daybreak, messengers on electric tricycles took the packages to their destinations. If implemented on a wider scale, the strategy could lead to fewer trucks, reduced costs per stop and lower CO<sub>2</sub> emissions.

Although bikes can't fix delivery backups by themselves—they struggle with larger shipments—Hani Mahmassani, of Northwestern University's Transportation Center, sees their potential. "They're the best way to beat the traffic," he says.

**THE NIGHT-DROP-OFF SOLUTION**

*Bikes are great for delivering smaller packages, but what about the bulk items forcing trucks into rush-hour traffic? The answer, say most transportation experts, is simple: give businesses incentives to deliver during off-peak hours—perhaps to storage lockers like the ones Amazon offers. Here's how Manhattan could benefit if at least 20% of all package drop-offs occurred after 10 p.m., according to Jose Holguin-Veras of the Rensselaer Polytechnic Institute:*

- 1. LESS CURBSIDE CLOGGING**  
Drivers could save three to five minutes of travel time each day, thanks to fewer trucks that would drive and park along busy streets.
- 2. LOWER PRICES**  
Holguin-Veras estimates that trucking companies pay at least \$500 per truck each month in parking fines, which aren't levied at night. There's also less traffic after hours, meaning that trucks can get better gas mileage. Reducing that overhead would trim delivery costs across the board.
- 3. MORE ECO-FRIENDLY VEHICLES**  
Because they make less



**TIME** magazine listed the OHD project as a "Top 10 Ideas" March 25<sup>th</sup>, 2013

ss.com

/20100701/FREE/100709981

## It called a success

tween 7

ne: The Official Blog of the U.S. Secretary

od, the U.S. Secretary of Transportation

a one-

## C Unveils Program for Delivery Truck Decongestion

illips  
es Staff

Last Updated: Jul 1, 2010 Created: Jul 1, 2010

**NEW YORK**—City officials are looking to reduce congestion on busy streets by using delivery trucks to transport their goods at night when the streets are relatively quiet.

An initial pilot test was conducted by the city's Department of Transportation, that found that companies that used trucks between 7 p.m. and 6 a.m. rather than at peak hours reduced costs, reduced congestion, and had an easier time finding parking. The federally-funded program took place last October.

Transportation Commissioner Janette Sadik-Khan and other officials made an announcement of their findings on Thursday and encouraged more companies to try nighttime deliveries.

owner of the New York City Department of Transportation Janette Sadik-Khan speaks in front of truck on 14th Street on Thursday. (Jack the Epoch Times)

much lighter at night and there is not as much competition for a space," said Sadik-Khan.

25 businesses, including Foot Locker, Sysco, Whole Foods Market, and eight trucking companies, in the pilot experiment, which Sadik-Khan said is the first of its kind in the nation.

s were on time and didn't contribute to congestion," she said, while standing in front of a delivery 4th Street in Manhattan.

stances, travel speeds for the nighttime delivery trucks experienced an improvement in speed by as 5 percent as well as a reduction in parking tickets. Parking tickets for each delivery truck exceeds both on average and nighttime delivery significantly reduced those fines, the Department of tion found.

more than 100,000 freight deliveries made in Manhattan on a daily basis and the bulk of that, or 80 wholesale, retail, and food deliveries, which generally do not require daytime delivery. On average, routes averaged 48 minutes faster overall.

n, a manager at New Deal Logistics, said that the "expansion of off-hour deliveries is a smart decision" because curb space is very limited. Any "attempt to keep traffic moving during ... normal never be sufficient to meet the need," Killen added.

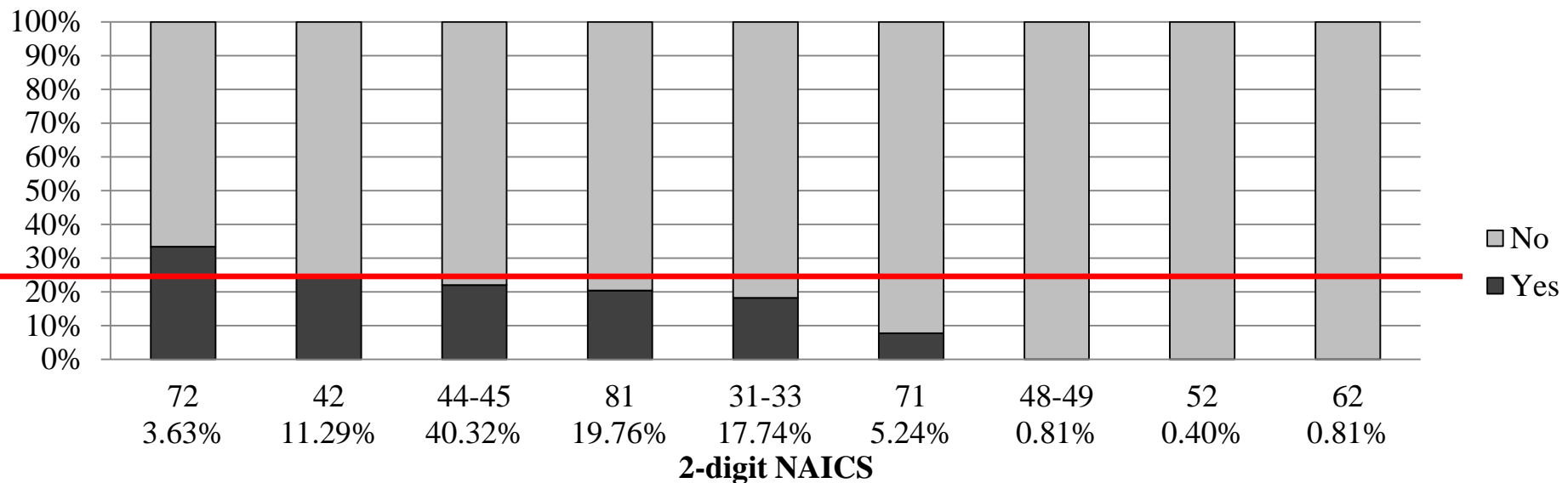
# Receiver-Led Consolidation Systems



- ❖ Currently, receivers place orders without considering the impacts of their actions
  - ❖ They are the ones that create the demand that translates into truck-trips and congestion...
  - ❖ We need to encourage them to change behavior
- ❖ Receiver-Led Consolidation (Delivery and Servicing Plans) encourage managers of large buildings to quantify and reduce delivery traffic
  - ❖ A pilot test in London: 20% reduction of traffic



- ❖ Survey collected data from 248 receivers (Manhattan), and inquired about the interest on “asking your vendors to reduce the number of individual deliveries that your company receives through consolidation”

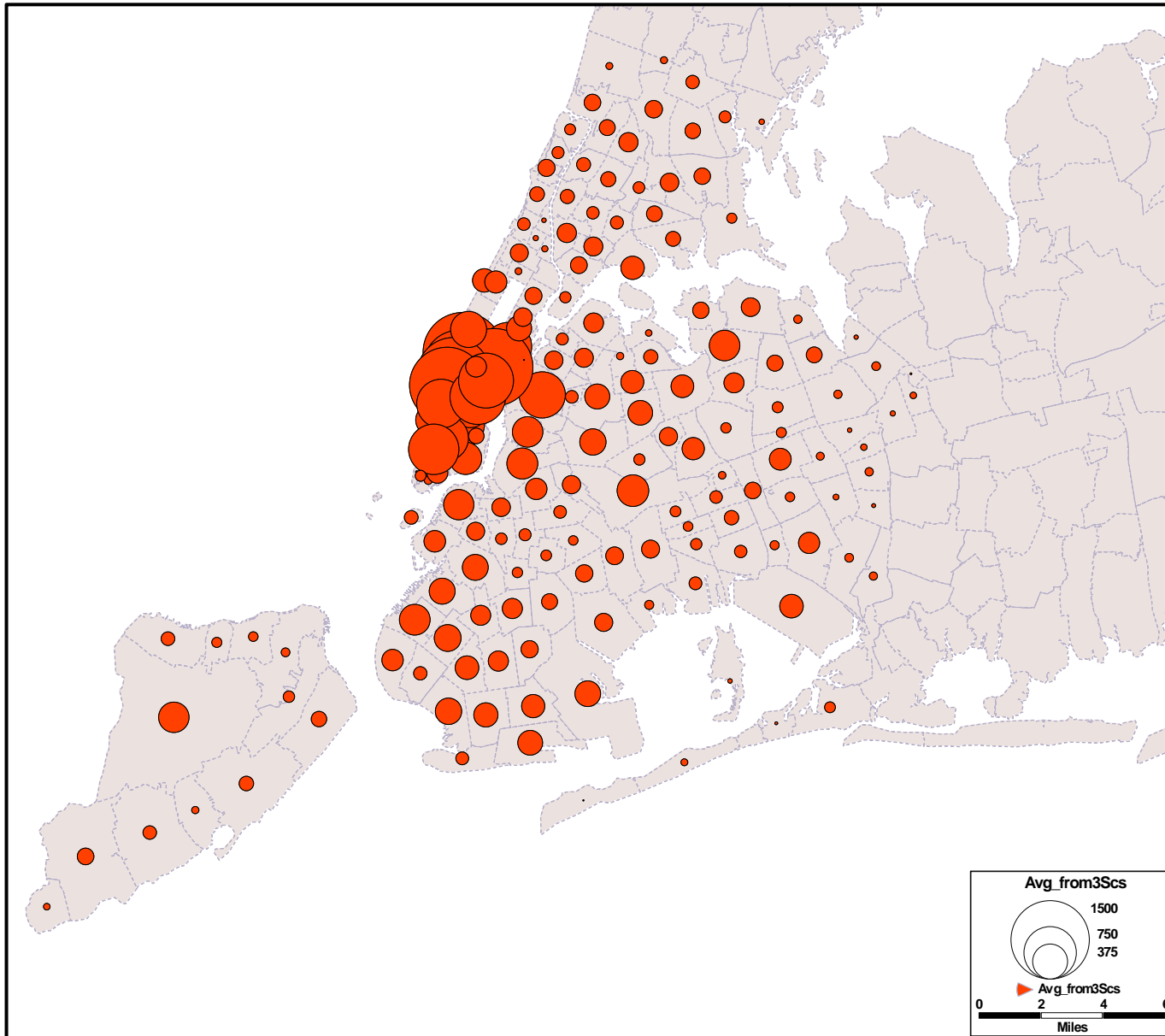


Notes: (1) NAICS 72: Accommodation / food services; NAICS 42: Wholesale trade; NAICS 44-45: Retail trade; NAICS 81: Other services; NAICS 31-33: Manufacturing; NAICS 71: Arts / entertainment / recreation; NAICS 48-49: Transportation / warehousing; NAICS 52: Finance / insurance; and, NAICS 62: Healthcare / social assistance. (2) Percentages under the NAICS code indicate the proportion in the sample.

# Potential Impacts

Scenario	Base Case	Scenario 1 (1 delivery/day)		Scenario 2 (25% of base case)		Scenario 3 (50% of base case)		Scenario 4 (75% of base case)	
County	FTG	FTG	Red. (%)	FTG	Red. (%)	FTG	Red. (%)	FTG	Red. (%)
Manhattan	163,239	144,436	11.5%	145,555	10.8%	151,450	7.2%	157,345	3.6%
Brooklyn	86,856	80,830	6.9%	80,268	7.6%	82,464	5.1%	84,660	2.5%
Queens	86,454	80,334	7.1%	79,903	7.6%	82,086	5.1%	84,270	2.5%
Bronx	29,507	27,070	8.3%	26,900	8.8%	27,769	5.9%	28,638	2.9%
Staten Island	15,283	14,216	7.0%	14,150	7.4%	14,528	4.9%	14,905	2.5%
Total	381,340	346,886	9.0%	346,776	9.1%	358,297	6.0%	369,817	3.0%

# Potential Impacts: Freight vehicle trip reductions<sup>38</sup>





# Potential Impacts: Vehicle-miles reductions

39

Scenario		Base Case	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Daily FTA		105,758	87,810	89,011	94,593	100,175
Daily FTA Savings		-	17,948	16,747	11,165	5,583
Cost	Total savings per day (US\$ thousands)	-	\$1,447.24	\$1,327.92	\$898.67	\$412.66
	Unit savings (US\$/ delivery)	-	\$80.64	\$79.29	\$80.49	\$73.91
Distance	Total savings per day (miles)	-	41,915.70	37,923.49	26,921.27	12,136.72
	Unit savings (miles/ delivery)	-	2.34	2.26	2.41	2.17
Time	Total savings per day (hours)	-	17,583.85	16,397.74	10,948.33	5,497.32
	Unit savings (min/ delivery)	-	58.78	58.75	58.84	59.08



# Concluding Thoughts ... How Could We Make it Happen?



# How Could We Change Things?

- ❖ By influencing the key decision maker so that they force a change in supply chains...
- ❖ Remember the power relations:
  - ❖ Shippers have power over Carriers
  - ❖ Receivers have power over ShippersReceivers → Shippers → Carriers
- ❖ Implication: Convincing the receivers to participate in the quest for sustainability is ESSENTIAL
- ❖ How could we convince receivers to change behavior?
  - ❖ Incentives
  - ❖ Regulations

# Citizens-Led Change...

- ❖ Citizens could provide the incentives needed to foster sustainability of supply chains:
  - ❖ A certification program that rates the degree of sustainability of the supply chains serving a establishment will
    - ❖ Provide information to citizens about what the companies are doing for sustainability
    - ❖ Lead citizens to patronize the businesses doing good
    - ❖ Ultimately, provide the incentives needed to foster transformation
- ❖ Achieving sustainability is all about behavior change
- ❖ Transformation of supply chains is possible, we (THE CITIZENS) have the power...

# Thanks!

**For a comprehensive Initiative Selector, see:  
<http://transp.rpi.edu/~NCFRP38PG/assessment.htm>**

