Need for, and Potential of, a Comprehensive Freight De-Carbonization Program

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Climate Change is a Collective Action Problem

Collective Action Problem

The problem created by disincentives that tend to discourage joint action by individuals (or agents) in the pursuit of a common goal

Implication

Collection Action Problems cannot be solved by Magic Bullets
(not even electrification) …
or any other single action

Who Generate Freight Externalities? What a Silly Question..!

Freight externalities

Non-Carrier-Agents (NCAs) Contributions to Freight Externalities

City Gov.-Real-Estate Sector: Parking Availabil

- Availab… Parkin…
- …Parking (NP)

(8.9% to 23.12%)

Shipper-Carrier: DC Location

- Closer to… City
- …er from the City (O1)

(33.91% to 42.62%)

Receiver: Delivery Time

- Off-Hour…
- …ular Hours (RH)

(42.97% to 48.90%)

Scenarios

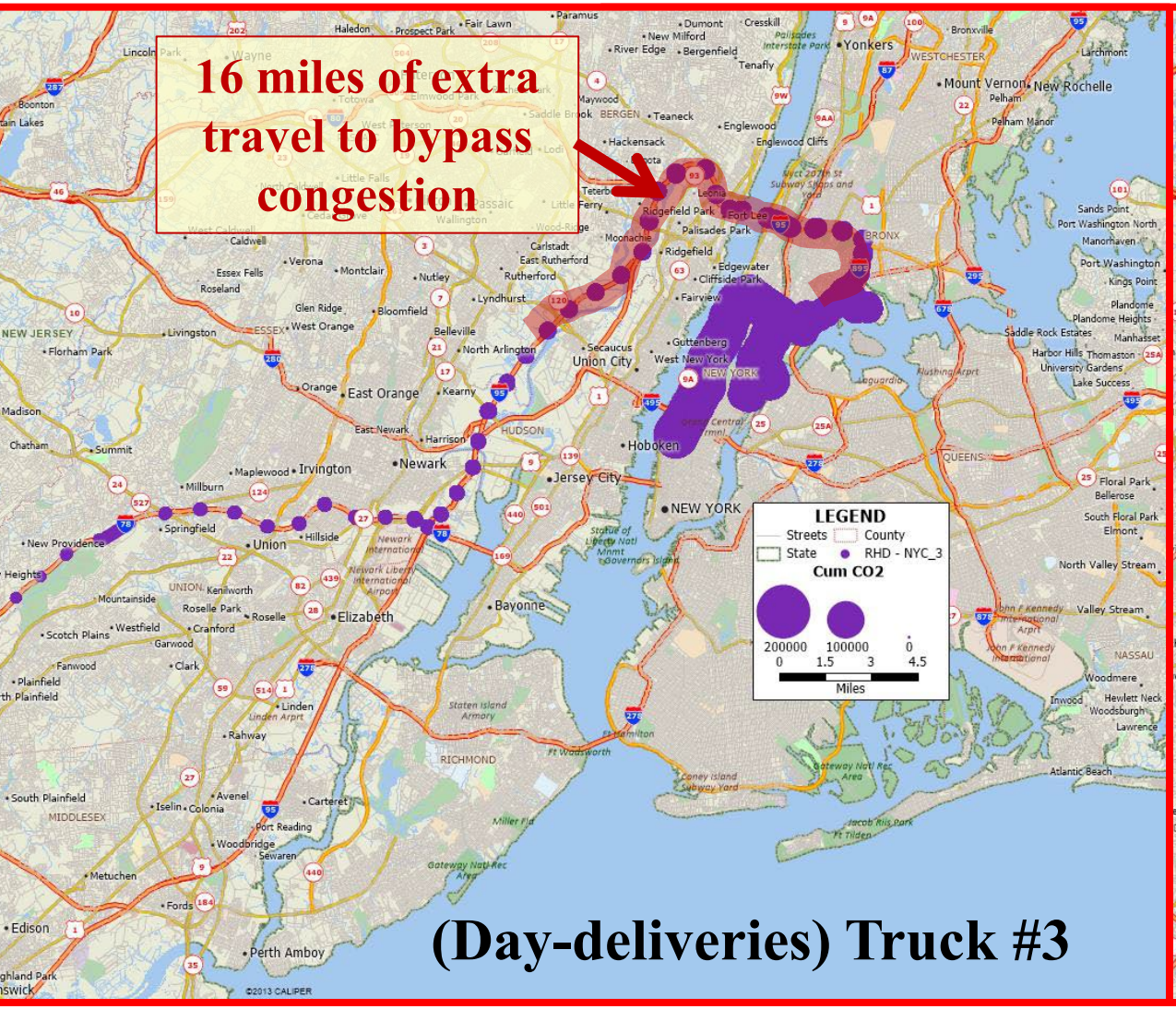
- AP-O2-OH
- AP-O2-RH
- AP-O1-OH
- AP-O1-RH
- NP-O2-OH
- NP-O2-RH
- NP-O1-OH
- NP-O1-RH

Strategy Framework and Suggested Actions

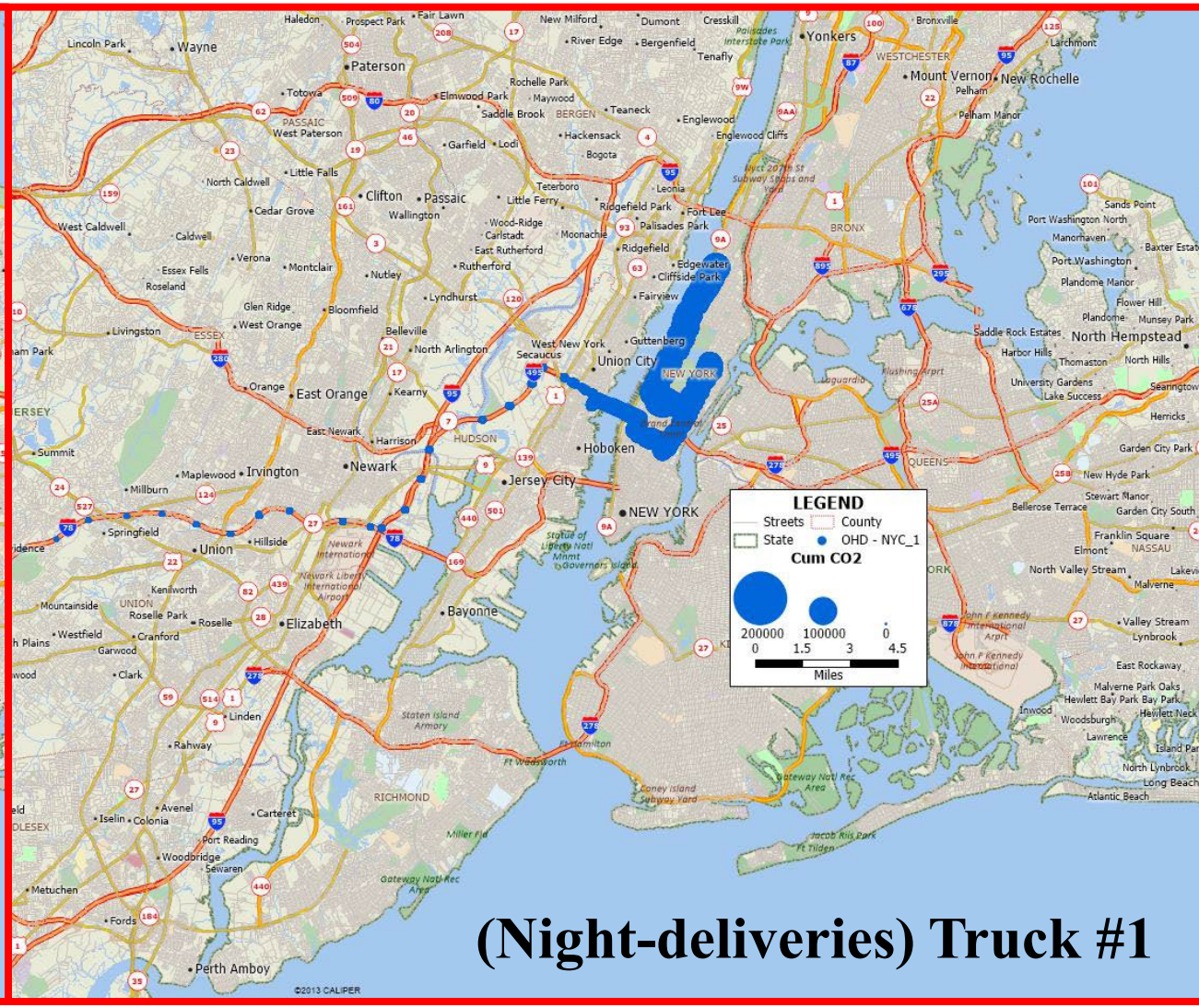
	Short-term	Medium-term	Long-term
Metro Areas	Demand Management: Off-Hour Deliveries Staggered Deliveries Change in Vehicle Choice, Change Ordering Patterns, etc. Slow deliveries	Vehicle Related Initiatives: Electric Trucks, Connected Trucks Freight Efficient Land Uses Demand Management	Freight Efficient Land Uses Vehicle Related Initiatives: Electric Trucks, Connected Trucks Demand Management
Intercity Freight	Demand Management: Changes in Vehicle/Mode Choice Staggered Deliveries at LTGs Slow deliveries, etc. Vehicle Related Initiatives: Manage truck over-supply Study truck size/weights regs	Vehicle Related Initiatives: Electric Trucks, Connected Trucks Demand Management: Change in Vehicle/Mode Choice	Freight Efficient Land Uses Vehicle Related Initiatives Electric Trucks, Connected Trucks Demand Management

Freight Demand Management:
Retiming of Freight Activity

Off-Hour Deliveries: NYC CO_2 Emissions: Day vs. Night Deliveries



(Day-deliveries) Truck #3



(Night-deliveries) Truck #1

Emission and Cost Reductions

Partial OHD (6PM to 10PM)

City\ Pollutant	ROG	TOG	CO	CO2	NOX	PM10	PM25
Bogotá	13.49%	13.49%	13.50%	13.12%	12.70%	13.41%	13.41%
New York City	67.17%	67.17%	67.00%	55.14%	59.47%	65.53%	65.53%
Sao Paulo	49.98%	49.98%	51.43%	42.52%	44.64%	45.90%	45.90%

Full OHD (7PM to 6AM)

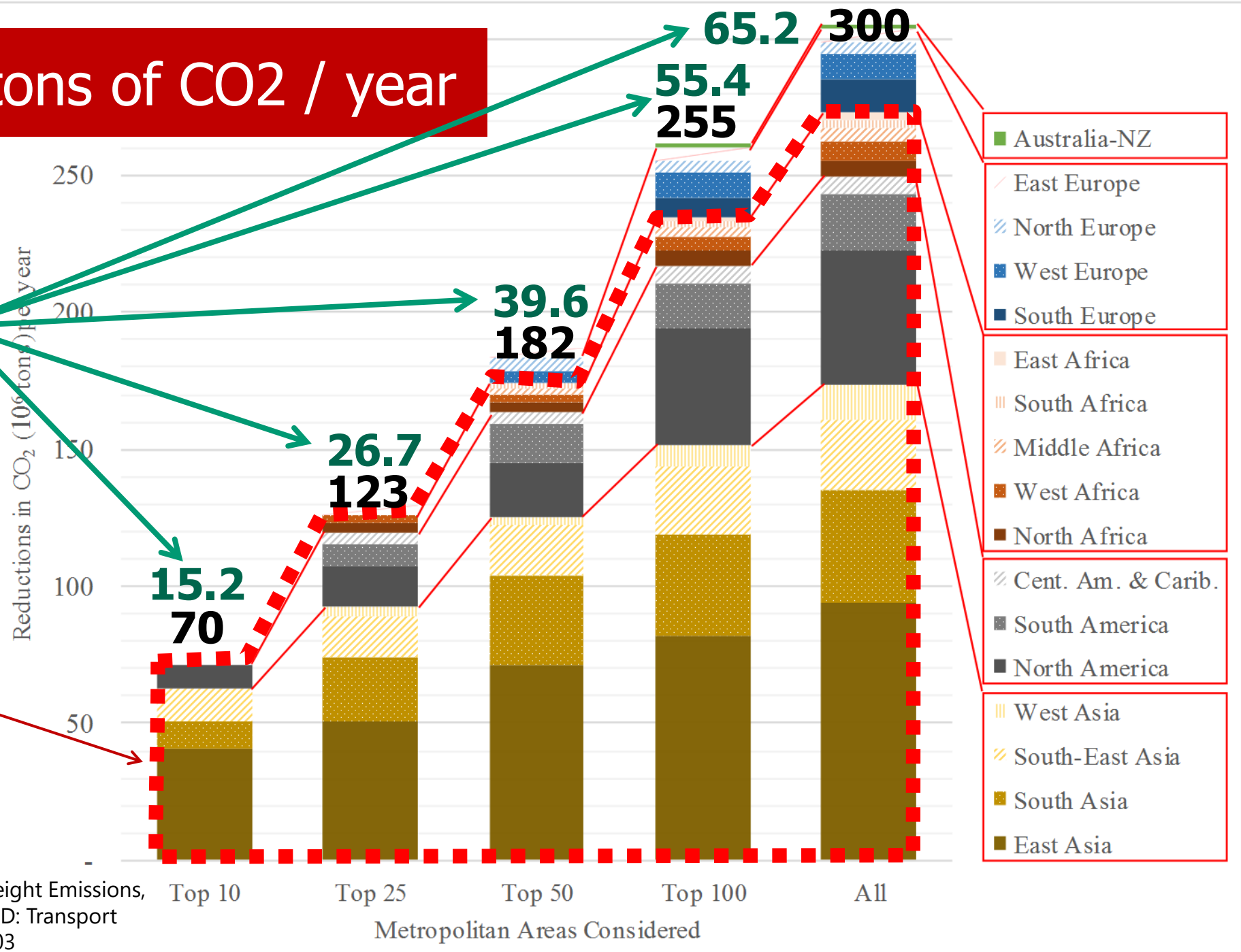
In addition, cost reductions in the range of 30-55%

Globally: Millions tons of CO2 / year

These are the equivalent number of electric cars needed to achieve these CO2 reductions (using 4.6 metric tons/year)

Based on https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

OHD in developing countries will help make their metro areas more competitive and will help reduce emissions…



Direct Impacts of Off-Hour Deliveries on Urban Freight Emissions, Holguín-Veras et al., Transportation Research Part D: Transport and Environment 2018 Vol. 61 Issue 1 Pages 84-103

Emissions by Time of Day: NY-NJ Port Complex

Arrival Time at the Port	Elizabeth NJ	Newark NJ	Bayonne	Carteret NJ	I-280	West of Hudson	I-287	East of Hudson	I-78	I-95 South	NY North	Average
Midnight		-22%		-30%					-24%	-11%		-24%
1AM		-30%						-30%	-28%			-28%
2AM	-39%	-23%		-29%			-25%	-30%	-33%	-9%		-27%
3AM		-20%		-32%		-21%			-25%	-12%		-25%
4AM		-10%		-31%					-16%	-7%	0%	-22%
5AM	0%	-19%		-18%				-30%	-25%	-10%		-13%
6AM	-20%	-6%		-12%		-19%			-26%	-8%		-5%
7AM	-18%	-13%	0%	-9%	-24%	-24%	-18%	-20%	-26%	-9%		-1%
8AM	-16%	-19%	-4%	0%		-20%	-18%	-14%	-26%	-6%	-5%	-5%
9AM	-22%	-26%	-5%	-14%		-16%	-17%	-19%	-21%	-5%	-9%	-13%
10AM	-31%	-18%	-11%	-9%	-9%	-21%	-19%	-15%	-16%	-4%	-7%	-12%
11AM	-37%	-15%	-24%	-11%	-17%	-25%	-12%	-25%	-22%	-5%	-6%	-11%
Noon	-29%	-16%	-19%	-6%		-26%	-12%	-27%	-24%	-1%	-4%	-7%
1PM	-31%	-23%	-5%	-16%	-16%	-24%	-14%	-16%	-23%	-5%	0%	-9%
2PM	-36%	-20%	-14%	-17%		-21%	-18%	-14%	-23%	-4%	-4%	-12%
3PM	-34%	-10%	-17%	-17%	-17%	-15%	-16%	-14%	-21%	-1%	-3%	-6%
4PM	-33%	0%	-5%	-14%	0%	0%	0%		-20%	-4%		-7%
5PM	-31%	-18%	-13%	-21%	-10%		-15%	0%	-17%	-11%		-9%
6PM	-29%	0%		-21%		-6%		-11%	0%	0%		0%
7PM	-22%	-18%		-25%					-22%	-10%		-17%
8PM	-21%	-25%		-31%					-27%	-3%		-16%
9PM		-33%		-27%	-21%	-29%		-21%	-30%	-7%		-27%
10PM		-17%		-17%	-11%		-25%	-22%	-31%	-8%		-24%
11PM	-50%	-38%								-6%		-28%
Average	-31%	-17%	-14%	-12%	-14%	-21%	-15%	-18%	-22%	-5%	-5%	-10%

Port Working Hours

"Optimal" time periods

Staggering deliveries reduces CO2 by 5% to 31%

Freight-Efficient Land Uses: Concept and Principles

Just Released!

Freight-Efficient Land Uses (FELU) Principles

- FELU principles provide guidance for action, to be adapted to the local conditions:
  - *Minimize Social Costs*, to reduce the private and external costs of supply chains and their stages;
  - *Foster Compactness of Supply Chains*, to reduce the distance traveled at supply chain stages, up and downstream;
  - *Mitigate Supply Chain Externalities*, to reduce or eliminate, the externalities at supply chain nodes and Large Traffic Generators (LTGs);
  - *Seek Appropriate Solutions*, that recognize and account for local conditions; and
  - *Engage Stakeholders*, to ensure their points of view and concerns are addressed.

Key Insight:
Complex Problems Need Complex Solutions…
There Is No Way Out

For a Deeper Lecture on this Subject, See:
Fall 2021 Kent Seminar Series: José Holguín-Veras
at the University of Illinois at Urbana-Champaign
https://www.youtube.com/watch?v=EXkmXc5ed2I

Thanks!
Questions?

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