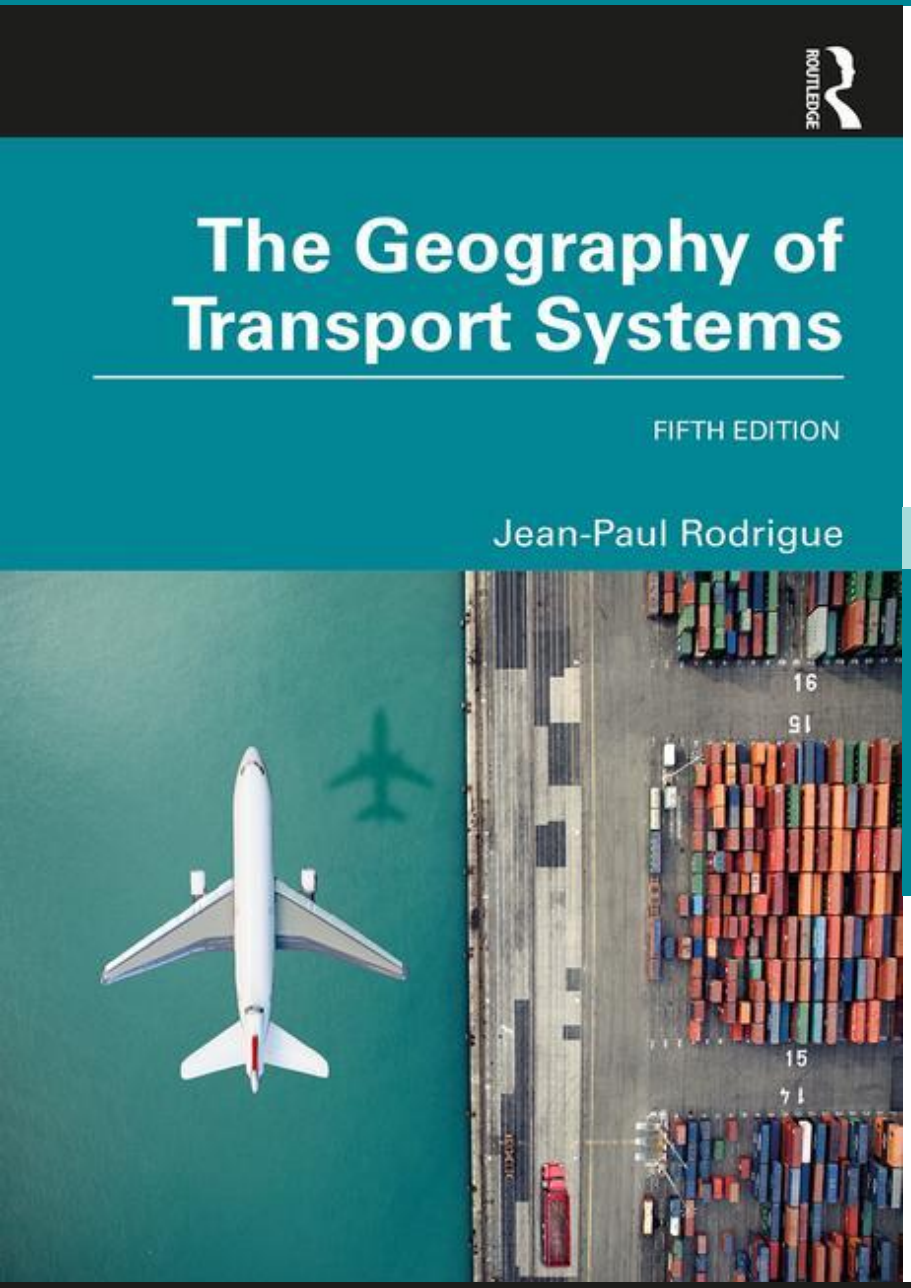

Applications and Case Studies – Part III (Planning and Environmental Issues)

APPENDIX B

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Jean-Paul.Rodrigue@hofstra.edu

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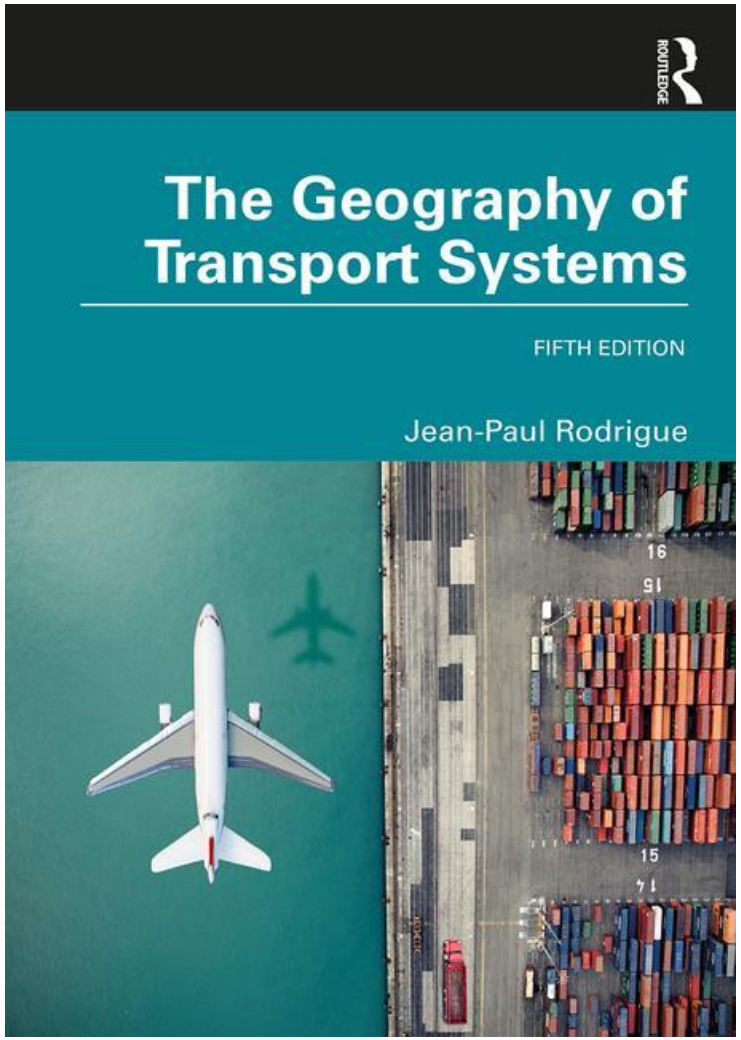

Pollutants Emitted by Transport Systems

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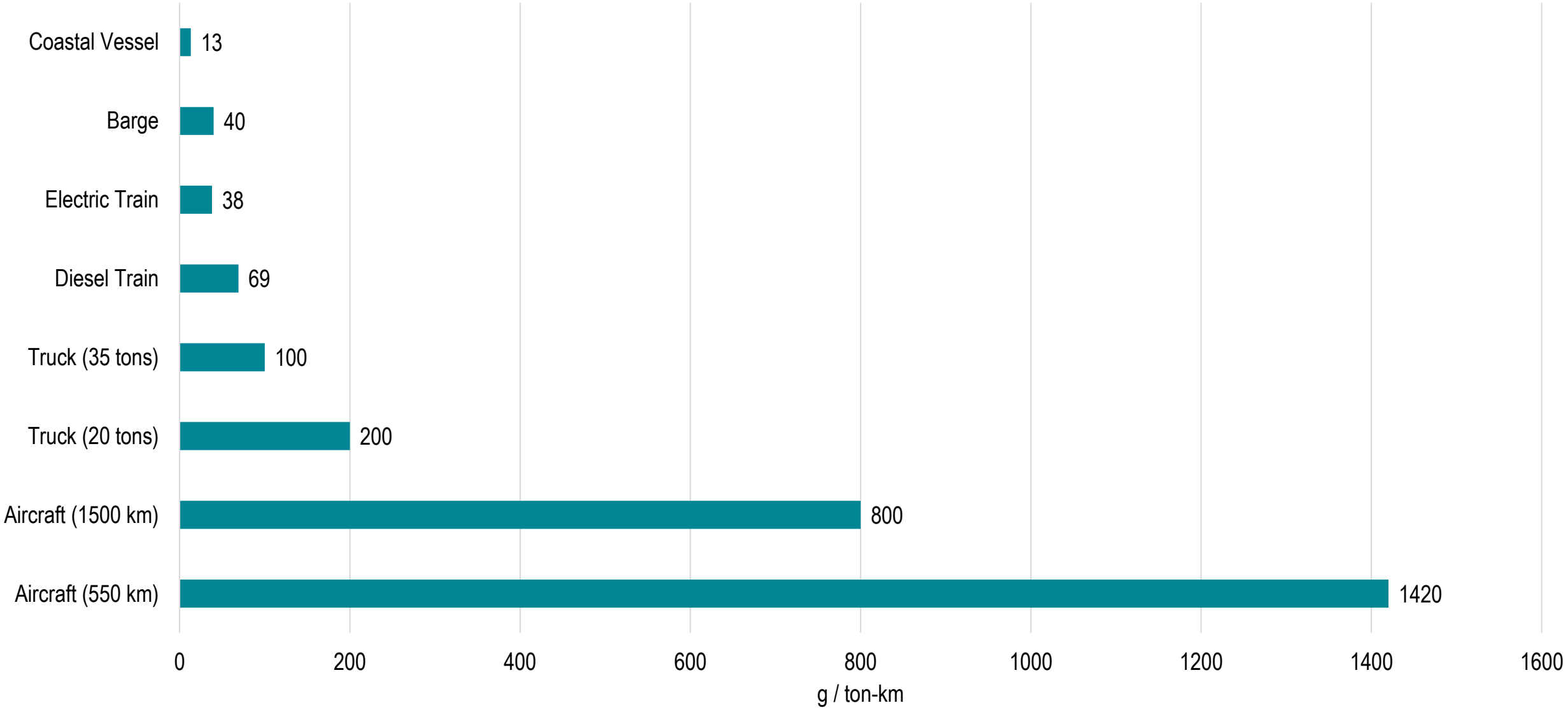
Carbon Emissions by Main Freight Transport Mode



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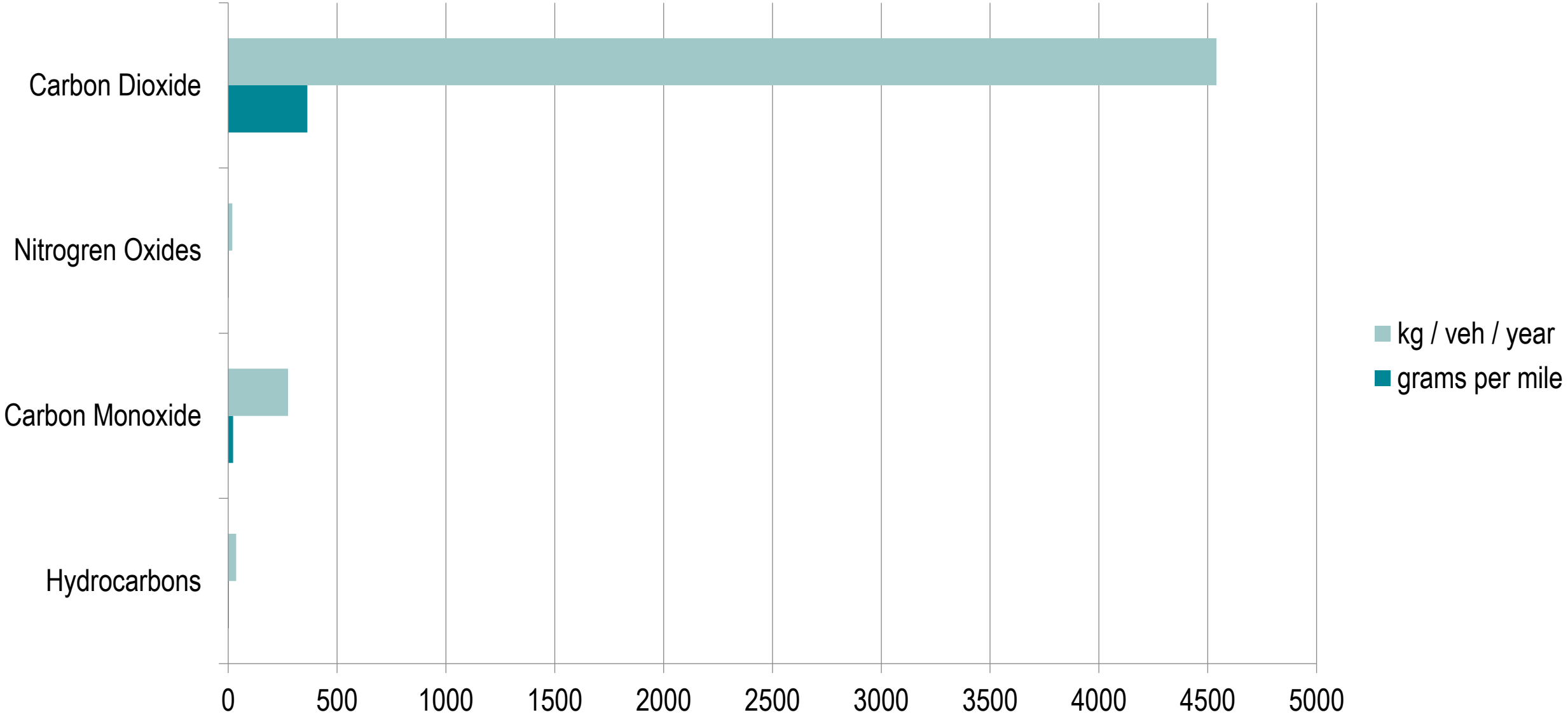
Annual Emissions of Air Pollutants for a Passenger Car in the United States, 1997



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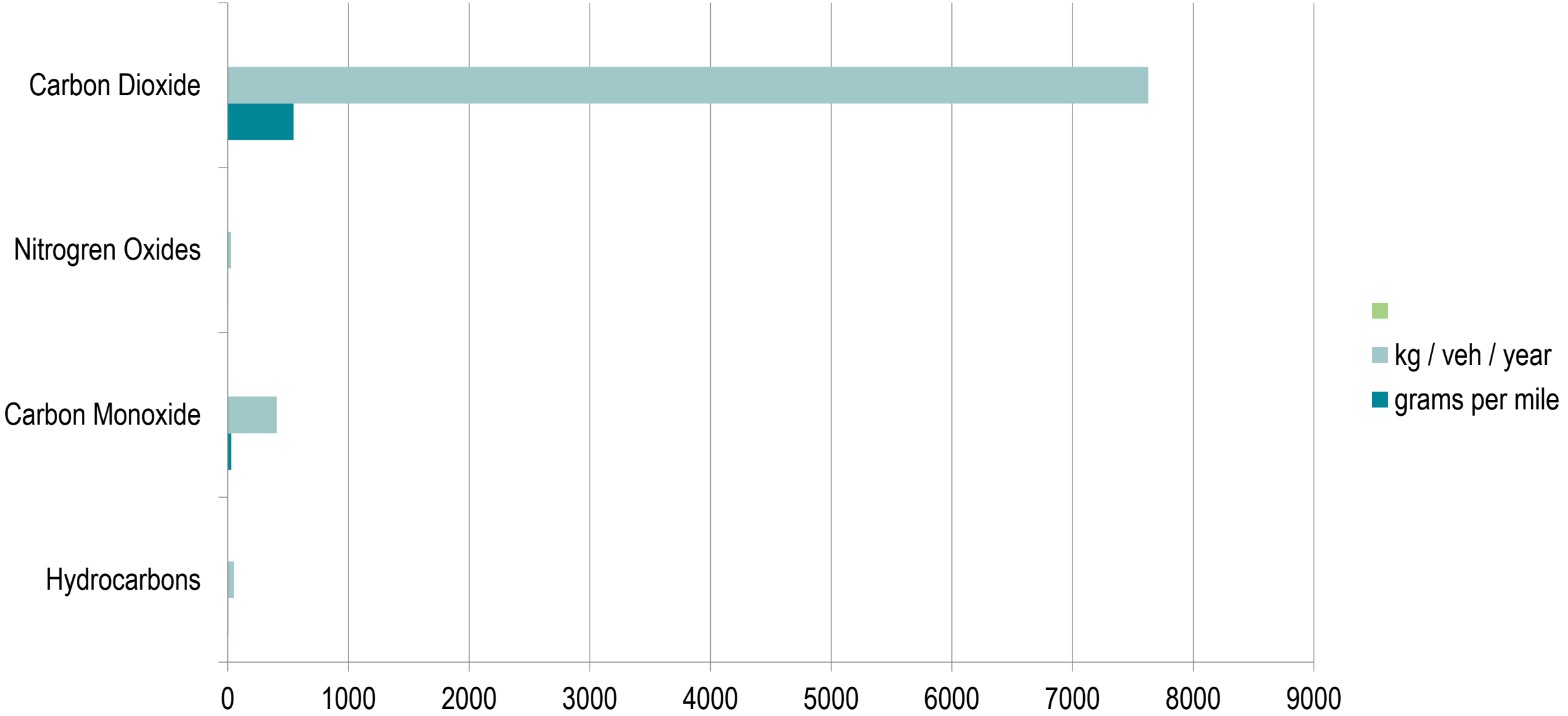
Annual Emissions of Air Pollutants for a Light Truck in the United States, 1997



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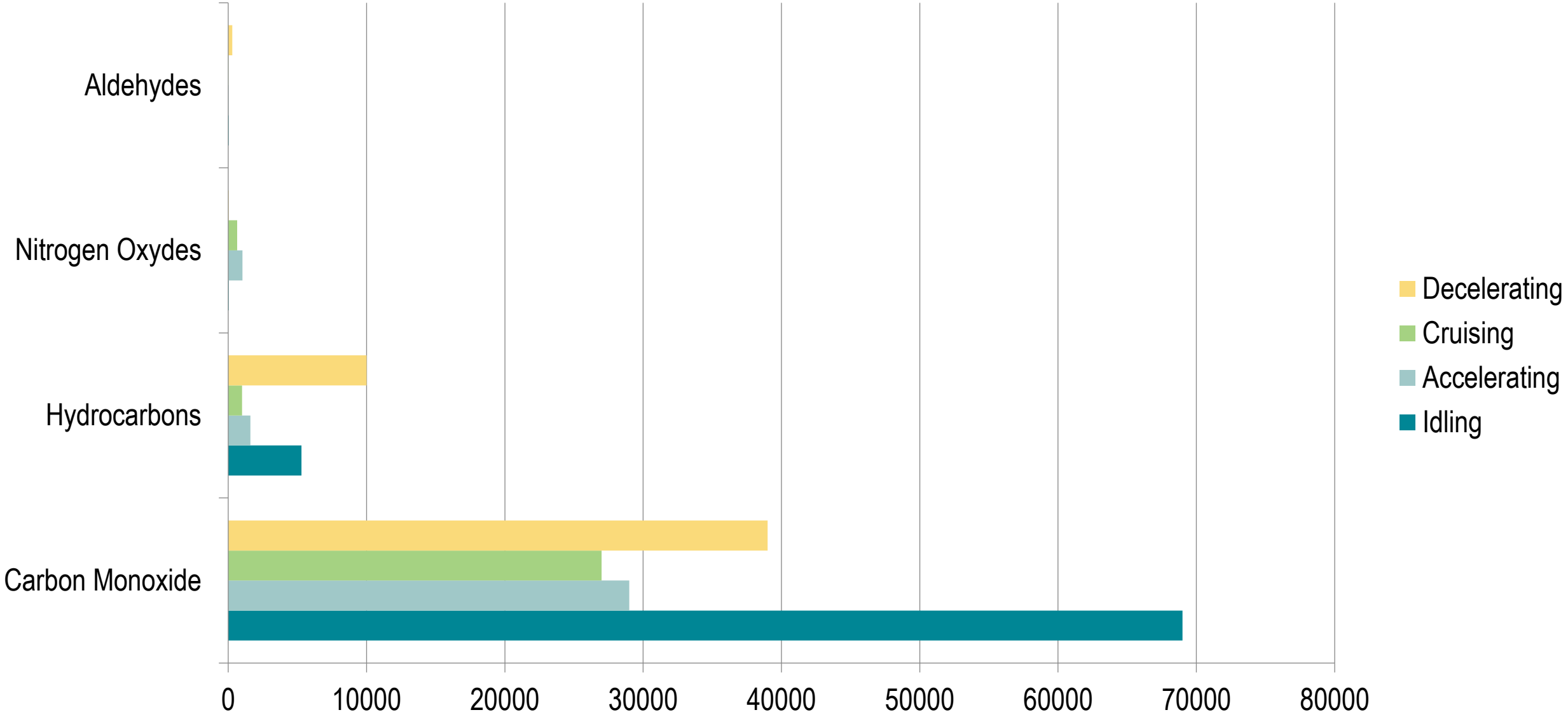
Atmospheric Pollution Caused by Different Stages in the Driving Cycle of Gasoline Engine



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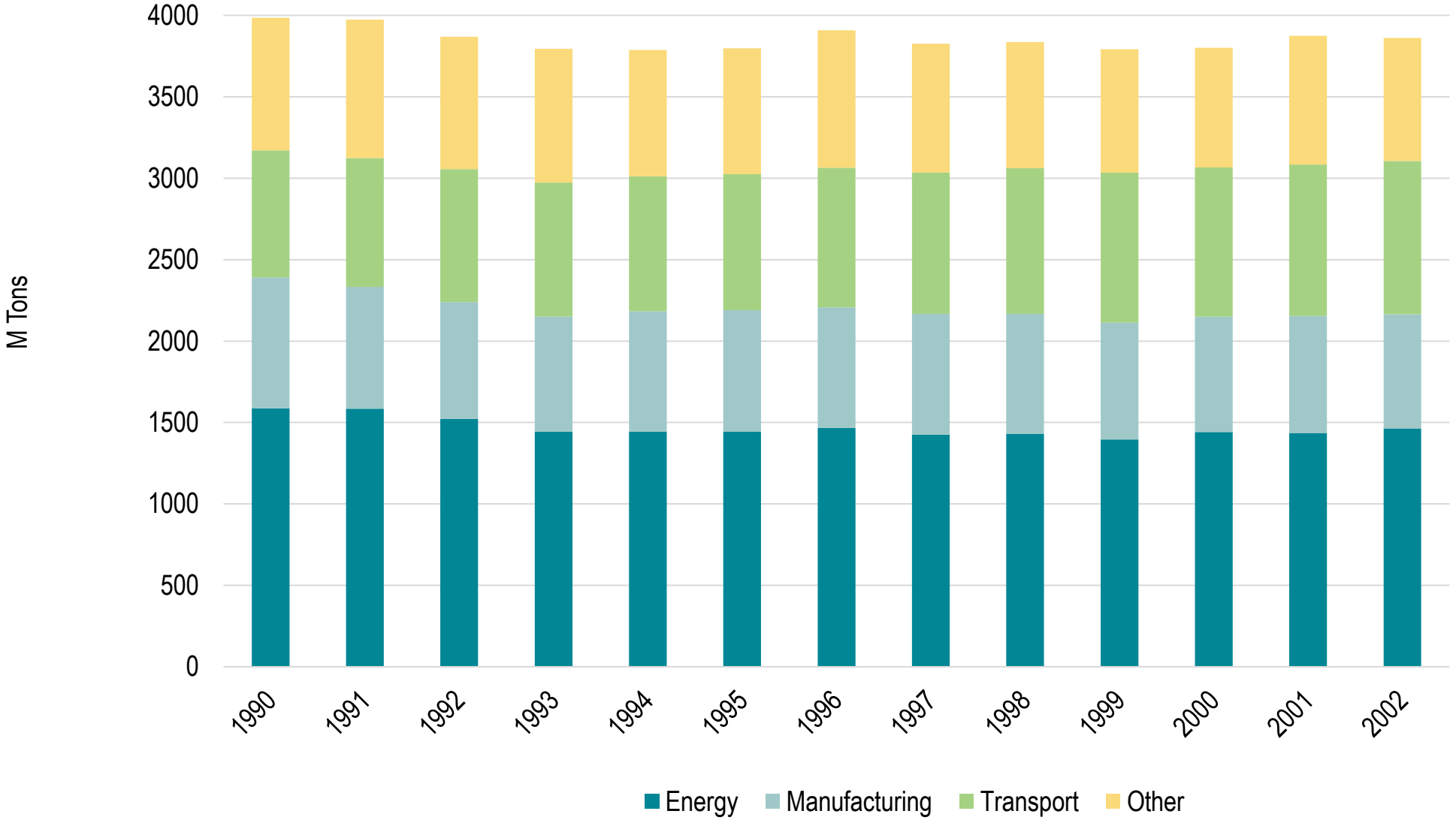
EU-25 Total Emissions of Greenhouse Gases from Fuel Combustion (CO2 Equivalent)



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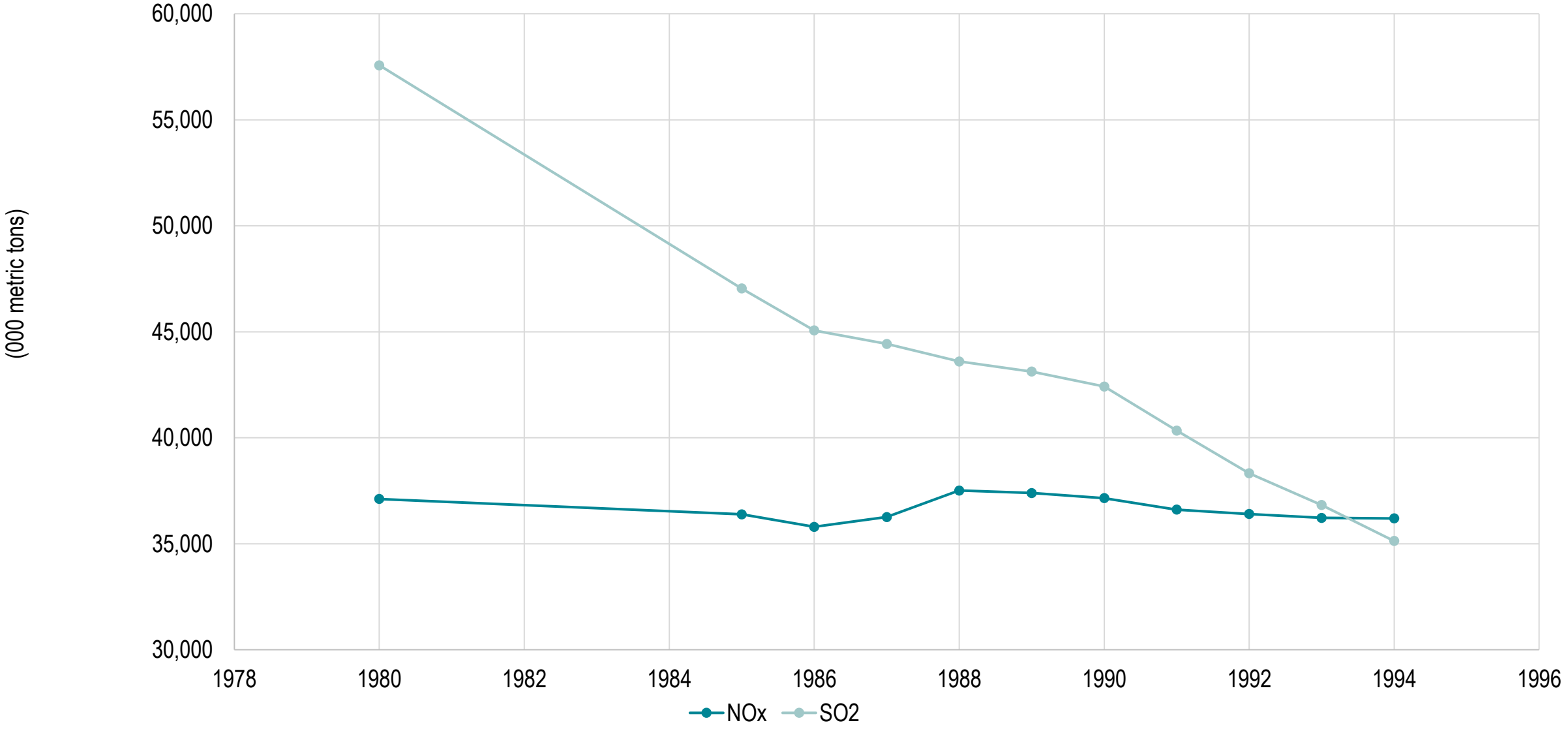
SO2 and NOx Emissions in North America and Europe, 1980-1994



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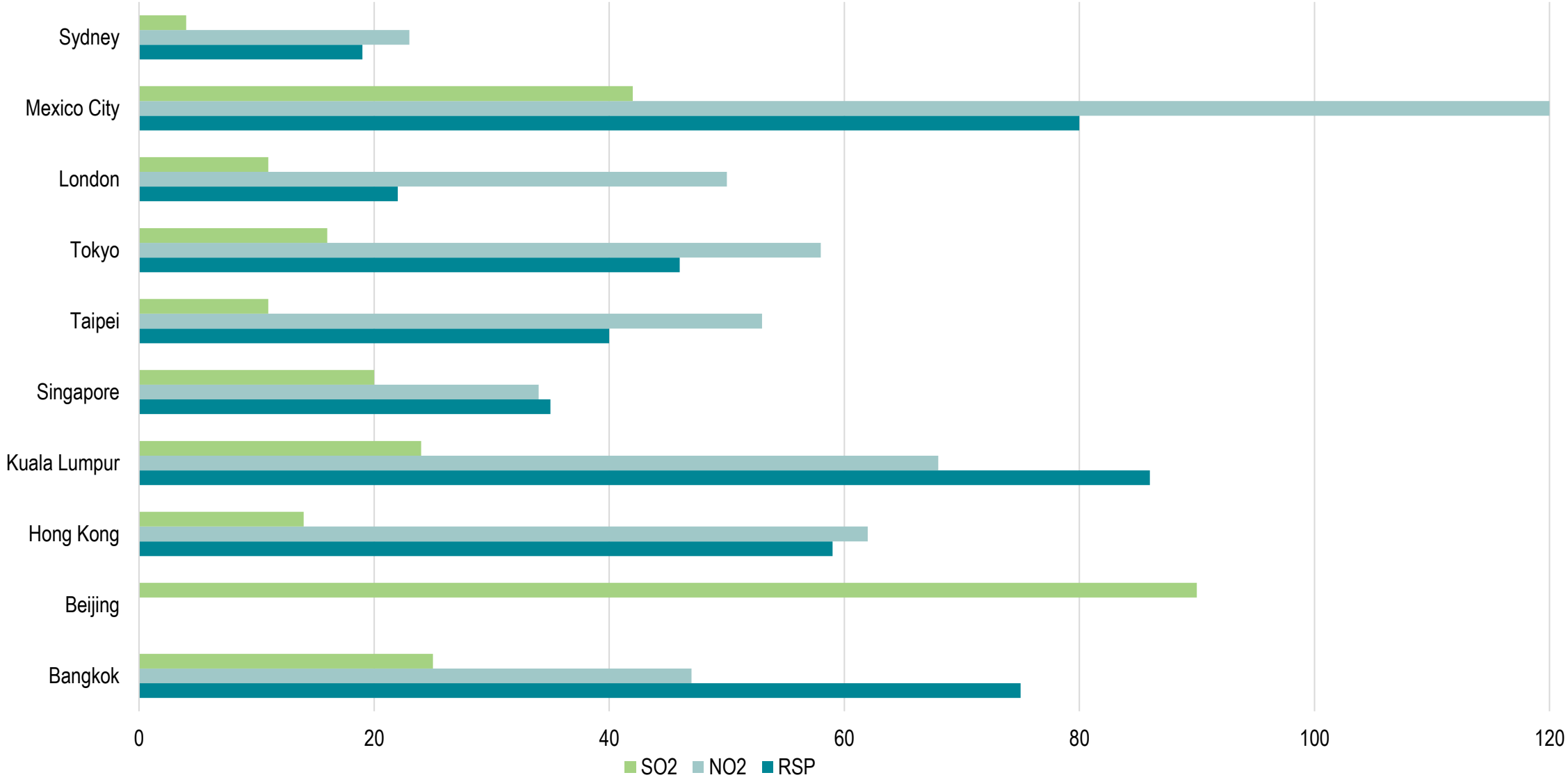
Air Pollutant Concentrations in some Cities, 1999 (in mg per m3)



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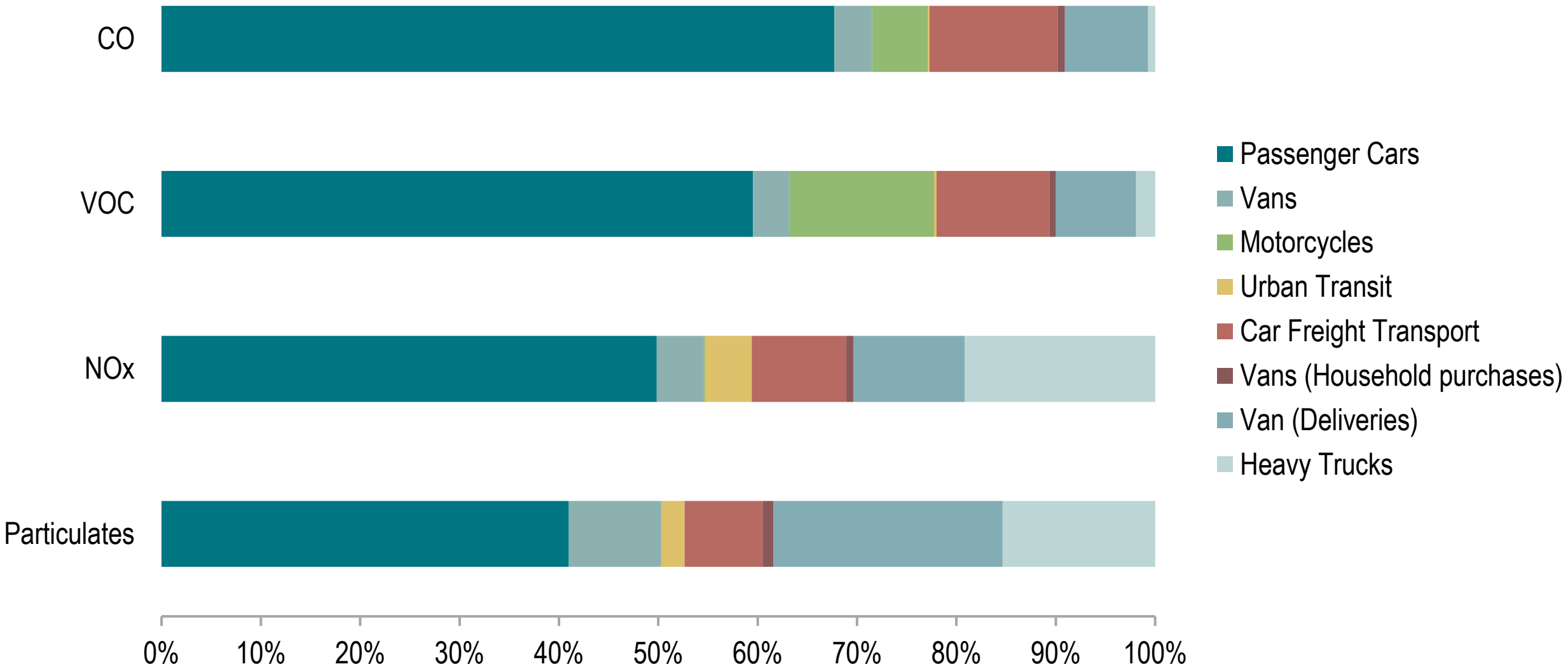
Emissions by Urban Transport Modes



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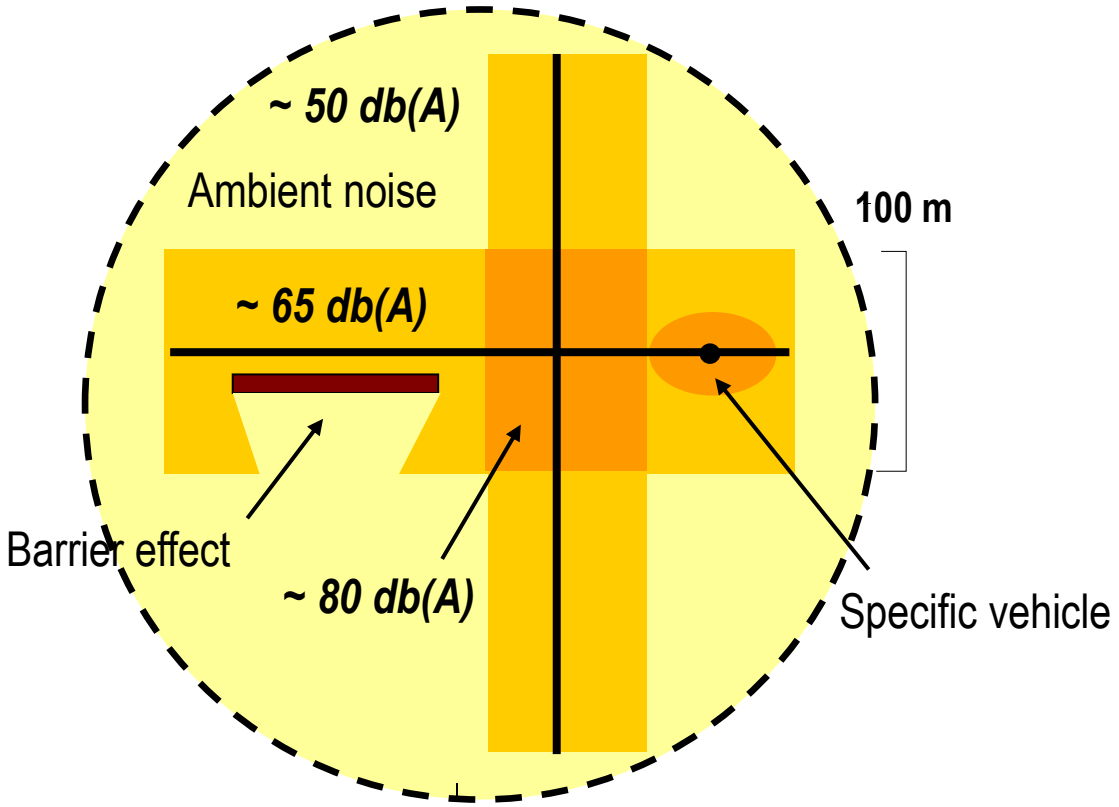
Road Transportation Noise



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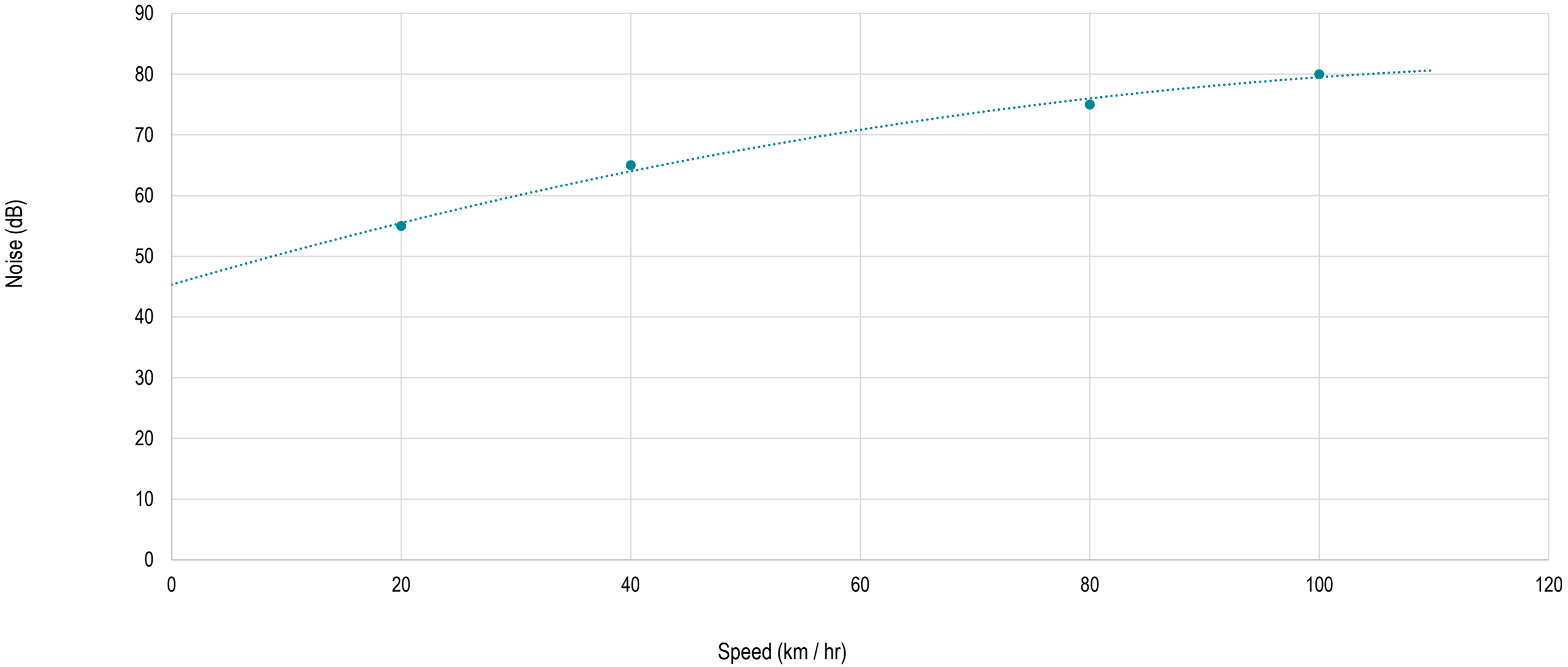
Noise Generated by a Passenger Car



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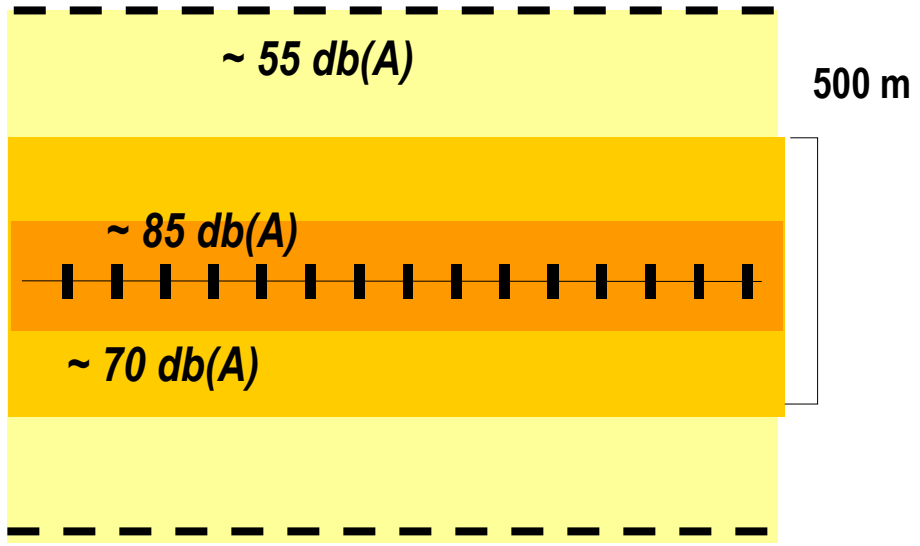
Rail Transportation Noise



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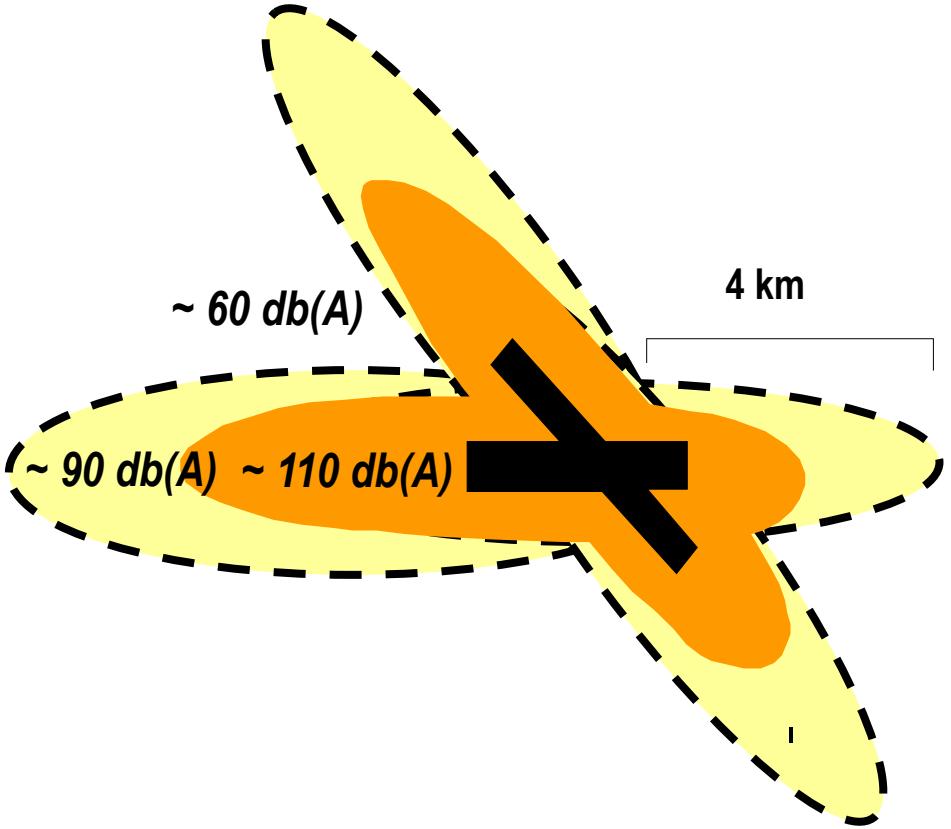
Air Transportation Noise



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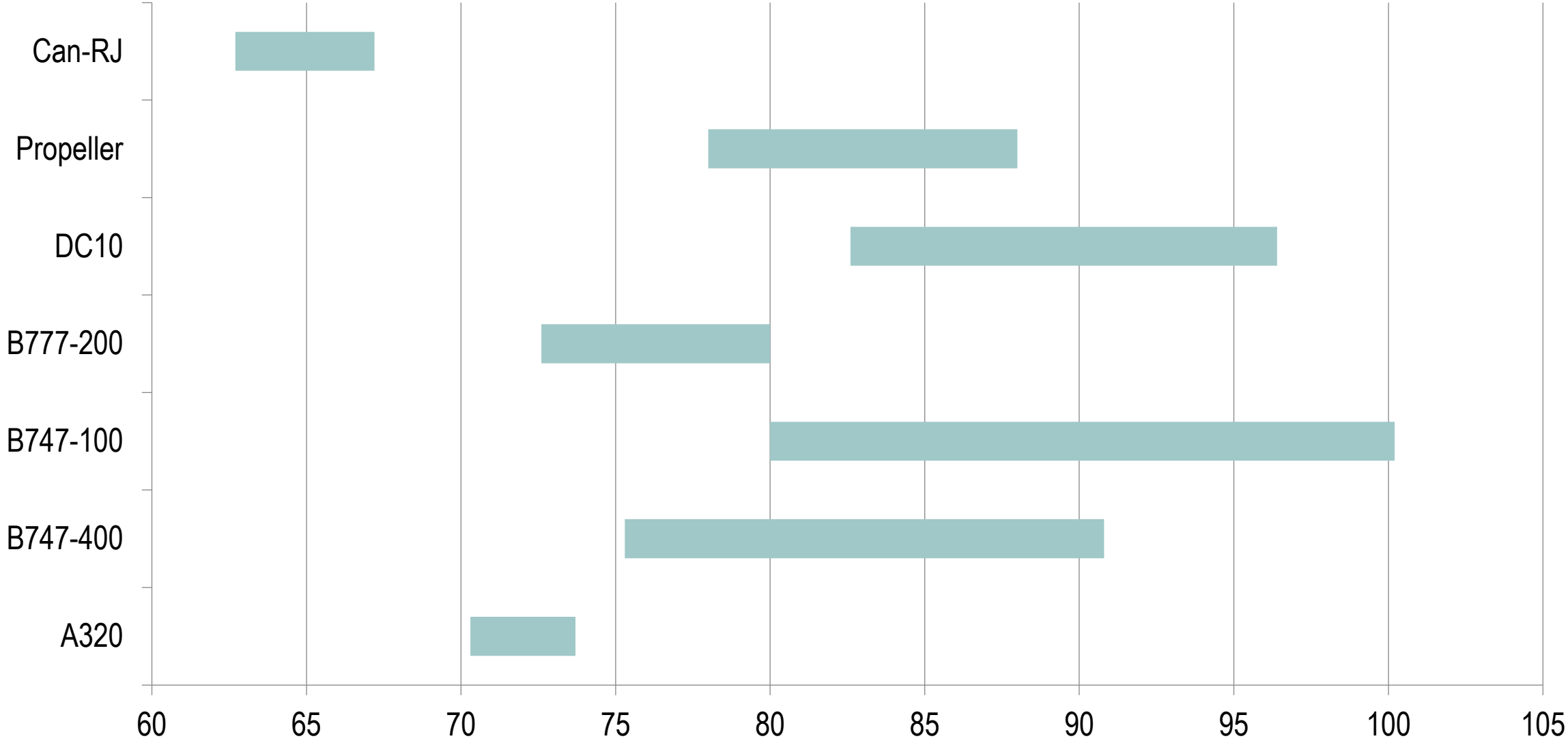
Aircraft Takeoff Noise in dB(A)



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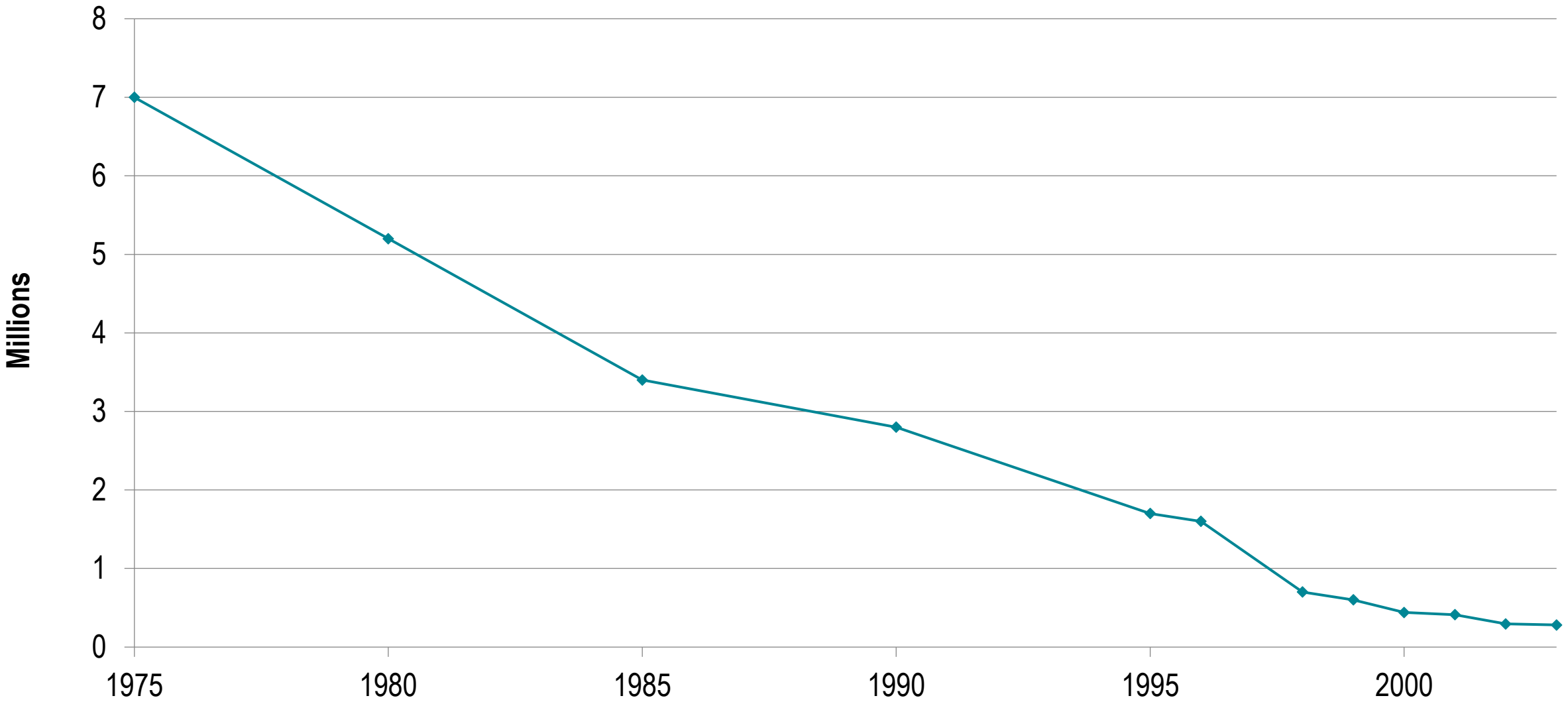
People Exposed to Aircraft Noise of more than 65 dbA, United States, 1975-2003



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Greenhouse gas	Concentration change, 1800s - 2016	Anthropogenic sources	100-yr GWP*	Proportion of total effect apart from water vapor (approximate)
Carbon dioxide	280 - 403 ppm	fossil fuel burning, deforestation	1	60%
Methane	0.75 - 1.85 ppm	agriculture, fuel leakage	25	20%
Halocarbons	0 - 0.7 ppb	refrigerants	1100-11,000	14%
Nitrous oxide	275 - 329 ppb	agriculture, combustion	298	6%
Ozone	15? - 20-30 ppb	urban pollution		

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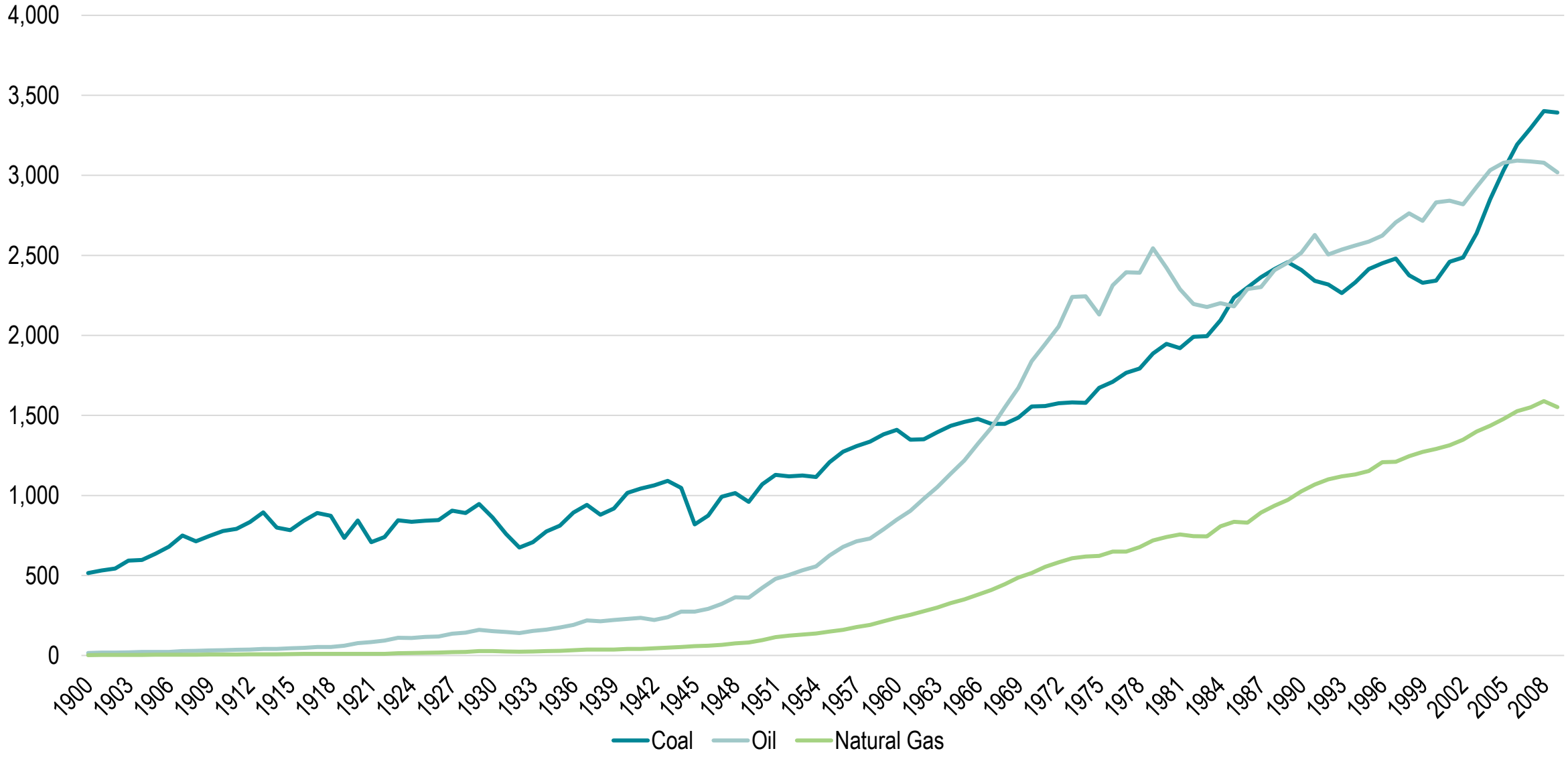
Global Carbon Dioxide Emissions from Fossil Fuel Burning by Fuel Type, 1900-2009



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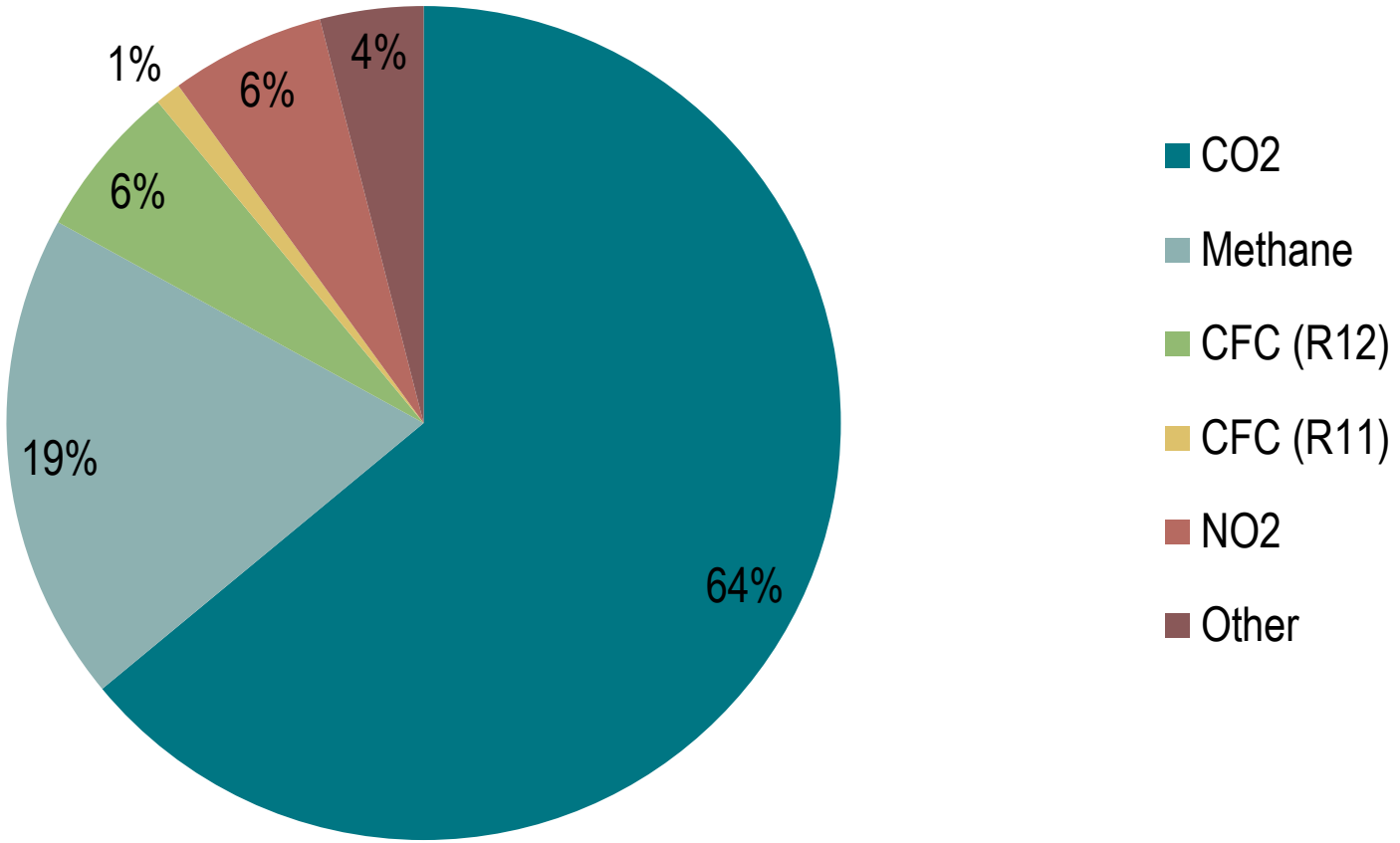
Contribution of Different Gases to the Greenhouse Effect, 1995



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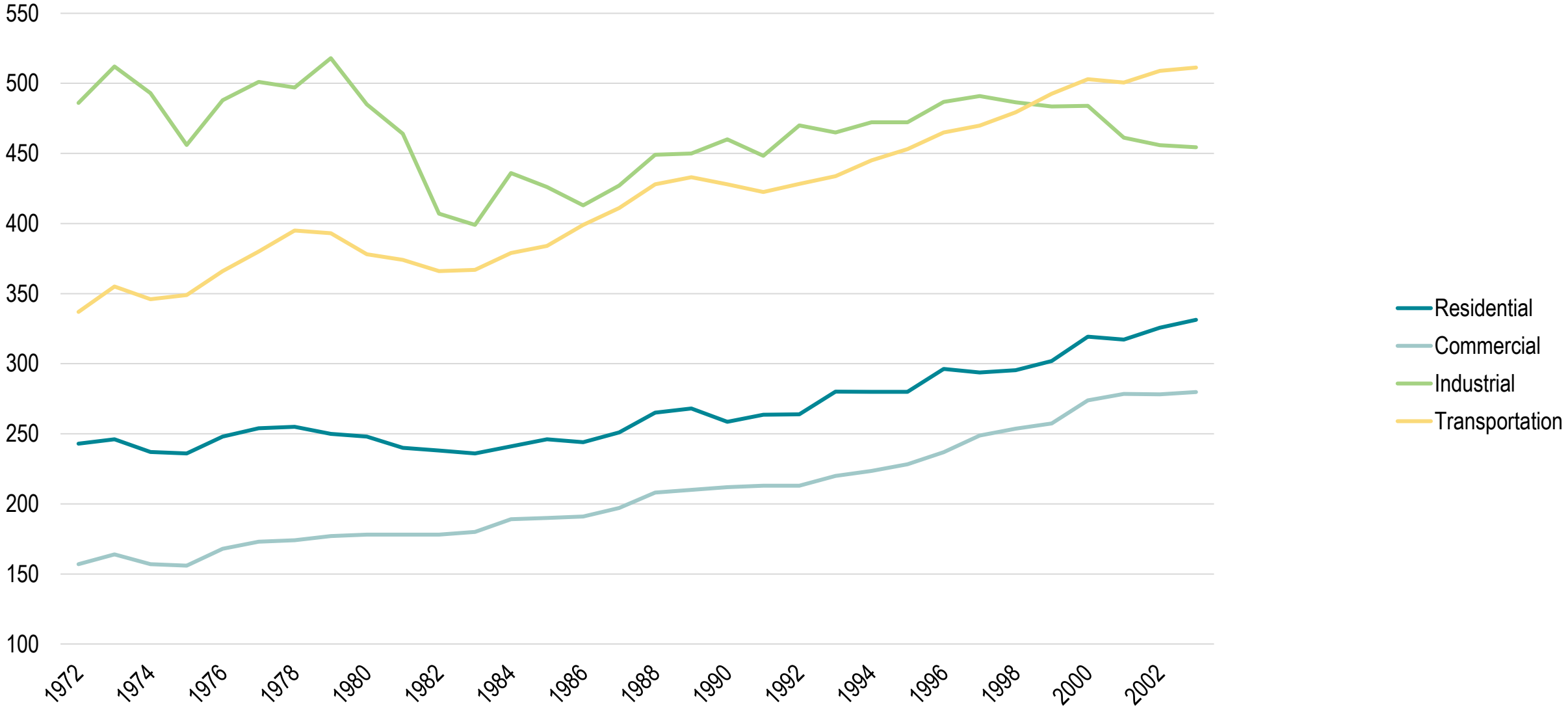
CO2 Emissions by Sector, United States, 1972-2003 (in million metric tons)



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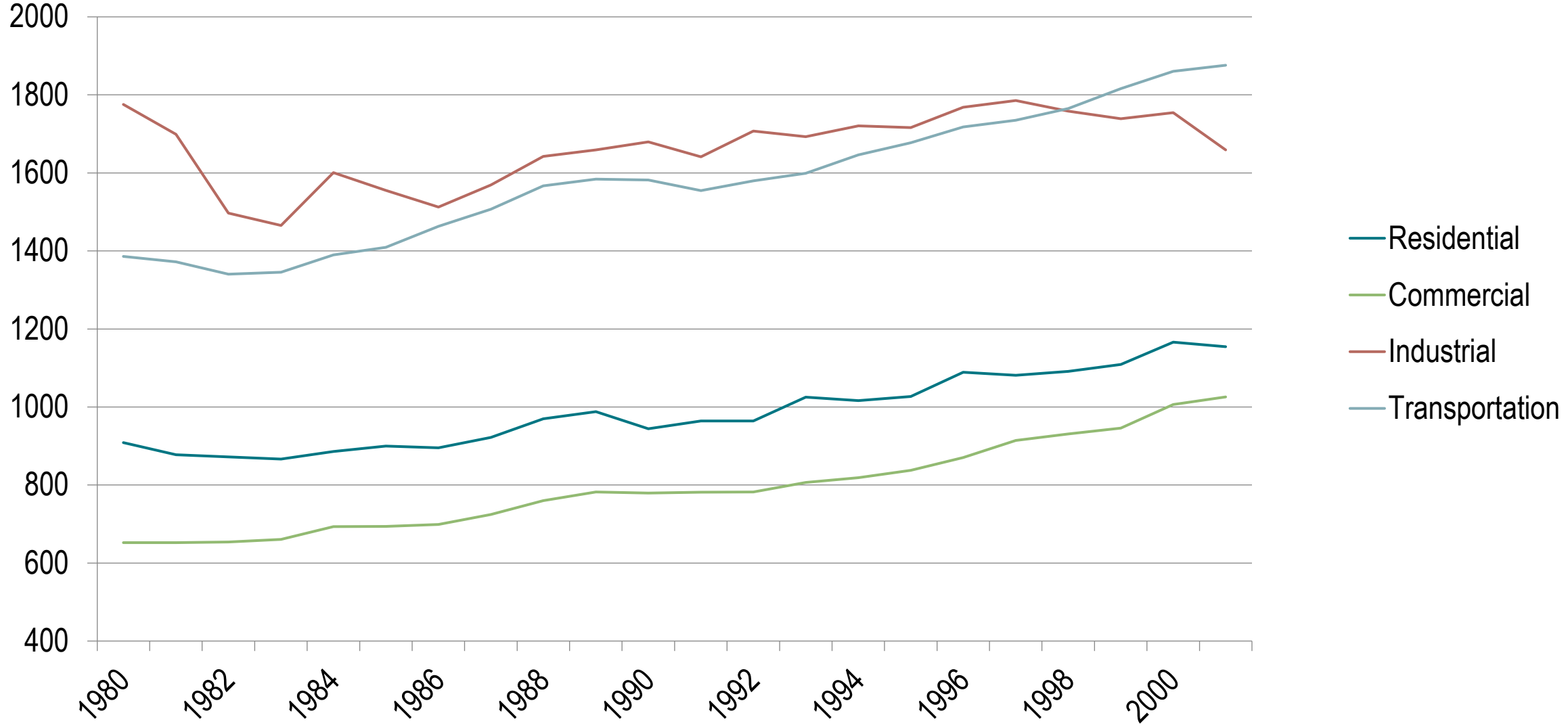
Carbon Dioxide Emissions From Energy Consumption by Sector, 1980-2001 (in million metric tons)



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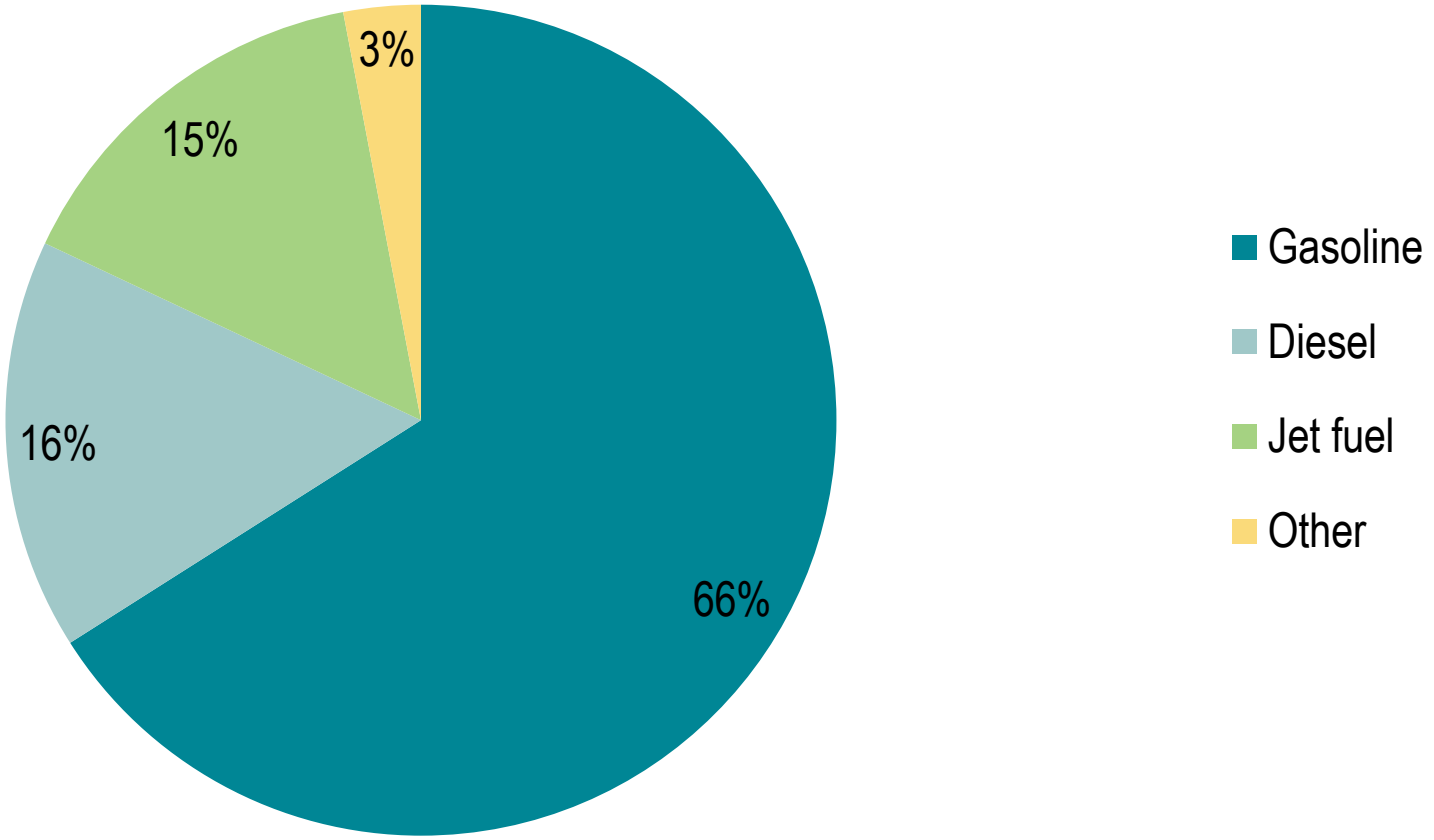
CO2 Emissions by Type of Fuel for the Transportation Sector in the United States, 1998



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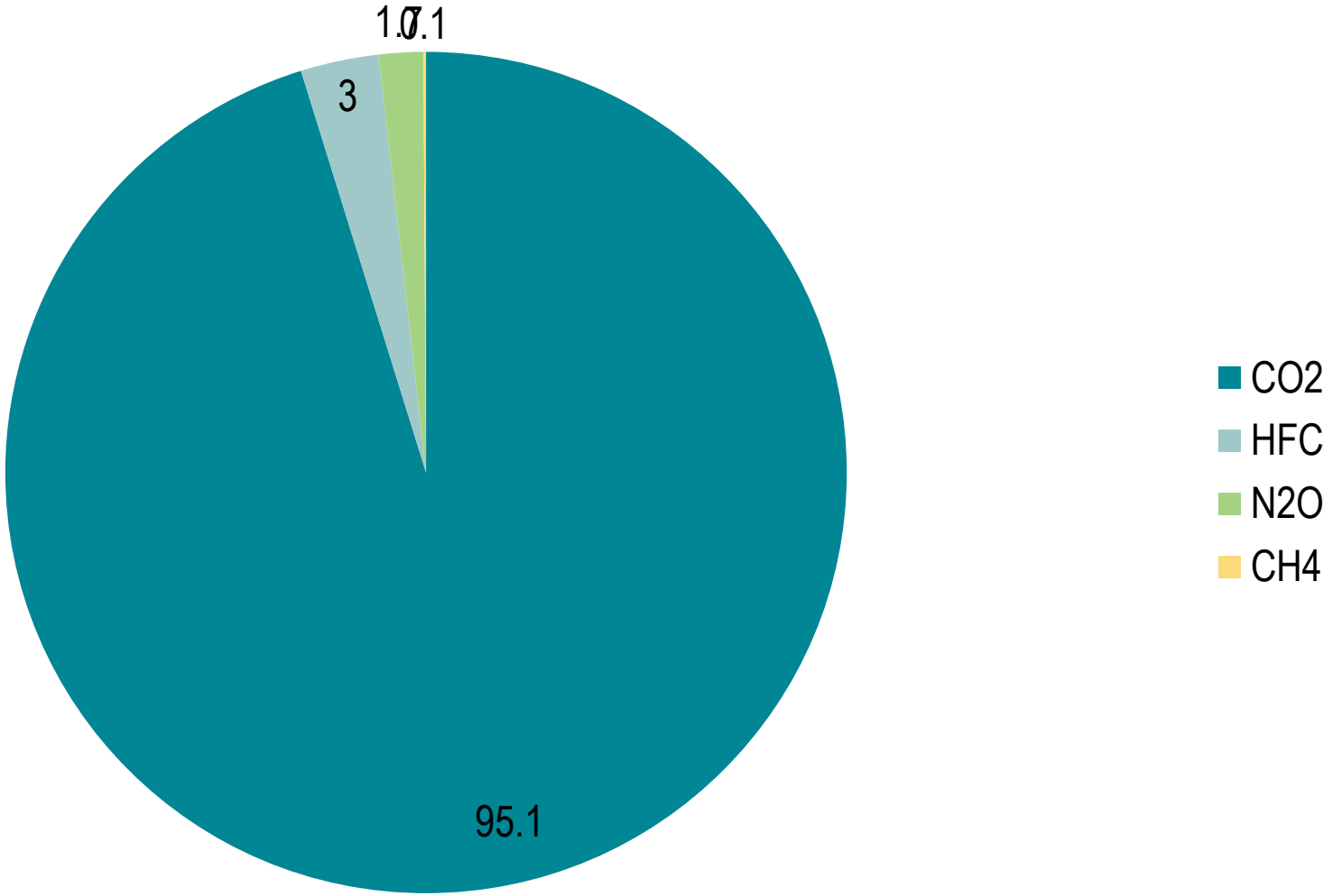
Greenhouse Gas Emissions for the Transportation Section, United States, 1990-2005



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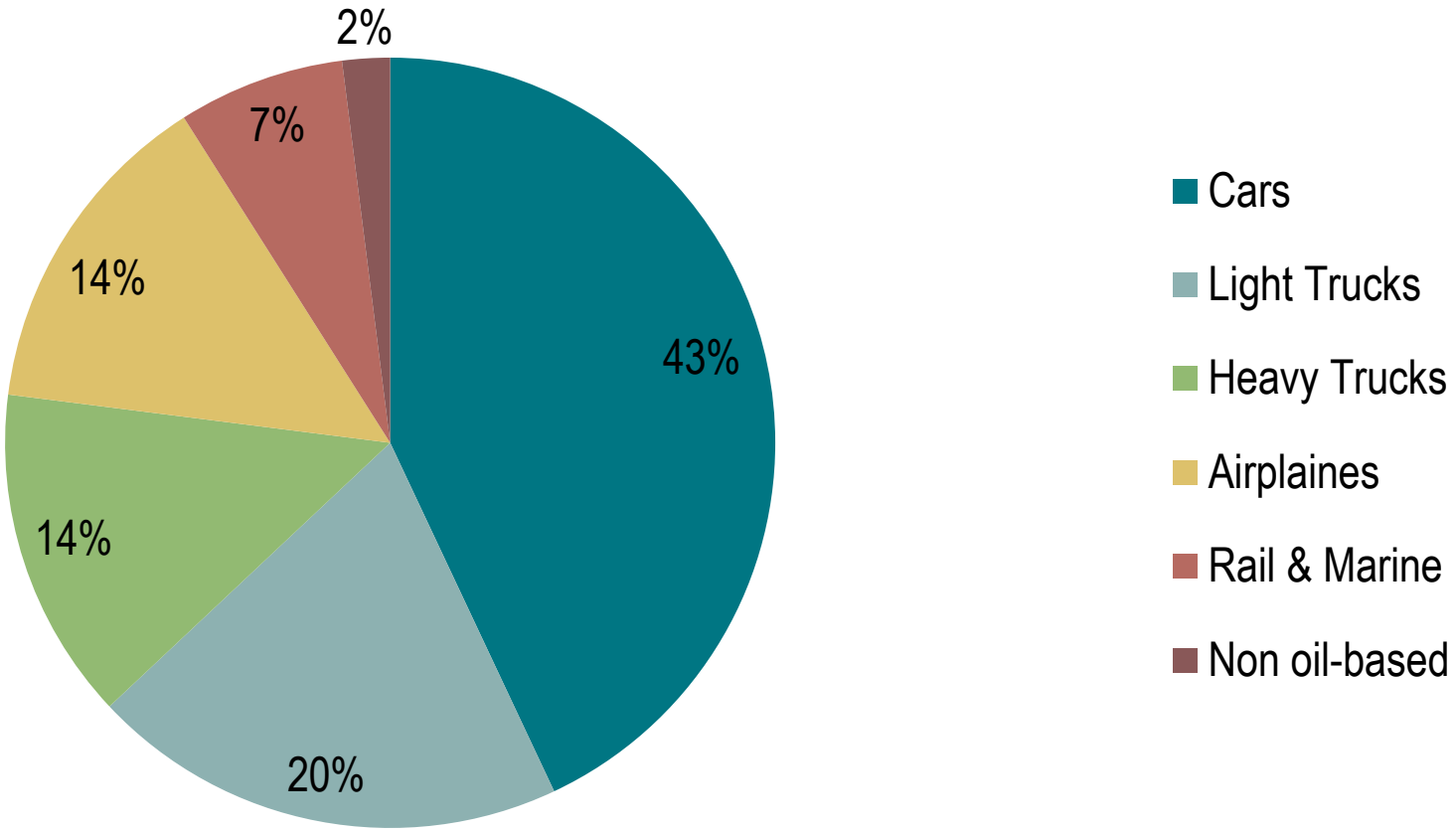
CO2 Emissions by Transportation Mode in the United States, 1998



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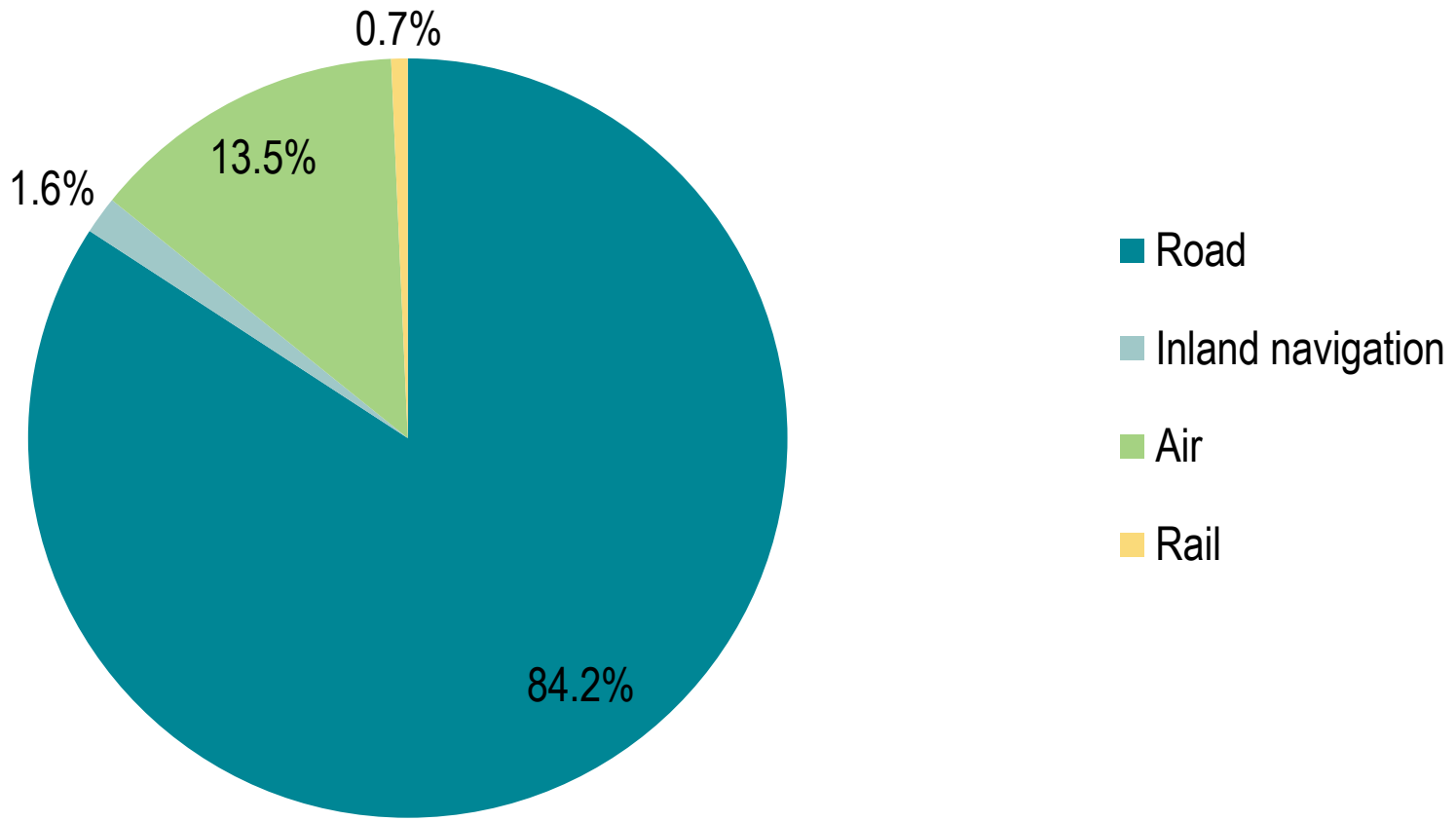
CO2 Emissions by Transportation Mode, EU-15, 2002



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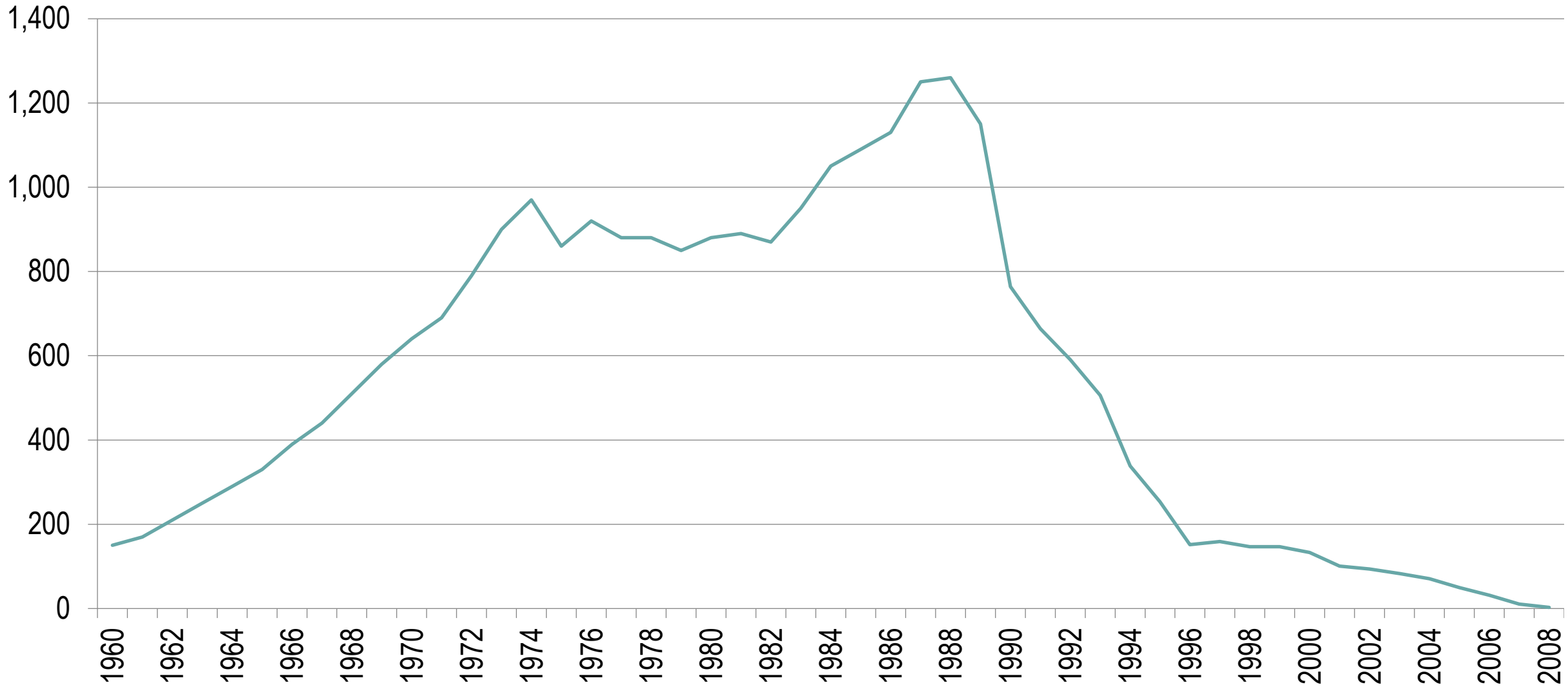
World Production of Ozone Depleting Substances, 1960-2008



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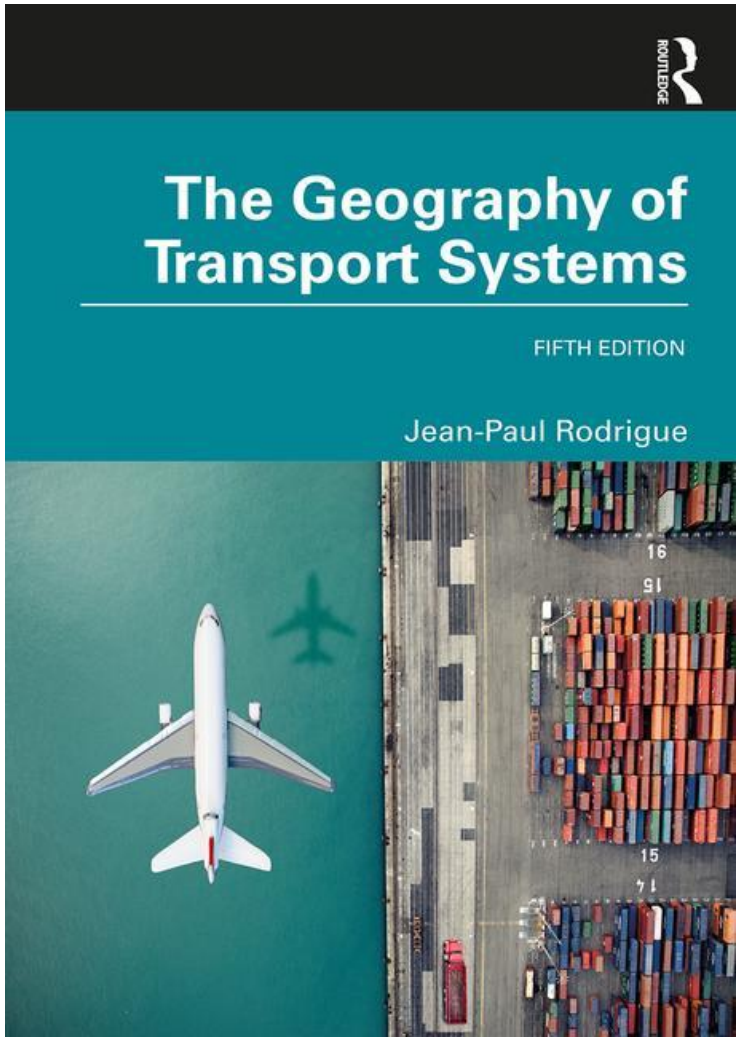

Climate Change and the Adaptation of Transport Infrastructure

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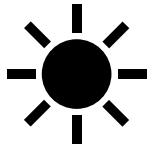
Climate Change and its Potential Impacts on Transportation

	Operations	Infrastructures
 **Heat waves**	• Impacts of lift-off load limits on shorter runways. • Limits on periods of construction activity.	• Thermal expansion of bridges. • Pavement integrity and softening. • Deformation of rail tracks.
 **Rising sea levels**	• Frequent interruptions of coastal low lying road, rail and air traffic due to storm surges.	• More frequent flooding of infrastructure (and potential damage) in low lying areas. • Erosion of infrastructure support. • Changes in harbor facilities to accommodate higher tides and surges.
 **Intensity of precipitation**	• Increase in weather related delays and disruptions, particularly road and air transport.	
 **More frequent hurricanes**	• Frequent interruptions of air services. • Frequent and extensive evacuations of coastal areas. • Debris on road and rail infrastructures.	• Greater probability of infrastructure failure. • Greater damage to port infrastructures.
 **Increase in arctic temperatures**	• Longer shipping season. • More ice-free ports in northern regions. • Availability of trans-arctic shipping routes.	• Damage to infrastructure because of the thawing of the permafrost. • Shorter season for ice-roads.

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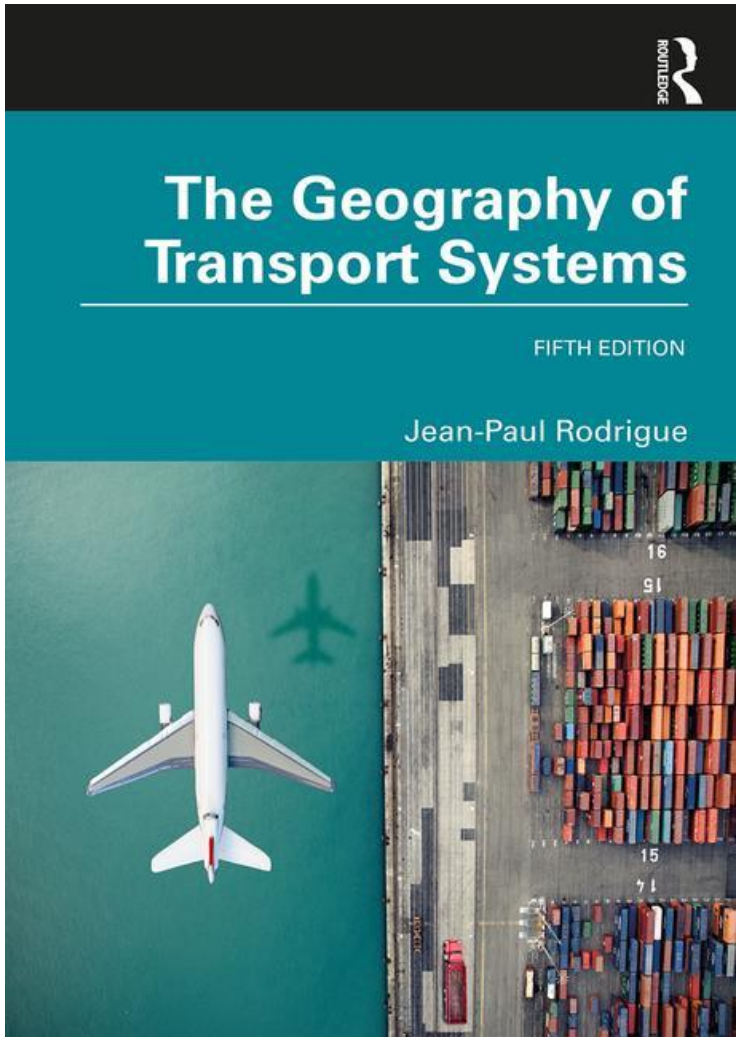

Green Logistics

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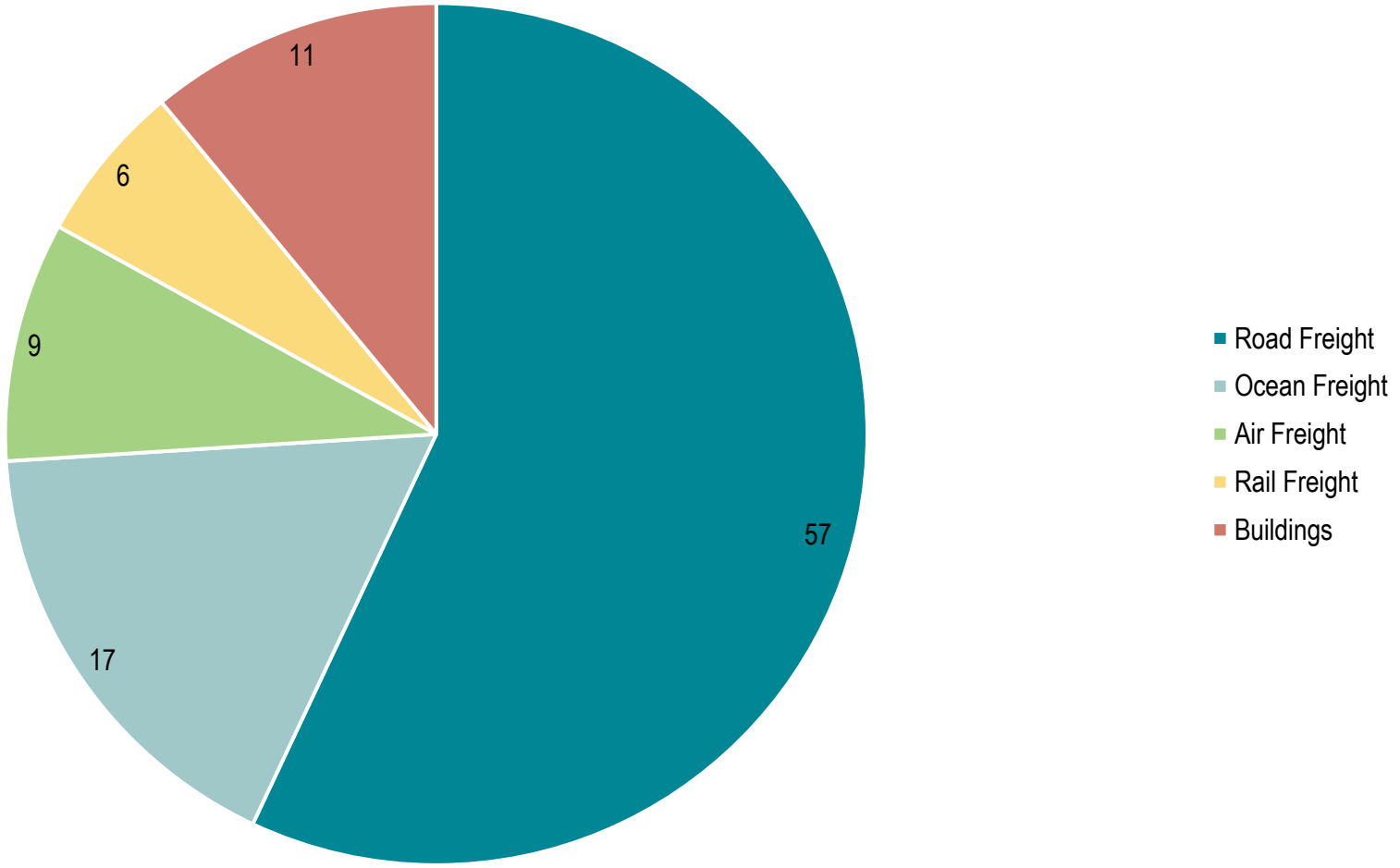
Logistics-Related Greenhouse Gas Emissions by Activity



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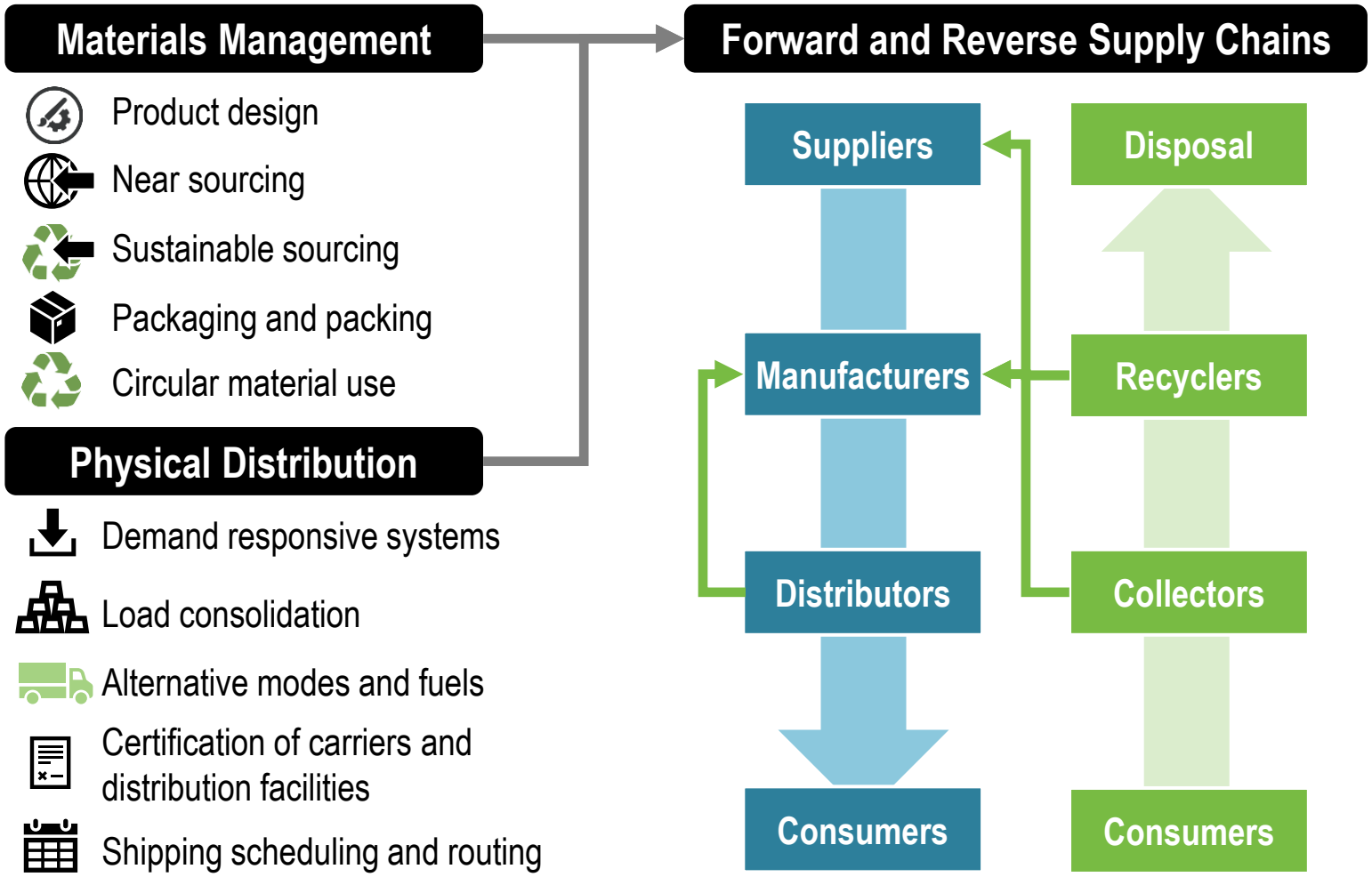
Logistic Activities and their Green Dimensions



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Logistical Strategies to Cope with Energy and Environmental Constraints

Objective	Strategy
Shipping less	Demand responsive systems. Reduce returns.
Changing sourcing	Reassessing sourcing both at the global and domestic levels.
Shipping scheduling	Allow greater shipping time and outside rush periods.
Efficient packaging	Reduce the shipment size (volume) of the same load.
Modal shift	For each segment, use a mode or a route that is more energy and environmentally efficient.

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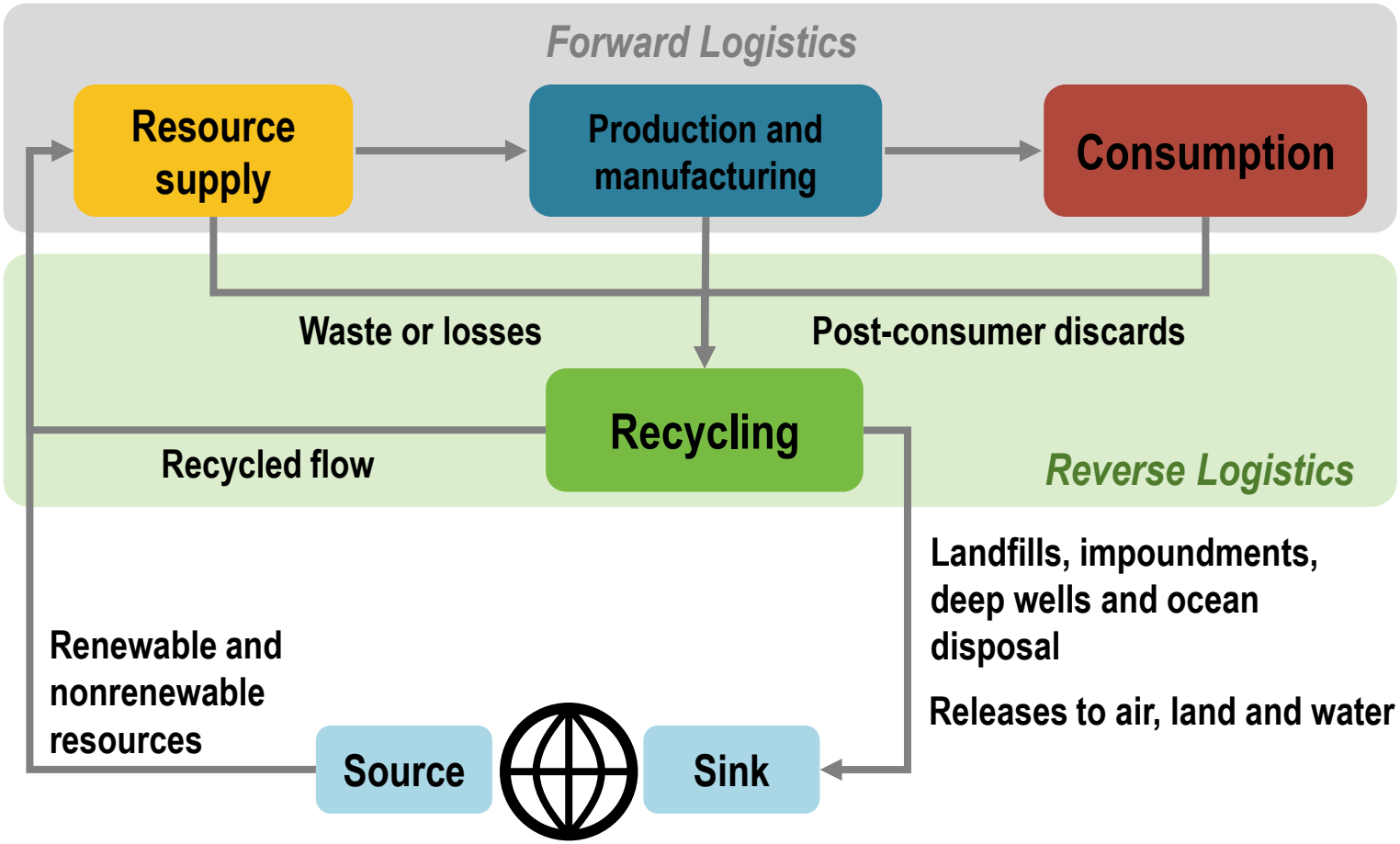
Material Flows Cycle



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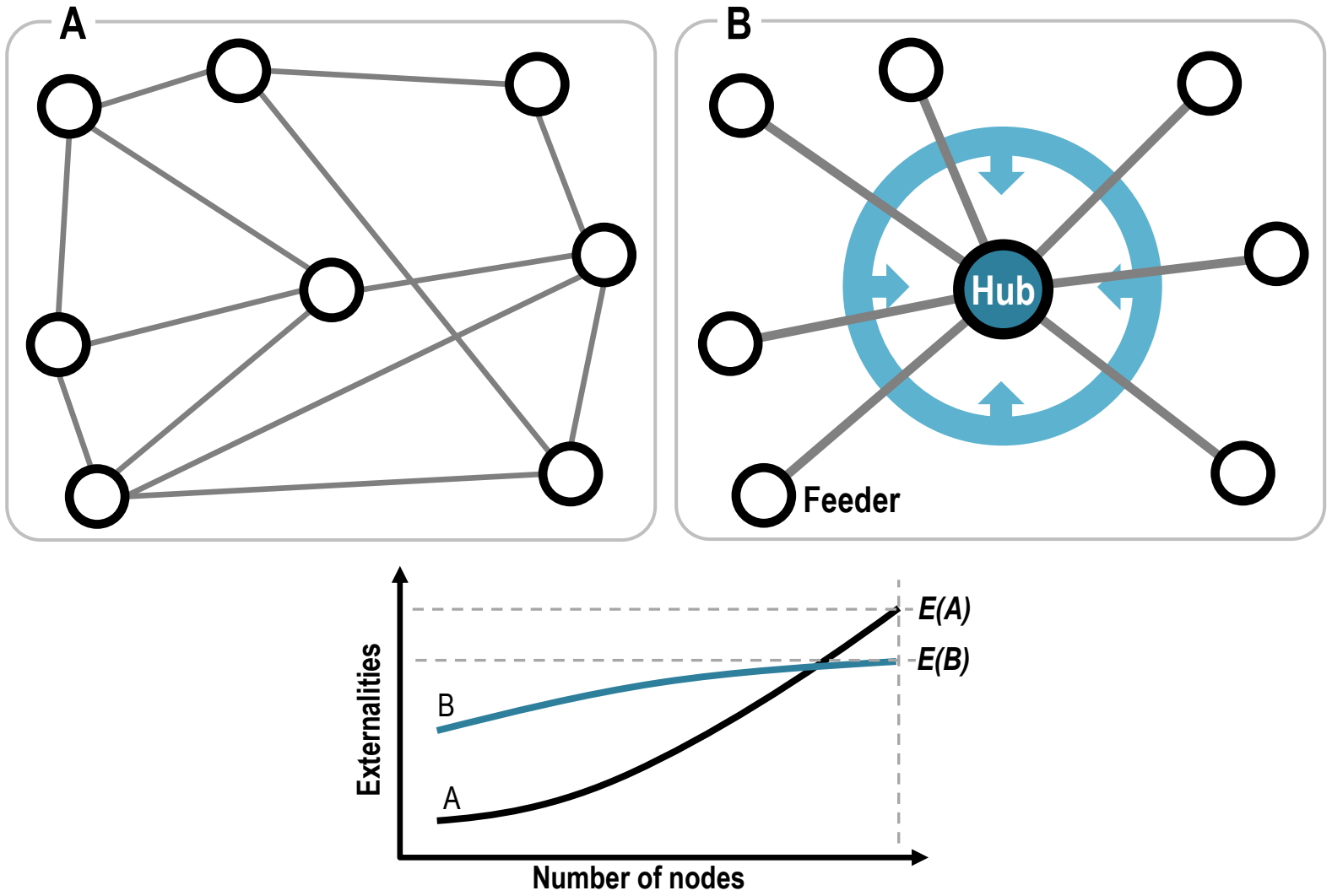
Hub-and-Spoke Network and Externalities



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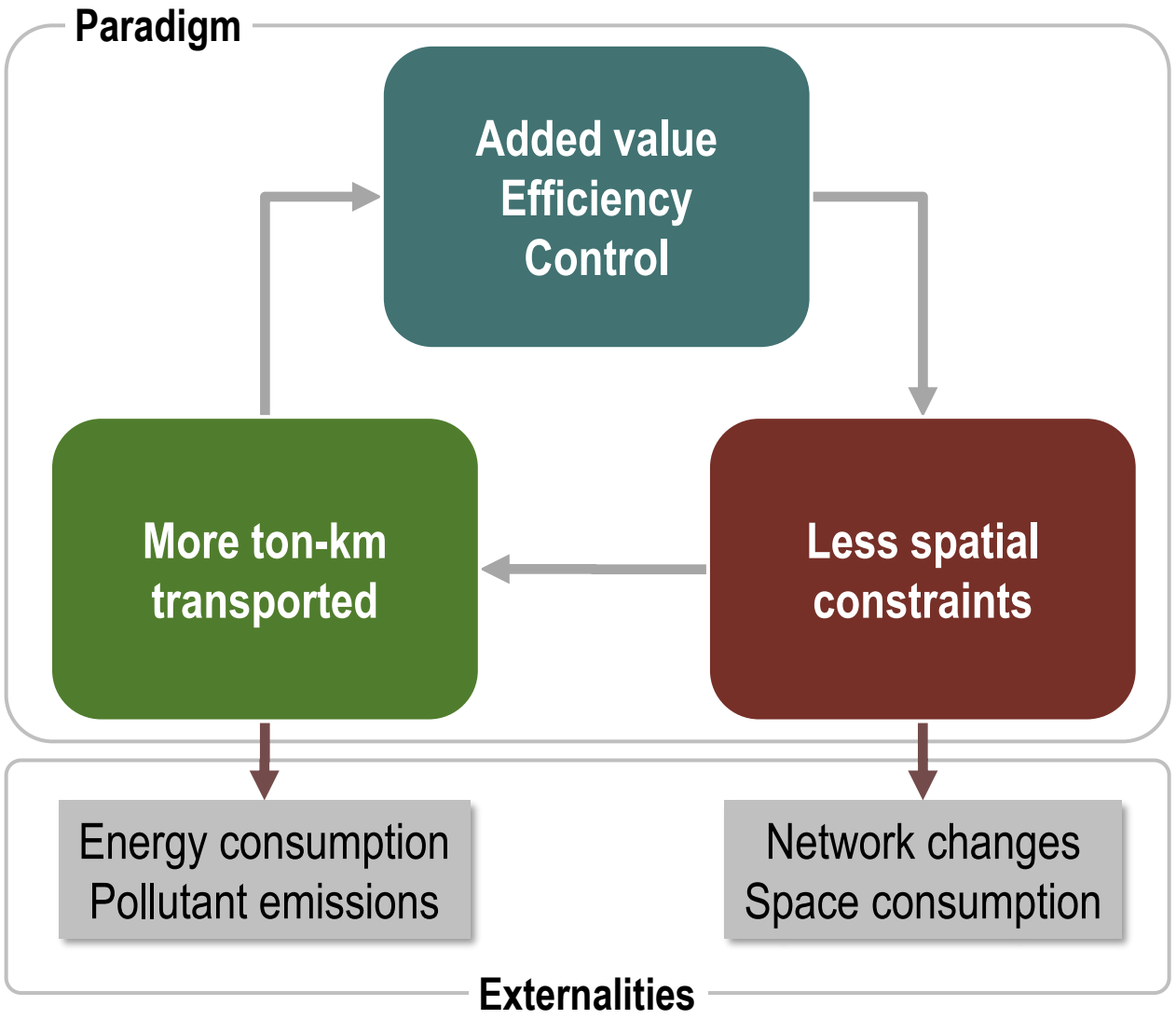
Environmental Vicious Circle of Logistics



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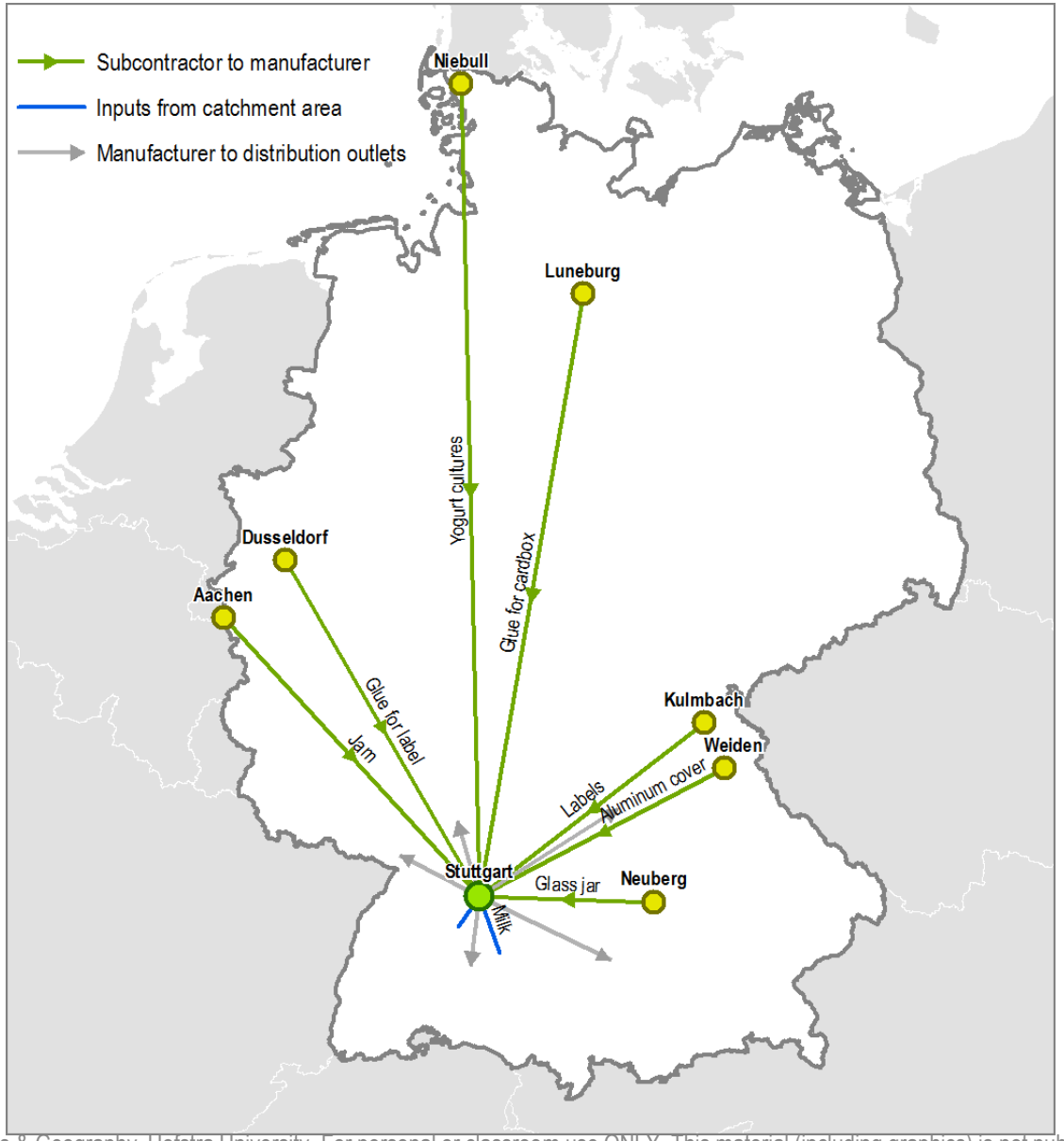
The Food Mile: Yogurt Supply Chain, Germany



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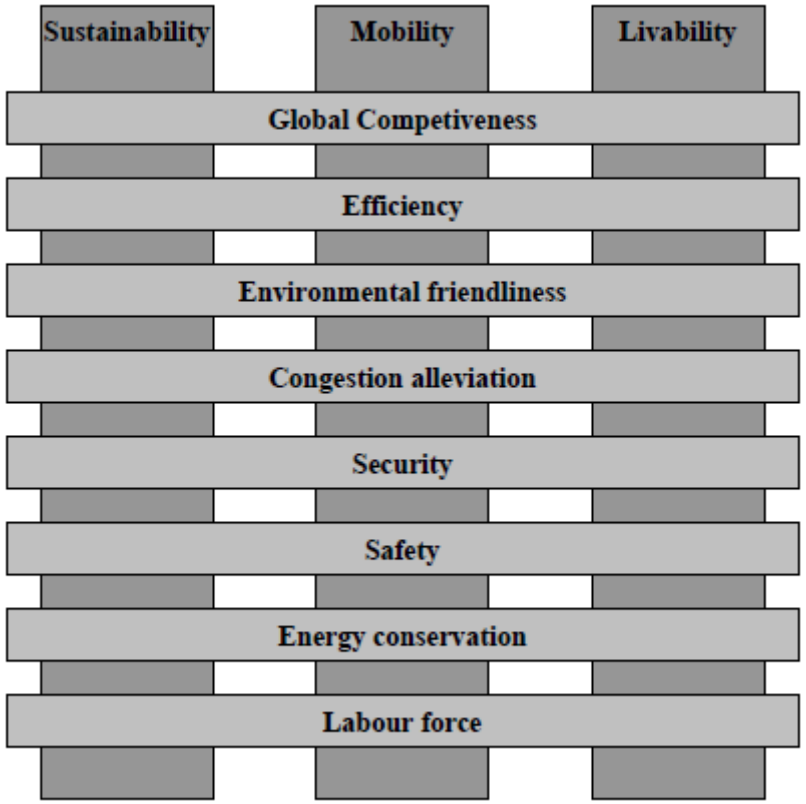
Main Dimensions of Green Logistics (under construction)



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The Paradoxes of Green Logistics

Dimension	Outcome	Paradox
Costs	Reduction of costs through improvement in packaging and reduction of wastes. Benefits are derived by the distributors.	Environmental costs are often externalized.
Time / Flexibility	Integrated supply chains. JIT and DTD provide flexible and efficient physical distribution systems.	Extended production, distribution and retailing structures consuming more space, more energy and producing more emissions (CO2, particulates, NOx, etc.).
Network	Increasing system-wide efficiency of the distribution system through network changes (Hub-and-spoke structure).	Concentration of environmental impacts next to major hubs and along corridors. Pressure on local communities.
Reliability	Reliable and on-time distribution of freight and passengers.	Modes used, trucking and air transportation, are the least environmentally efficient.
Warehousing	Less warehousing per unit of freight. Inventory in circulation.	Inventory shifted in part to public roads (or in containers), contributing to congestion and space consumption.
E-commerce	Increased business opportunities and diversification of the supply chains.	Changes in physical distribution systems towards higher levels of energy consumption.

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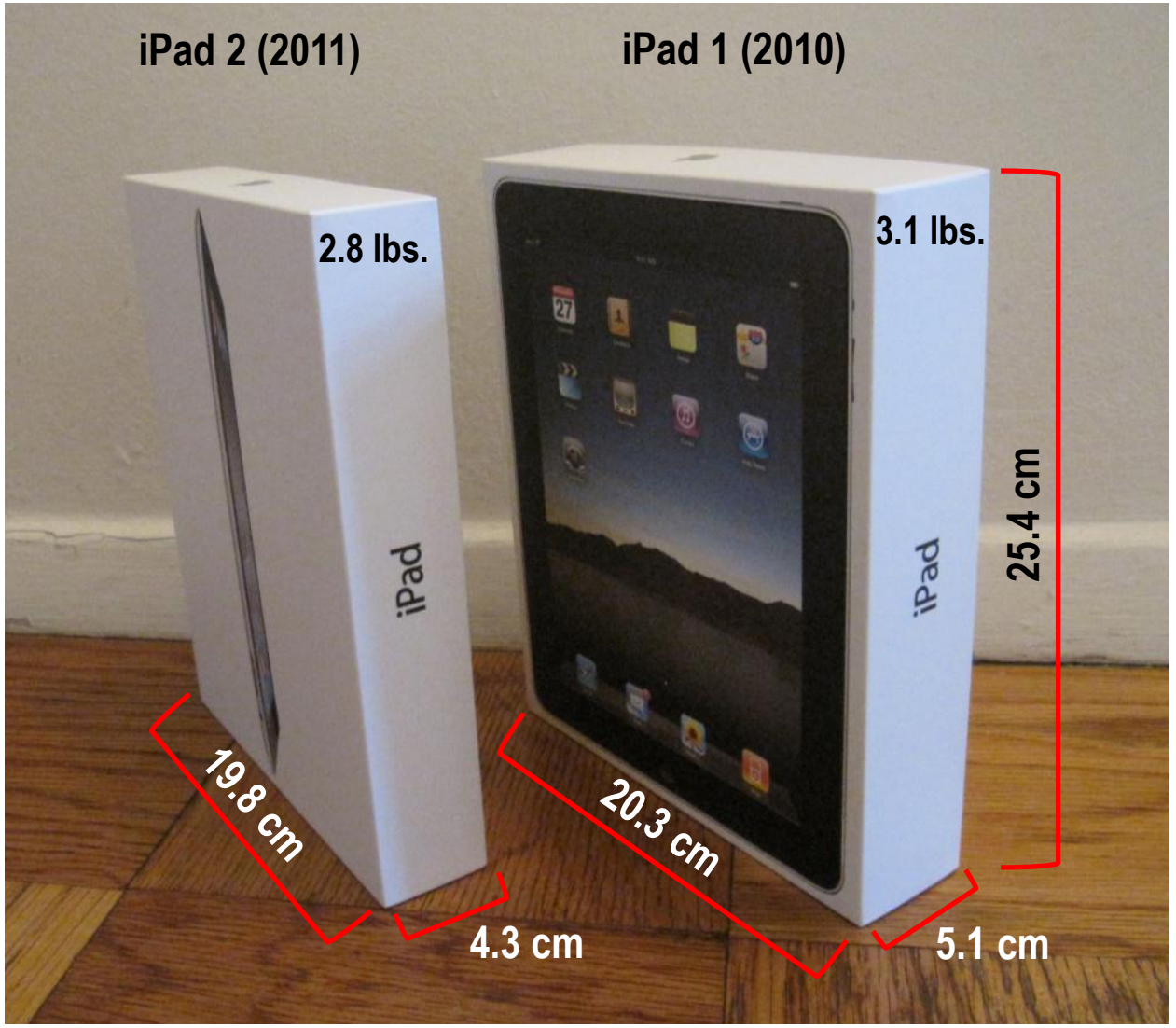
Weight and Packaging Improvements: iPad 1 versus iPad 2



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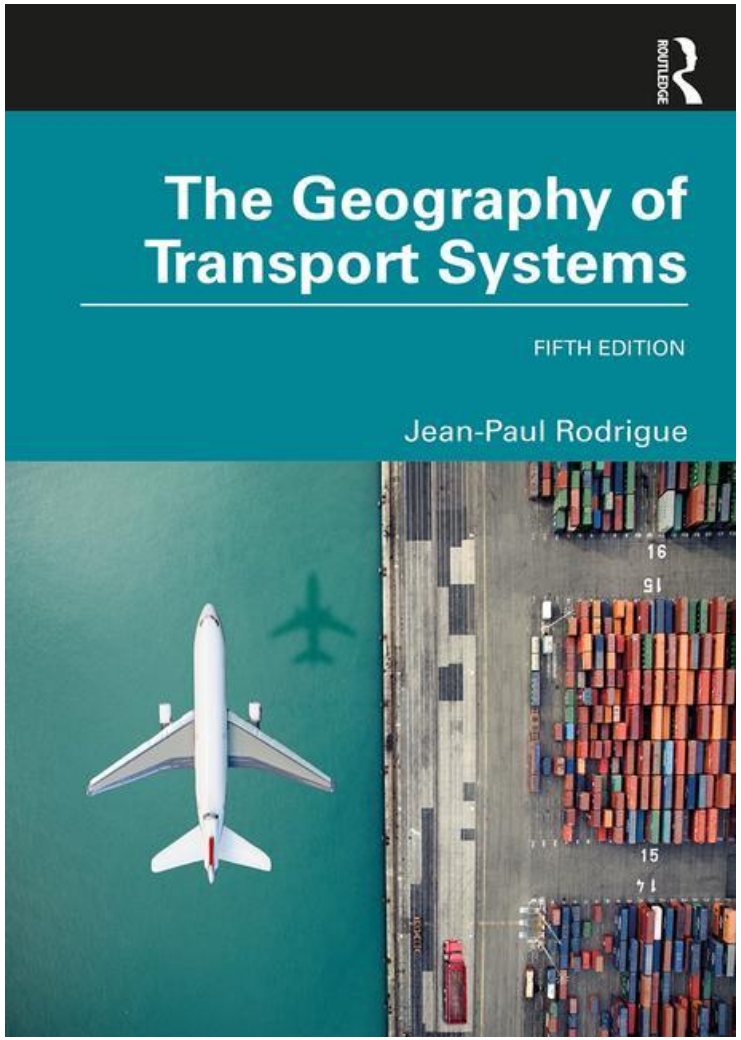

Rail Deregulation in the United States

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Major North American Rail Mergers, 1980-2007

Year	Merger -> (Resulting Firm)
1980	Burlington Northern and St. Louis - San Francisco (Burlington Northern)
1980	Seaboard Coast Line, Chesapeake and Ohio, and Baltimore and Ohio (CSX)
1982	Louisville and Nashville and CSX (CSX)
1982	Union Pacific, Western Pacific, Missouri Pacific (Union Pacific)
1982	Southern Railway and Norfolk and Western (Norfolk Southern)
1985	Southern Pacific and St. Louis South-Western (Southern Pacific)
1985	Union Pacific and Missouri-Kansas and Texas (Union Pacific)
1991	Southern Pacific and Denver & Rio Grande (Southern Pacific)
1991	Canadian Pacific and Delaware and Hudson Railway (Canadian Pacific)
1995	Burlington Northern and Santa Fe (Burlington Northern Santa Fe)
1995	Union Pacific and Chicago and North-Western (Union Pacific)
1996	Southern Pacific and Union Pacific (Union Pacific)
1998	Norfolk Southern, 58% of CONRAIL (Norfolk Southern)
1998	CSX and 42% of CONRAIL (CSX Transportation)
1998	Canadian National and Illinois Central Railroad (Canadian National)
2001	Canadian National and Wisconsin Central (Canadian National)
2005	Kansas City Southern, Transportacion Ferrovia Mexicana (Kansas City Southern de Mexico)
2007	Canadian Pacific and Dakota, Minnesota and Eastern Railroad (Canadian Pacific)

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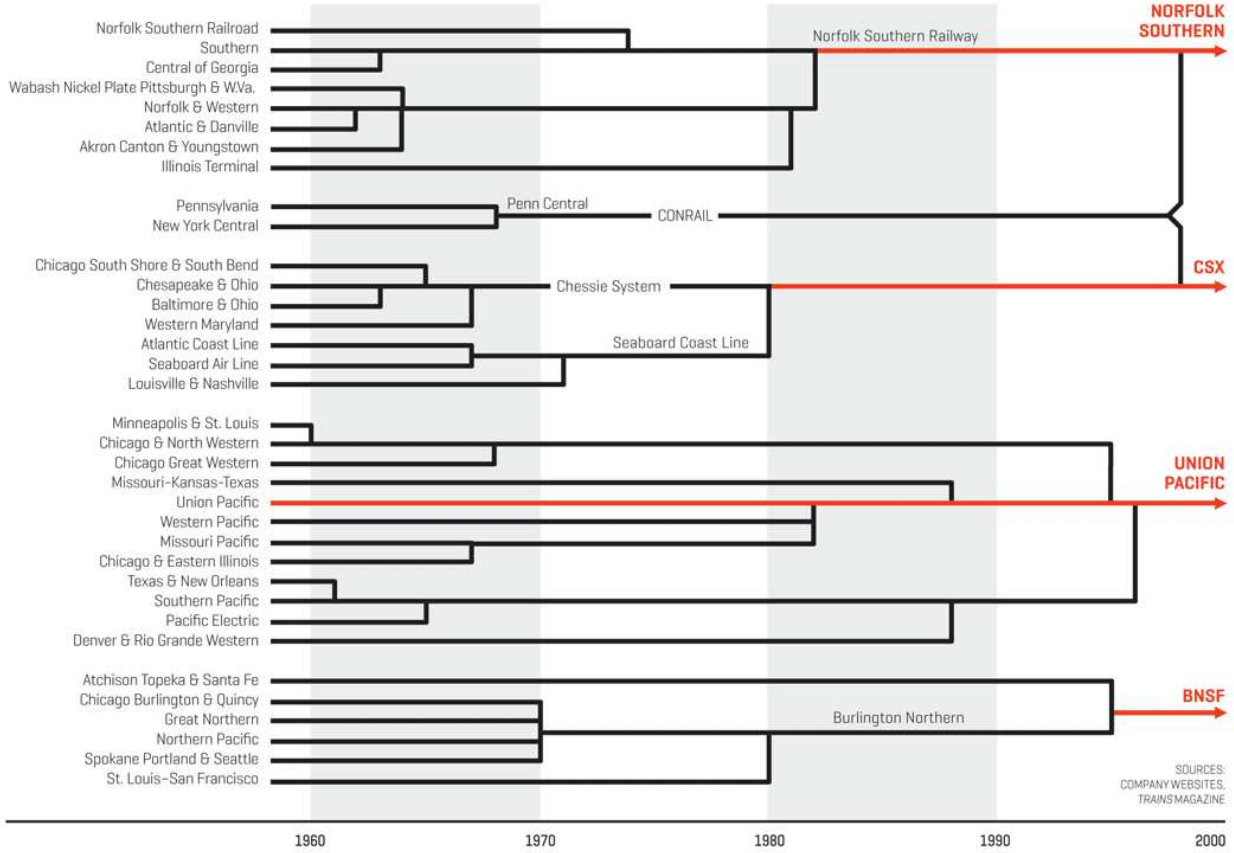
MAKING THE BIG FOUR

A series of mergers over the past 50 years has led to the creation of four freight rail behemoths that now control 90% of all business. Below, some of the notable deals along the way.



"The board works actively to help try to solve problems.")

The rate relief process is expensive and notoriously complex. Some companies, such as those shipping iron, lumber, or cheese, aren't even allowed to appeal. The STB has excluded customers in those industries from the relief

But the STB is essentially the only option for shippers, since other government agencies are mostly shut out. The Federal Trade Commission has no ability to intervene; neither does the Justice Department, which can only offer advice on mergers. The DoJ issued a stern warning against

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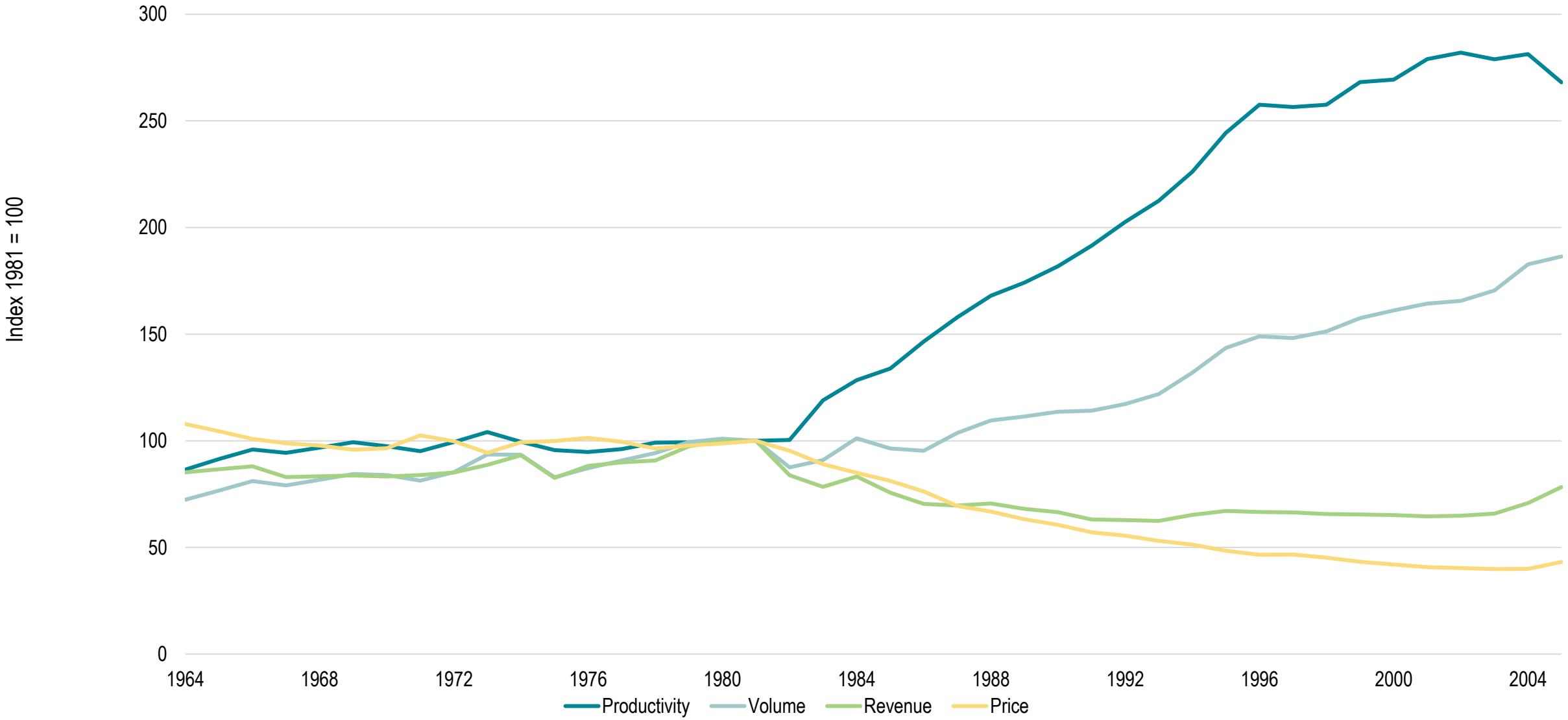
Performance of Class I Railroads, 1964-2005



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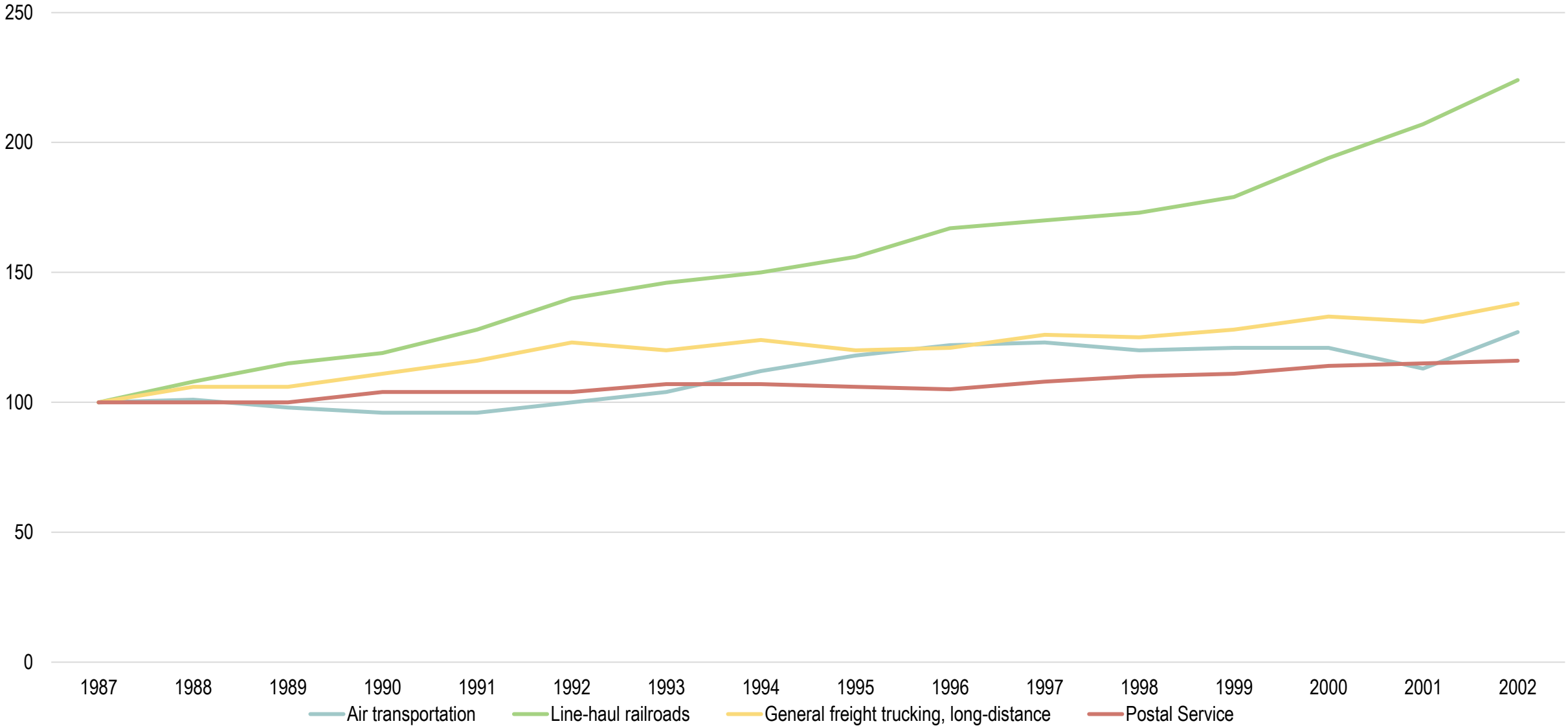
Productivity in Selected Transportation Industries: 1987-2002 (Output per Employee, Index, 1987 = 100)



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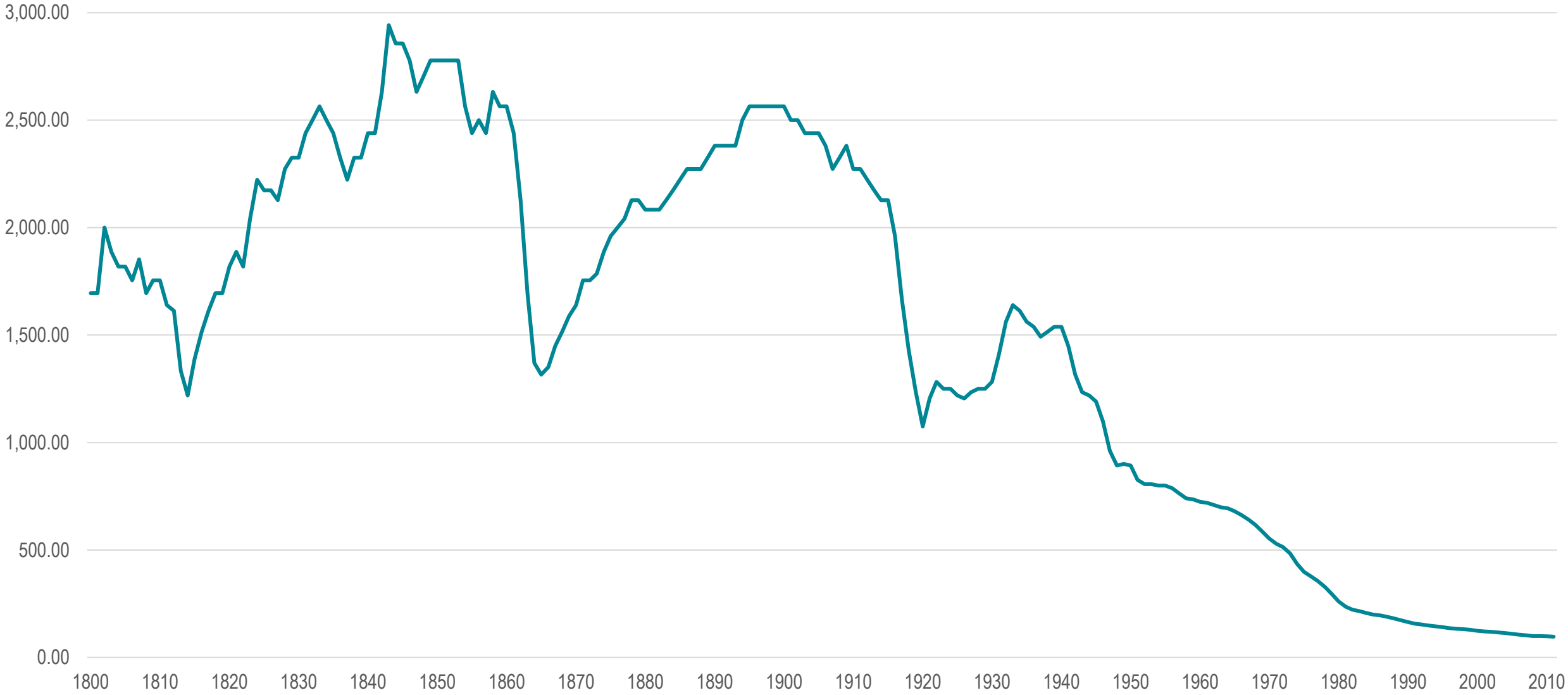
Value of a 2009 $100 Dollar, 1800 - 2011



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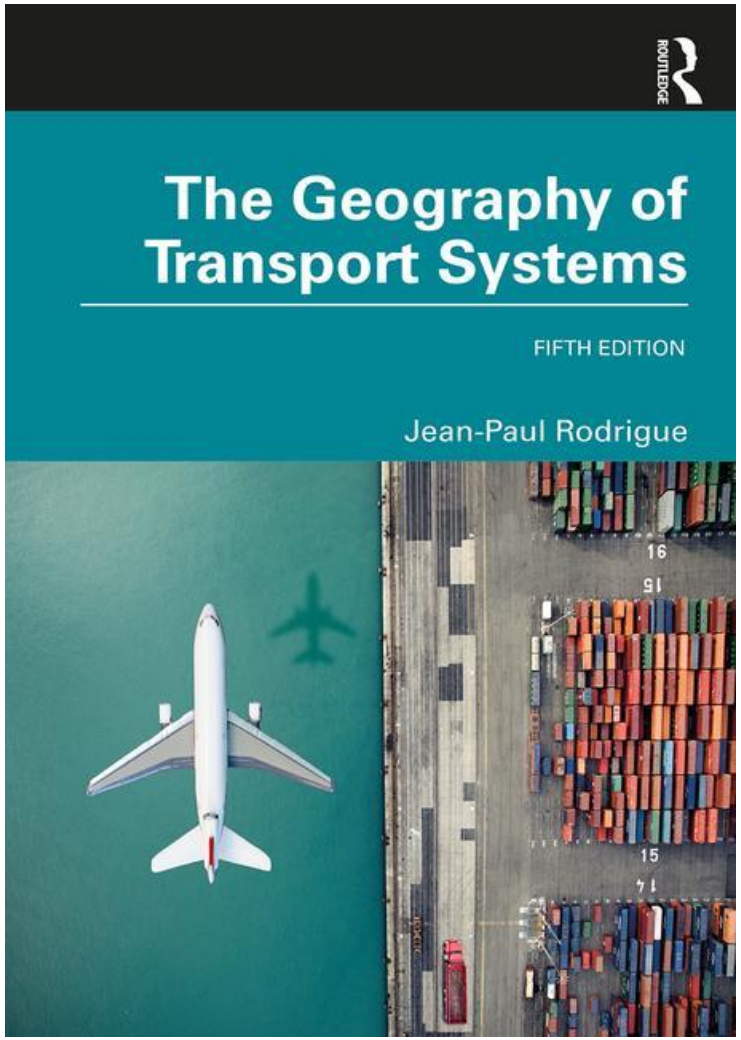

Transportation and Pandemics

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Main Factors behind the Global Spread of Diseases

Global Travel

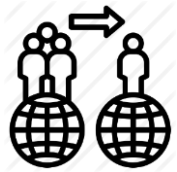
- Air connectivity.
- People as vectors (e.g. Flu, West Nile Virus, SARS, COVID-19).

Wars and conflicts

- Destruction / damaging of healthcare systems and public utilities (aqueduct / sewage).
- Displacement of populations (refugees).

Global Trade

- Animals and insects.
- Cargo as the vector (e.g. Mad Cow Disease).



Migration

- Migrants bring endemic diseases in developed countries (e.g. tuberculosis).
- Creation of disease clusters.

Poverty

- Overcrowding and malnutrition.
- Lack of healthcare and unsanitary conditions.

Medical practices

- Pathogenic natural selection.
- More virulent and resistant diseases.

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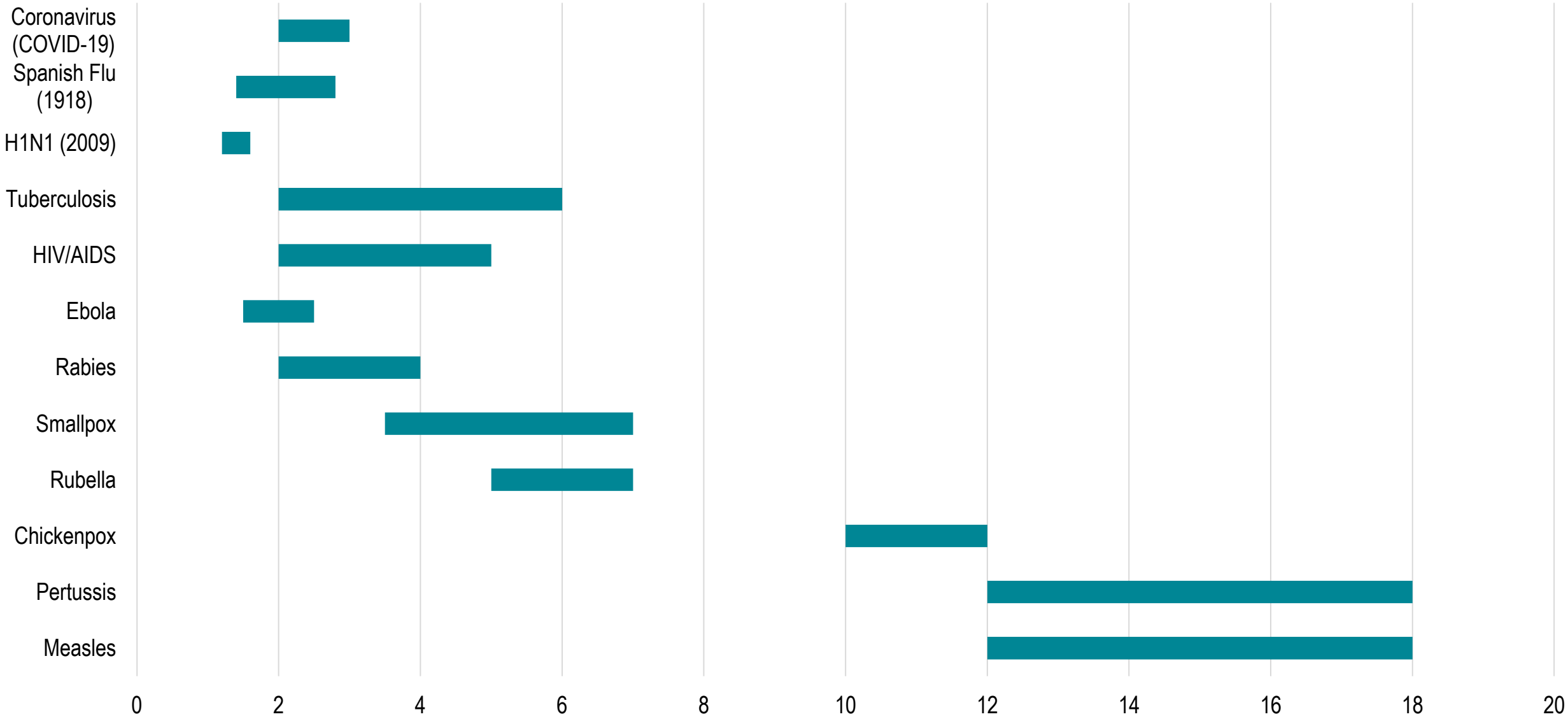
Basic Reproduction Number (R0) of Major Infectious Diseases



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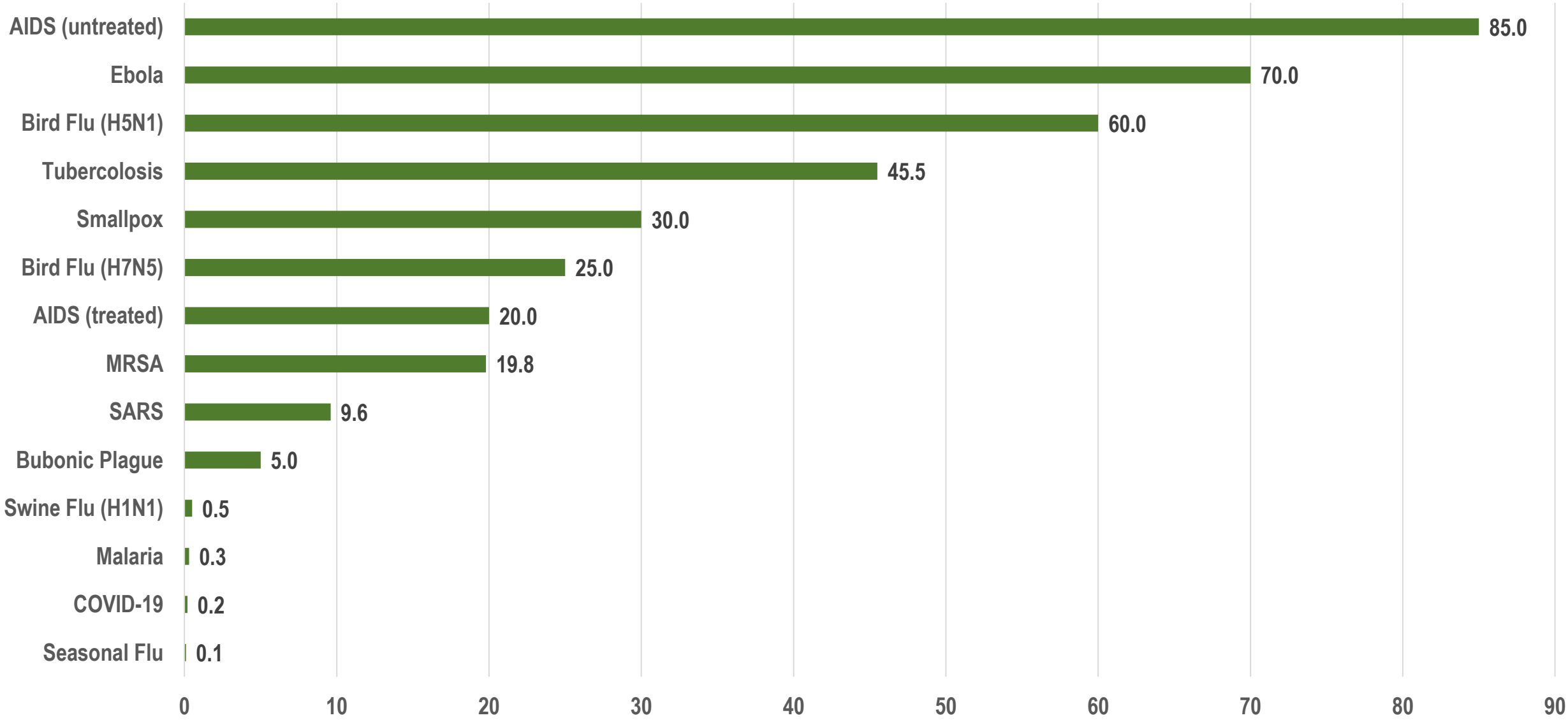
Case Fatality Rates per Type of Disease (per 100)



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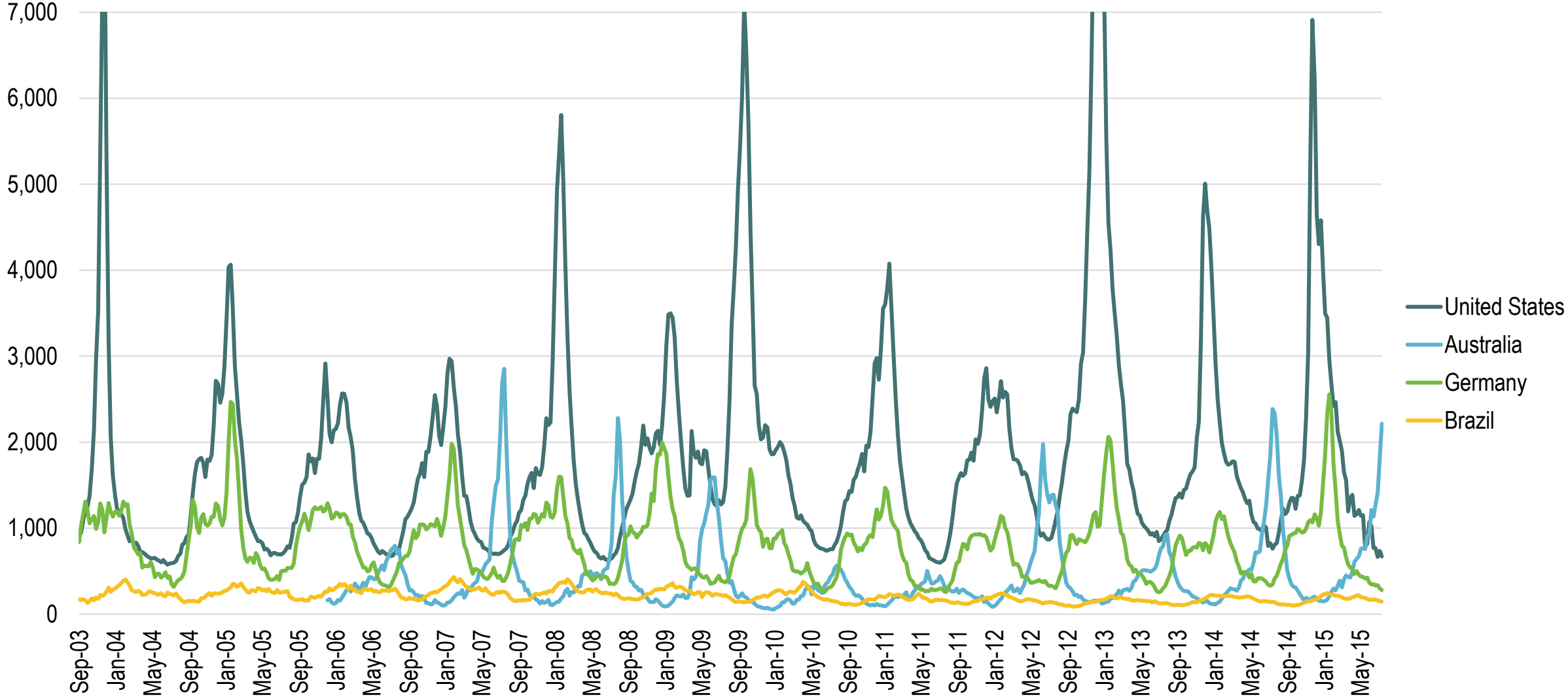
Influenza-Like Illnesses per 100,000 Population, Selected Countries, 2003-2015



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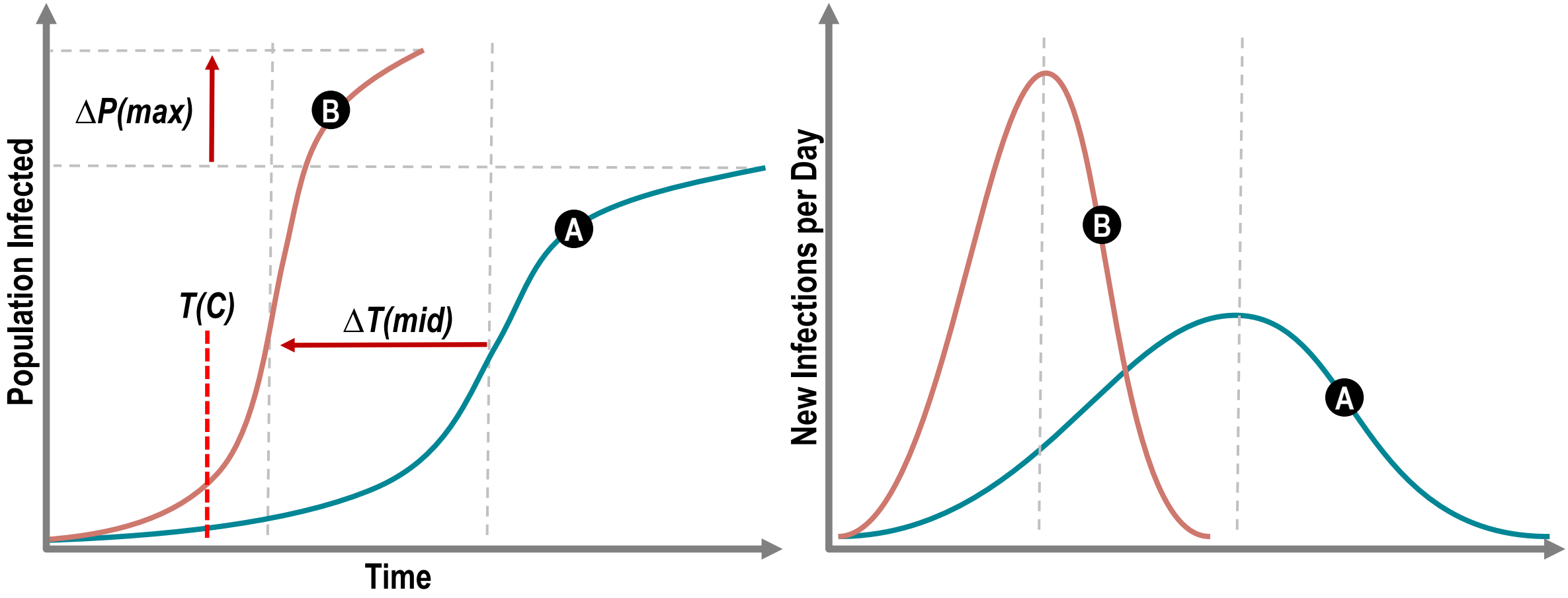
Impacts of Transportation on the Velocity and Extent of a Pandemic



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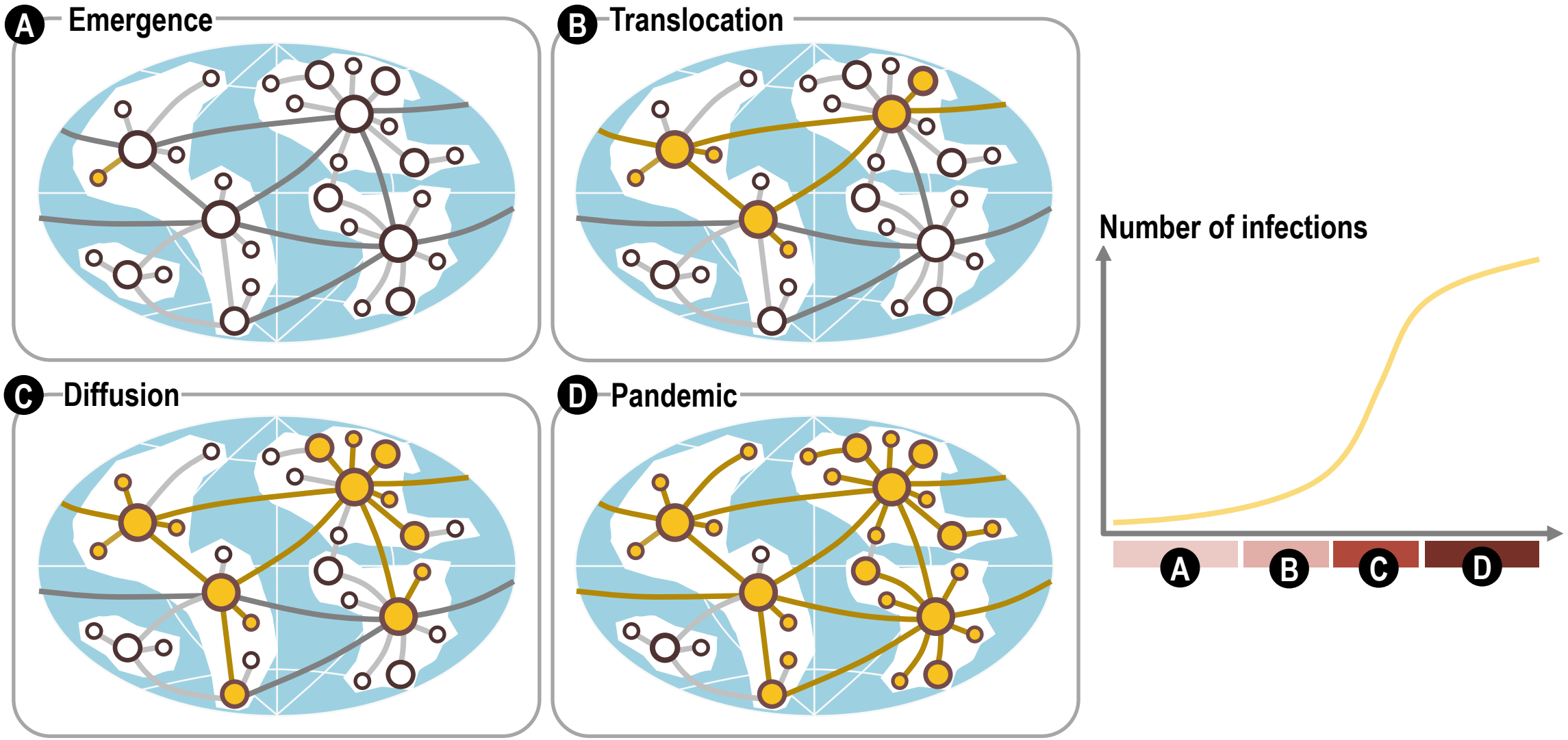
Diffusion of a Pandemic through a Global Transportation Network



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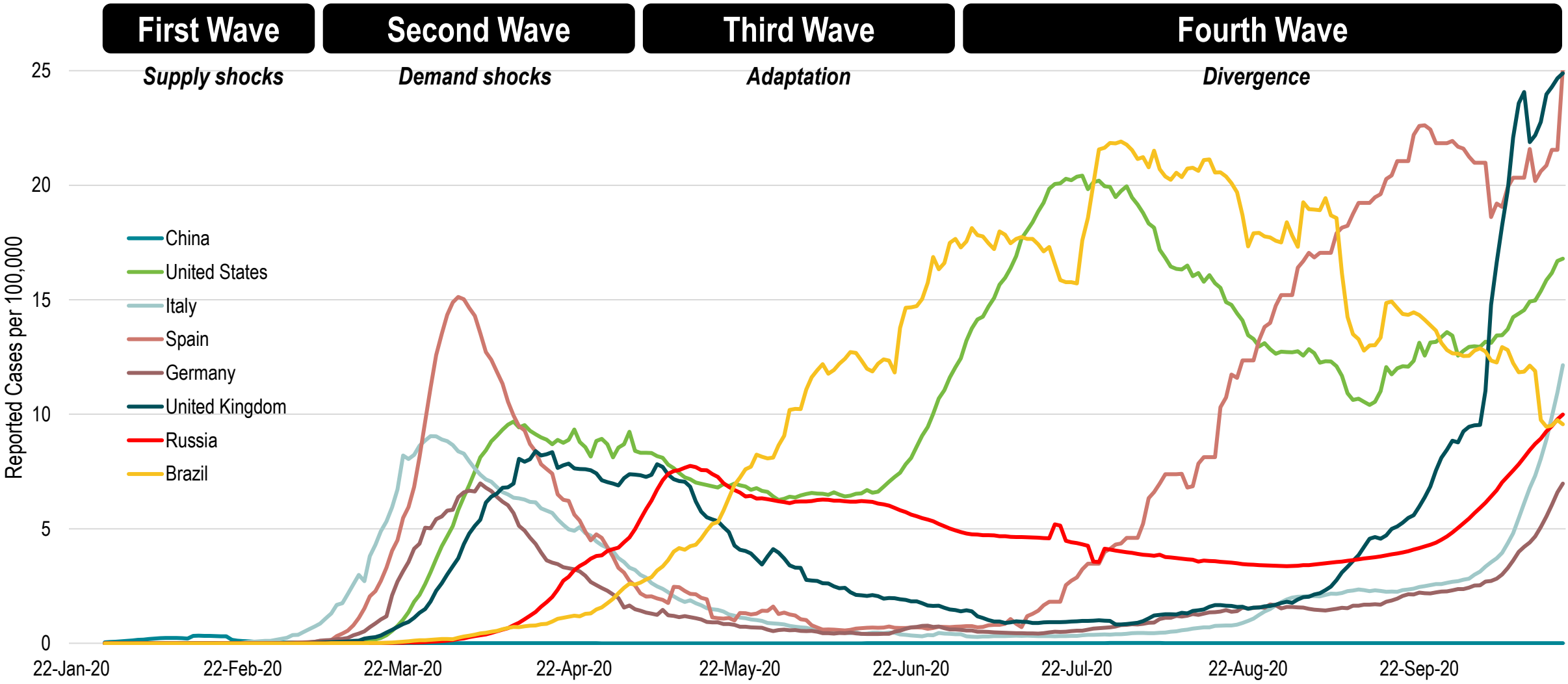
Coronavirus (COVID-19) Reported Daily New Cases, 2020



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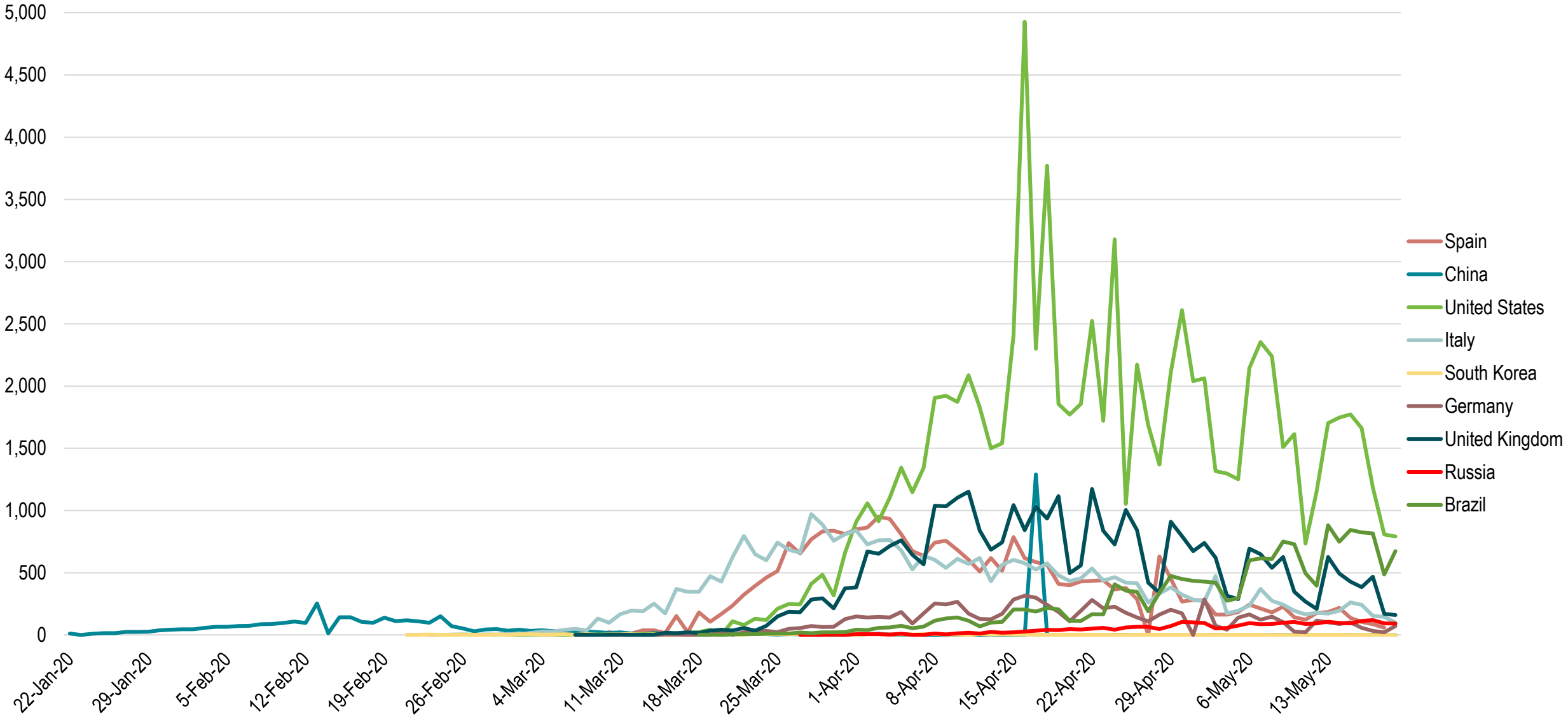
Coronavirus (COVID-19) Reported Daily Deaths, 2020



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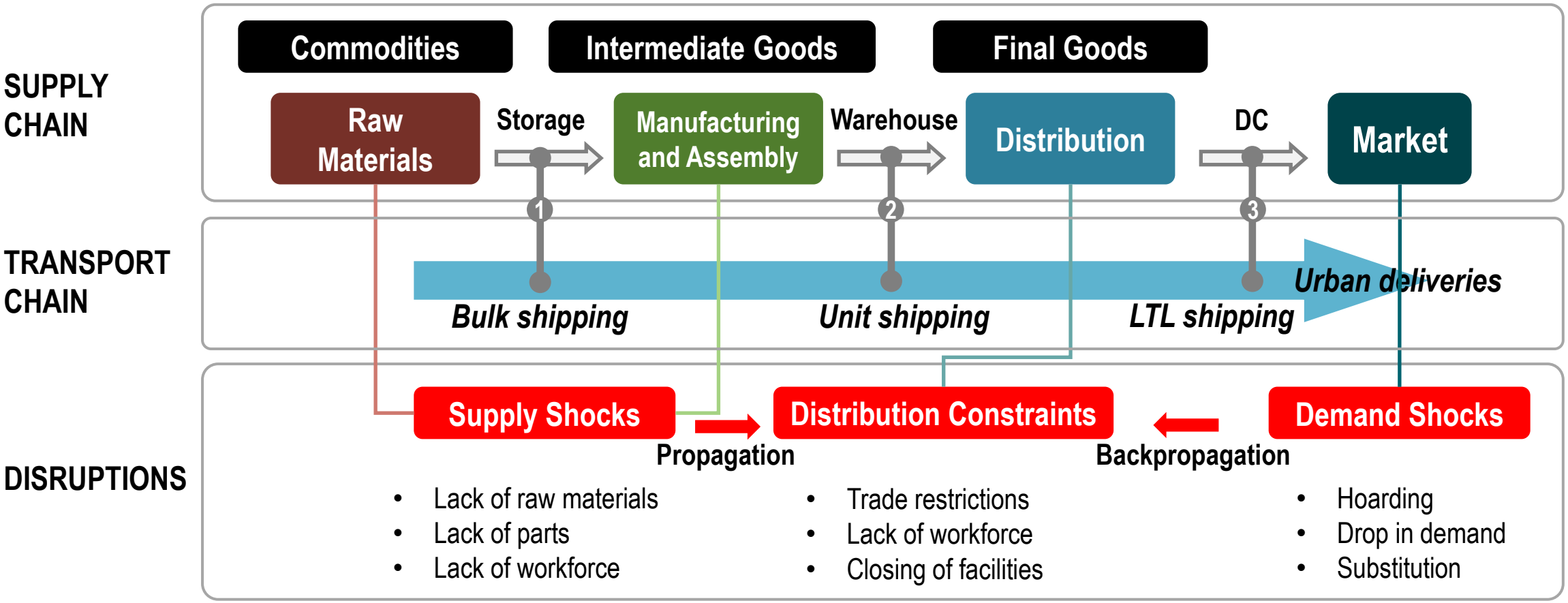
Impacts of Pandemics on Supply Chains



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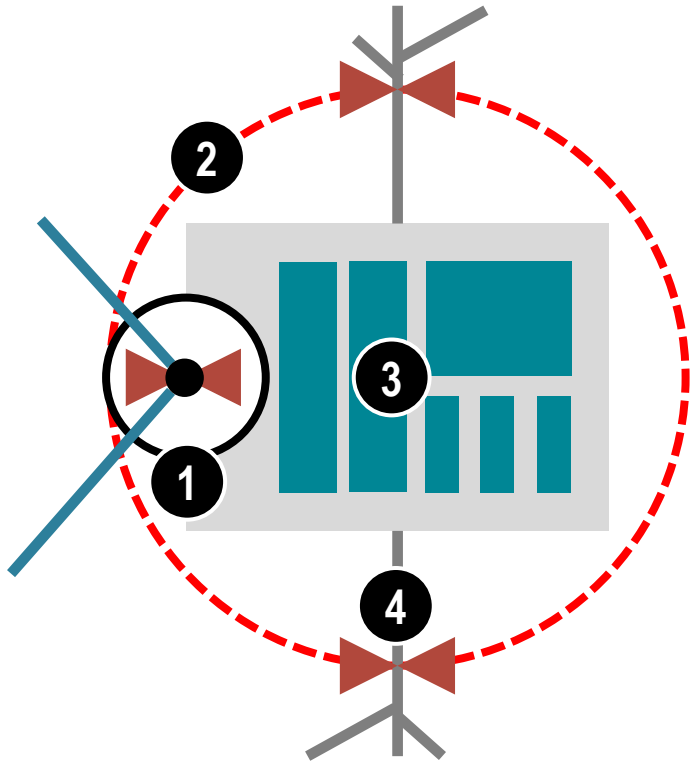
The Logistics Stronghold Concept



1 Strategic Asset

- Port, airport, inland terminal, distribution cluster, energy generation facility.
- Access to global/national resources and markets.

2 Secure Facility Area

- Secure area (fences).
- Access restriction (checkpoints).
- Maintenance of basic operations.
- Key personnel on site continuously.

3 Inventory Management

- Procurement, storage and distribution of key resources.
- Energy, goods and parts, food, medical supplies.
- Support facilities (maintenance).

4 Secure Corridors

- Access to local/regional distribution.
- Setting of secure convoys.

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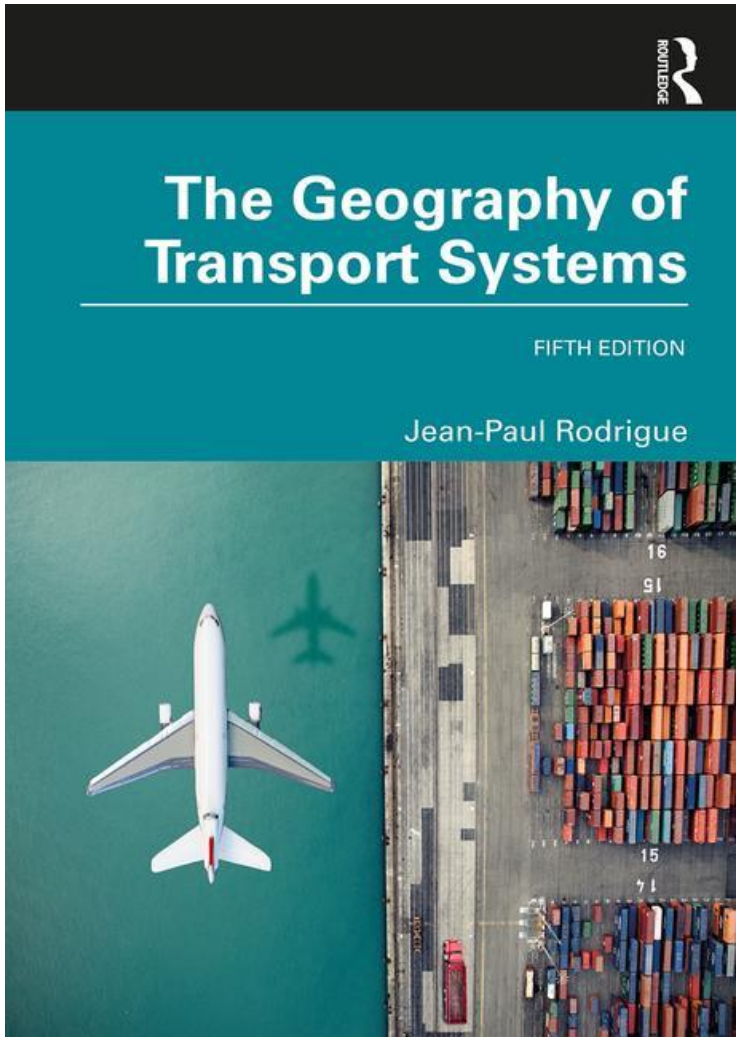

The Port Authority of New York and New Jersey

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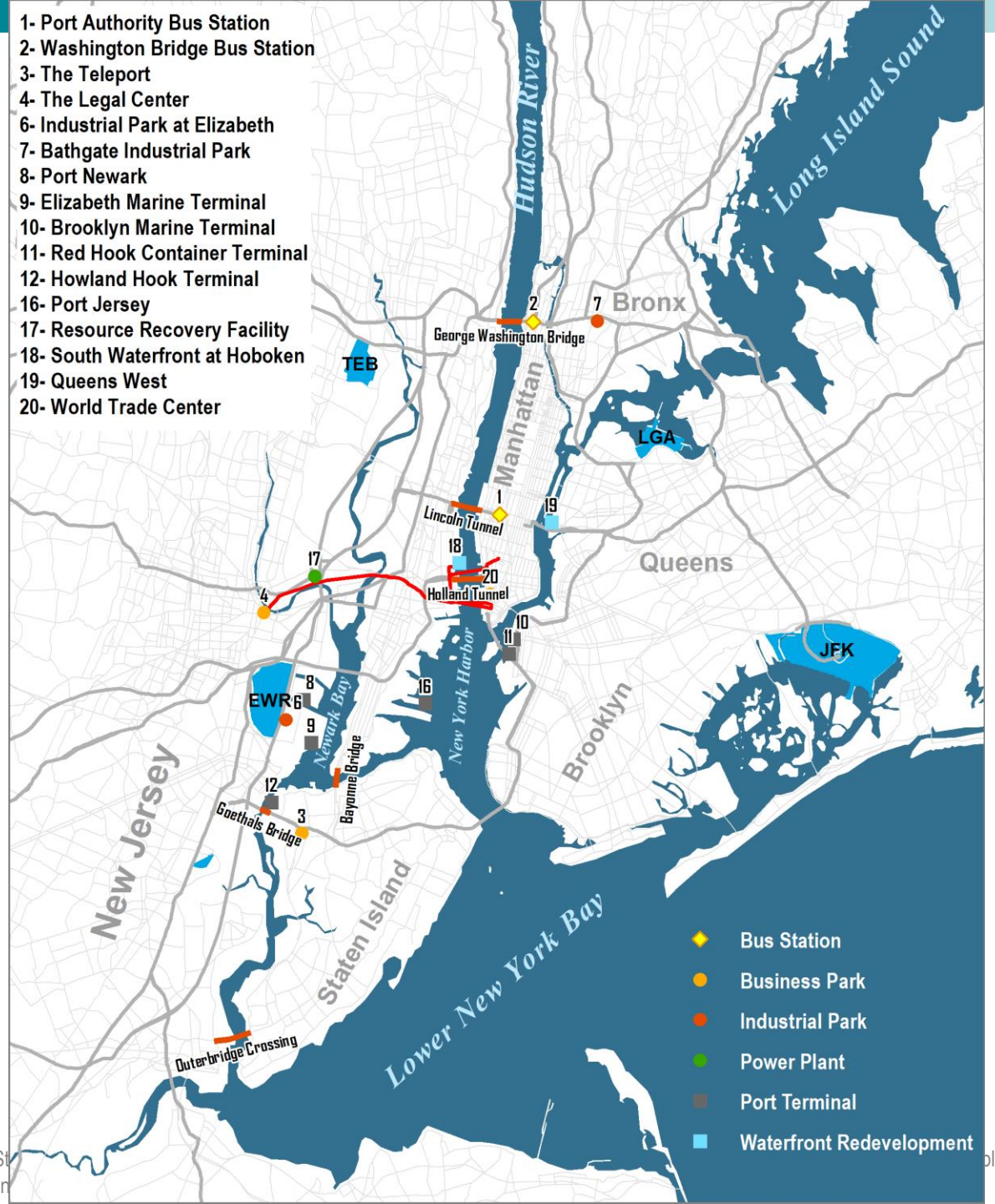

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Major Planning Agencies Involved in the New York Metropolitan Area

Agency	Jurisdiction	Modes	Type	Functions
New York Metropolitan Transportation Council	New York City and 5 counties in NY		MPO	Plan, coordinate
North Jersey Transportation Planning Authority	13 counties in New Jersey		MPO	Plan, coordinate
New York State Department of Transportation	State of New York	State highways and traffic control systems	DOT	Plan, build, maintain
New Jersey Department of Transportation	State of New Jersey	State highways and traffic control systems	DOT	Plan, build, maintain
New York City Department of Transportation	City of New York	Local streets, arterials, traffic control systems	DOT	Plan, build, maintain
Port Authority of New York and New Jersey	Port district in NY and NJ	Marine terminals, bridges, tunnels, airports, transit system	Special purpose	Plan, build, operate, maintain, issue debt, toll, collect rent
Metropolitan Transportation Authority	New York City and 7 counties in NY	Buses, subways, commuter lines, bridges, tunnels	Special purpose	Plan, build, operate, maintain, issue debt, toll, collect rent
New York City Economic Development Corporation	New York City	Marine terminals	Special purpose	Plan, operate, maintain
Federal Agencies: USDOT, FHWA, FTA	United States			Oversight, regulate

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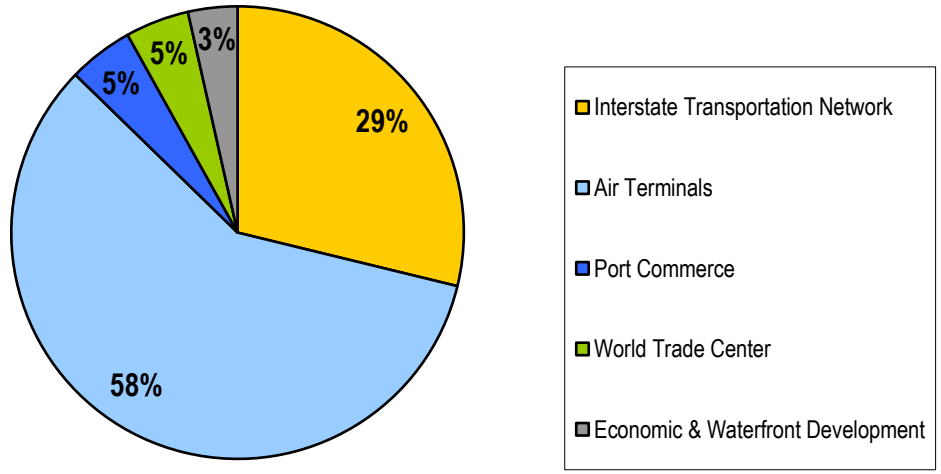
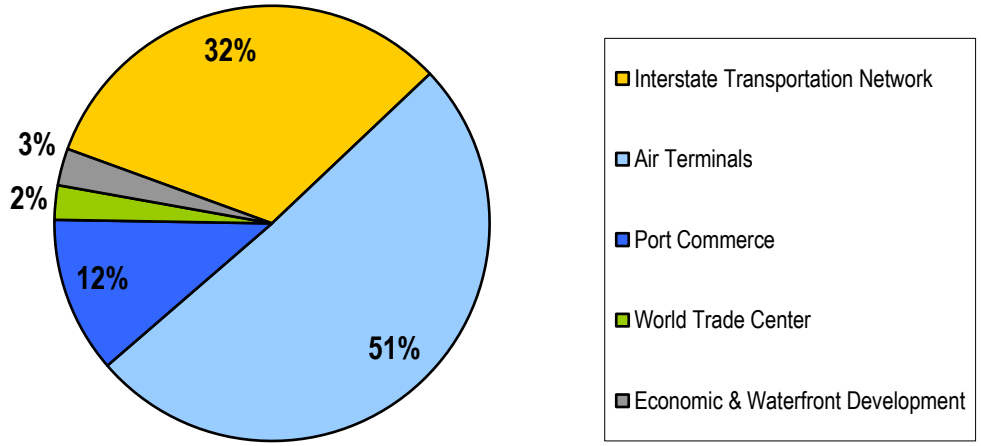
Financial Profile of the New York – New Jersey Port Authority, 2003

Gross Operating Revenues ($2.76 billion)



Assets ($11.4 billion)



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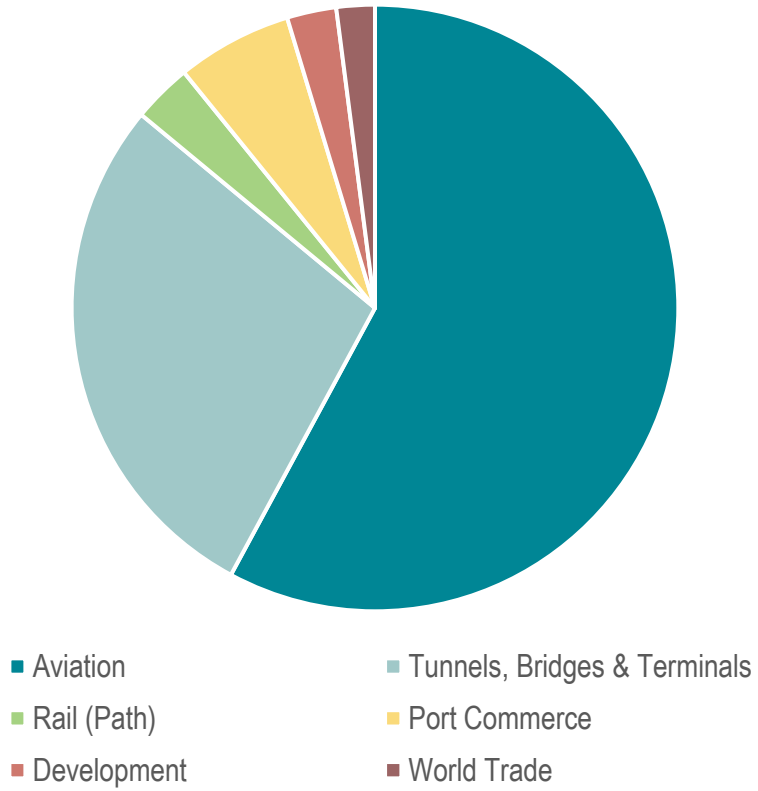
Gross Operating Revenues ($3.837 billion)



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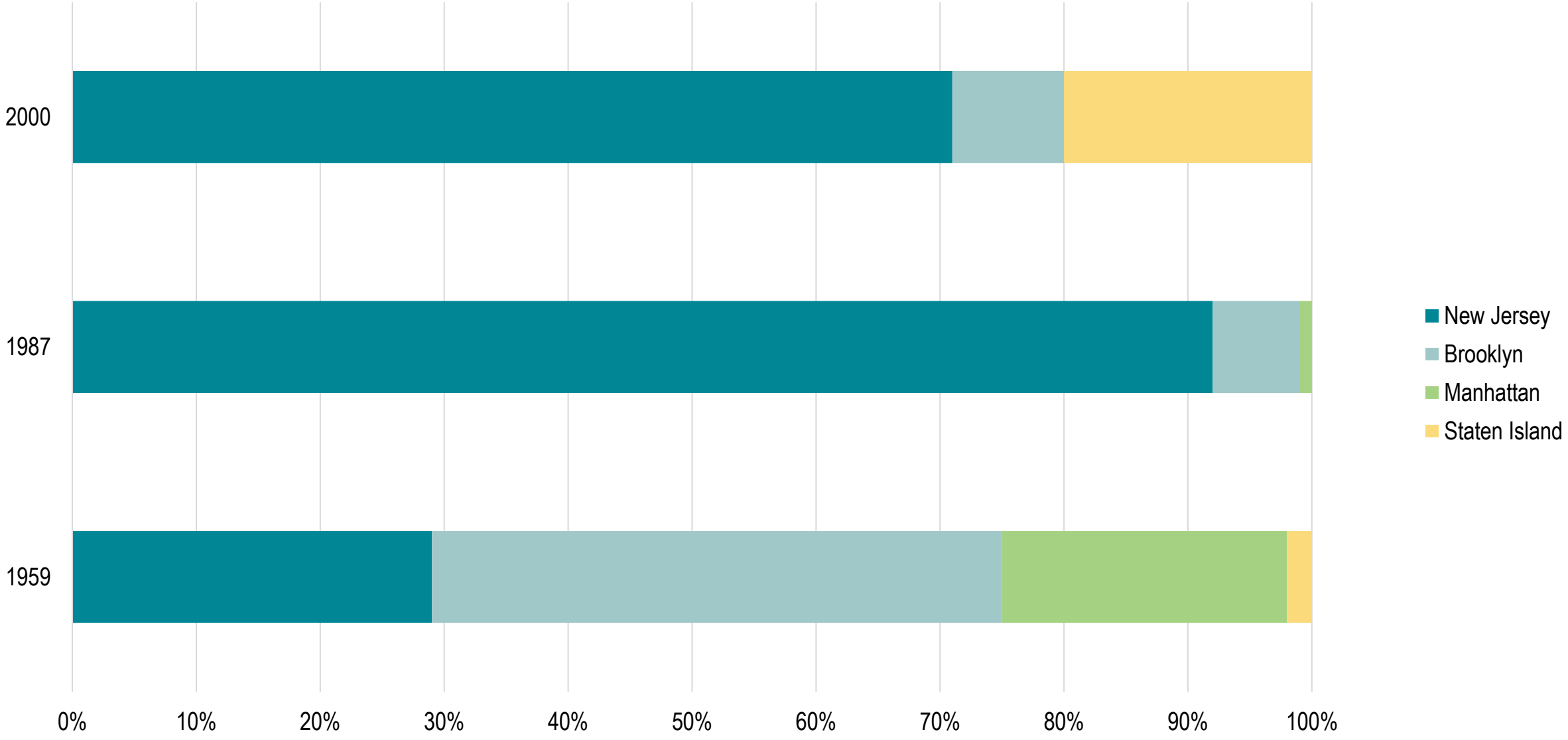
Distribution of General Cargo Operations, Port of New York, 1959, 1987 and 2000



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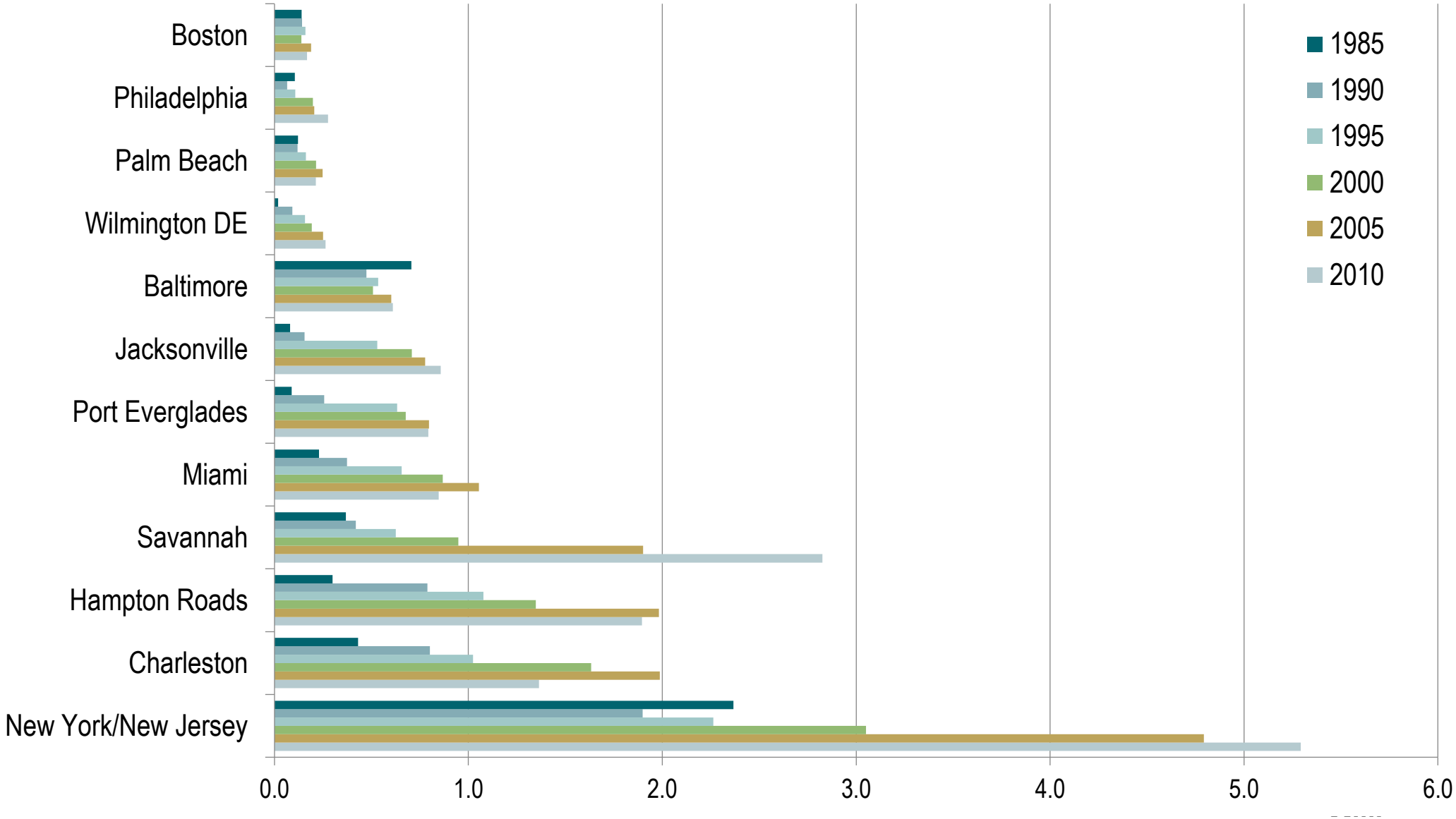
Main Container Ports of the American East Coast, 1985-2010 (TEUs)



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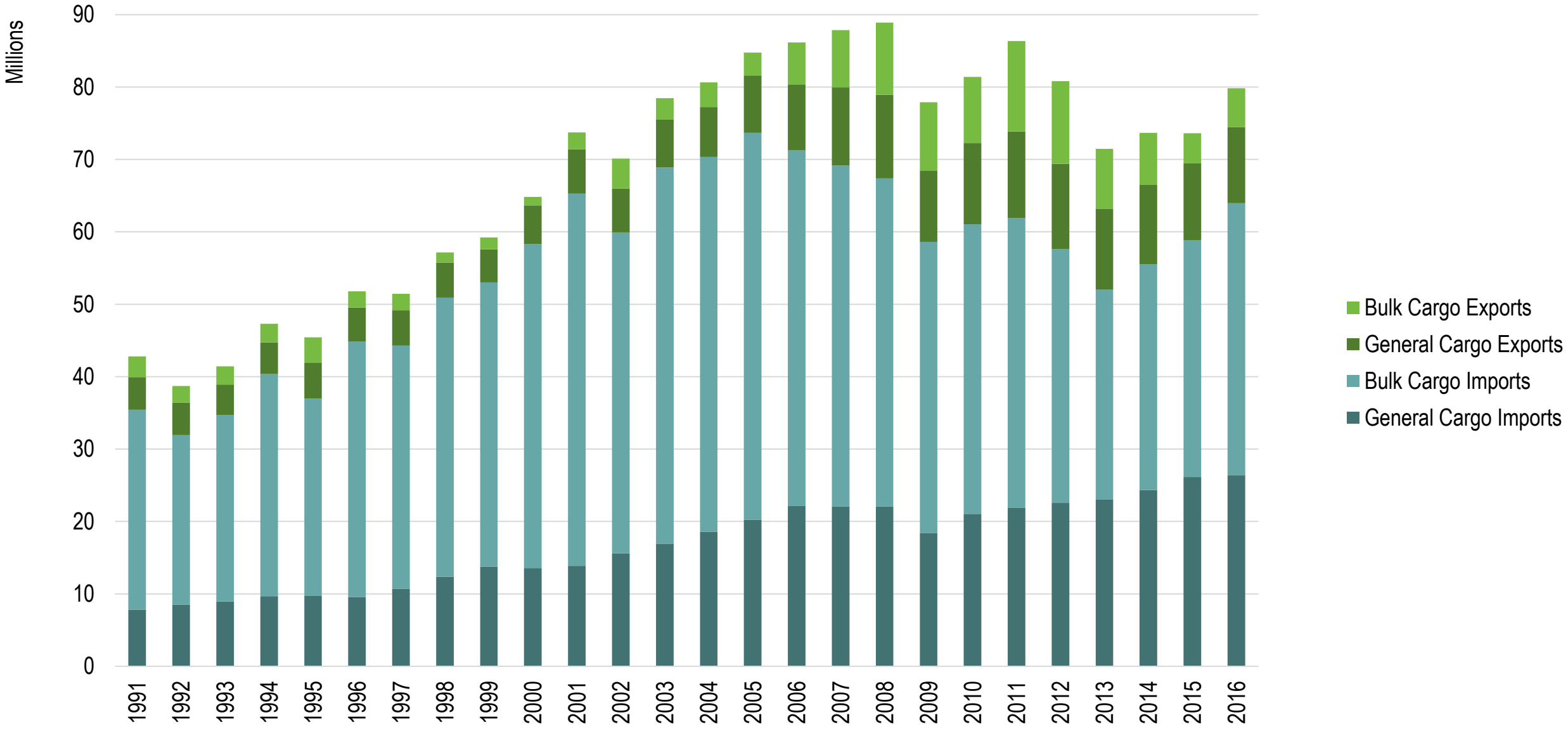
Cargo Handled by the Port of New York, 1991-2016 (metric tons)



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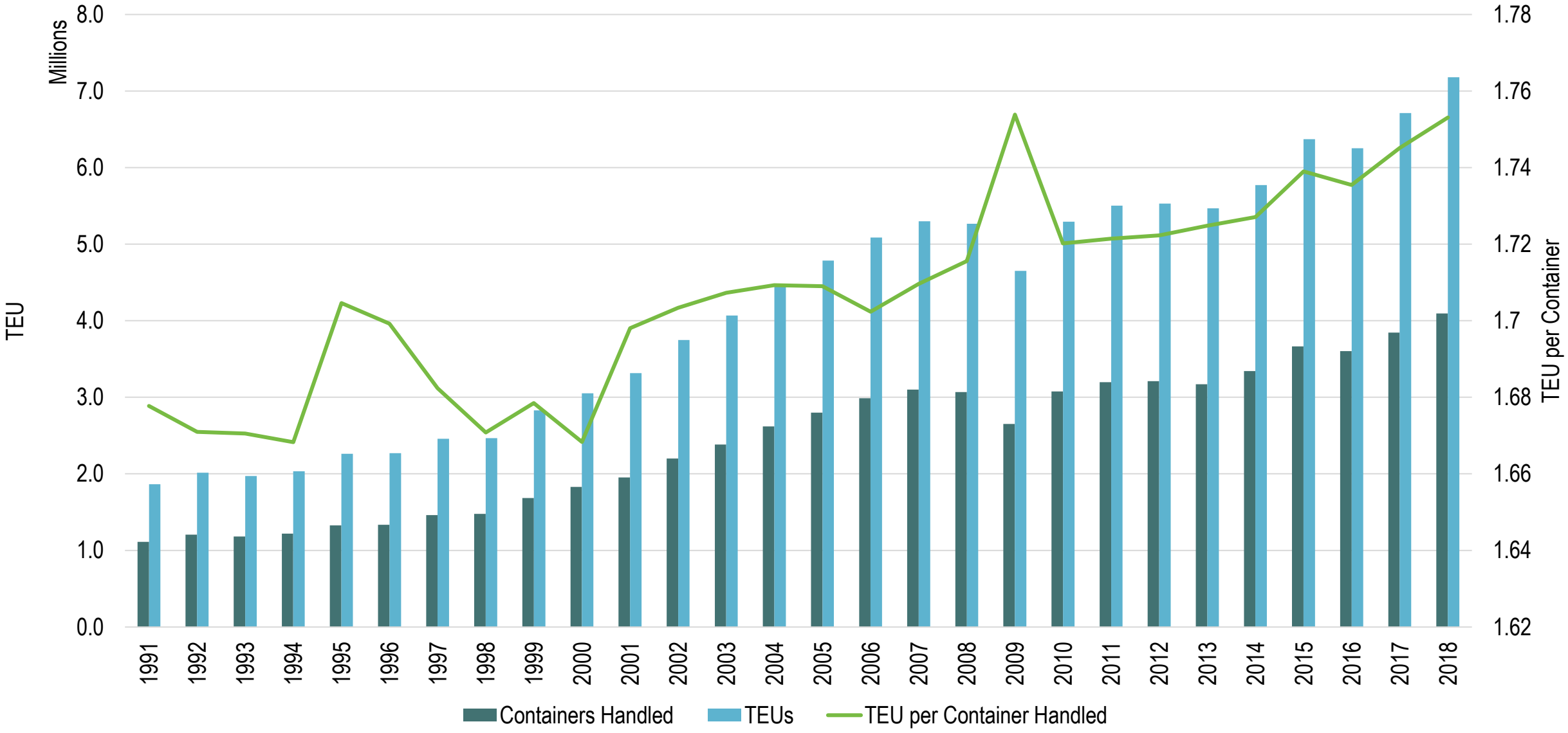
Container Traffic Handled by the Port of New York, 1991-2018



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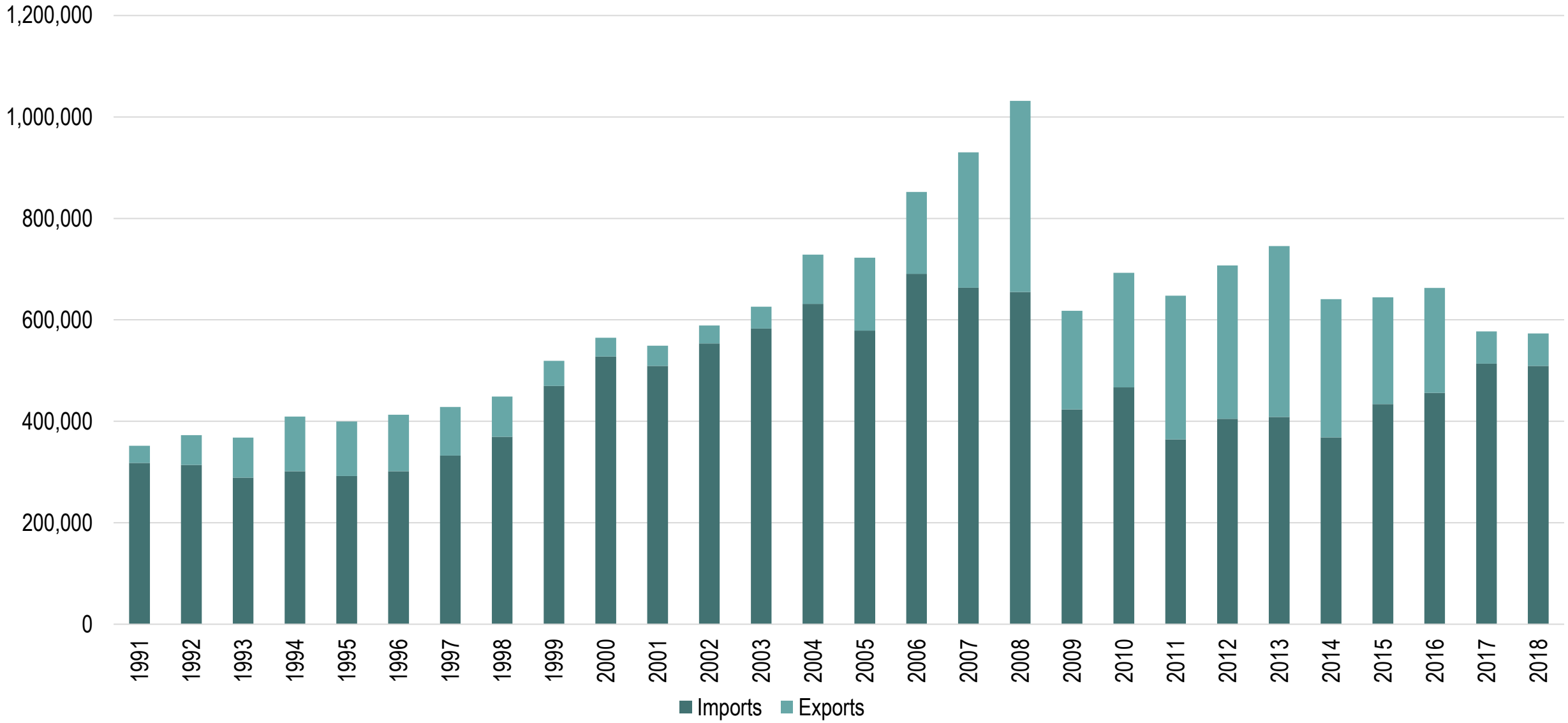
Motor Vehicles Handled by the Port of New York, 1991-2018



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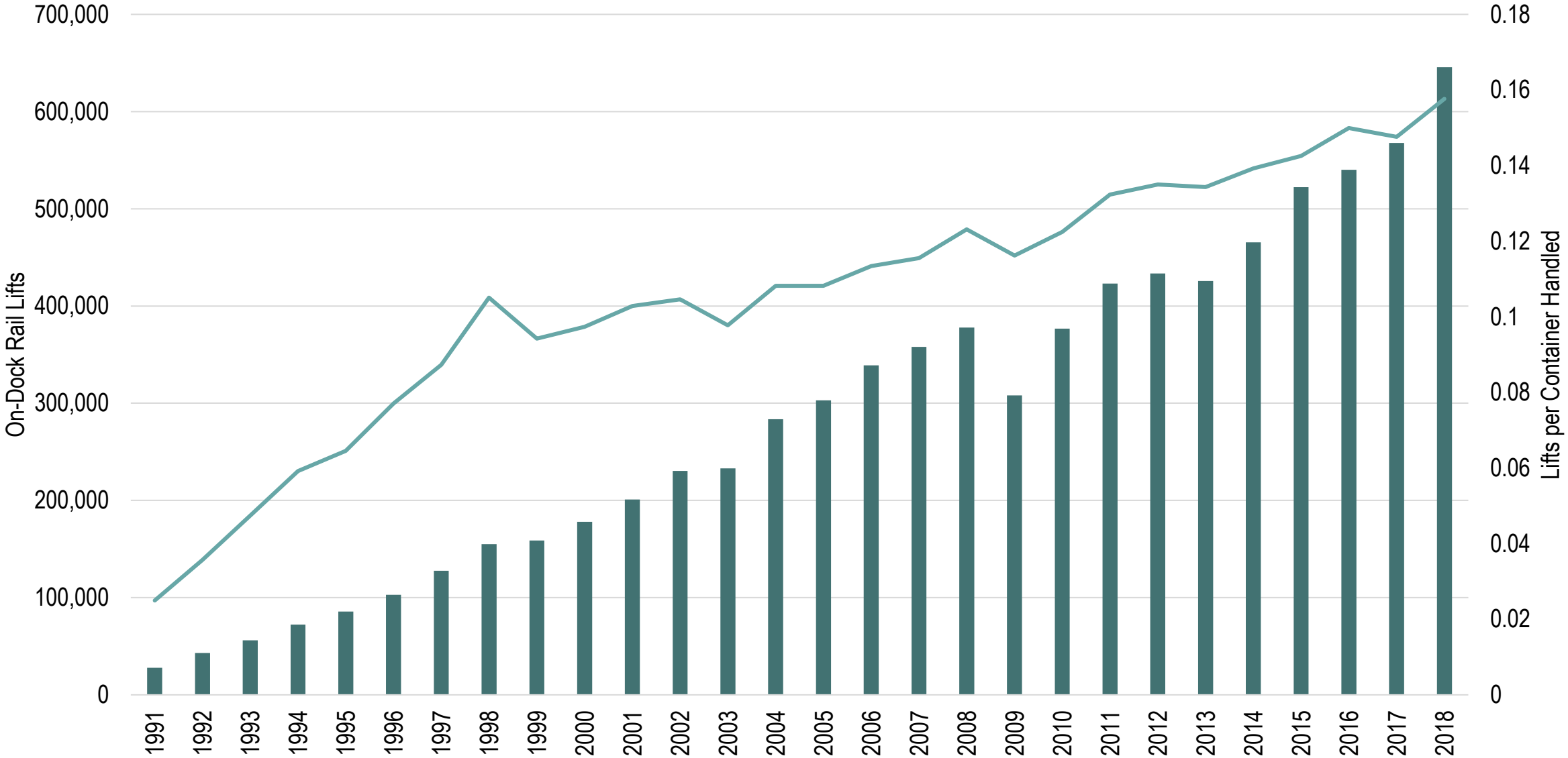
On-Dock Rail Lifts, 1991-2018



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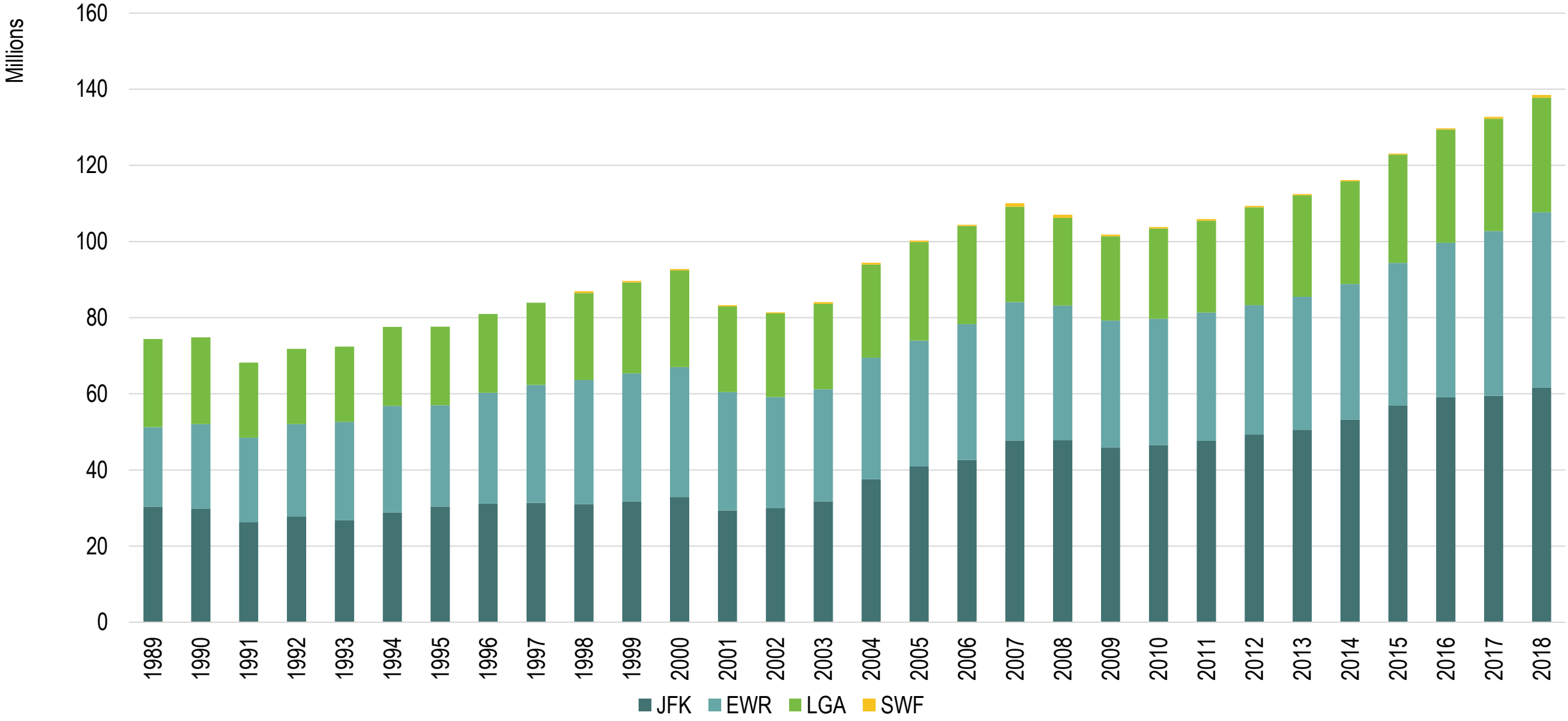
Passengers Handled at New York's Major Airports, 1989-2018



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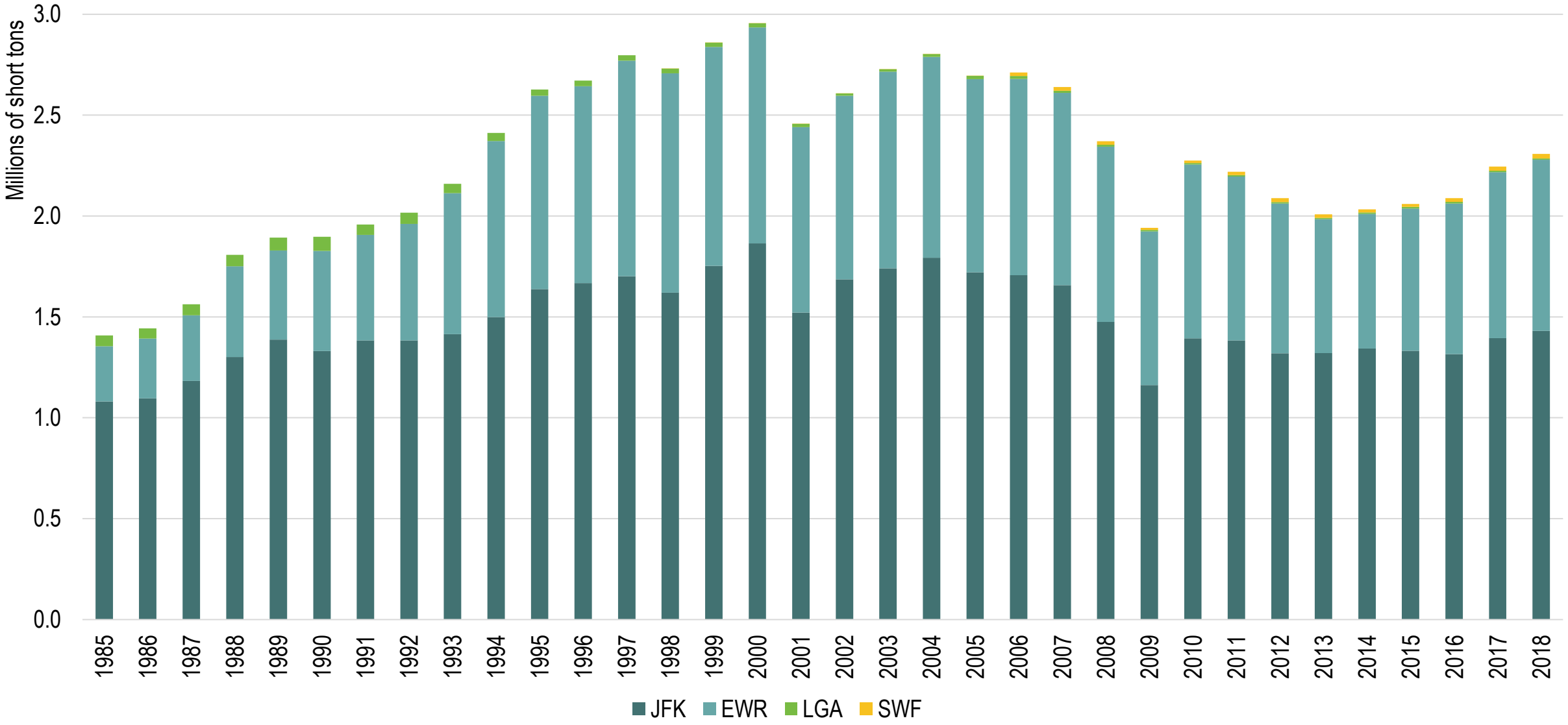
Freight Handled at New York's Major Airports, 1985-2018



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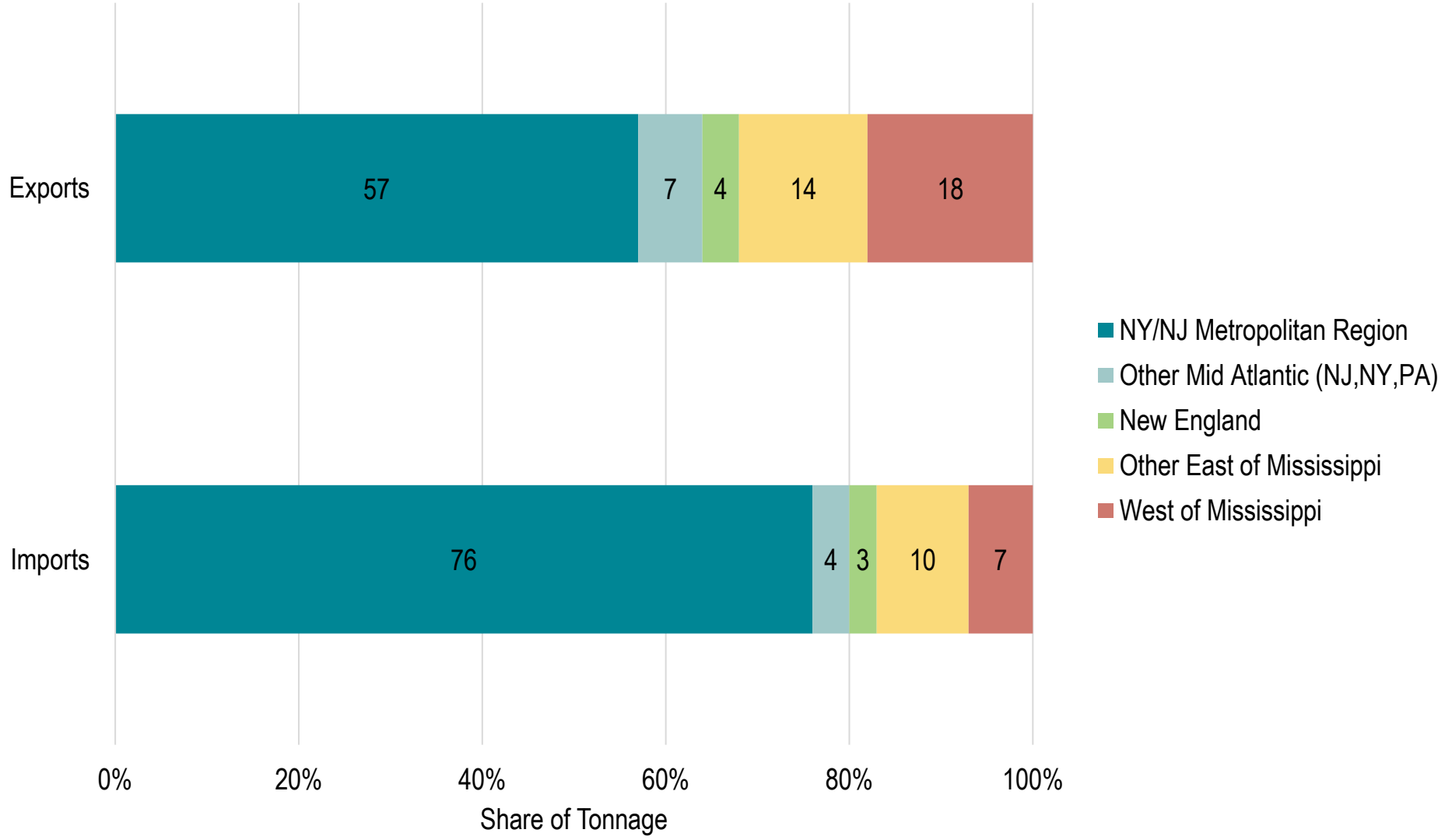
Inland Flows, Port of New York c2010



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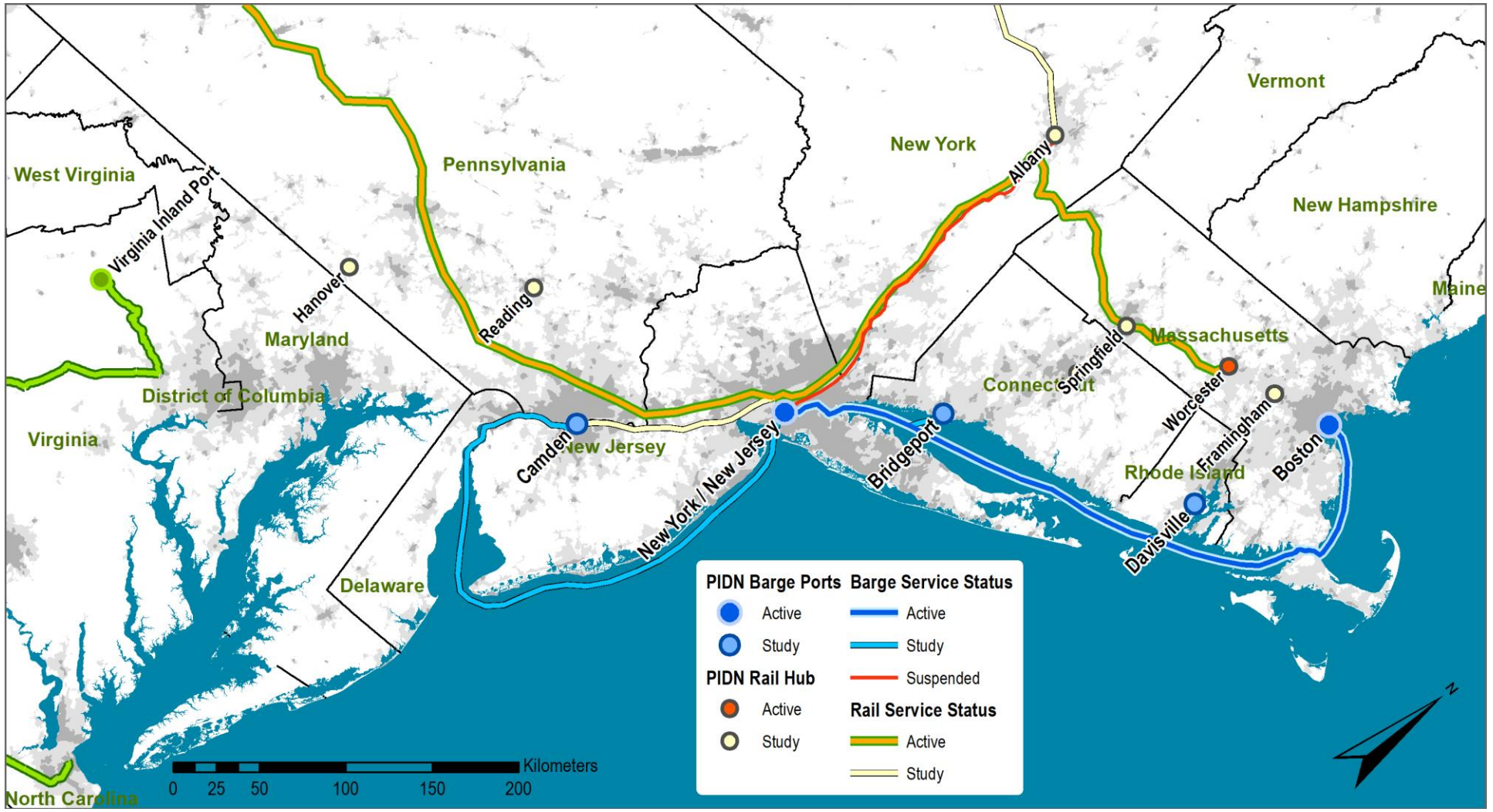
Port Inland Distribution Network of the Port Authority of New York and New Jersey



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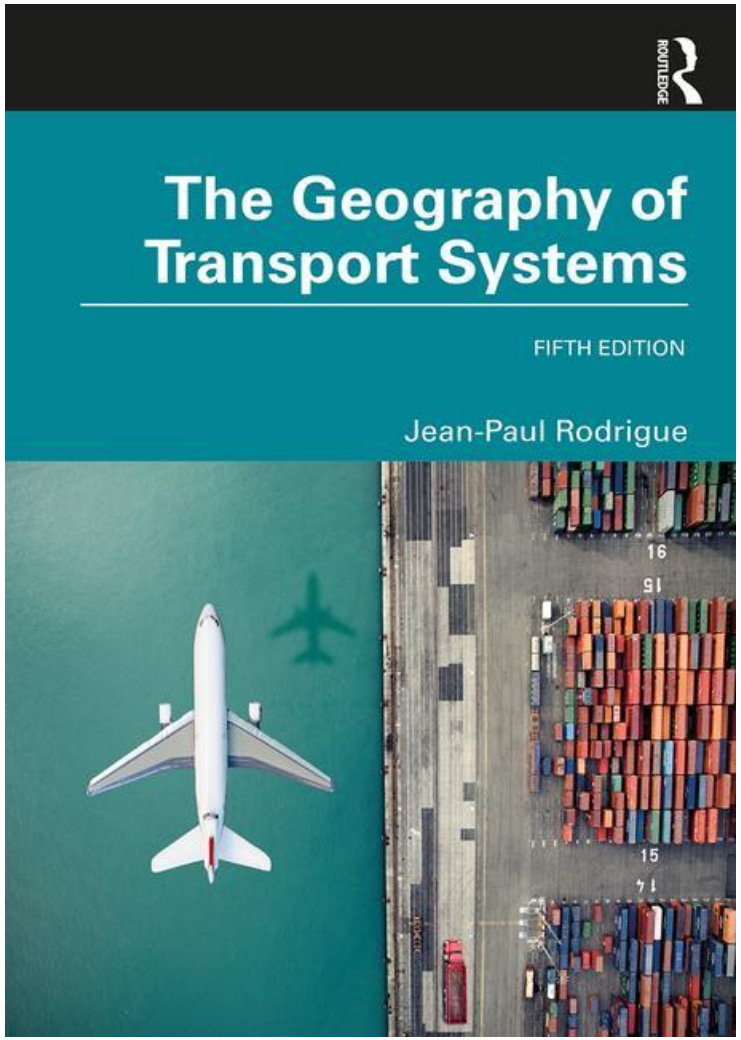

The St. Lawrence Seaway and Regional Development

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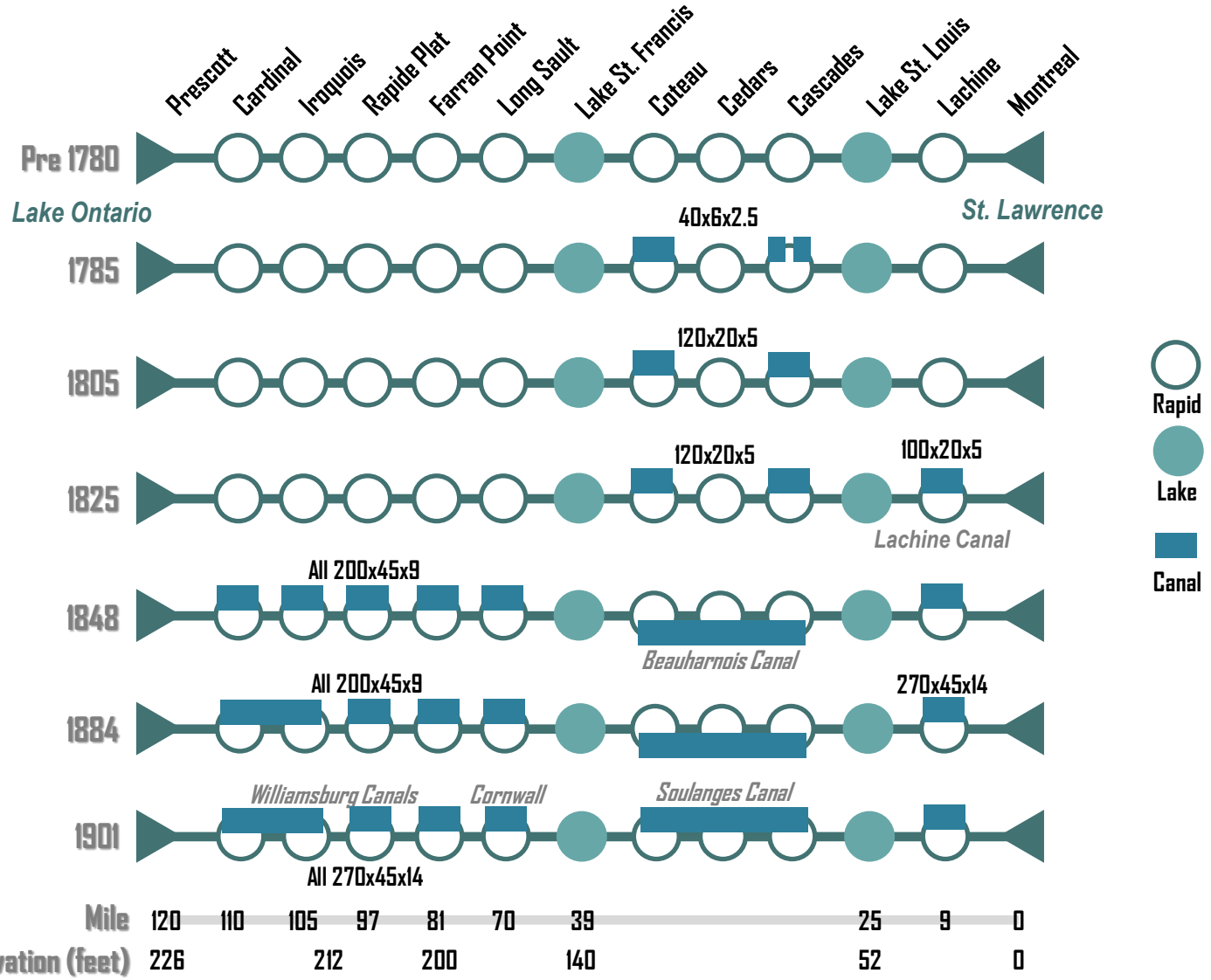
Locks of the Montreal – Lake Ontario Section of the Seaway prior to 1901



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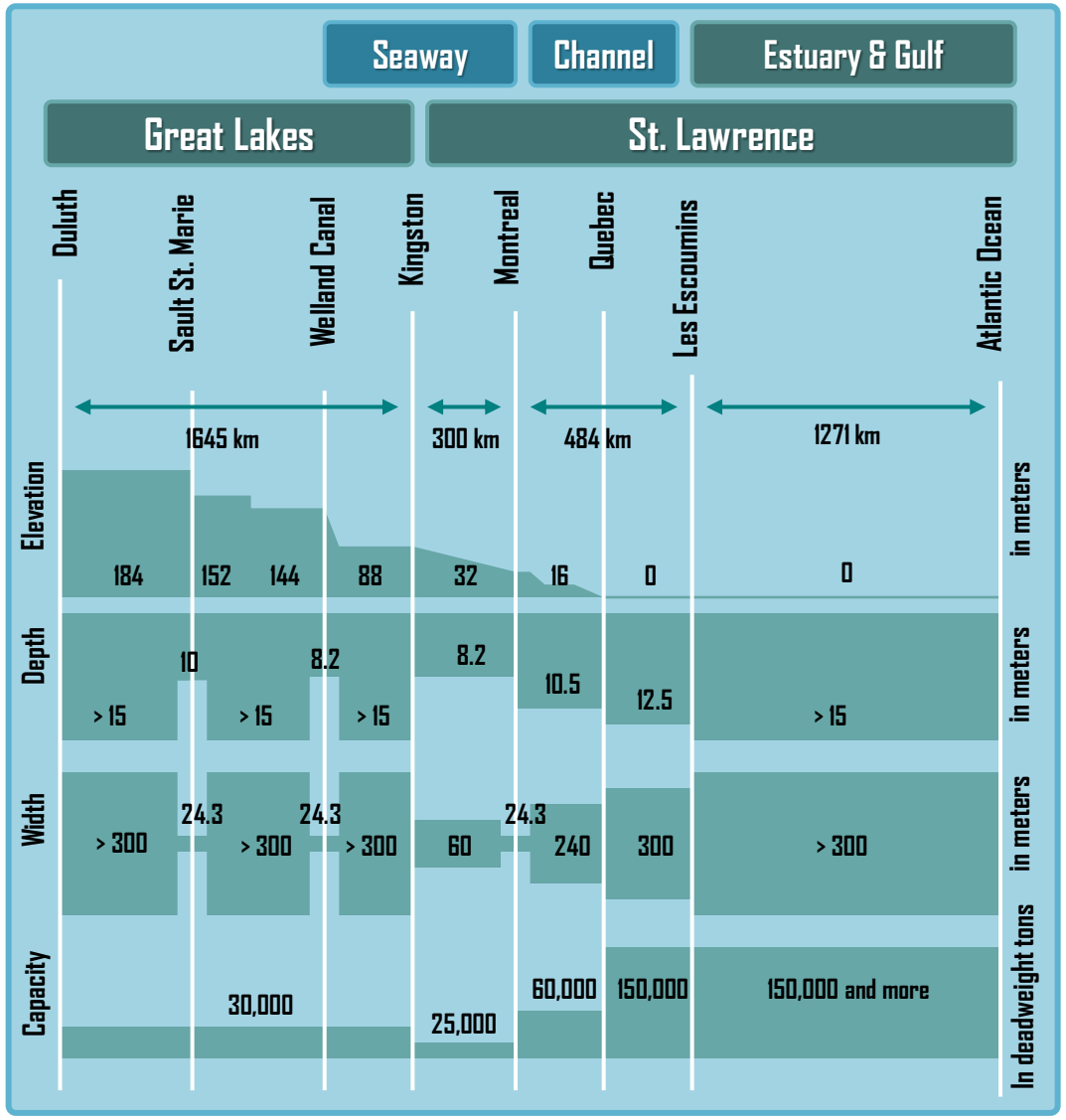
Technical Characteristics of the St. Lawrence Seaway and the Great Lakes System



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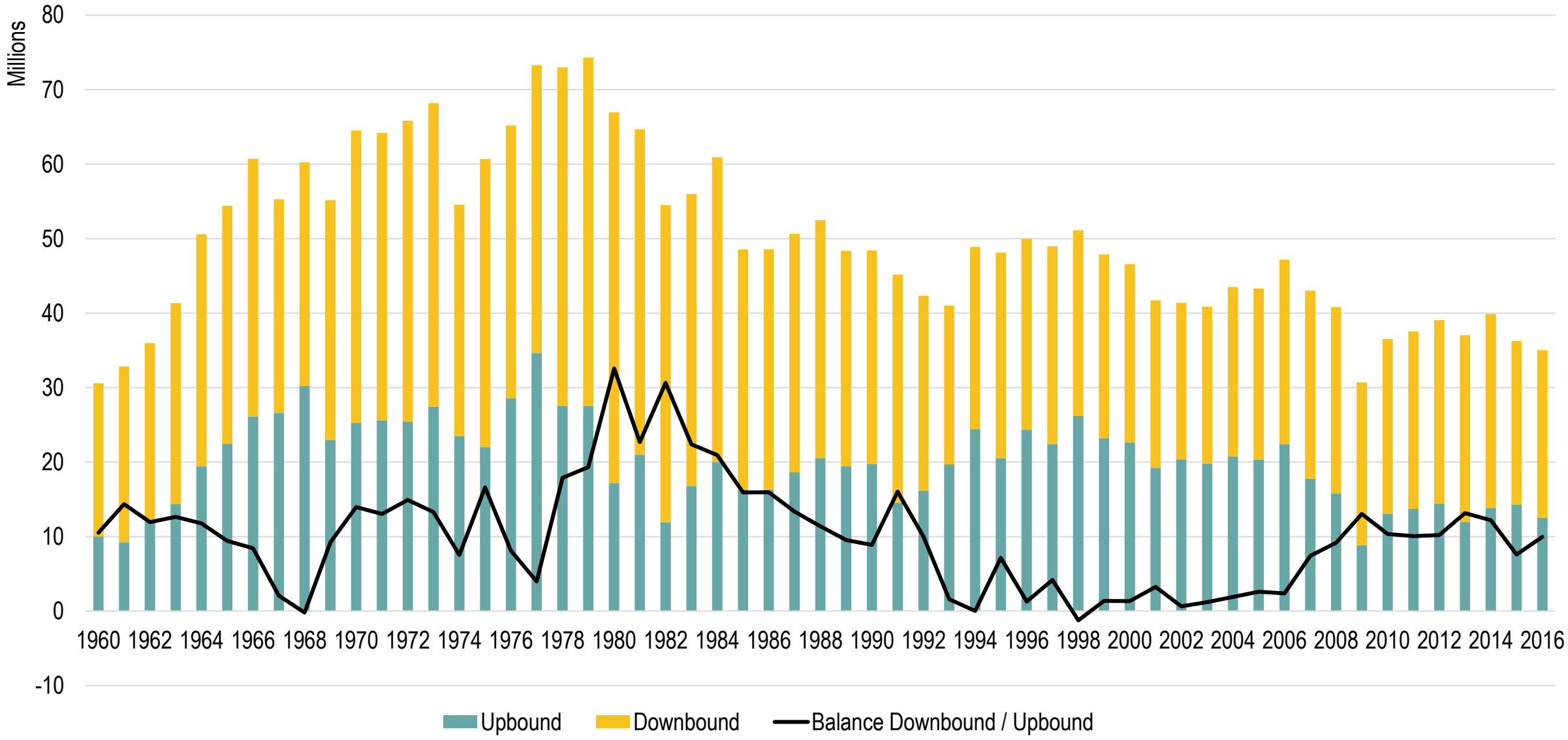
Tonnage Transiting Through the St. Lawrence Seaway, 1960-2016



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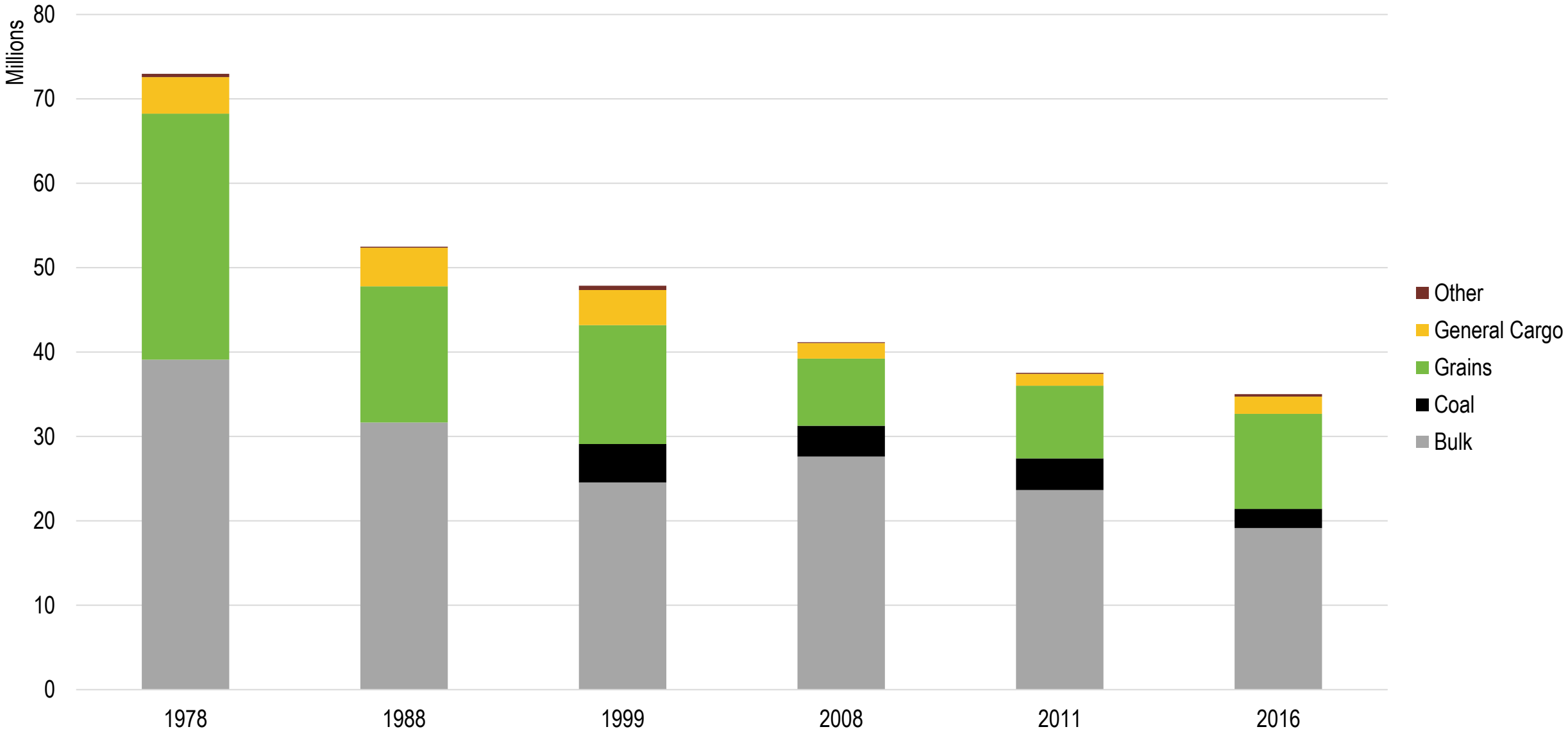
Composition of the Traffic Transiting Through the St. Lawrence Seaway, 1978-2016



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Transit Time on Sections of the St. Lawrence Seaway

	Average Transit (hours)	90% of Transits within (hours)	95% of Transits within (hours)
Welland Canal	11	9-13	7-15
Montreal / Lake Ontario			
Inland Up	24	22-26	20-28
Inland Down	22	20-24	18-26
Ocean Up	23	21-25	19-27
Ocean Down	22	20-24	18-26

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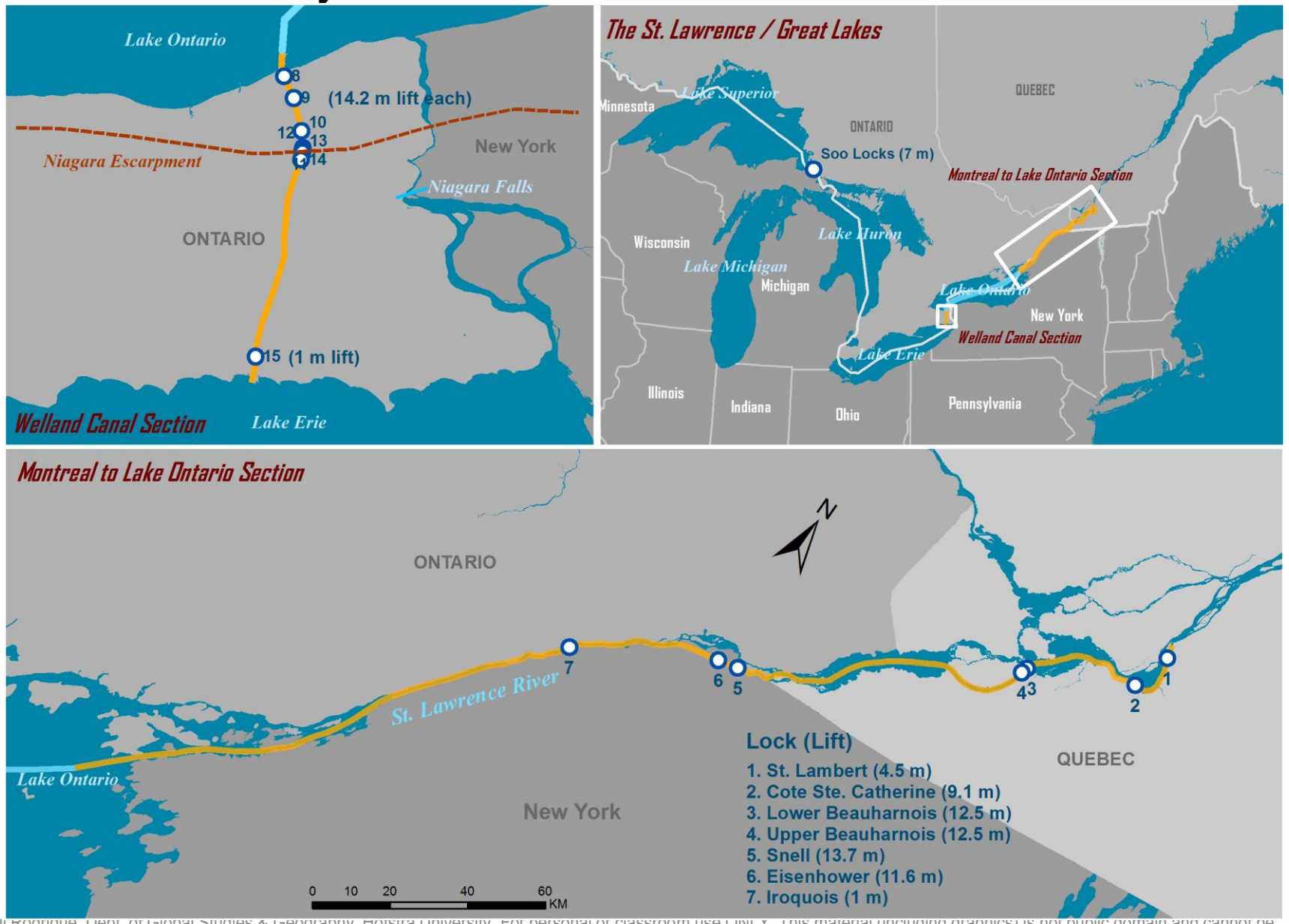
The St. Lawrence Seaway



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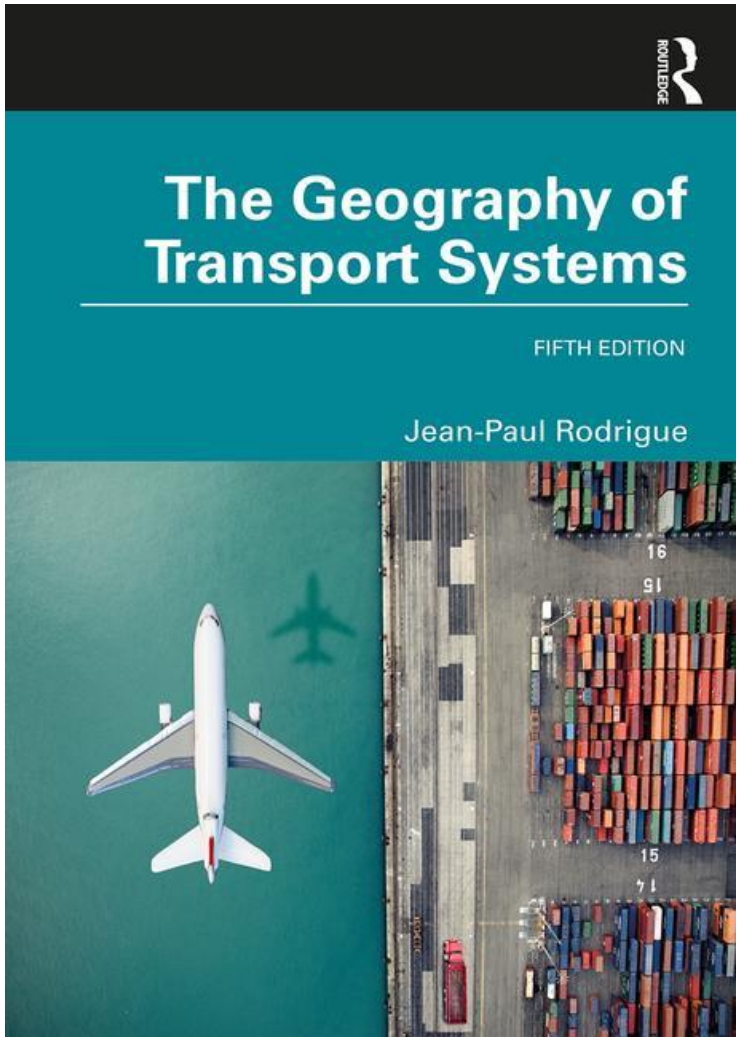

The Financing of Transportation Infrastructure

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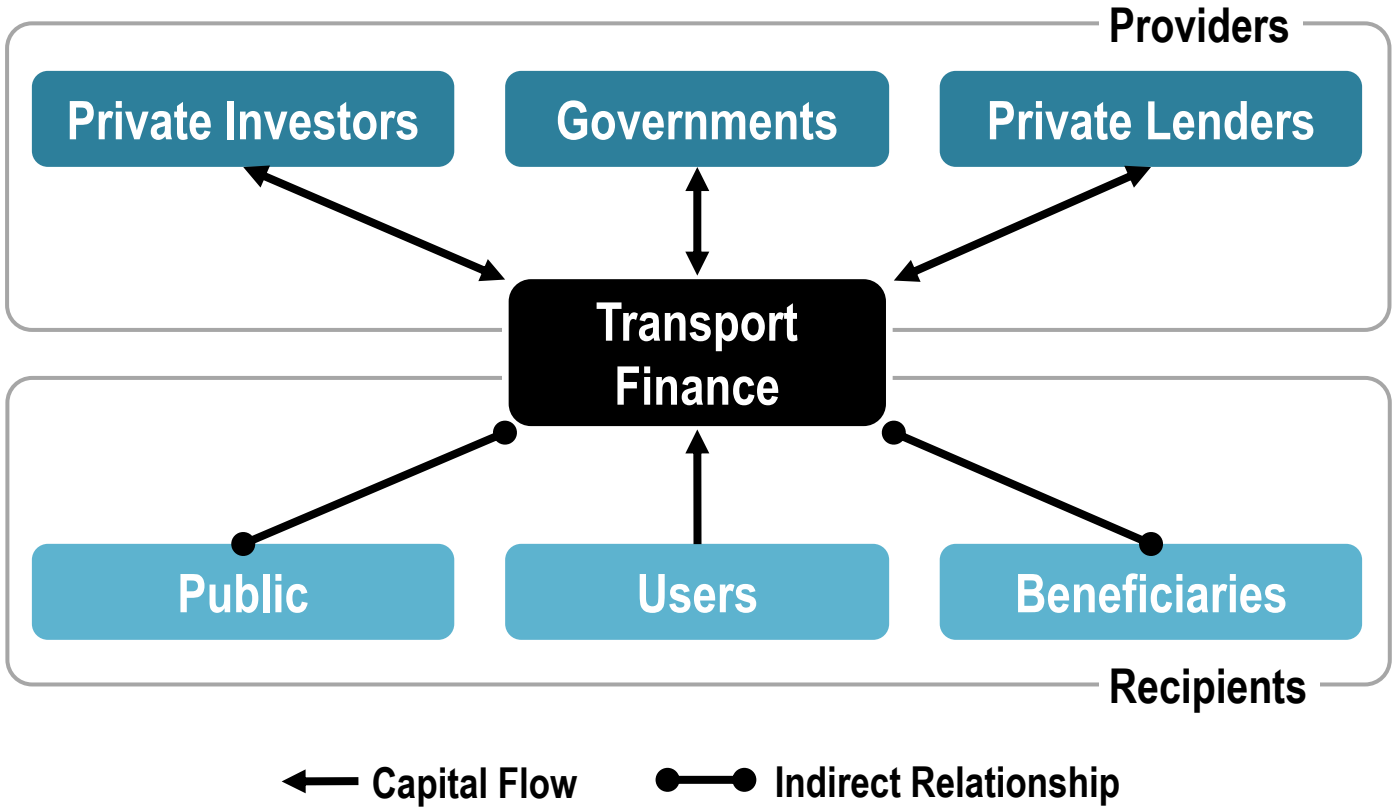
Actors in Transport Finance



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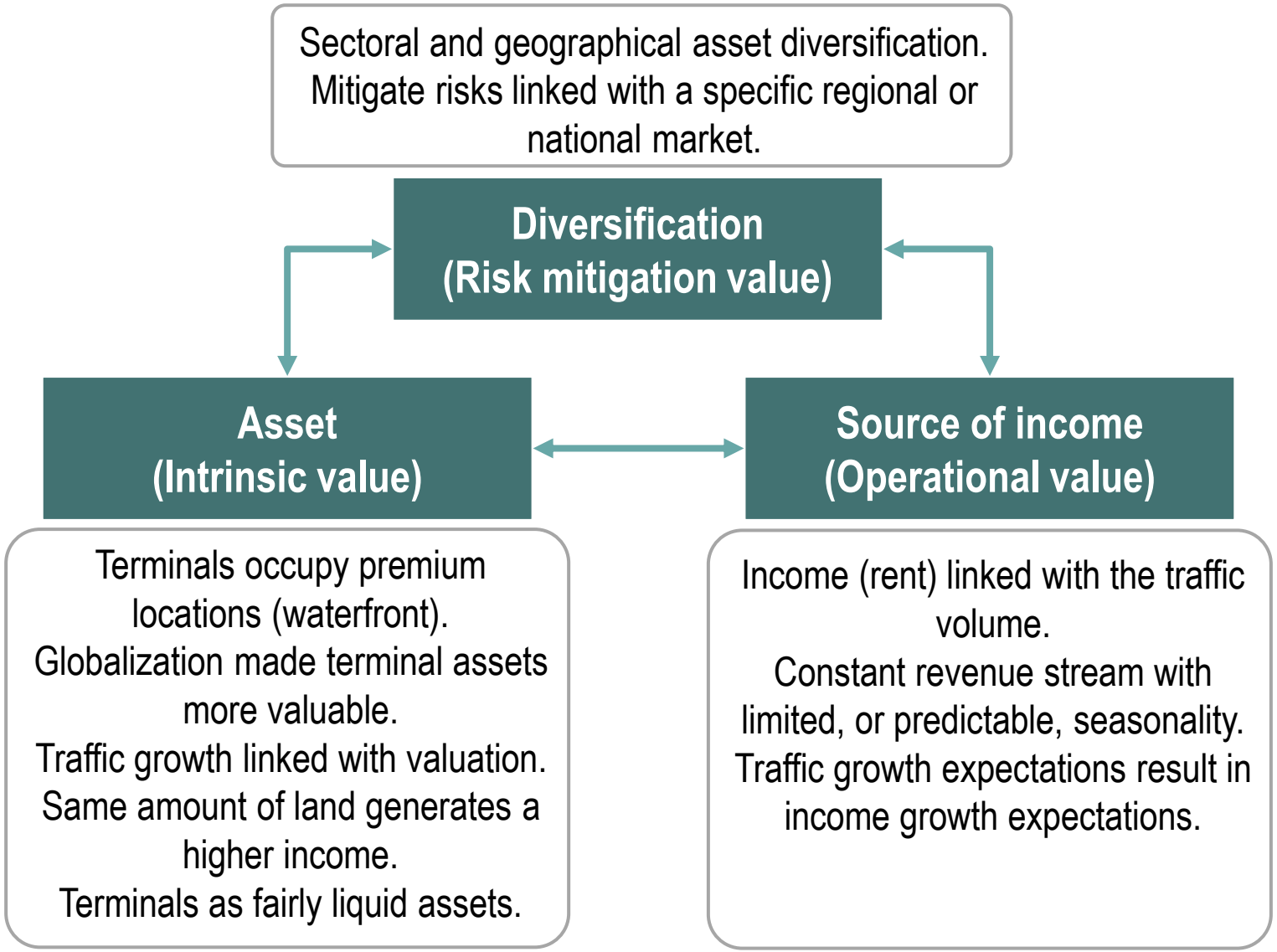
Value Propositions behind the Interest of Equity Firms in Transport Terminals



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Examples of Highway Public / Private Partnerships in the United States

	Chicago Skyway	Indiana Toll Road
Year	2005	2006
Infrastructure	7.8 miles (12.5 km) of toll urban highway with a bridge	156.9 mi (252.5 km) of toll intercity highway
Leaser	City of Chicago	State of Indiana
Lessee	Skyway Concession Company	Cintra and Macquarie consortium
Lease duration	99 years	75 years
Amount	$1.85 billion	$3.85 billion

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Table 4: Top Ten Sovereign Wealth Funds (SWFs) by Assets[1]				
Country	SWF Name	Assets (U.S. $ billions)	Inception	Origin
Norway	Government Pension Fund - Global	1,035.2	1990	Oil
China	China Investment Corporation	900.0	2007	Non-commodity
UAE – Abu Dhabi	Abu Dhabi Investment Authority	828.0	1976	Oil
Kuwait	Kuwait Investment Authority	524.0	1953	Oil
Saudi-Arabia	SAMA Foreign Holdings	494.0	1952	Oil
China-Hong Kong	Hong Kong Monetary Authority Investment Portfolio	456.6	1993	Non-commodity
China	SAFE Investment Company	441.0	1997	Non-commodity
Singapore	Government of Singapore Investment Corporation	390.0	1981	Non-commodity
Singapore	Temasek Holdings	320.8	1974	Non-Commodity
Qatar	Qatar Investment Authority	320.0	2005	Oil & gas
Total top ten SWFs		5,709.6		
Other SWFs		2,131.8		
Total All SWFs		7,841.4		

[1] Data compiled from Sovereign Wealth Fund Institute (April 2018). Of the more than $7.8 trillion held by SWFs, over $4.3 trillion was derived from oil and gas revenues and the rest ($3.5 trillion) from other sources.

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