



The Cost of Moving Food

Exploring Food Sustainability Through the Lens of Transport
Time, Resources, Environmental Impact and Price

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Data Sources

- U.S. Surface Transportation Board ([Rail Service Data](#))
- U.S. Department of Transportation
([Average Truck Speeds on Selected Interstate Highways: 2009](#))
- U.S. Department of Energy ([Motor Vehicle Mileage, Fuel Consumption, and Fuel Economy](#))
- U.S. Department of Energy ([Short-Term Energy Outlook, December 2021](#))
- U.S. Department of Energy ([Carbon Dioxide Emissions Coefficients by Fuel](#))
- The Geography of Transport Systems, by Jean-Paul Rodrigue
([Fuel Consumption by Containership Size and Speed](#))
- The Conservation Fund ([Moving Freight: Economy and Atmosphere](#))
- The National Air and Space Museum ([How Things Fly](#))
- The Engineering Toolbox ([Combustion of Fuels- Carbon Dioxide Emission](#))

Data Questions

- How fast does cargo travel via different methods?
- How much fuel does it take to move cargo by these methods?
- How much CO₂ is produced to move this cargo?
- How much is spent (USD) on fuel to move our food-centric cargo?



Challenges



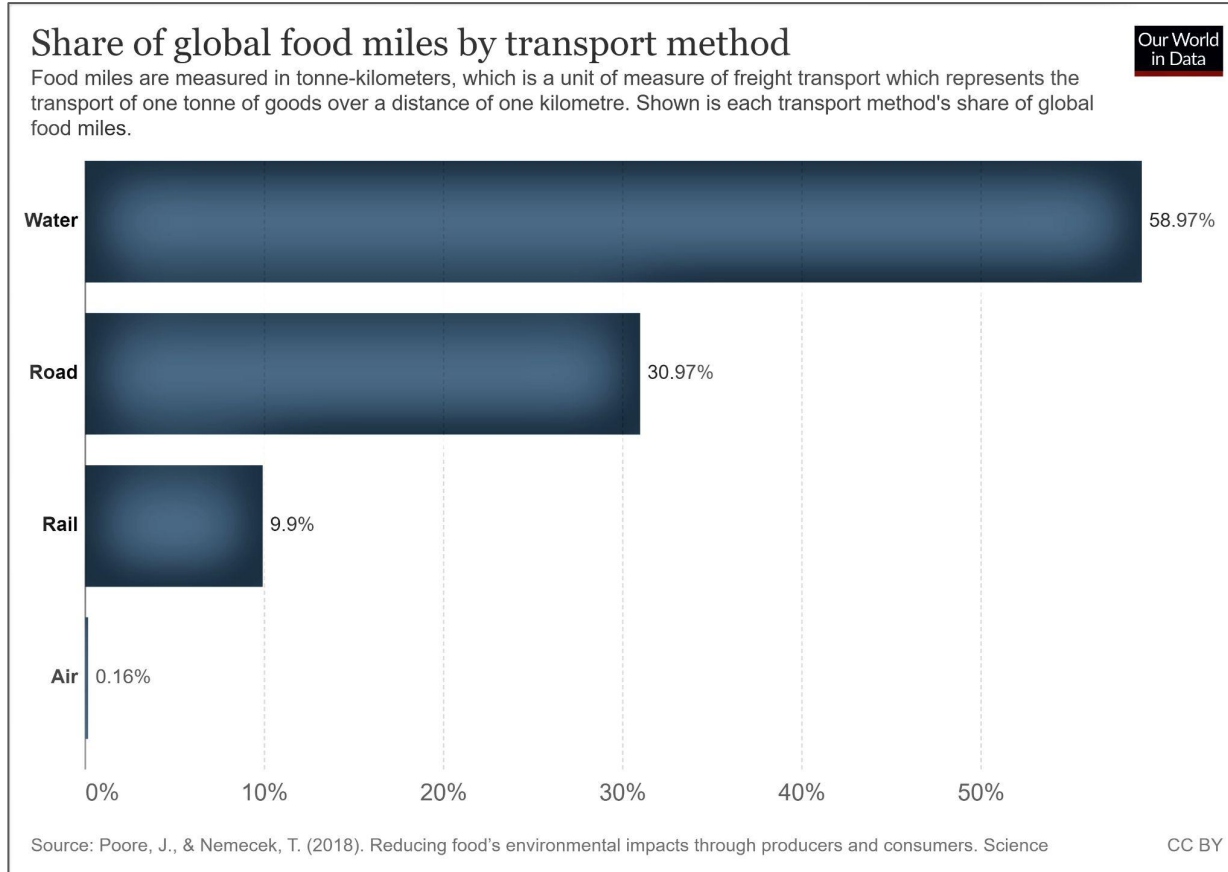
- Variable diversity within the scope of my data questions
 - Many of my questions center on how much fuel is consumed when moving cargo, but that depends upon the kind of fuel being used, the kind of vessel using it, and how much total weight that vessel is carrying
- Variable diversity within the data itself
 - Some **fuel measurements** were listed in tons, others in gallons; different types of fuel weigh different amounts
 - **Fuel consumption** levels were sometimes provided by amounts of fuel consumed by day, other times by hour, and other times by distance
 - **Speed data** was listed in kilometers per hour, miles per hour, and nautical knots across different data sets and different transportation types
 - The **weight** of a shipping container, or how much weight a transport vessel is carrying, can vary significantly depending upon what is in the container, necessitating a consistent method of determining averages in cargo weights across my datasets

Methodology

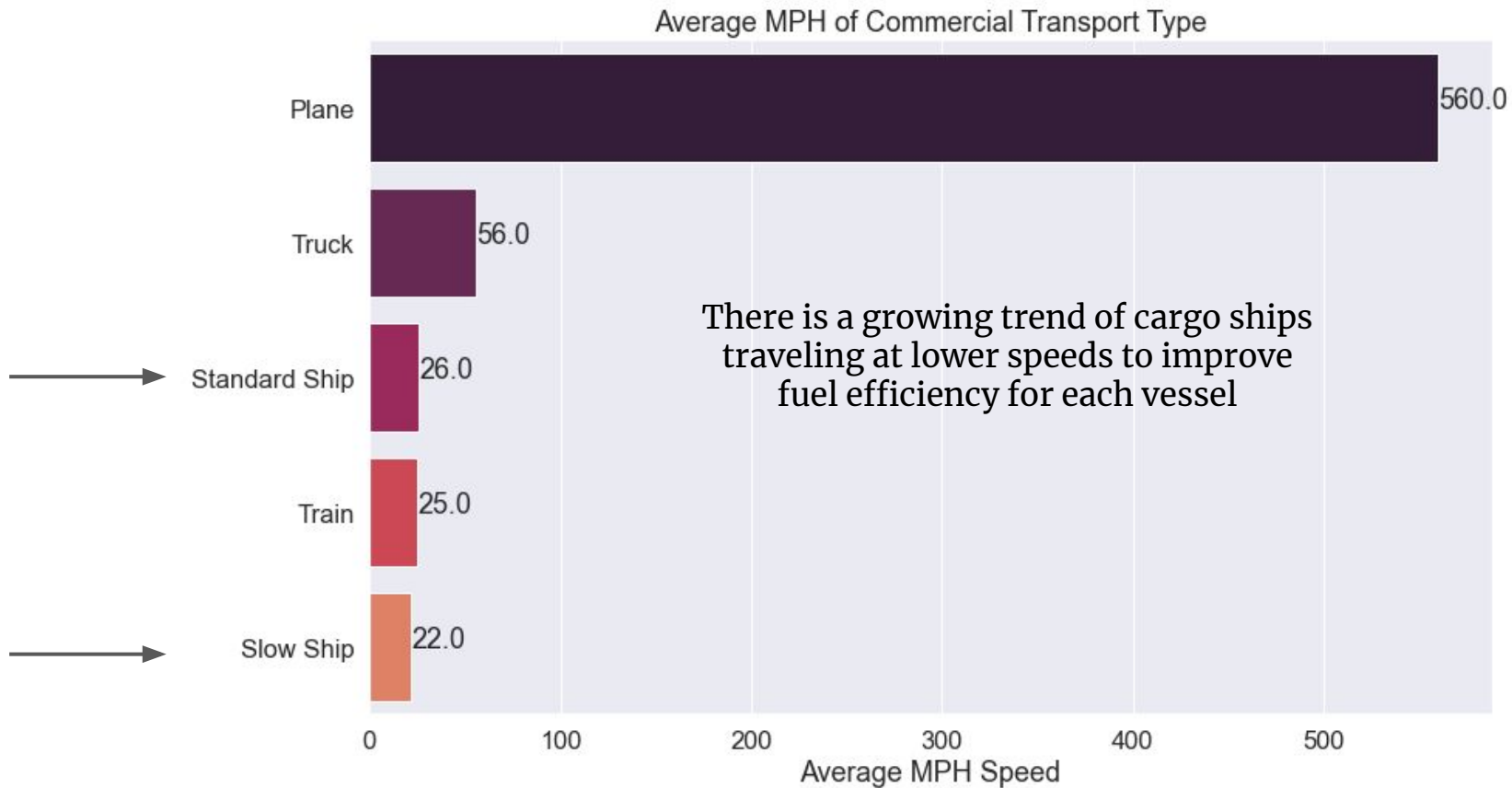
- **Convert all speeds to miles per hour (MPH)**
- **Convert all fuel measurements to gallons**
- **Determine average weights for cargo loads – convert all to tons**
 - Methodology varied by transit type (see README for further details)
- **Filter all information through the lens of efficiency via ton-mile**
 - Calculated by multiplying how much weight a vessel is carrying by the miles-per-gallon of that vessel

Where to start:

How does food get from the source to the market?



How fast does food travel by these different methods?



How fuel efficient are these modes of transport?
~~How many miles per gallon (MPG) does each type
get?~~

IT DEPENDS

Smaller Truck

10 tons

10 mpg

2 gallons
10 mi.



Larger Truck

20 tons

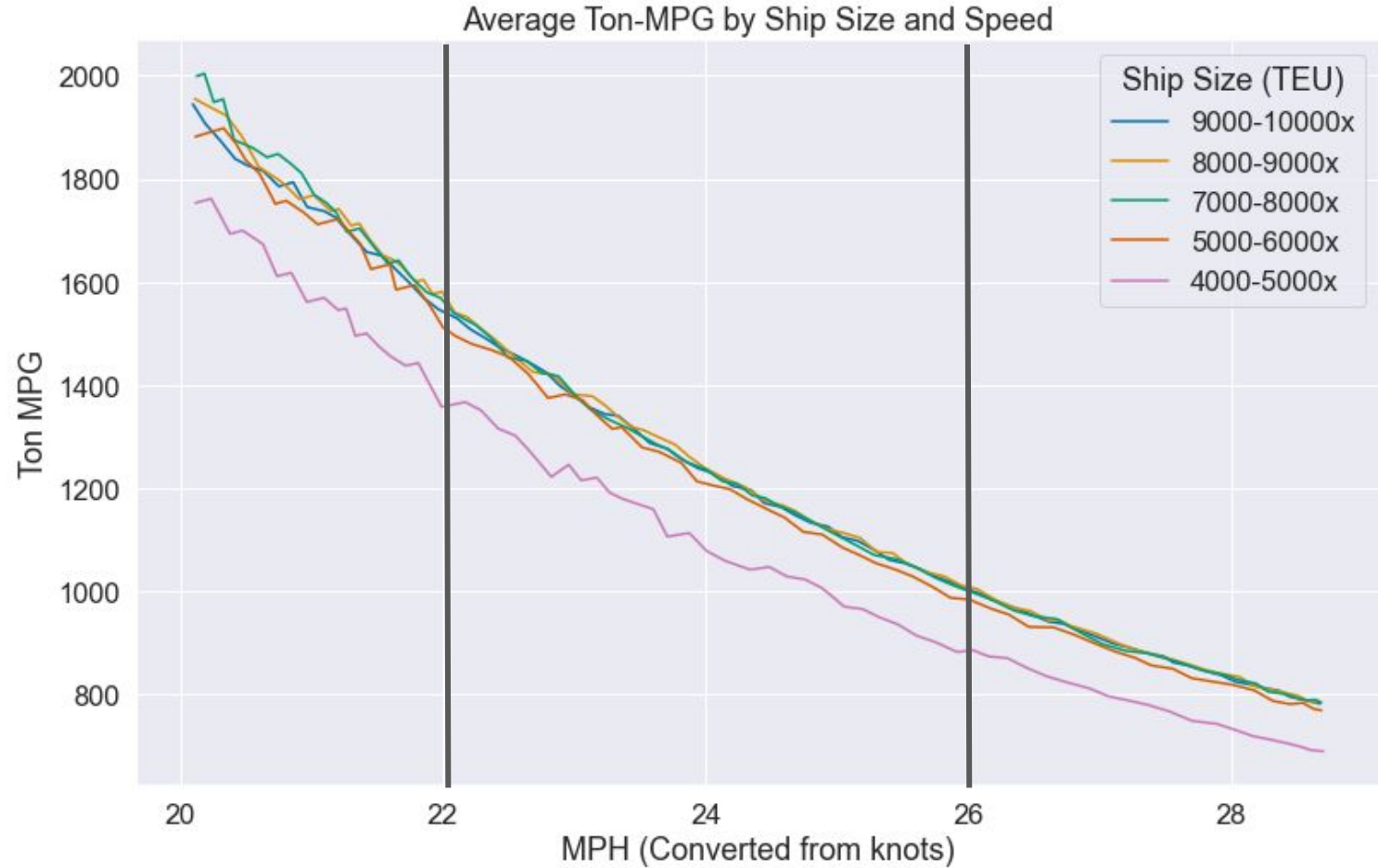
7 mpg

2 gallons
14 mi.

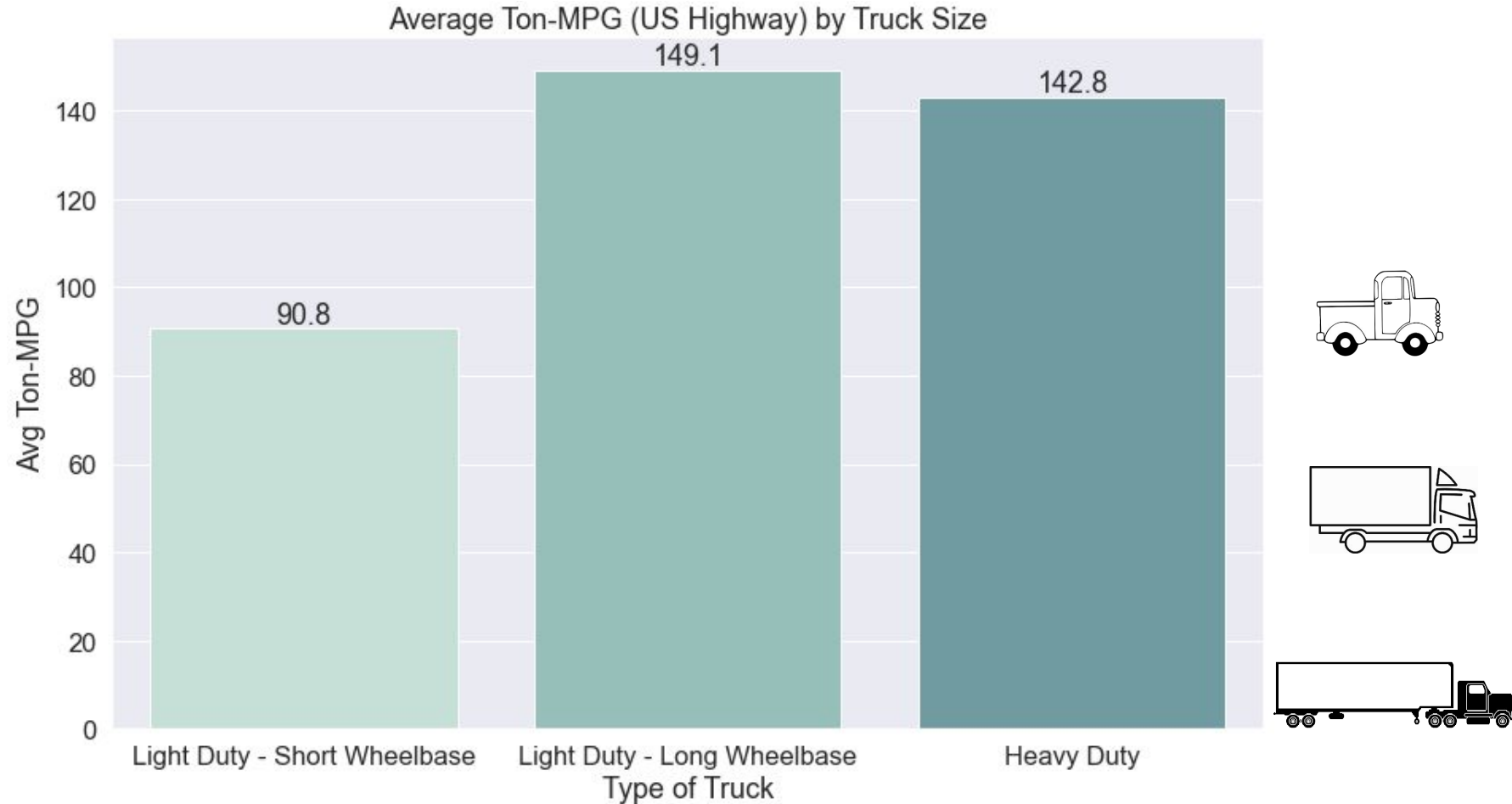
How fuel efficient are these modes of transport?

How many miles can a ton of cargo travel on a gallon of fuel (on average)?

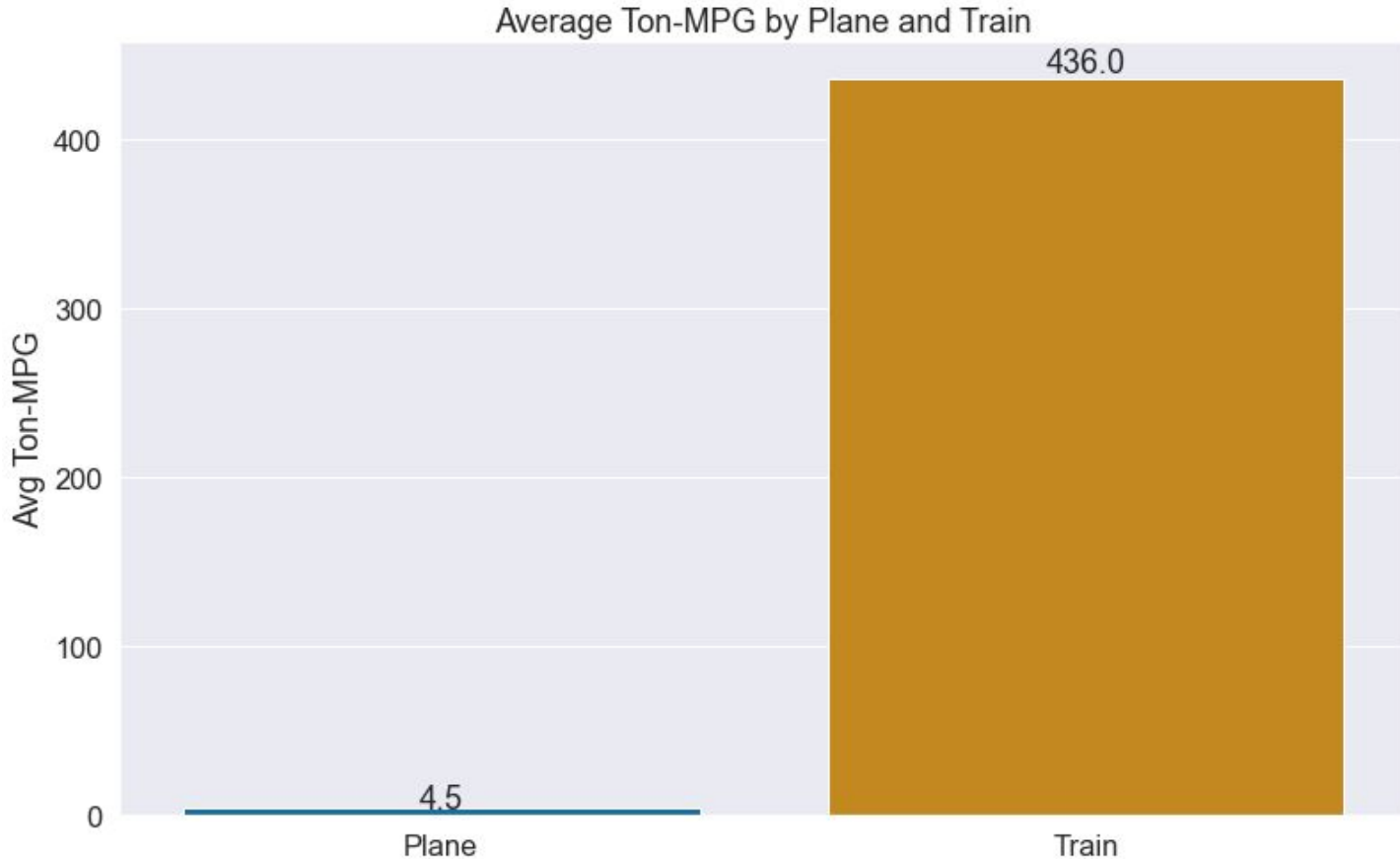
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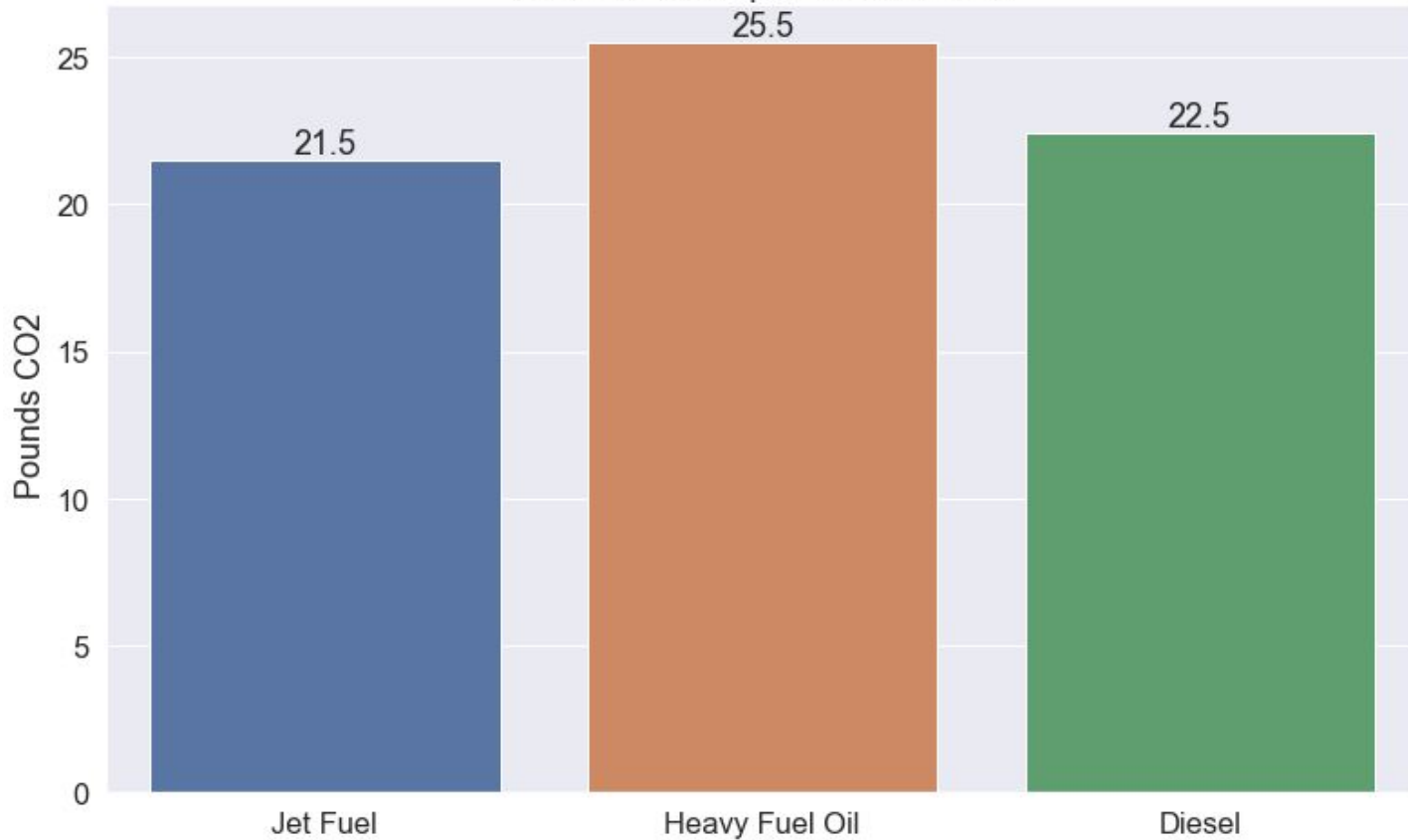
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What kind of environmental impact do these different methods of transport have?

- The most direct impact when discussing transport, are greenhouse gas emissions from fuel consumption
- Fuel = carbon = CO₂
- For every pound of carbon burned, three pounds of CO₂ are produced

CO2 Emissions per Gallon of Fuel



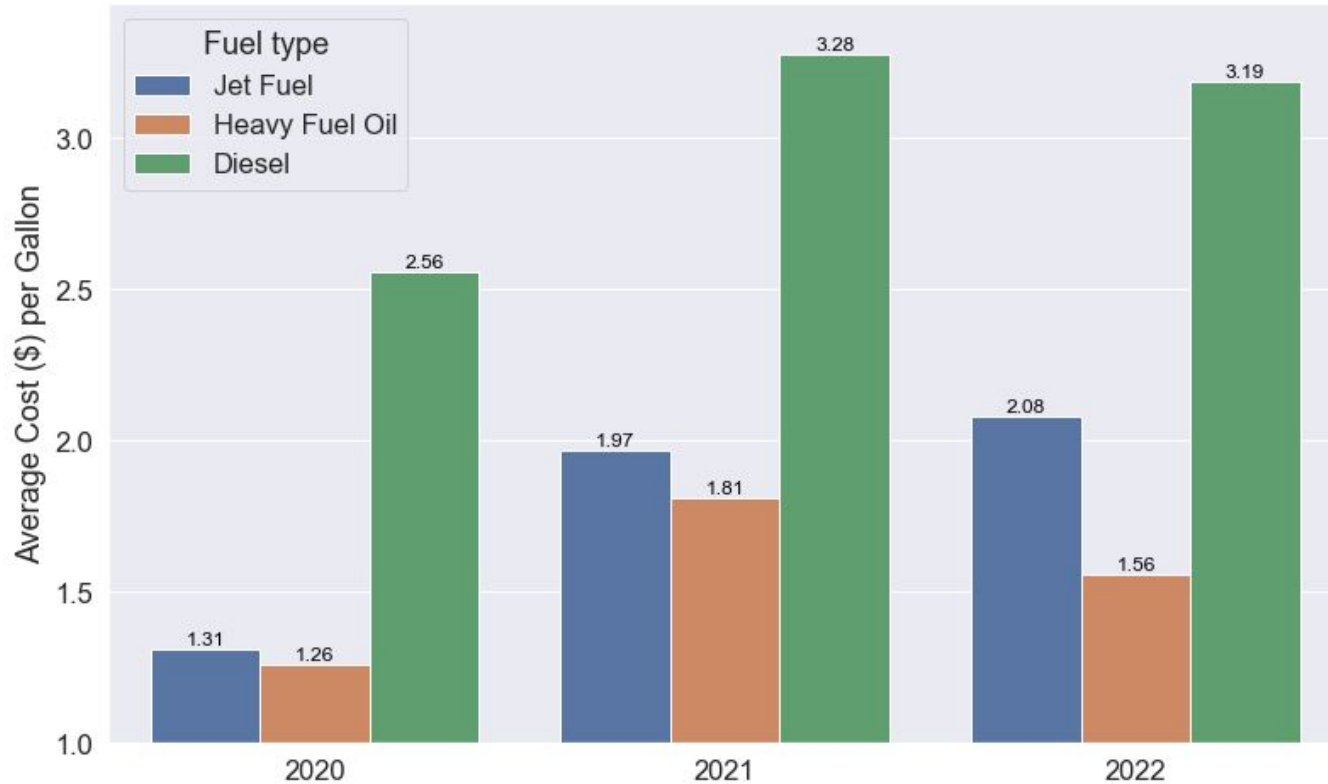
How much does fuel cost?



How much does fuel cost?

Average Cost (USD) per Gallon of Fuel by Year

(2022 projections from US Department of Energy)



What does this all mean?

How is all this data relevant to any decisions I make?

Leopold Center for Sustainable Agriculture

Iowa State University, 2001

“Food, Fuel, and Freeways: An Iowa perspective on how far food travels, fuel usage, and greenhouse gas emissions”

Average Distances from Farm to Market

Terminal Market vs. Ferry Plaza Farmers Market

Apples: 1,555 miles vs. 77 miles

Tomatoes: 1,369 miles vs. 117 miles

Grapes: 2,143 miles vs. 134 miles

Beans: 766 miles vs. 101 miles

Peaches: 1,674 miles vs. 173 miles

Winter Squash: 781 miles vs. 98 miles

Greens: 889 miles vs. 99 miles

Lettuce: 2,055 miles vs. 102 miles

What's the overall impact (1-Ton/1000 miles)?

Fast Ship Slow Ship Small Truck Medium Truck Big Truck Plane Train

Time
(Hours)

38.5	45.5	17.9	17.9	17.9	2	40
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Gallons
of Fuel

.99	.63	11	6.7	7	222.2	2.3
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CO₂
(lbs)

25.37	16.18	247.5	150.7	157.3	4777.8	51.5
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Fuel cost
2021

1.80	1.15	36.14	22.00	22.97	437.78	7.52
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Is this really the best
option?

Fast Ship Slow Ship

Time
(Hours)

38.5

45.5

Gallons
of Fuel

.99

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CO₂
(lbs)

25.37

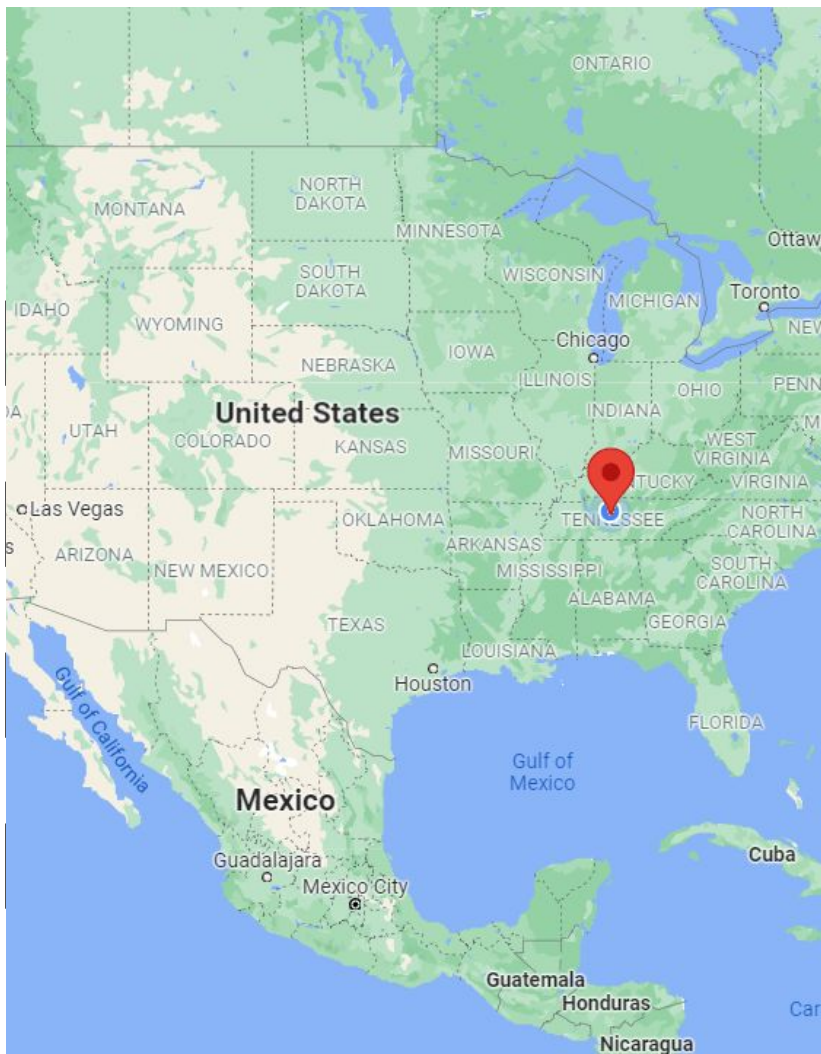
16.18

Fuel cost
2021

1.80

1.15

Is this really the best
option?



Train

40

2.3

51.5

7.52

Transporting food by Ship or Train

vs. Locally by Truck:

Pros:

- Fuel efficient over long distances
- Effective at moving large amounts at once
- Less CO₂ production - by cargo weight

Cons:

- Slow
- Food most likely processed or under-ripe: less nutritious *unless frozen
- Ship and Train is not the end point of that cargo's journey

- Less distance = faster delivery time
- Produce is fresher/riper
- More carbon emissions per gallon using diesel trucks
- Fewer gallons/emissions overall by cutting transit distance

Sustainability

Finding a balance between how much food is imported over large distances and how much food is sourced locally

Emphasis on obtaining a greater % of food from local sources

Minimizing fuel usage, CO₂ emissions, and spending less \$\$ on transportation of food-cargo

Areas for Further Analysis

- Refine the data for transit by truck by including data for urban driving conditions
- Are shipping companies actually saving fuel and money by traveling slower
 - Started the practice during the 2008 Recession
 - Individual ships save on fuel, but do companies?
 - Does slower ships = less profit? Larger fleets?
- It would be fascinating to further examine where exactly different ingredients are grown and how exactly they're transported, to get a clearer vision of a food-product's journey from origin to market
 - Shipping ports mapped
 - Rail lines mapped
 - Distribution centers highlighted

Questions

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