2040 Portland Freight Plan: Dominant & Disruptive Trends

Overview

Portland is well positioned to successfully adapt to rapidly evolving trends within freight industry such as diversified delivery modes, increasing warehouse/distribution development, and e-commerce supply and demand, due to:

- **Continued *economic and job-related growth in freight sector***

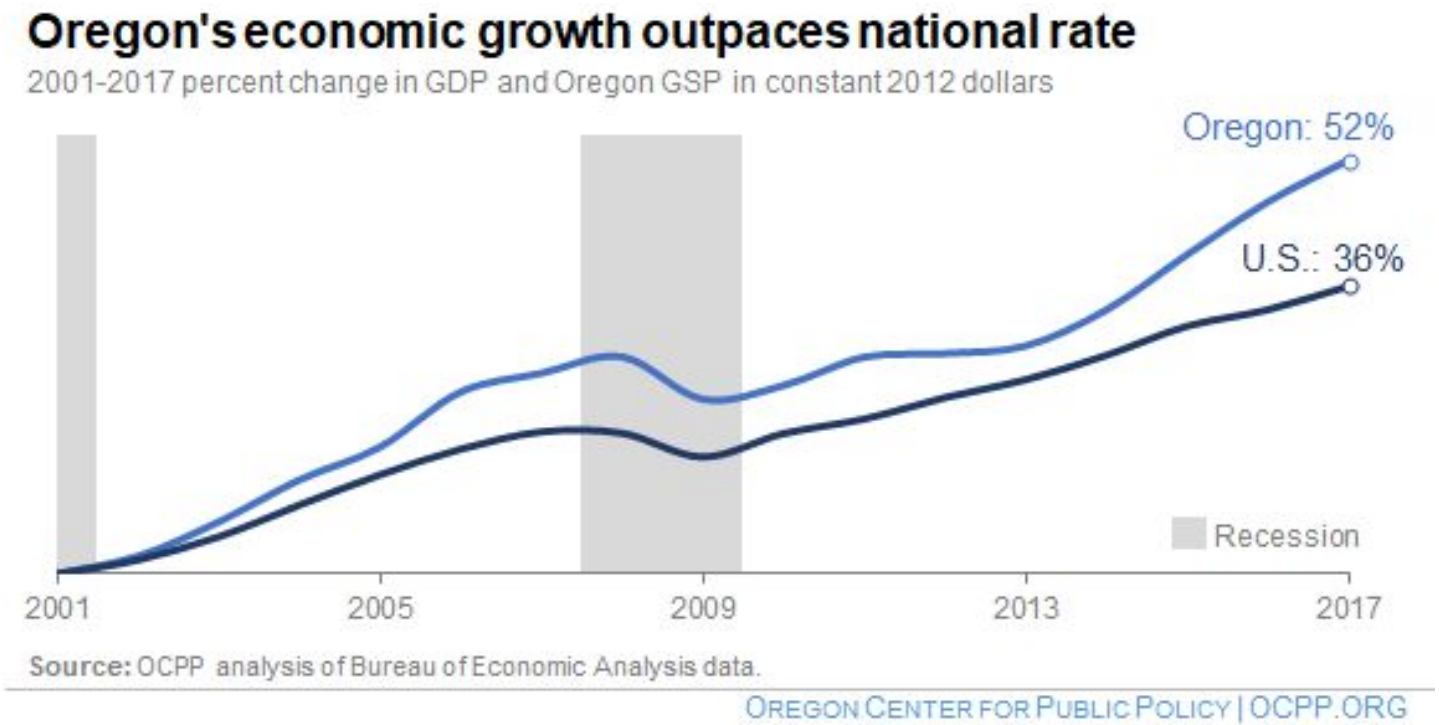
- **Successful last-mile initiatives including urban-area warehouses, cargo bike and parcel locker programs, and crowdsourcing delivery systems**

- **Highly automated Amazon Fulfillment Center and other large distribution facilities in Portland region**

Continued Strong Economic Growth

Portland is considered a gateway and distribution center for domestic inland and international markets[1]

- ***21st largest metropolitan economy in US (2019)*** [2]
- Trade flows in Portland to ***grow 16% from 2017 to 2040, to nearly 260 million tons, totaling nearly $460 billion*** [3]



[1] https://www.oregonmetro.gov/sites/default/files/2014/04/24/12022005_cost_of_congestion_study_full_report.pdf

[2] "Regional Data - GDP & Personal Income". Bureau of Economic Analysis, FY 2019

[3] FAF4 and FAF5 Database, Portland, OR

Steady Growth in Portland Employment as Industry Growth Continues

Oregon is the U.S.'s 9th most trade-dependent state in the US [1]

Full-time workforce in Portland region totals 748,000 workers (as of 2019), with **15% in freight occupations**, and **6% in freight intensive sectors** [2]

Key Growth Industries include: [3]

- Clean Technology & Green Cities
- Computers & Electronics
- Health Sciences & Technology
- Metals & Machinery
- Software & Media

Source: Bureau of Labor Statistics, Current Employment Statistics, 2019.

Source: https://portlandalliance.com/assets/pdfs/economic-reports/2020-VOJ-State-of-Economy-WEB.pdf

[1] 2018 Regional Transportation Plan: Regional Freight Strategy, Oregon Metro

[2] Bureau of Labor Statistics & PBOT Analysis

[3] https://www.brookings.edu/wp-content/uploads/2019/05/2019.05.21_Brookings-Metro_Portland_Market-Scan.pdf

Freight Sector Growth Provides Opportunity for Improved Diversity of Workforce in Portland Region

PBOT findings highlight key areas for equity advancement, though do not indicate how performance compares to other industries in region

- **81% of freight occupations earn below the median family income** (MFI) [1] [2]

- Black, indigenous, and people of color (BIPOC) are **disproportionately represented across lower wage freight occupations**, **earning 16-17% less than the average freight worker** [3] [4]

- Women accounted for 51% of the Portland region population in 2019**,** and **represent 40% of workers within freight occupations** [5]

- Compared to other industries in the region, **freight jobs offer roughly 14% more than other jobs available to those with less than GED-level education**

Note: Low income is defined as individuals earning less than $30,800, or those earning less than $43,950 for a family of four (50% median family income) as of 2019.

[1] Portland Housing Bureau. 2019. "2019 Income and Rent Limits." https://www.portland.gov/sites/default/files/2020-04/2020-ami-rents-phb.pdf & PBOT Analysis

[2] https://www.oregonmetro.gov/sites/default/files/2014/04/24/12022005_cost_of_congestion_study_full_report.pdf & PBOT Analysis

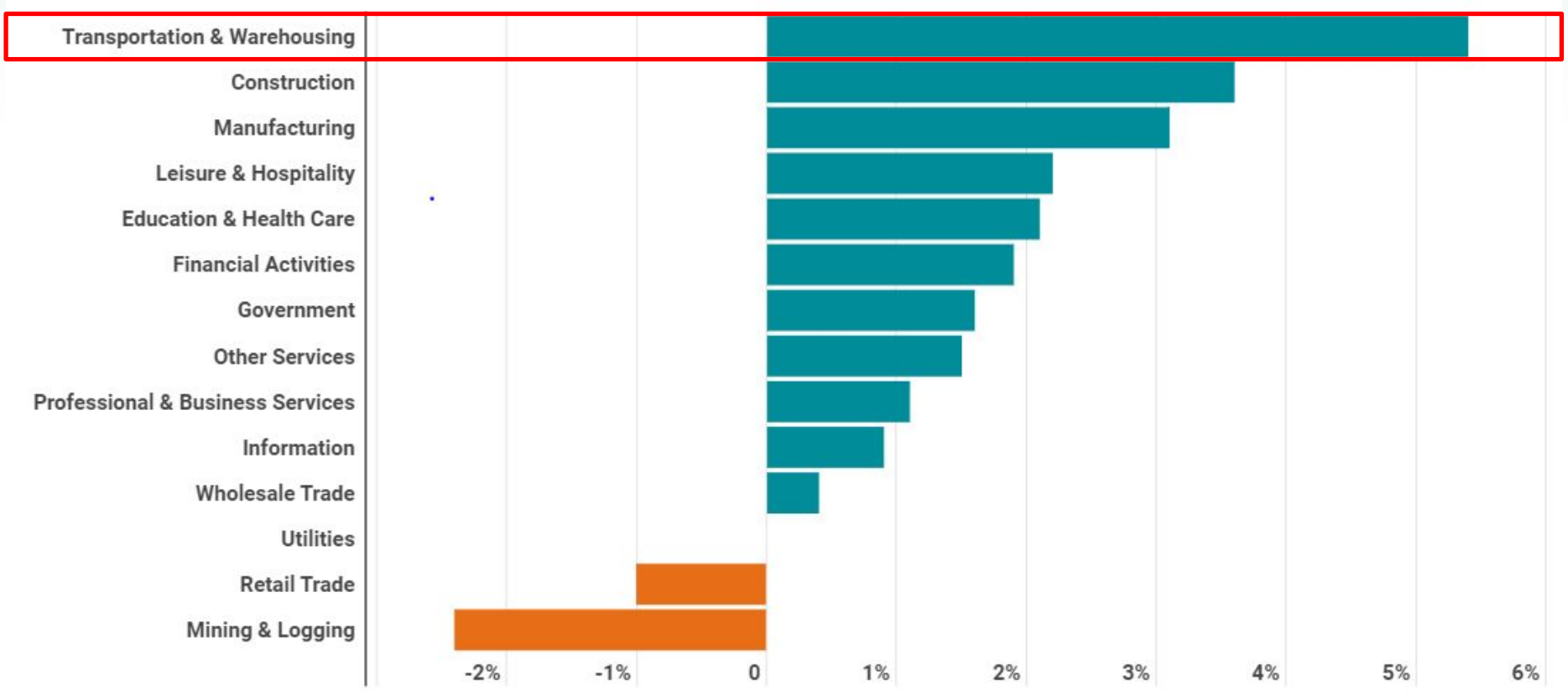
[3] https://www.federalreserve.gov/econres/notes/feds-notes/disparities-in-wealth-by-race-and-ethnicity-in-the-2019-survey-of-consumer-finances-20200928.htm

[4] Bureau of Labor Statistics & PBOT Analysis

[5] https://data.census.gov/cedsci/table?q=population%20by%20sex&g=310M400US38900&tid=ACSST5Y2019.S0101&tp=false&hidePreview=true & PPBOT Analysis

Pre-COVID Economic Outlook favors Transportation Sector growth in Portland

YoY change in employment by industry in Portland (as of 2019)



Source: Bureau of Labor Statistics, Current Employment Statistics survey.

Source: https://portlandalliance.com/2020#:~:text=Prosperity%20%26%20Productivity&text=Job%20growth%20in%20Portland%20continues,See%20Figure%201.&text=And%20yet%20job%20growth%20continues,the%20U.S.%20average%20of%201.6%25.

Shifting E-Commerce Market Share in Portland

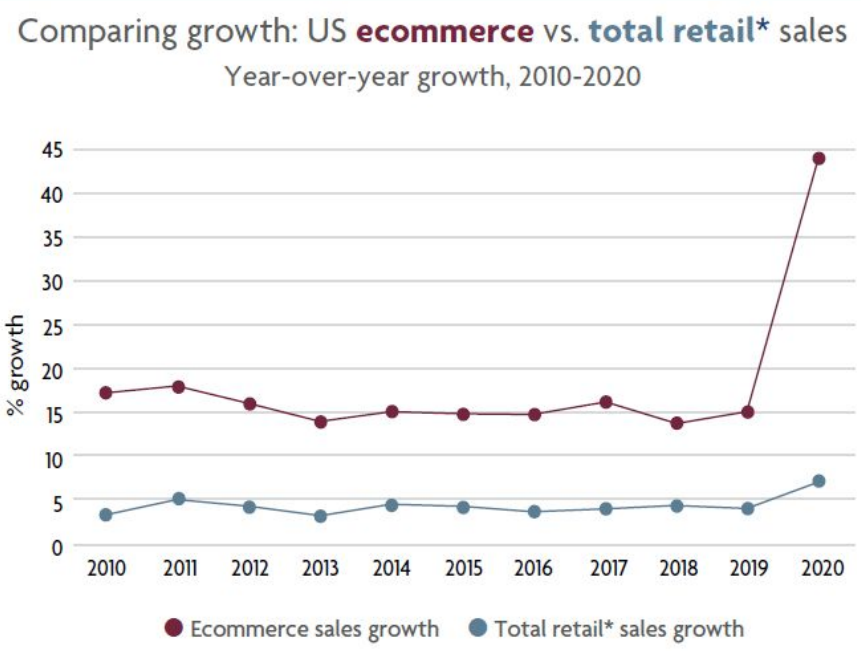
As of 2017, retail sales represented approximately 10% of the state's total GDP, while e-commerce accounted for 11% of total retail employment in the Portland metro region [1]

[1] E-Commerce and Emerging Logistics Technology Report, PBOT Dec. 2019

Source: https://oregoneconomicanalysis.com/2018/03/16/retail-and-e-commerce-graph-of-the-week/

E-Commerce Growth

During 2020, total sales of retail products in the U.S. increased by 6.6% from 2019, while online retail sales grew by 27.7%, with consumers spending 130% more on e-commerce products since 2015 [1]



Source: Digital Commerce 360, U.S. Department of Commerce; Updated January 2021

*Total retail figures exclude sales of items not normally purchased online such as spending at restaurants, bars, automobile dealers, gas stations and fuel dealers

Source: The COVID-19 Pandemic and North Jersey Freight Report, March 2021

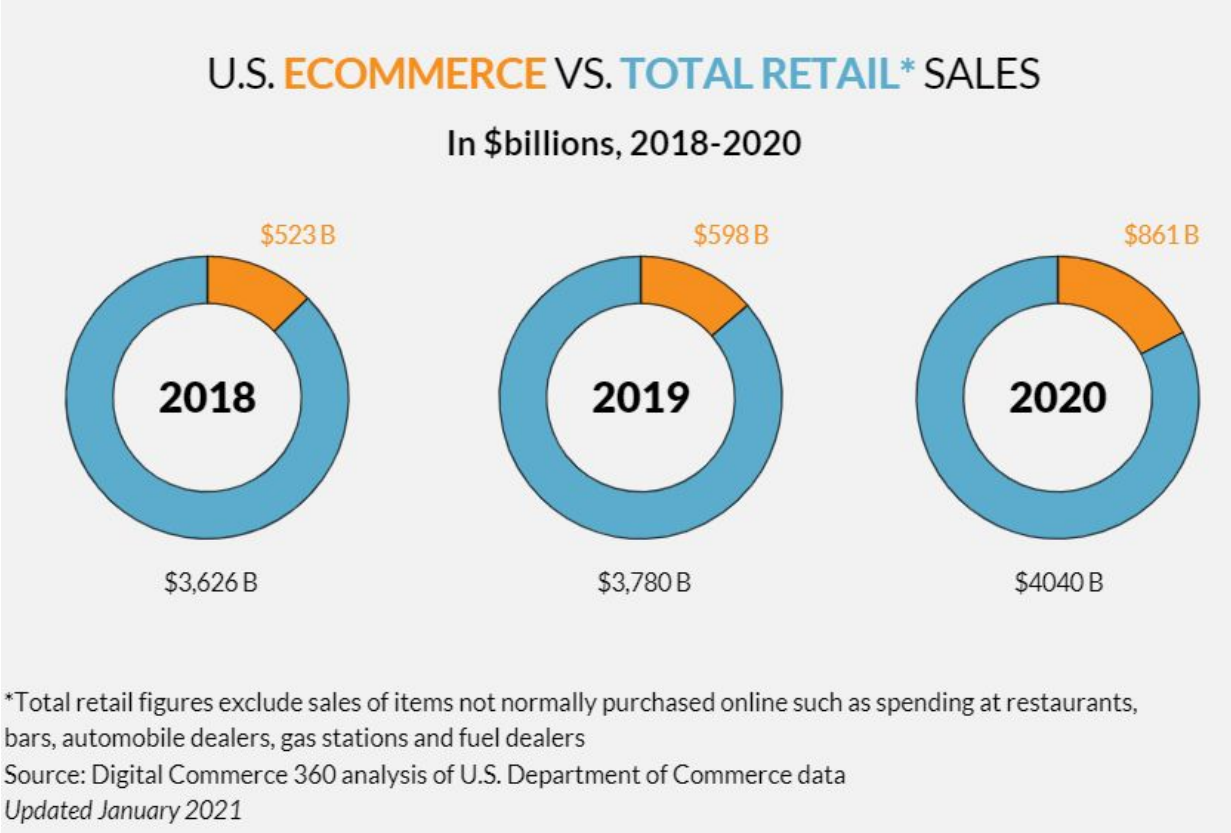
Source: Retail Indicators Branch, U.S. Census Bureau

Source: *Economic Impact of E-commerce in the Texas Triangle,* 2021

[1] *Are Home Deliveries Increasing during the Pandemic? ,* Sorin Garber, 3/25/2021

E-Commerce Growth Fuels Shift in Market Share

To understand the magnitude of change in delivery volume as it relates to e-commerce growth, e-commerce deliveries annually in the U.S. were estimated at 11 billion in 2018 , forecasted to rise to 16 billion for FY2020 [1]



[1] https://www.strategy-business.com/article/The-Rise-of-the-Last-Mile-Exchange?gko=7cf43

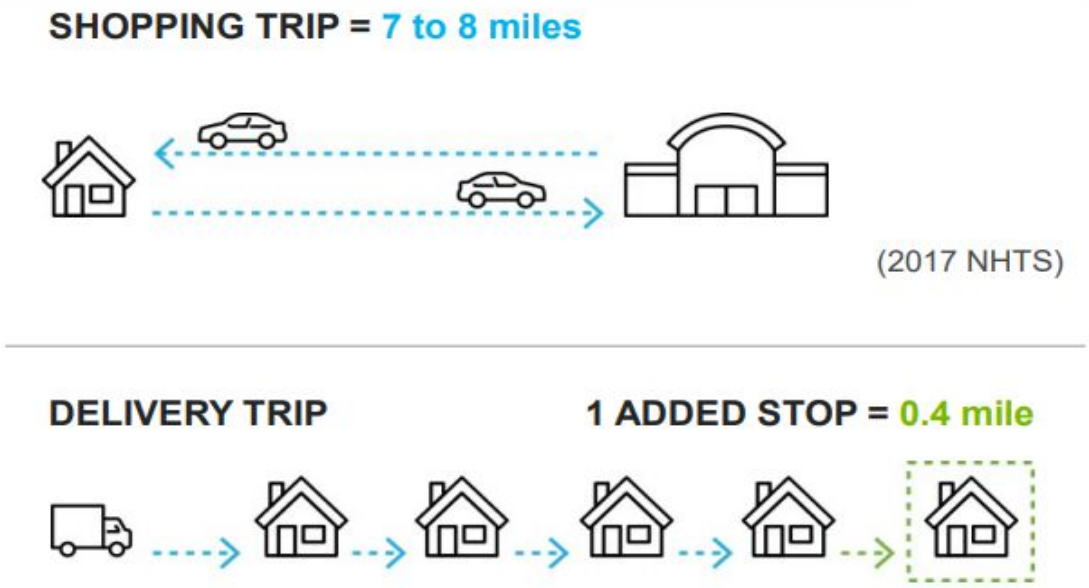
Source: https://www.digitalcommerce360.com/article/us-ecommerce-sales/

E-Commerce and Shifting Travel Behavior

Home deliveries involve a tradeoff between a customer trip to a store and a last-mile truck/van/car delivery to your house, with uncertain impacts of this shift

Factors affecting urban truck and total VMT forecasts: [1]

- **Market penetration of electrification technologies**
- **Private automated vehicle use**



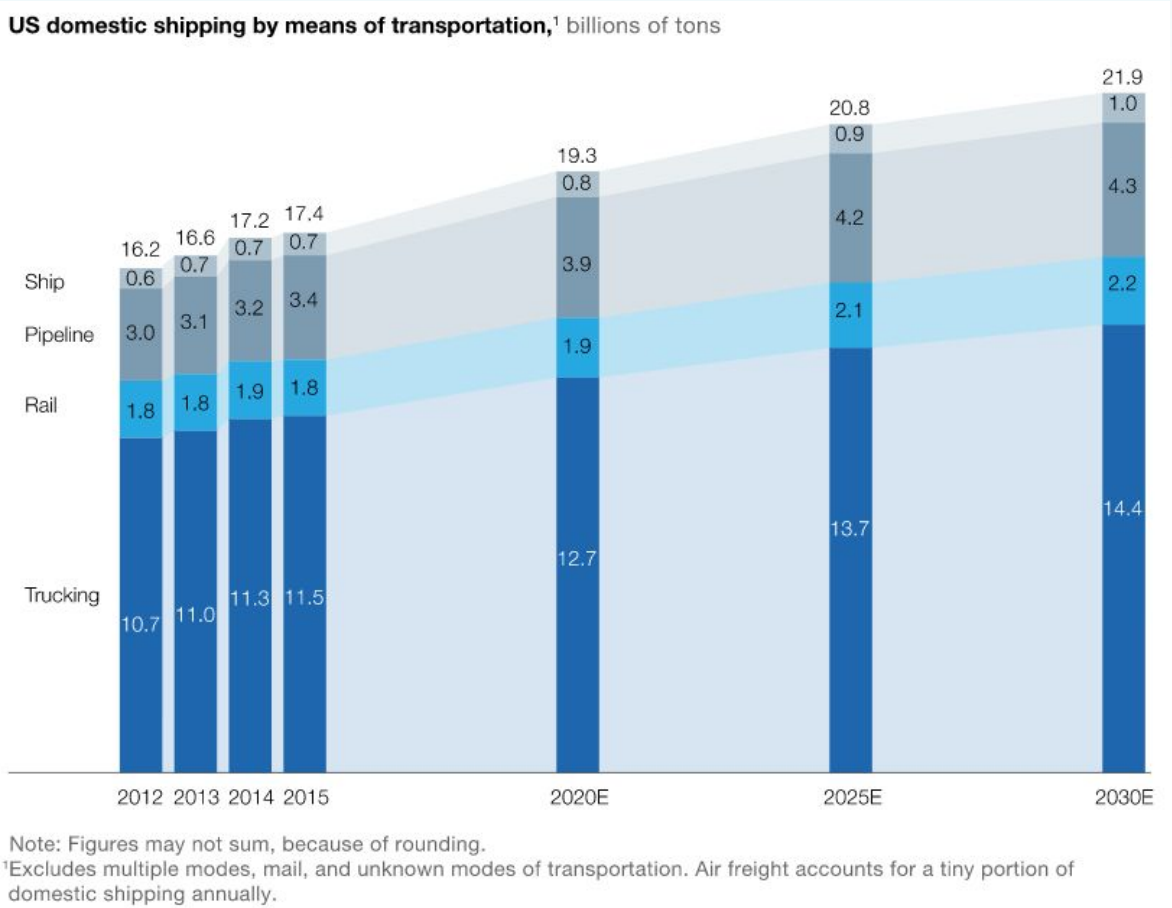
[1] *E-Commerce Impacts on Regional Travel and Energy Use: Household Shopping and Parcel Delivery Tradeoffs*, Dec. 2019

Source: PowerPoint Presentation (dot.gov)

With Rise in E-Commerce, Trucking Remains Leading Force in Domestic Shipping amid Driver Shortage

- Portland region truck driver employment **decreased by 5.4% between June 2019 and June 2020** [1] [2]

- Rising driver shortage due to an **aging workforce, working conditions, and regulation changes** [3]



Note: Figures may not sum, because of rounding.
[1]Excludes multiple modes, mail, and unknown modes of transportation. Air freight accounts for a tiny portion of domestic shipping annually.

Source: Autonomous trucks disrupt US logistics | McKinsey

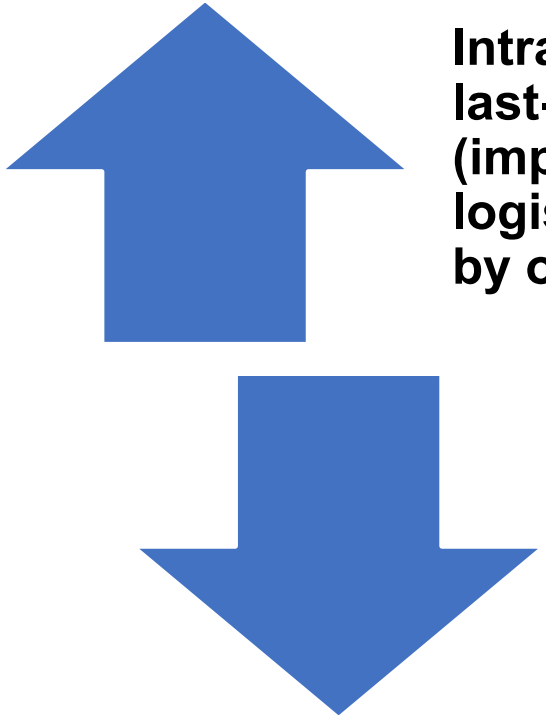
[1] *Are Home Deliveries Increasing during the Pandemic? Update 2*, Sorin Garber 8/11/2020

[2] https://www.joc.com/trucking-logistics/labor/us-truck-driver-shortfall-steeper-expected_20201125.html

[3] Autonomous trucks disrupt US logistics | McKinsey

Effects of E-Commerce on Truck Fleets and VMT

As e-commerce grows and last-mile truck trips continue to increase, average freight truck trip lengths are decreasing, with a 37% decrease since 2000 [1]



Intra-regional and last-mile truck trips (impacted by reverse logistics fueled increasing by online sale returns) [2] [3]

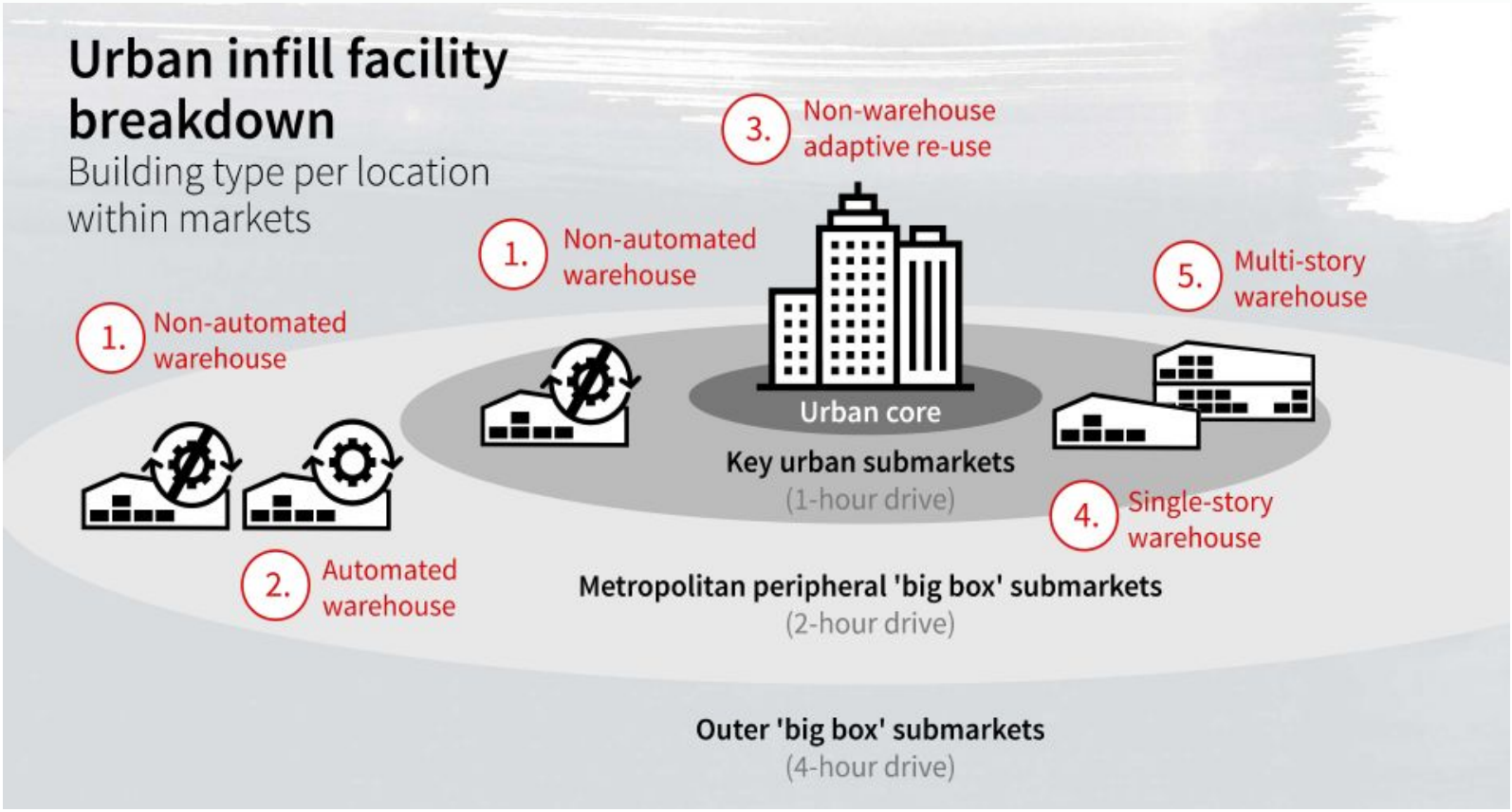
Distance of freight truck haul [3]

[1] E-Commerce Trends are Game Changing for Trucking Industry | Material Handling and Logistics (mhlnews.com)
[2] US freight industry after COVID-19: What's next? | McKinsey
[3] E-Commerce Trends are Game Changing for Trucking Industry | Material Handling and Logistics (mhlnews.com)

Greater Need for Warehousing Capacity across Local Supply Chains

E-commerce requires three times the amount of warehouse space as traditional retail, supporting trend of increased warehouse space in Portland region [1]

Two-Stage Distribution Model



[1] "As Amazon Moves In, Demand for Warehouse Space Climbs", *The New York Times*, 10/24/17

[2] Jones Lang LaSalle, 2020

Source: Jones Lang LaSalle, 2020

Evolving Supply Chain Priorities

Recent shift from lean just-in-time inventory to increased inventory on-hand supports recent trend in increased warehouse/fulfillment centers across the US

Source: “COVID Resilience Report: The Impact of COVID-19 on Supply Chains and How Businesses are Preparing for the Next Shock”, Interos, 2020

Rise in Nearshoring Strategy Accelerating Globally

Private sector companies have been investigating increasing production capacity domestically or nearer to the US [1]

Nearshoring in the U.S.

Diversification of supplier base, regionalization of supply chains, increased domestic inventory [2]

Direct impact on local supply chains in regions like Portland

[1] The COVID-19 Pandemic and North Jersey Freight Report, NJTPA, March 2021

[2] Economic Impact of E-commerce in the Texas Triangle, TDOT, 2021

Urbanization & E-Commerce drive Last-Mile Connection

To account for increase in deliveries, North American cities have become increasingly reliant on last-mile carriers to handle volatile demand

[1] *E-Commerce and Emerging Logistics Technology Report*, PBOT Dec. 2019

Source: http://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf

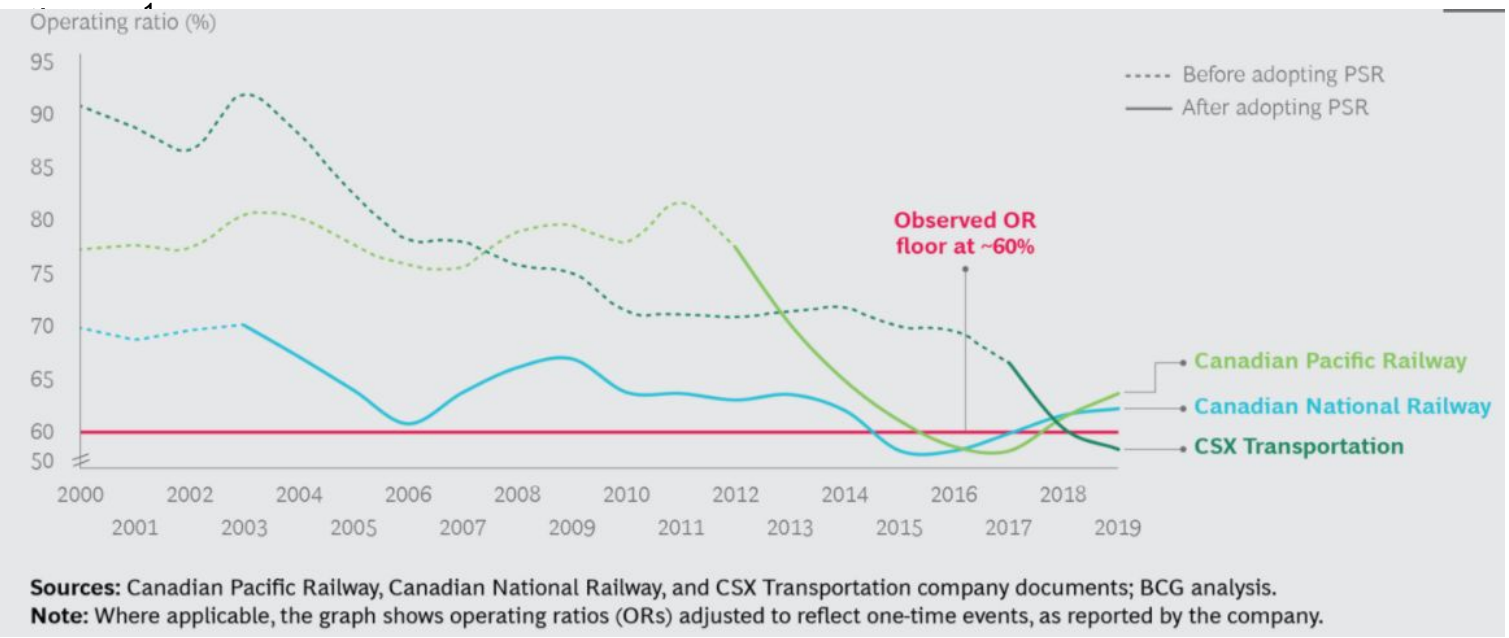
Source: http://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf

E-Commerce impact on Multimodal Freight Trends

Intermodal transportation offers an alternative to trucking with continued volatility in the trucking industry

Rail

- **Improving operations by implementing precision scheduled railroading** (PSR) which could have a large impact on development of intermodal facilities [1]
- Intermodal rail companies have been **purchasing and redeveloping abandoned rail rights-of-way to reestablish routes to legacy distribution centers** as e-commerce growth co[1]



Sources: Canadian Pacific Railway, Canadian National Railway, and CSX Transportation company documents; BCG analysis.
Note: Where applicable, the graph shows operating ratios (ORs) adjusted to reflect one-time events, as reported by the company.

[1] As E-commerce Booms, Transportation Logistics Are Shifting to Meet Demand | Dialogue Blog | Research & Insight | Gensler

Source:https://www.bcg.com/publications/2020/going-beyond-precision-scheduled-railroading

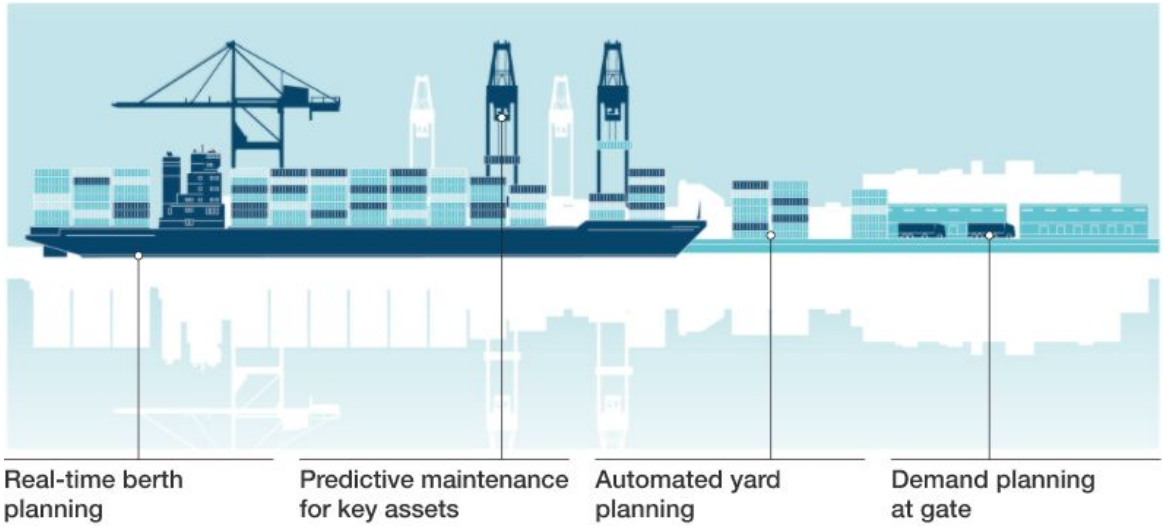
E-Commerce impact on Multimodal Freight Trends

E-commerce has influenced automation and digital transformation in marine logistics

Maritime/Ports

- In 2017, shipping firms A.P. Moller Maersk, CMA CGM and Evergreen Line partnered with Alibaba to **offer direct booking of maritime cargo space for customers** using the company's OneTouch service [1]

- Growing complexity of port operations is leading to div**ersification and intensification of land use, which requires new synergies between ports and cities to maximize spatial productivity** [2]



Source: The future of port automation | McKinsey

[1] Shipping and e-commerce: keeping pace in the age of automation (ship-technology.com)
[2] deloitte-nl-cb-global-port-trends-2030.pdf

Land Use Trends [1]

Changing e-commerce landscape and focus on last-mile delivery has placed greater requirements on land use adaptation nationally and in the Portland region

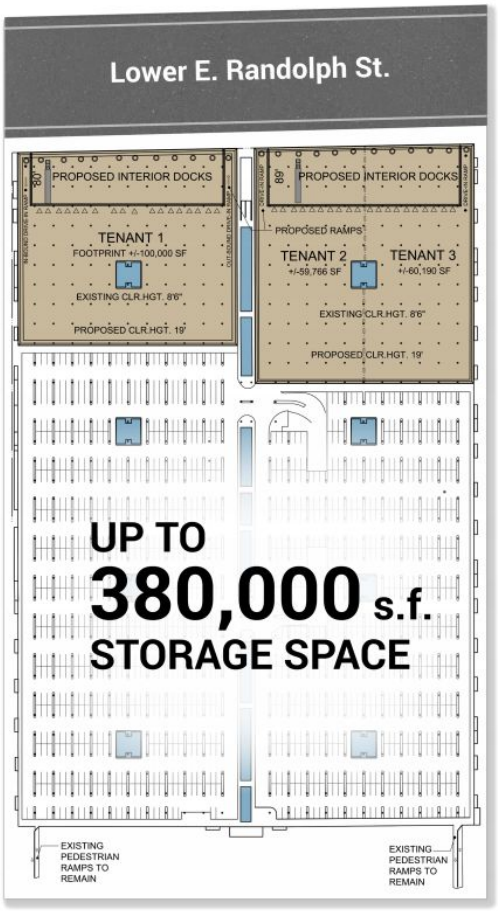
- **2.1 million sq. ft. of warehouse and distribution space opened in 2019**, with additional **3.7 million sq. ft. opening in 2020 in Portland region**
- **115-acre Portland Meadows horse racing facility being redeveloped** as an urban logistics facility by Prologis
- **2.8 million sf of industrial, warehouse and flex space under construction as of Q4 2020** in Portland including:
  - PDX Logistics Center West Buildings 1 and 2, Airport Way (928,000 sf)
  - Prologis Meadows Phase 2 (633,000 sf)
  - Prologis Park Broadmoor along Airport Way (345,000 sf)

[1] *Are Home Deliveries Increasing during the Pandemic? Update 4,* Sorin Garber 3/25/2021

National Land Use Trends [1]

National trends show increase in larger and/or more centrally located warehouse sites within urban centers

- In Chicago, construction of last-mile facility is underway, **converting a portion of a city-owned underground parking garage** in the central business district, within 15-minutes of nearl 230,000 residents



[1] *E-Commerce and Emerging Logistics Technology Report*, PBOT Dec. 2019

Source: millenniumchicago_brochure-digital-approved.(millennium-chicago.com)

Warehouse & Distribution Center Automation

Increased investment in automation of warehouses, including robotics, as e-commerce and customer demand continue to grow

- **2.2 million sq. ft. Amazon Fulfillment Center in Troutdale, OR** recently built in 2018 as a **robotics multi-floor** (4 floors) facility[1]

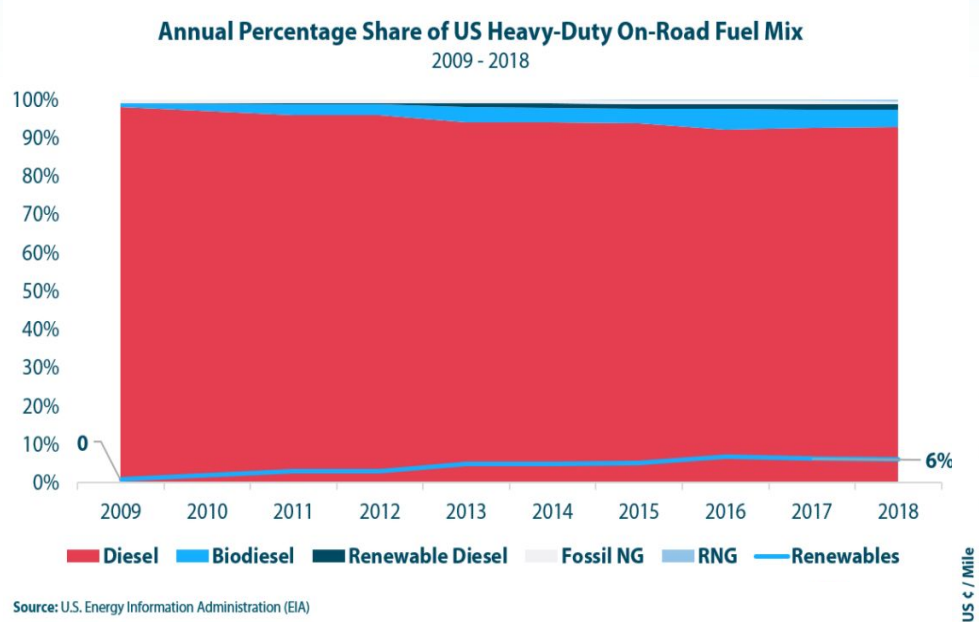
- As a result of COVID-19, likely **increased investment in robotic systems to improve processes, prioritizing the health, safety and well-being of employees[2]**

Source: https://sanantonioreport.org/humans-robots-at-work-at-shertz-amazon-center/scott_amazonfulfillmentwarehousecenter-27/

[1] *E-Commerce and Emerging Logistics Technology Report*, PBOT, Dec. 2019
[2] *The COVID-19 Pandemic and North Jersey Freight Report*, NJTPA, March 2021

Rise in Alternative Fuel Vehicles (AVFs)

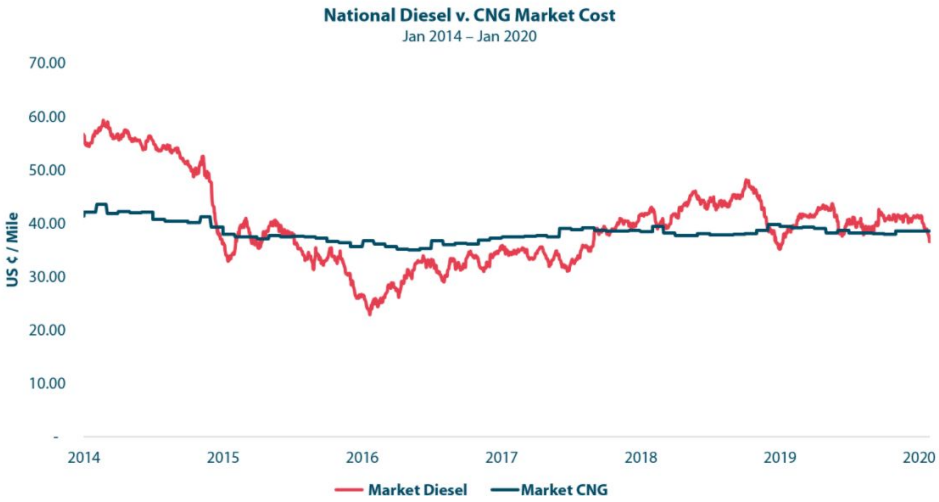
With gasoline price volatility, alternative fuels are appealing more to vehicle fleet managers and consumers, with biofuels and CNGs leading across HDVs [1]



Source: https://www.breakthroughfuel.com/blog/overview-alternative-transportation-fuels/

National Average Price Between October 1 and October 15, 2020	
Fuel	**Price**
Biodiesel (B20)	$2.29/gallon
Biodiesel (B99-B100)	$3.33/gallon
Electricity	$0.13/kWh
Ethanol (E85)	$1.96/gallon
Natural Gas (CNG)	$2.18/GGE
Liquefied Natural Gas	$2.72/DGE
Propane	$2.73/gallon
Gasoline	$2.18/gallon
Diesel	$2.40/gallon

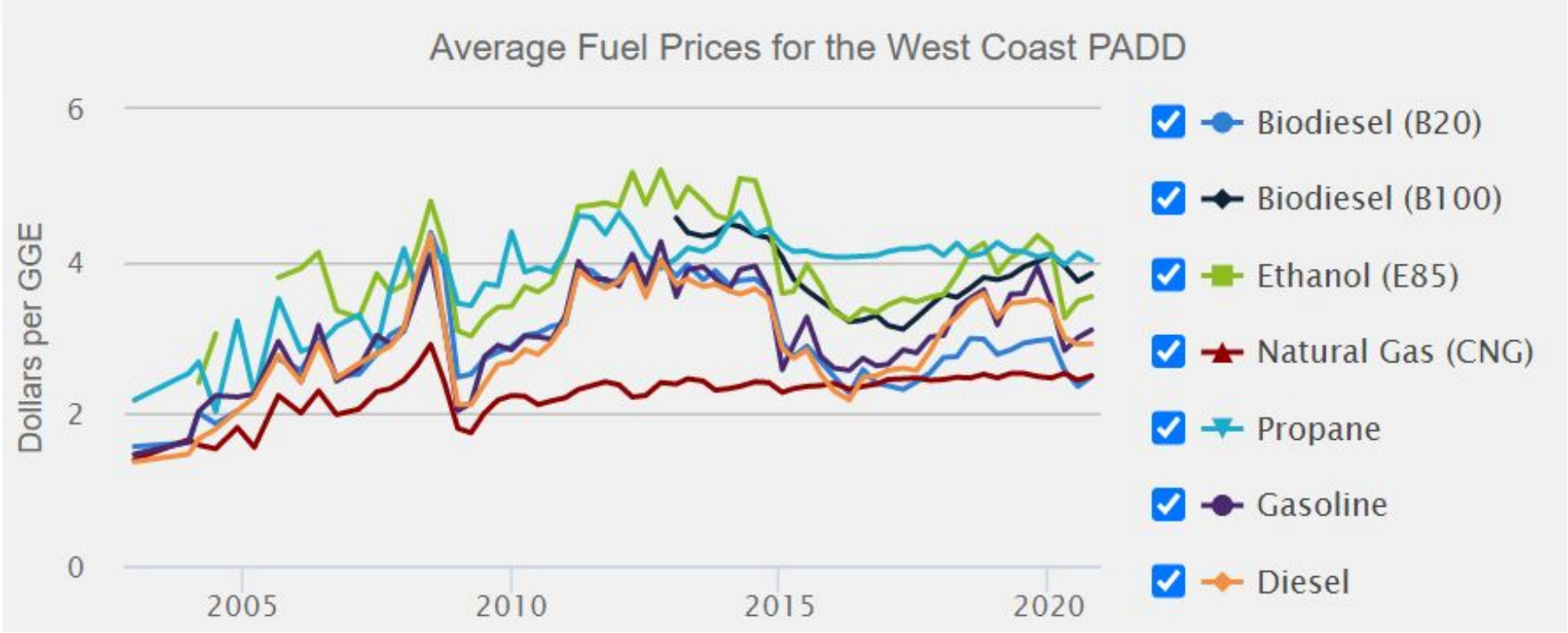
Source: https://afdc.energy.gov/fuels/prices.html



[1] https://www.worktruckonline.com/10131379/digging-into-alternative-fuel-trends-growth-drivers
[2] https://www.mpofcinci.com/blog/guide-to-alternative-fuel-sources-and-technologies-for-the-trucking-industry/

West Coast Fuel Price Trends Favor EV Adoption

Biodiesel and CNGs are cost-competitive alternatives with CNGs experiencing least price volatility in recent years, mirroring national trend



Gasoline gallon equivalent (GGE), Oct. 2020

Source: https://afdc.energy.gov/states/or

AVF Trends in Oregon

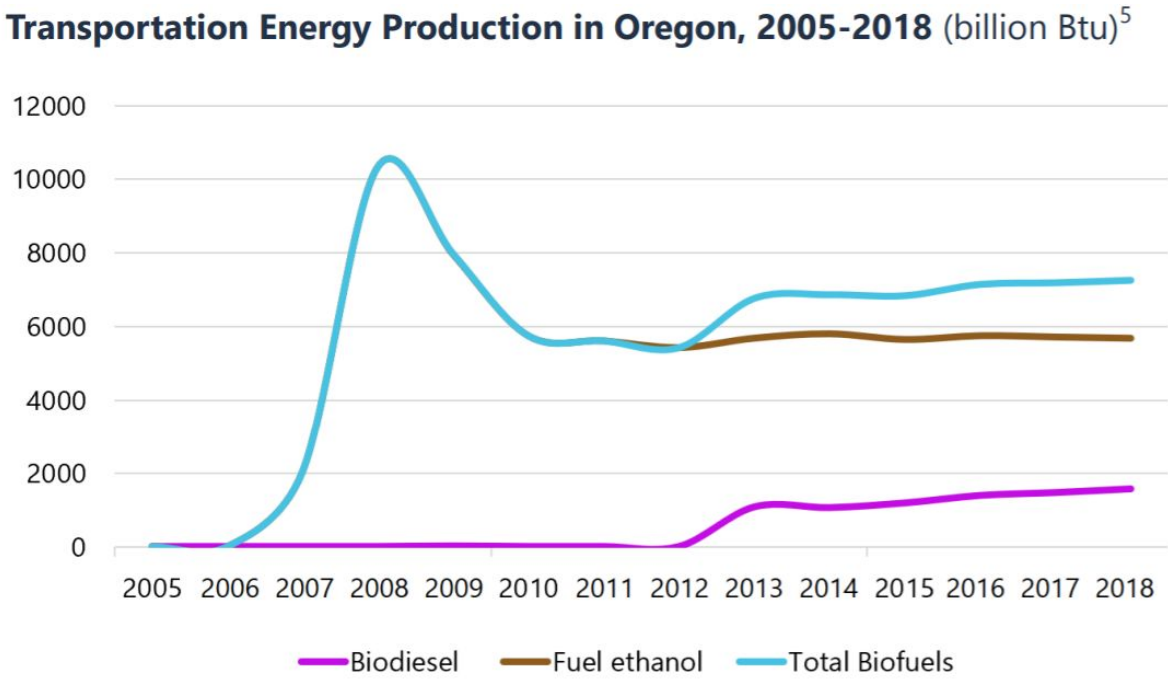
Policy Action: [1]

- **41 laws and incentives in Oregon** related to alternative fuels and advanced vehicles

Infrastructure (fueling stations): [1]

- 50 LPG
- 15 CNG
- 37 biodiesel
- 4 E85
- 2 LNG

Source: https://www.oregon.gov/energy/Data-and-Reports/Documents/2020-BER-Energy-by-the-Numbers.pdf



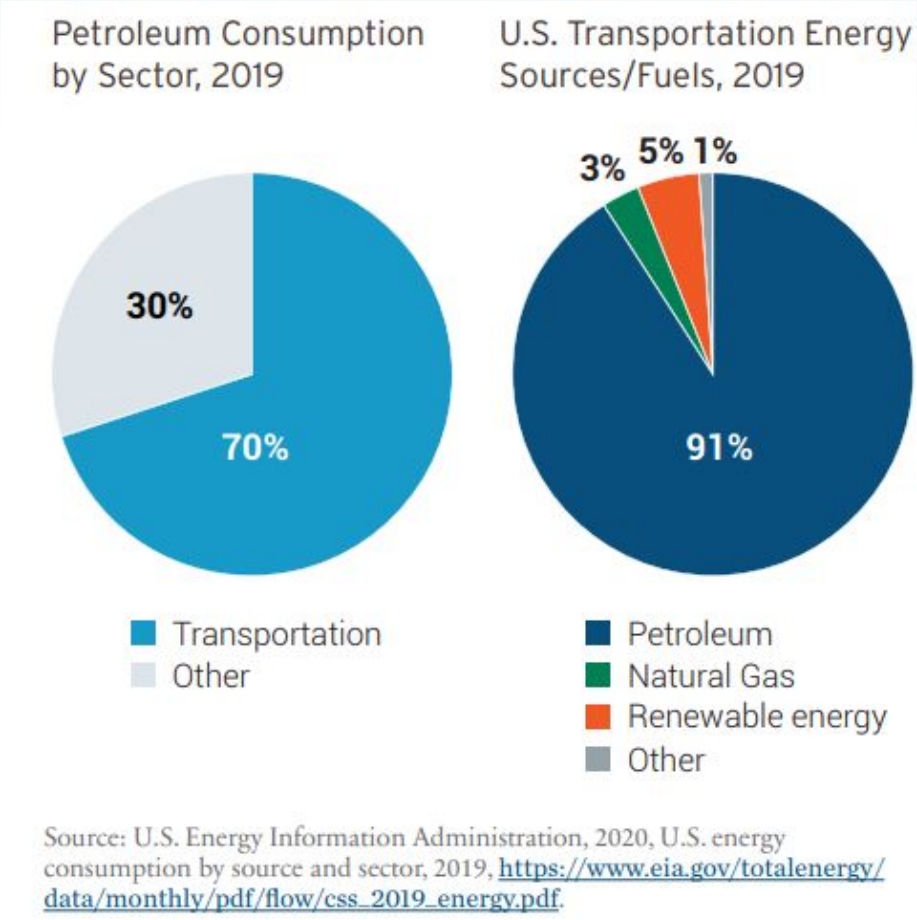
Source: https://www.oregon.gov/energy/Data-and-Reports/Documents/2020-BER-Energy-by-the-Numbers.pdf

[1] https://afdc.energy.gov/states/or

Electric Transportation and the Expanding EV Market

Private sector and states have begun setting ambitious EV targets, expanding charging infrastructure, and increasing policies supporting EVs [1]

- IKEA has set a goal to **electrify all home delivery vehicles by 2025** [2]
- Amazon has ordered **100,000 electric delivery vans from Rivian to deploy 2030** [2]
- Daimler announced production of **longest-range battery electric trucks will begin in 2022**
- Portland General Electric and Daimler Trucks co-development of "Electric Island" in Portland, **US' 1st large public charging site for medium- and heavy-duty electric commercial vehicles** [3]



Source: U.S. Energy Information Administration, 2020, U.S. energy consumption by source and sector, 2019, https://www.eia.gov/totalenergy/data/monthly/pdf/flow/css_2019_energy.pdf.

[1] Freight Electrification is Accelerating, but it's Heavy Work (act-news.com)

[2] https://www.electrificationcoalition.org/wp-content/uploads/2020/11/Electrifying-Freight-Pathways-to-Accelerating-the-Transition.pdf

Source: https://www.electrificationcoalition.org/wp-content/uploads/2020/11/Electrifying-Freight-Pathways-to-Accelerating-the-Transition.pdf

[3] https://daimler-trucksnorthamerica.com/PressDetail/daimler-trucks-north-america-portland-general-2020-12-01

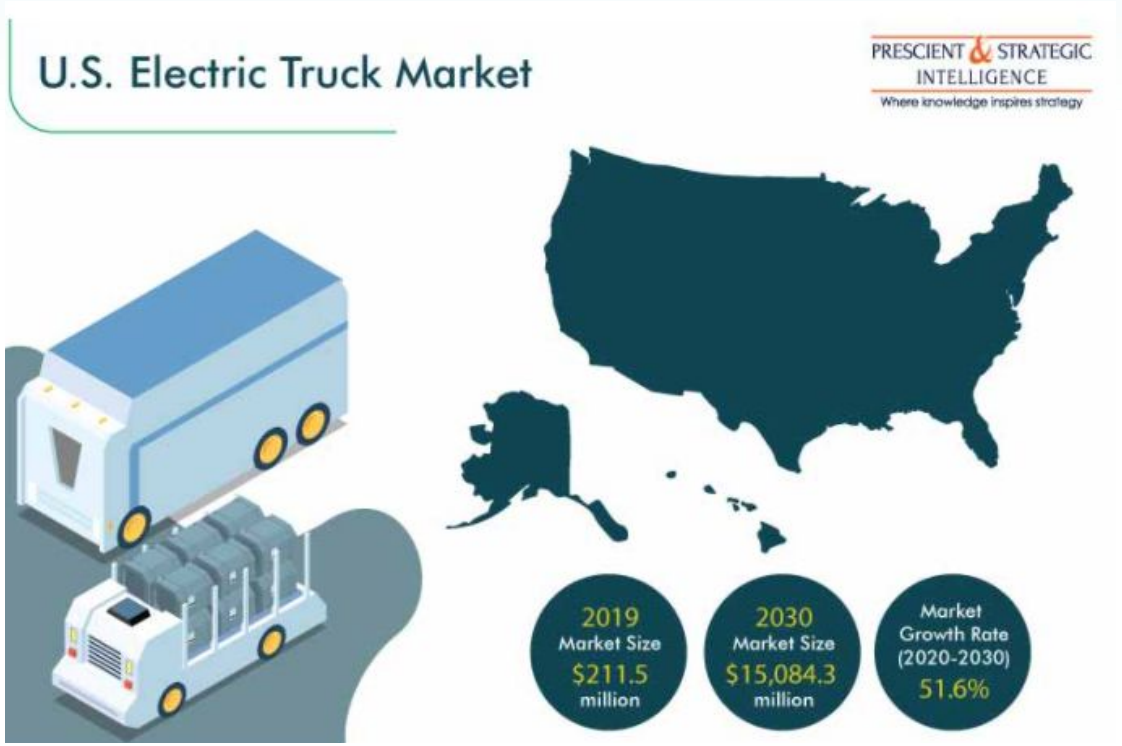
Electric Transportation and Evolving Public Policy Surrounding EV Adoption

Public policy actions are key to advancing freight electrification, passing measures that increase access and affordability while tackling costs [1]

- Portland's Climate Action Plan has goal of a **50% reduction in carbon emissions by 2030 and net zero by 2050** [2]

- Oregon Clean Fuels Program began in 2016 with goal of **25% reduction in climate pollution by 2035** [3]

- **Federal government planning to replace fleet of 650,000 combustion engine vehicles** with electric vehicles built in the US, **driving growth in US electric truck market** [4]



[1] Electrifying-Freight-Pathways-to-Accelerating-the-Transition.pdf (electrificationcoalition.org)
[2] Climate Action Plan | The City of Portland, Oregon
[3] Oregon's Clean Fuels program gets a major boost in 2020 (oeconline.org)
[4] US EV Market will Grow With Federal Fleet Electrification (environmentalleader.com)

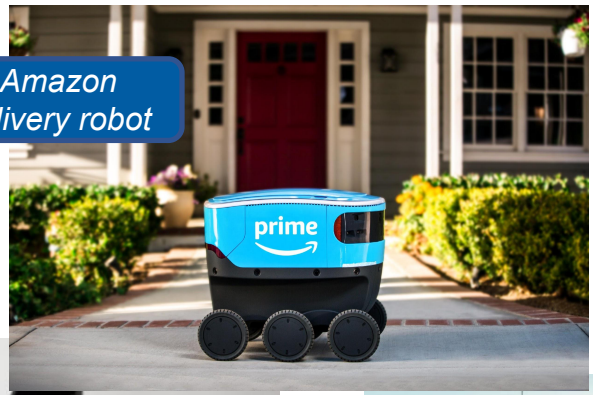
Source: U.S. Electric Truck Market Analysis Growth Forecast to 2030 (psmarketresearch.com)

Connected & Automated Vehicle Advancements

Opportunity exists to increase productivity and decrease operating costs, though public acceptance of driverless freight vehicles on public roadways is not foreseeable in near future

- Pilot programs for trucks, cars, self-driving robots, and drones have been ongoing across the US

Postmates and Amazon self-navigating delivery robot



Source :*E-Commerce and Emerging Logistics Technology Report*, Dec. 2019

Autonomous grocery delivery pilot testing through Kroger and Stop & Shop

Source: https://www.therobotreport.com/wp-content/uploads/2020/Screen-Shot-2020-02-06-at-2.32.43-PM.png

Autonomous freight truck

Source: https://www.lookoutpro.com/wp-content/uploads/2018/07/uberdrive_truck_c.jpg

[1] *Self-Driving Truck's First Mission: A 120-Mile Beer Run*, New York Times, 10/25/2016

Drone Technology for Freight Delivery

More feasible in rural areas due to navigable airspace/landing sites and less restrictive laws & policies

- Drones are **cost-competitive in rural areas at only 10 percent higher cost of today's delivery model** [1]
- Drone deployment in logistics sector: [2]
  - · Automation of Intralogistics
  - · Parcel delivery (First/Last mile)
  - · Medical Good Supply
  - · Transportation of Freight

Source: Elroy Air

Source: Amazon

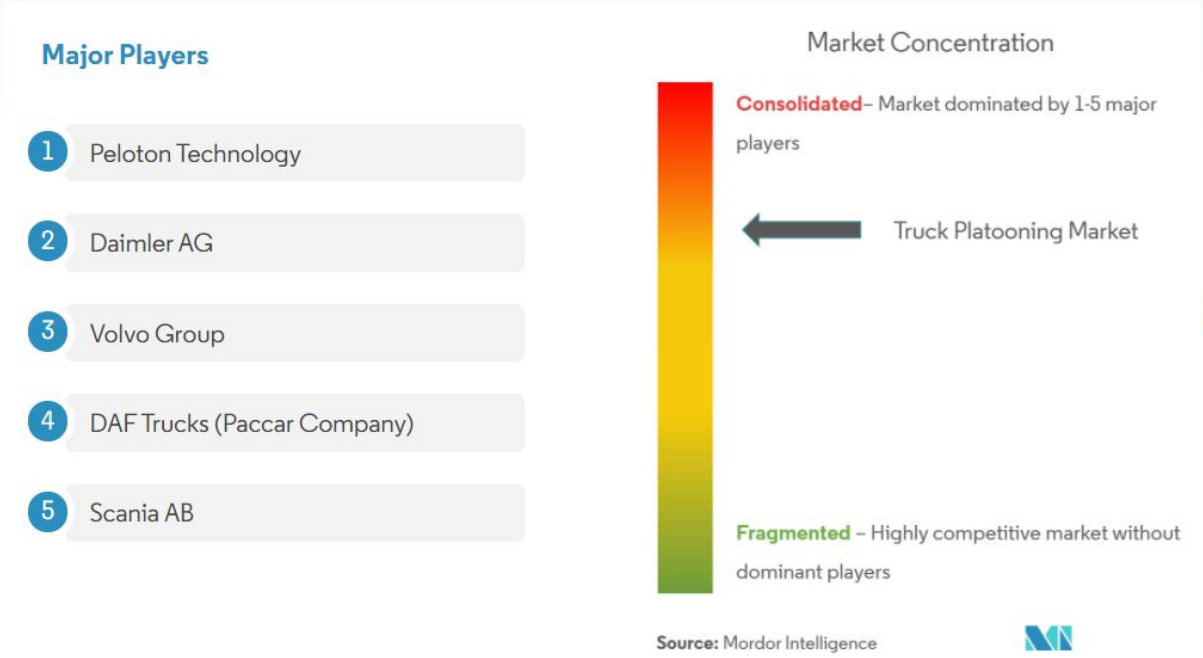
Source: https://dronecenter.bard.edu/projects/other-projects/state-and-local-drone-laws/

[1] Parcel delivery: The future of last mile, McKinsey & Co. (2016)

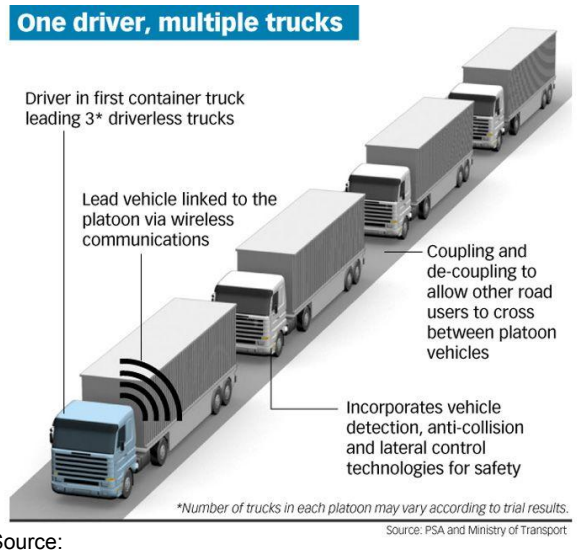
[2] Cargo drones: The future of parcel delivery | Roland Berger

Implementation Hurdles related to Connected & Automated Vehicles

Platooning technology remains in testing and development stage, with recent Peloton trials in the U.S. resulting in an average of 7% in fuel savings [1]



Source: https://www.oemoffhighway.com/electronics/smart-systems/automated-systems/article/21114230/truck-platooning-expected-to-make-inroads-in-2020



Source:
Scania, Toyota come on board to test-bed truck platooning system, Transport - THE BUSINESS TIMES

Challenges surrounding real-world adoption of platooning led **Daimler Trucks, headquartered in Portland, to reduce its investment in the technology in 2019** [1]

[1] https://www.oemoffhighway.com/electronics/smart-systems/automated-systems/article/21114230/truck-platooning-expected-to-make-inroads-in-2020

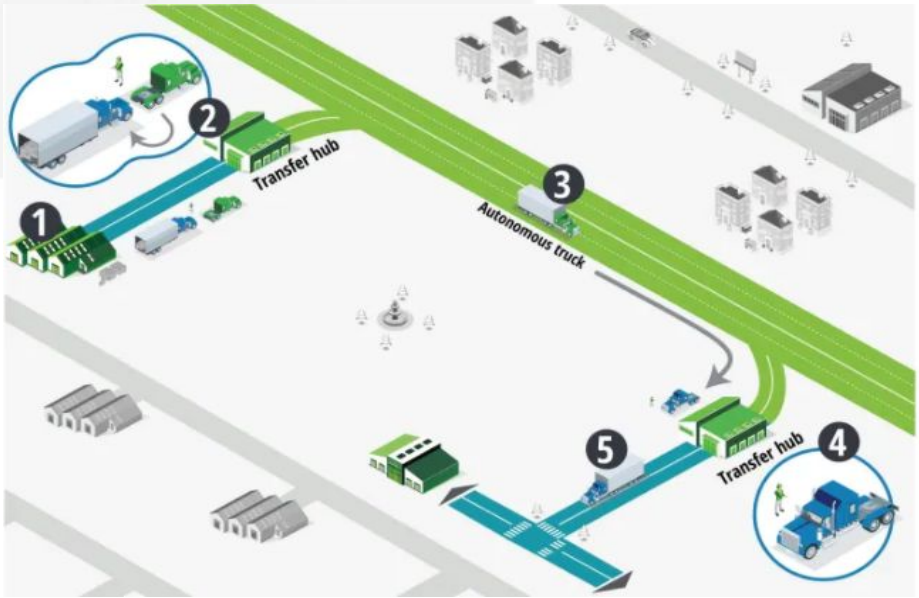
[2] https://peloton-tech.com/majority-of-us-freight-ton-miles-now-occur-in-platooning-approved-states/

Evolving Landscape of Autonomous Trucking

Industry has developed phased approach to reach ultimate goal of Point-to-Point model of autonomous trucking including more transitional models such as the Transfer Hub model [1]

Human-driven route Autonomous route

1. **Human** drives truck from distribution center to **transfer hub.**
2. **Human switches trailer** to autonomous power rig.
3. The **autonomous truck** exits transfer station, onto highway to drive highway portion of run.
4. The autonomous truck exits highway and pulls into **transfer hub** at final location. Trailer is switched to human operated power rig.
5. **Human** exits transfer hub and drives vehicle to end destination.

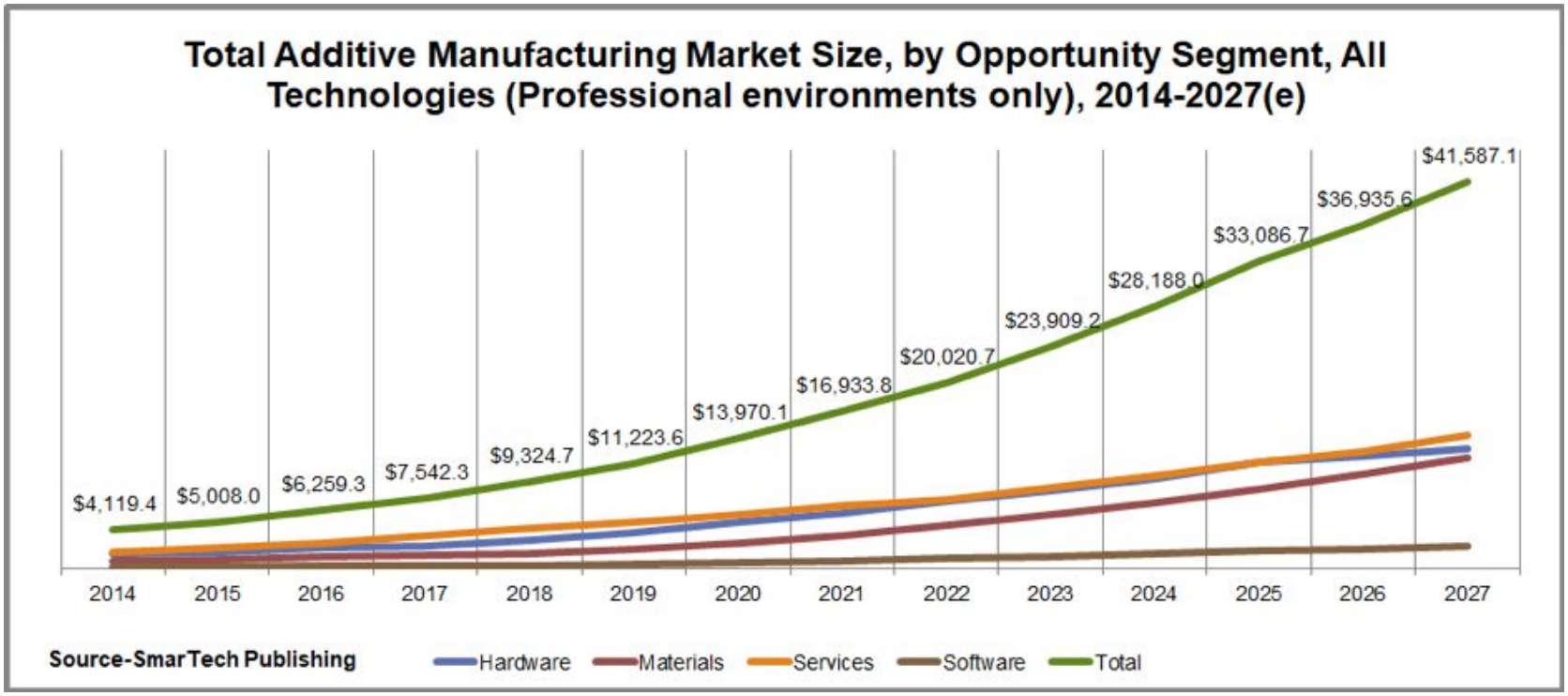


[1] https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/autonomous-trucks-lead-the-way.html/#endnote-12

Source: Deloitte Insights

Additive Manufacturing (3D printing)

Additive manufacturing industry was $7.3 billion worldwide in 2017, growing 17% over 2016, forecasted to grow at a compound annual rate of 15.2% in the five years through 2023 [1] [2]



[1] Wohlers Report 2018, Wohlers Associates, quoted in Forbes, 6/18.

[2] "3D Printing Market 2018", Wiseguy Reports, 9/18.

[3] https://www.mainepointe.com/practical-insights/five-ways-3d-printing-will-impact-the-global-supply-chain

Source: https://www.mainepointe.com/practical-insights/five-ways-3d-printing-will-impact-the-global-supply-chain

COVID-19 Impact on Freight & Logistics Trends

COVID-19 Impact on Portland's Economy

COVID-19 pandemic led to sharp drop of economy activity and further e-commerce-related job growth in delivery & warehousing jobs in Portland region.

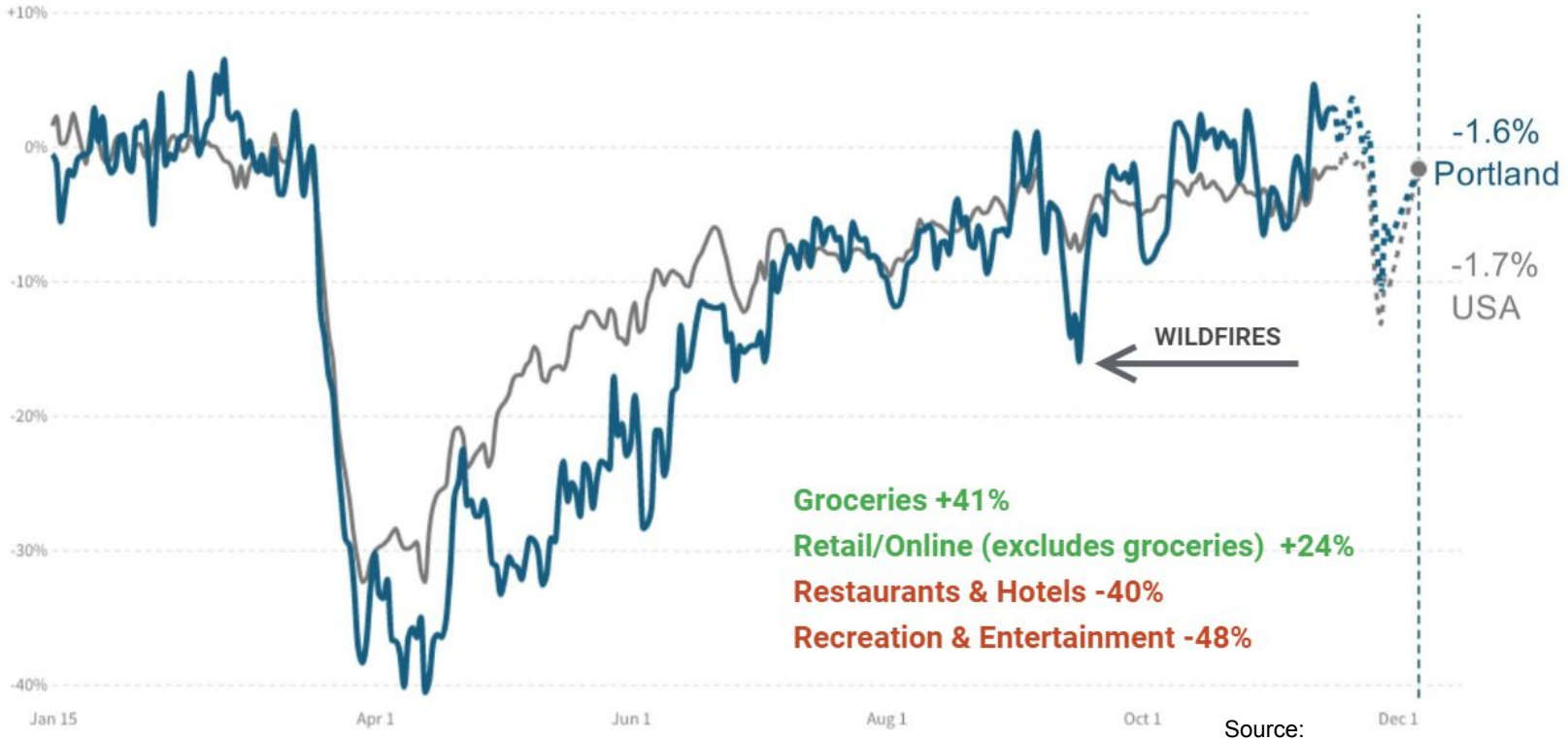
Job Sector	Job Changes between 2019–2020		% Change between 2019–2020	
	Statewide	Change	Portland Region	Change
Total Private Sector Employment	*-1,378,600*	-7.5%	*-96,800*	-9.2%
Truck Transportation	*-5,000*	-2.2%	*-4,800*	-3.7%
Couriers and Messengers	*+32,200*	20.3%	*+24,700*	21.3%
Warehouse & Storage Workers	*+60,600*	26.9%	*+49,000*	31.1%

[1] *Are Home Deliveries Increasing during the Pandemic*?, Update 4, Sorin Garber, 3/25/221

Source: *Are Home Deliveries Increasing during the Pandemic*?, Update 4, Sorin Garber 3/25/221

COVID-19 Impact on Portland's Economy cont.

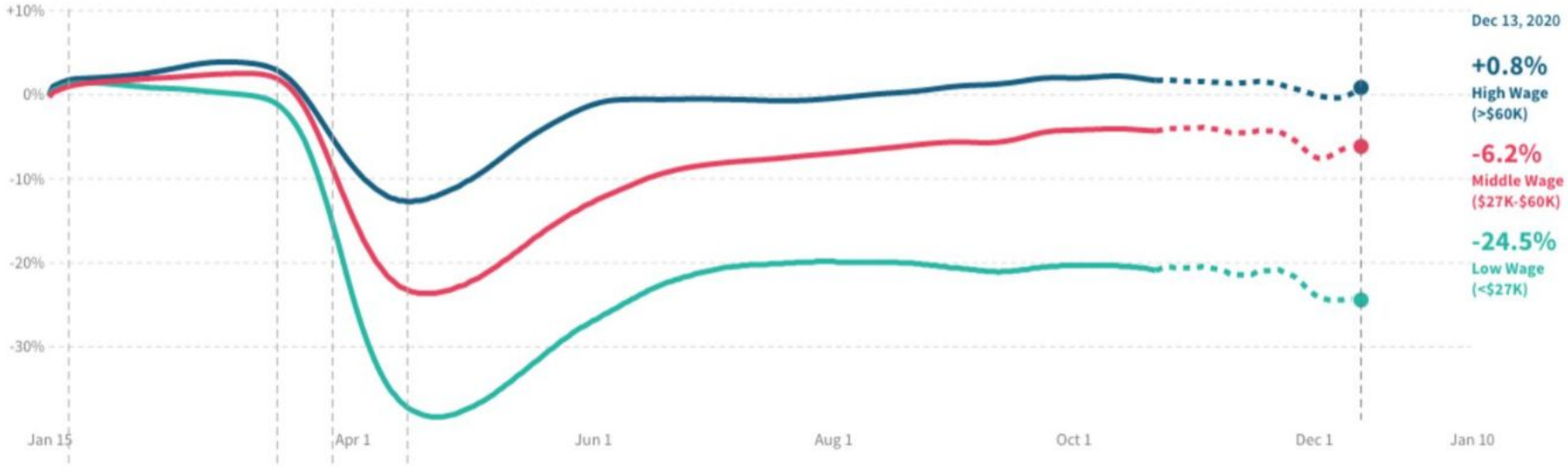
Total consumer spending in Portland relative to January 2020 shows a rebound in line with rest of U.S., though consumer purchase patterns have changed significantly, impacting hospitality and food service industries hardest



Source: https://portlandalliance.com/2021

COVID-19 Impact on Workforce Demographics in Oregon

COVID-19 has led to 33% more women exiting the labor force than men in Portland region, with low-income workers losing jobs at significantly higher rates [1]



Oregon Unemployment Rate:

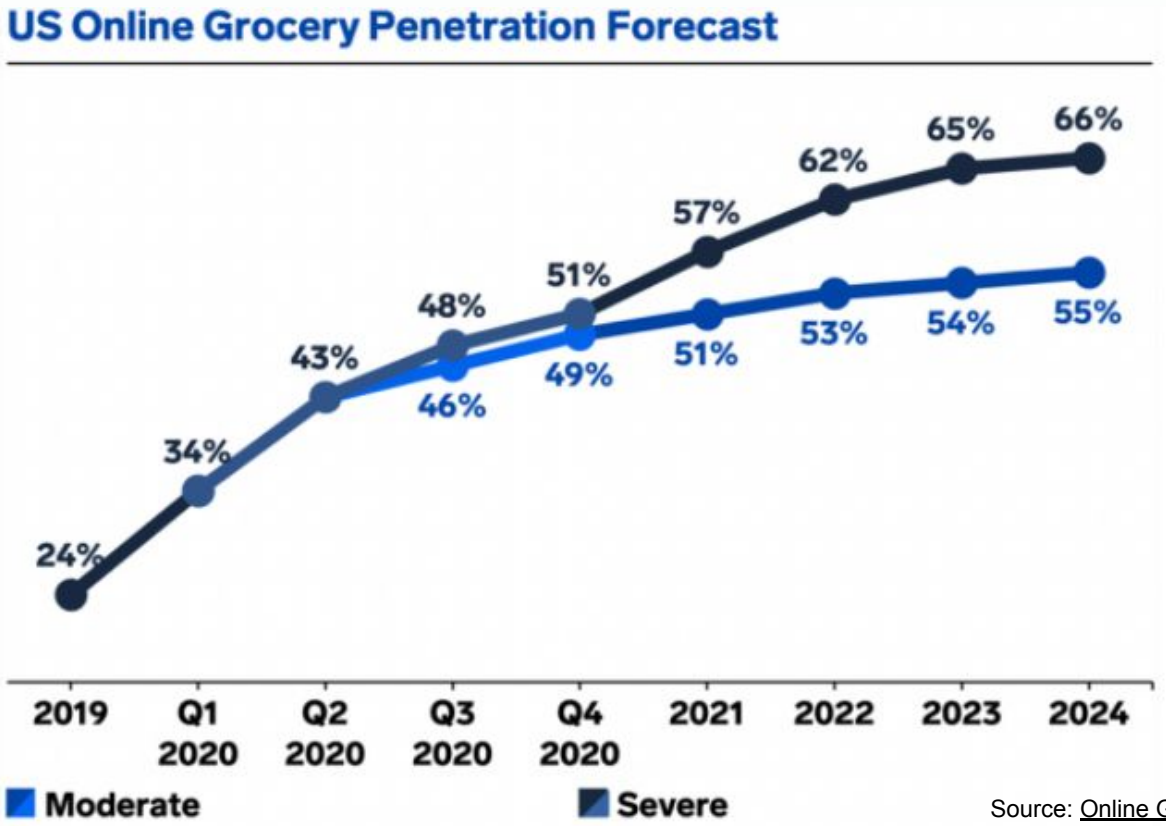
5.9% MEN vs. 7.9% WOMEN

Source: BLS, Oregon Employment Department, Opportunity Insights

[1] https://portlandalliance.com/2021

Growth of On-Demand Delivery Services

E-commerce growth and COVID-19 impact push on-demand delivery economy to estimated $435 billion market share globally in 2021 ($213 billion in 2017), with an annual growth rate of 49% [1]



Source: Online Grocery Industry Report: Market Stats in 2021 (businessinsider.com)

[1] On-demand delivery in 2021: Top trends and predictions (yelowsoft.com)

COVID-19 Impact on E-Commerce on Supply Chain Strategy

- Expanded US e-commerce share of total retail market **to 21.3% (5.5% increase)** [1], with **44% total YoY increase in sales** [1]
- **Significant growth in on-demand delivery**
- Accelerated **automation efforts across warehouses and last-mile delivery options**
- Private sector supply chain modifications: **production and supplier location diversification, nearshoring, increased on-hand inventory,**
  - **Information technology and cybersecurity risk mitigation**
  - Federal demand for **increase of U.S.-based manufacturing capacity** [2]

National-scale COVID-19 impacts had widespread effect on Portland's local e-commerce and supply chain strategies throughout pandemic.

[1] https://www.digitalcommerce360.com/article/us-ecommerce-sales/
[2] *The COVID-19 Pandemic and North Jersey Freight Report*, March 2021