October 26, 2022

Bay Area Supply Chain Resilience Seminar Series

Supply Chain Fundamentals Part 2: Bay Area Supply Chains

http://www.bayareauasi.org/sites/default/files/resources/Bay%20Area%20UASI%20FY2019-2019%20Annual%20Report%20Website.pdf

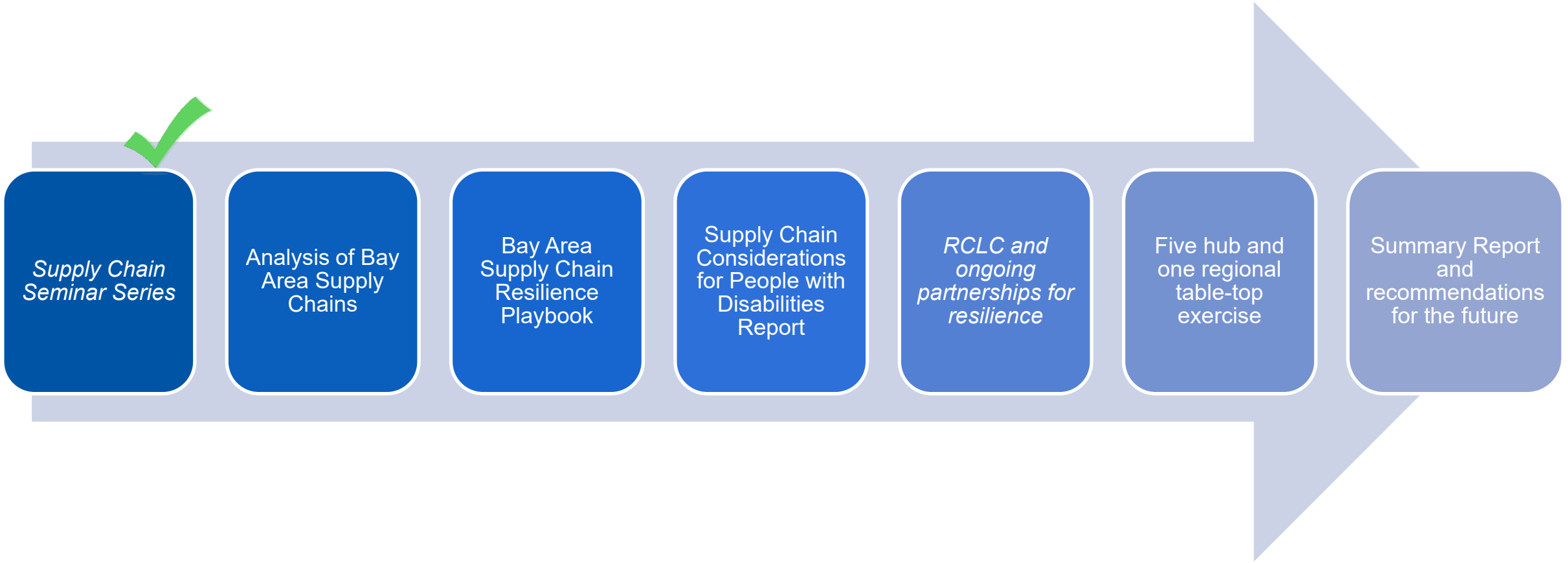
Agenda

- Welcome and Introductions
- What is the Bay Area RCPGP Supply Chain Resilience Grant
- Module I: Structural Challenges of Bay Area Supply Chains
- Discussion I
- Module II: Bay Area Commodity Flows
- Discussion II
- Wrap-Up and Next Steps

Regional Catastrophic Preparedness Grant Program (RCPGP)

- The purpose of the Bay Area's RCPGP Supply Chain Resilience project is to:
  - Improve public/private partnership coordination capabilities for disaster response by enabling the private sector to reconstitute supply chains as rapidly as possible following a disaster.
  - Reduce the impacts of supply chain disruptions on vulnerable populations through the development of guidance and materials to support critical path decision-making and awareness of how people with disabilities in the Bay Area access groceries and food.

What will the Bay Area RCPGP Supply Chain Resilience Grant Produce



Welcome & Introductions

Introduce Yourself <u>in the Chat</u>:

- Name and Jurisdiction/Agency (Organization)

Discussion Logistics

- Please ensure you're muted during the presentation
  - *6 to mute/unmute if calling in
- During Q&A, please raise your hand to ask a question
  - *9 to raise and lower hand if calling in

Module I: Structural Challenges of Bay Area Supply Chains

- Quick Review
  - What are Supply Chains?
  - Demand Pulls / Supply Pushes
  - High-volume, high-velocity capacity
  - Consideration of Big Local Bottlenecks
- Bay Area Flows, Bottlenecks, and Chokepoints
  - Food
  - Fuel
  - Freight
- “Facilitation” Role in Emergency Management

Quick Review then Big Bottlenecks

For about the next fifteen minutes, we will review some **supply chain basics** to which we gave much more time on October 12. Then I will answer questions for about ten minutes.

Then we will take another fifteen minutes to tee-up some **big local bottlenecks** for your consideration, followed by another ten minutes for questions and answers.

Quick Review then Big Bottlenecks

Quick Review

- What are Supply Chains?
- Demand Pulls / Supply Pushes
- High-volume, high-velocity capacity
- Consideration of Big Local Bottlenecks

Bay Area Flows, Bottlenecks, and Potential Chokepoints

- Food
- Fuel
- Freight

"Facilitation" Role in Emergency Management

What are supply chains?

Supply chains are **complex adaptive systems** that target how, when, and where to source and push supply in response to prior, anticipated, and sometimes current pull (demand).

Supply chains involve **logistics** – how to move volume from here to there – but are much more focused on demand dynamics than 5000-plus years of traditional logistics.

Supply Chain Management tries to **calibrate upstream sourcing, midstream movement, and downstream consumption** so that continuous **flow** is as cost-efficient and operationally effective as possible in fulfilling demand and achieving objectives.

Supply Chain Resilience is an emerging practice for **facilitating continuous flow of essential goods and services** (e.g., water, food, fuel, pharmaceuticals, and other critical freight) under severe duress.

Demand Pull and Supply Push

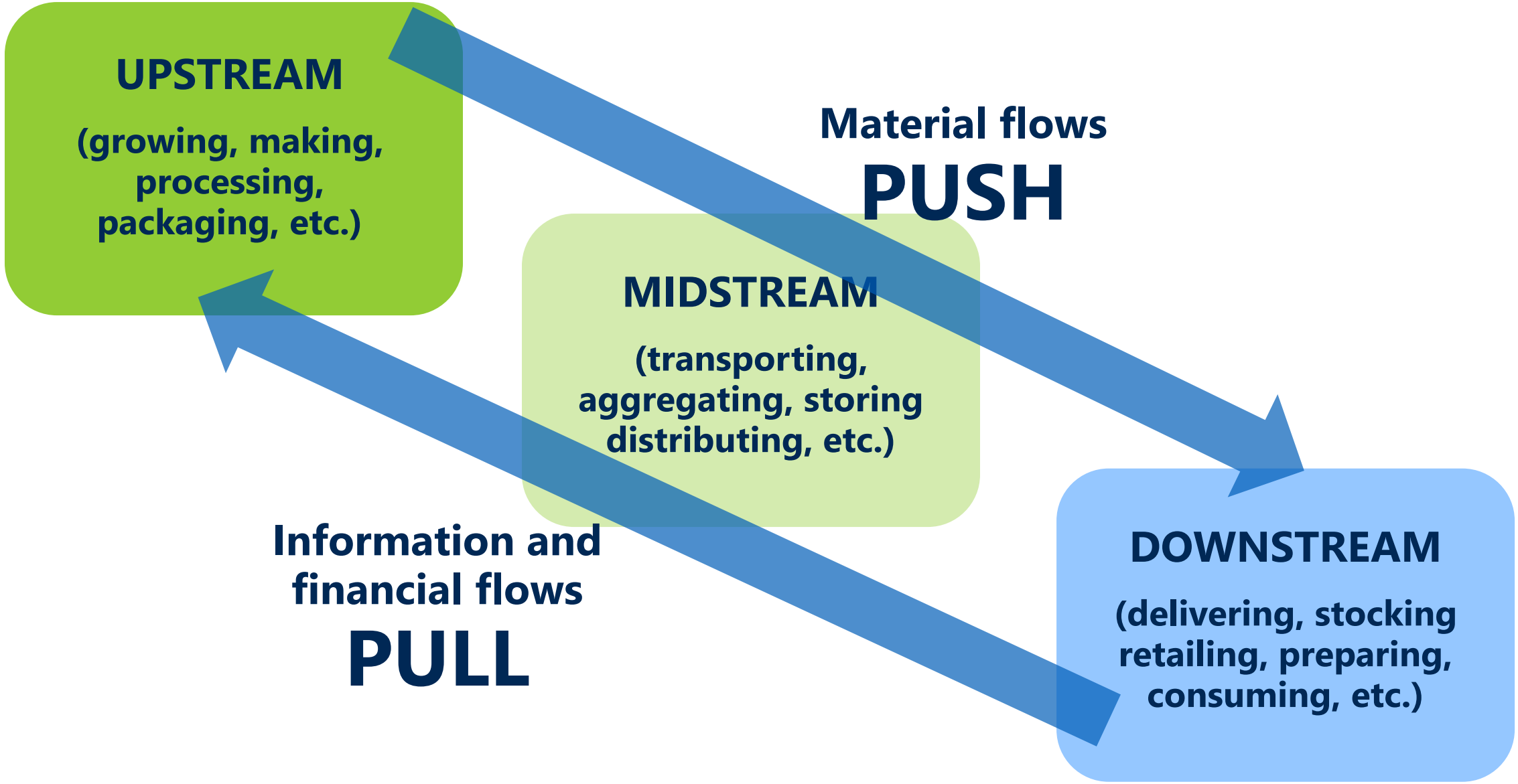
Demand pulls supply

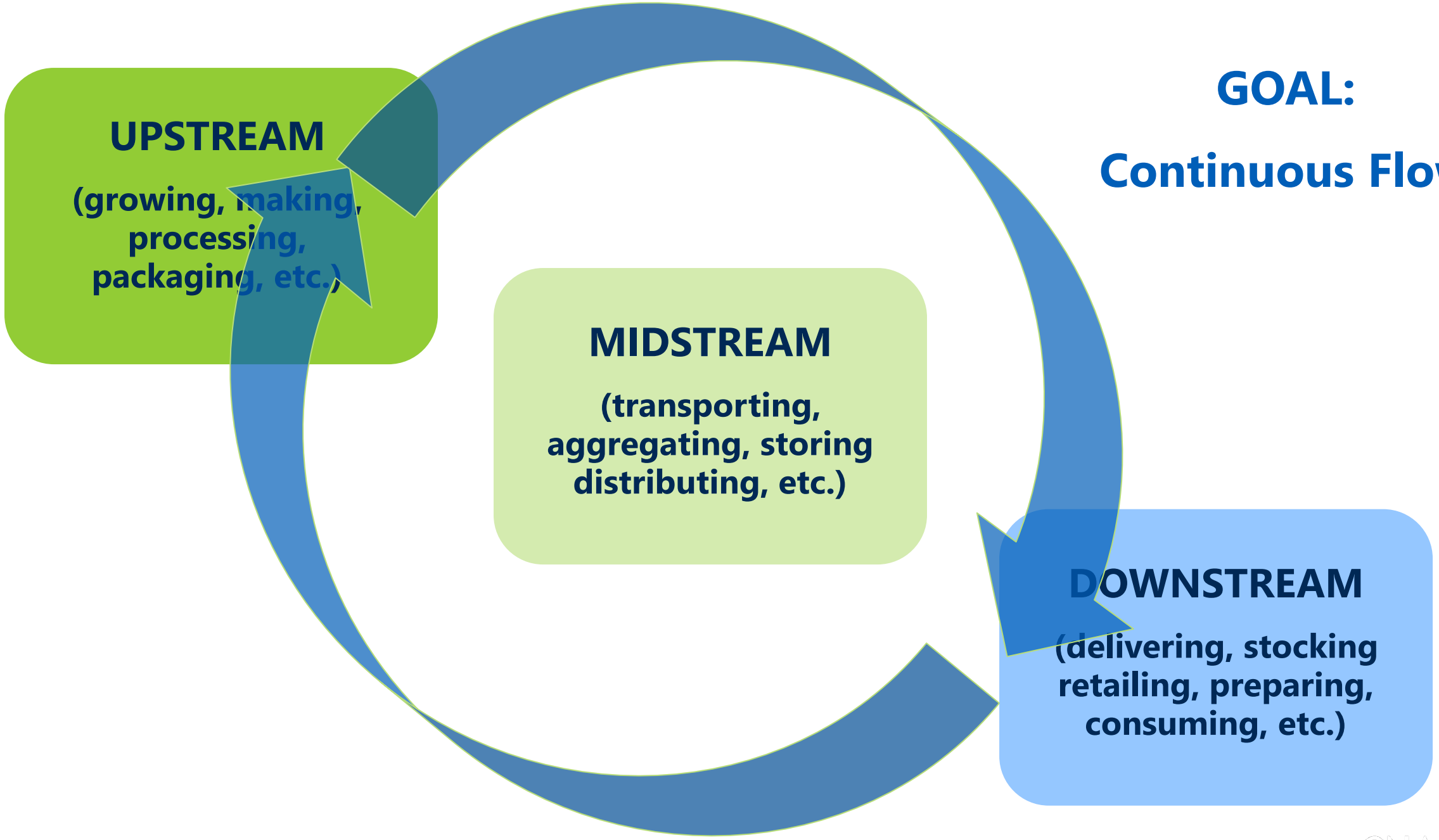
- High vs. low velocity demand (e.g., shopping trips)
- Higher vs. lower marginal demand (e.g., basket size/price sensitivity)
- Dense vs. scattered demand (especially wealth density)

Demand is mostly signaled with credit cards, debit cards, EBT cards, or cash (for food, fuel, and most freight)

Supply pushes toward demand

- Trucks operating from nodes with aggregated stock (food)
- Pipelines (water and fuel) pump from nodes with storage
- More diverse transportation modes the more distant from demand


UPSTREAM
(growing, making, processing, packaging, etc.)
Material flows
PUSH
MIDSTREAM
(transporting, aggregating, storing distributing, etc.)
Information and financial flows
PULL
DOWNSTREAM
(delivering, stocking retailing, preparing, consuming, etc.)



GOAL:

Continuous Flow

(In)flexible Capacity

1.33 million cases distributed through Government: FEMA, ARC, DLA

<u>One</u> grocery supplier surged up to 24 million cases

Superstorm Sandy Case Study
FEMA Office of Policy, Program Analysis, and International Affairs
(Palin, 2012)

(In)flexible Capacity

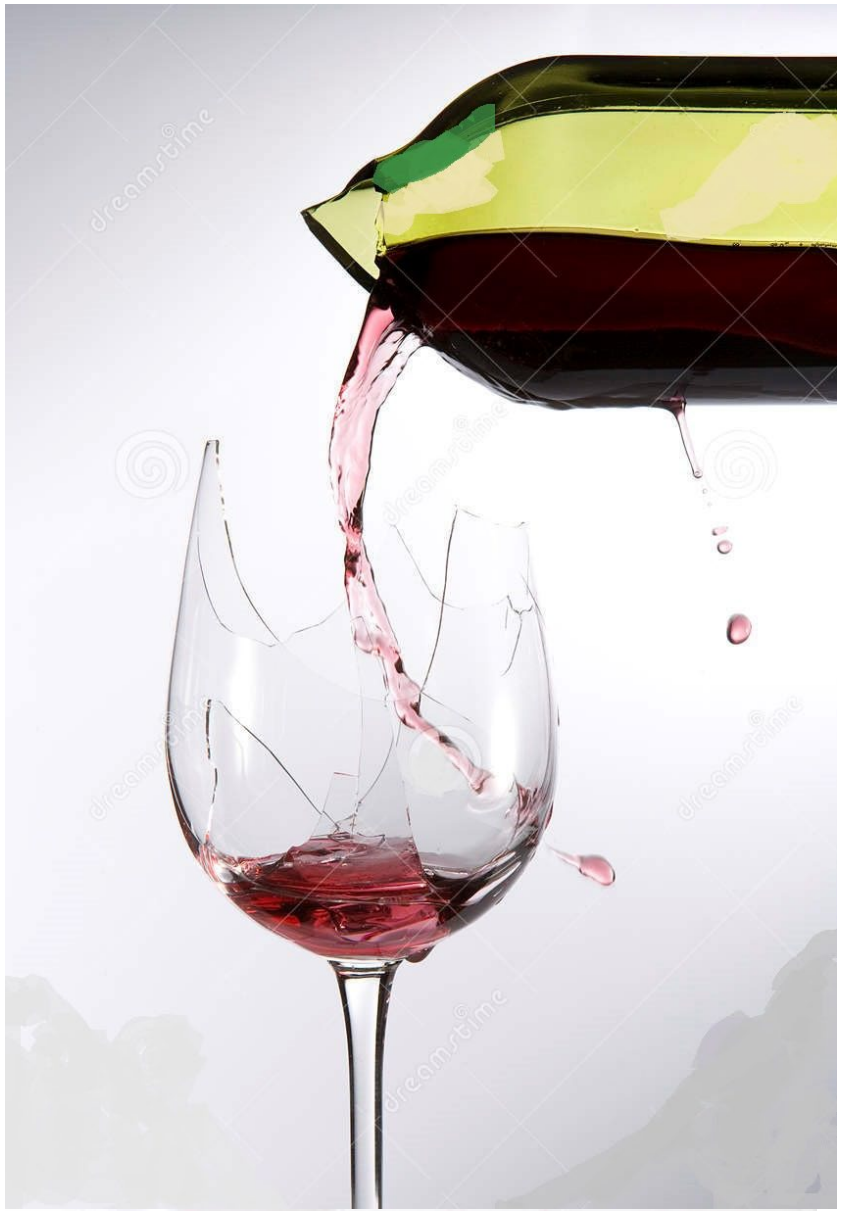
Total private sector capacity was more than 50 times public sector capacity

The bottleneck (is) the point in a supply chain that limits its flow (or, more formally, the stage in the system with the highest utilization).

Strengthening Post-Hurricane Supply Chain Resilience

National Academies of Sciences, Engineering, and Medicine (2020)

Bottlenecks become Chokepoints



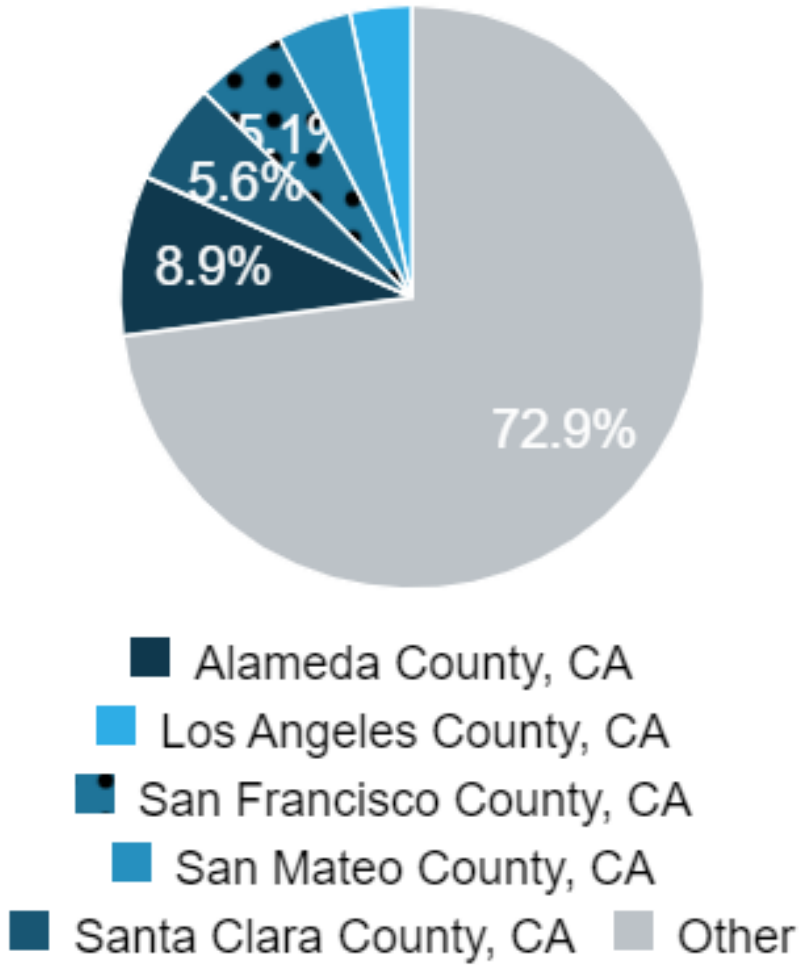
Capacity Concentrations

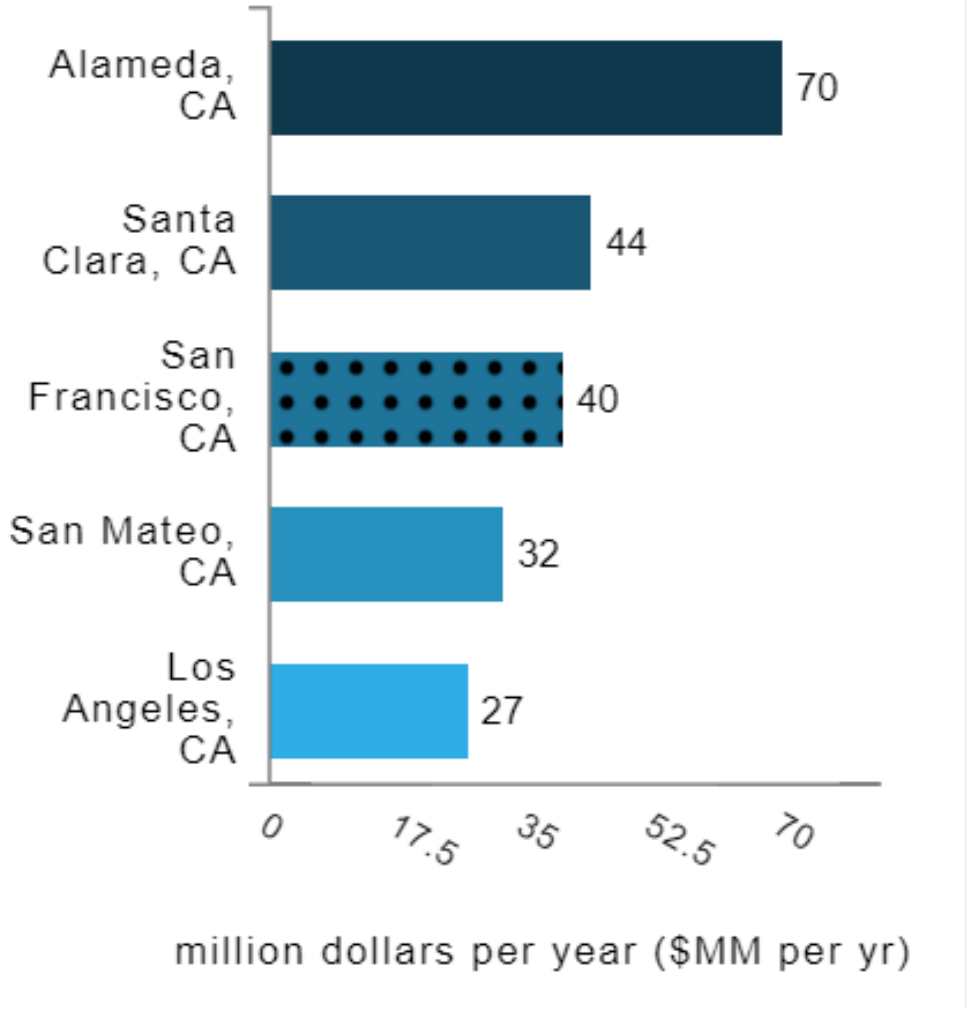
Grocery sales are dynamic and highly competitive. Precise data on grocery flows are difficult to generate. But both published sources and private conversations indicate the following proportions to be roughly accurate for the broad San Francisco Bay area.

- Albertsons (Safeway): 24 to 26 percent of grocery flows
- Super Store Industries: 21 to 23 percent
- C&S Wholesale Grocers: 11 to 13 percent
- UNFI (Supervalu): 11 to 13 percent
- Walmart: 10 to 12 percent

For a total of **77 to 87 percent of total supply** (by value) depending on only five crucial players.

Direct Flows of Food and Beverage into San Francisco County by Dollar Value





Ruddell, B.L., Miller, J., Rushforth, R.R., Salla, R., Soktoeva, E., and Gorantla, R. (2021), 'FEW-View™ 1.3, the FEWSION™ Visualization System', https://fewsion.us / https://fewsion.dtn.asu.edu, 04 October, 2021.

Direct Flows of Food and Beverage into San Francisco County by Dollar Value

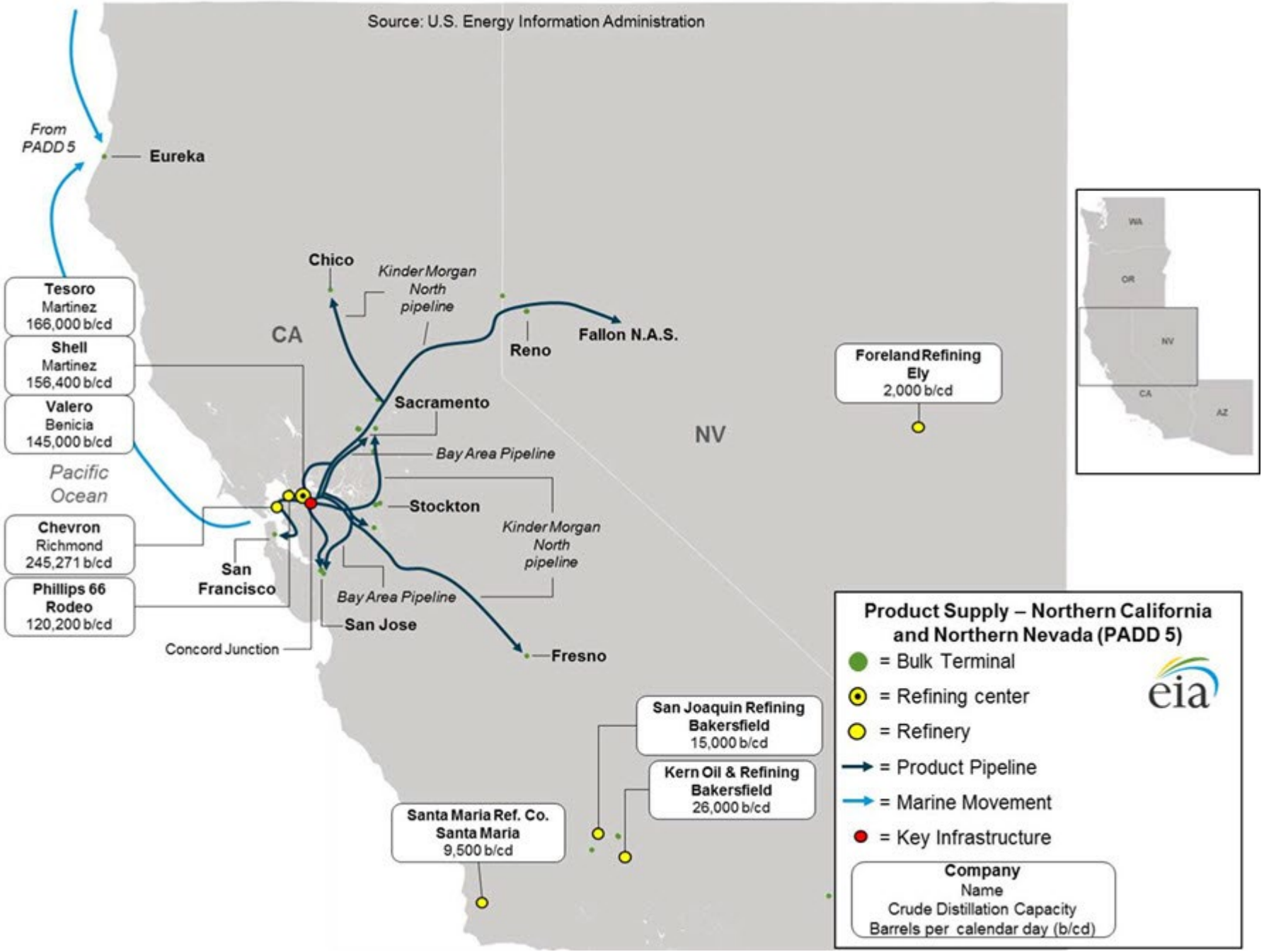
Green Arrows = Top Twenty Flows **Gray Counties = Any direct flows**

(In)flexible Capacity

Bottlenecks become Chokepoints

Oakland-Bay Bridge AADTT:6526

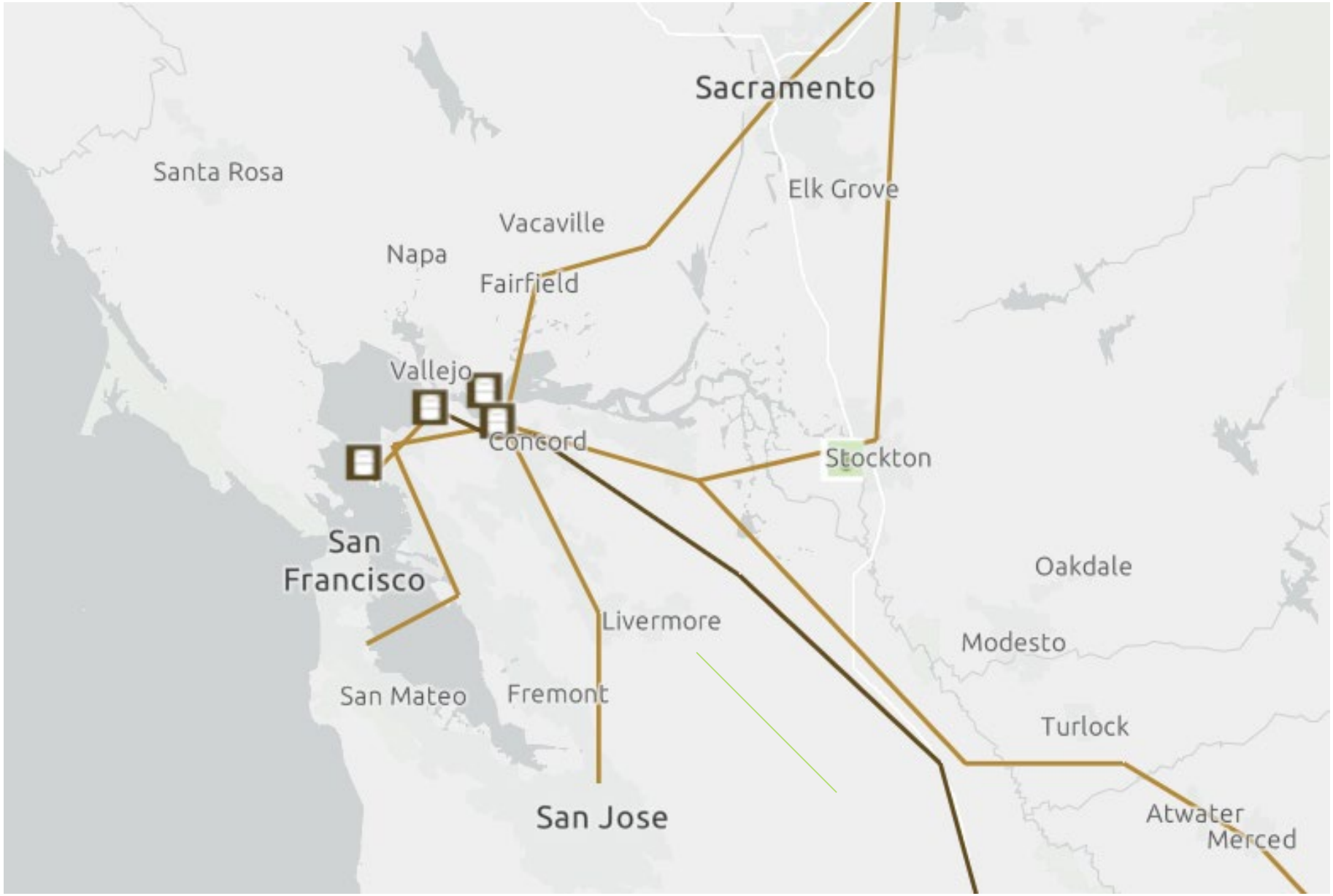
San Mateo-Hayward Bridge
AADTT:6370


Source: U.S. Energy Information Administration
From PADD 5
Eureka
Tesoro
Martinez
166,000 b/cd
Shell
Martinez
156,400 b/cd
Valero
Benicia
145,000 b/cd
Pacific Ocean
Chevron
Richmond
245,271 b/cd
Phillips 66
Rodeo
120,200 b/cd
San Francisco
Concord Junction
Chico
Kinder Morgan North pipeline
CA
Reno
Fallon N.A.S.
Sacramento
Bay Area Pipeline
Stockton
Kinder Morgan North pipeline
Bay Area Pipeline
San Jose
Fresno
NV
Foreland Refining
Ely
2,000 b/cd
San Joaquin Refining
Bakersfield
15,000 b/cd
Kern Oil & Refining
Bakersfield
26,000 b/cd
Santa Maria Ref. Co.
Santa Maria
9,500 b/cd
WA
OR
NV
CA
AZ
Product Supply – Northern California and Northern Nevada (PADD 5)
= Bulk Terminal
= Refining center
= Refinery
= Product Pipeline
= Marine Movement
= Key Infrastructure
eia
Company
Name
Crude Distillation Capacity
Barrels per calendar day (b/cd)

Petroleum Refineries

Crude Oil Pipeline

Petroleum Product Pipeline

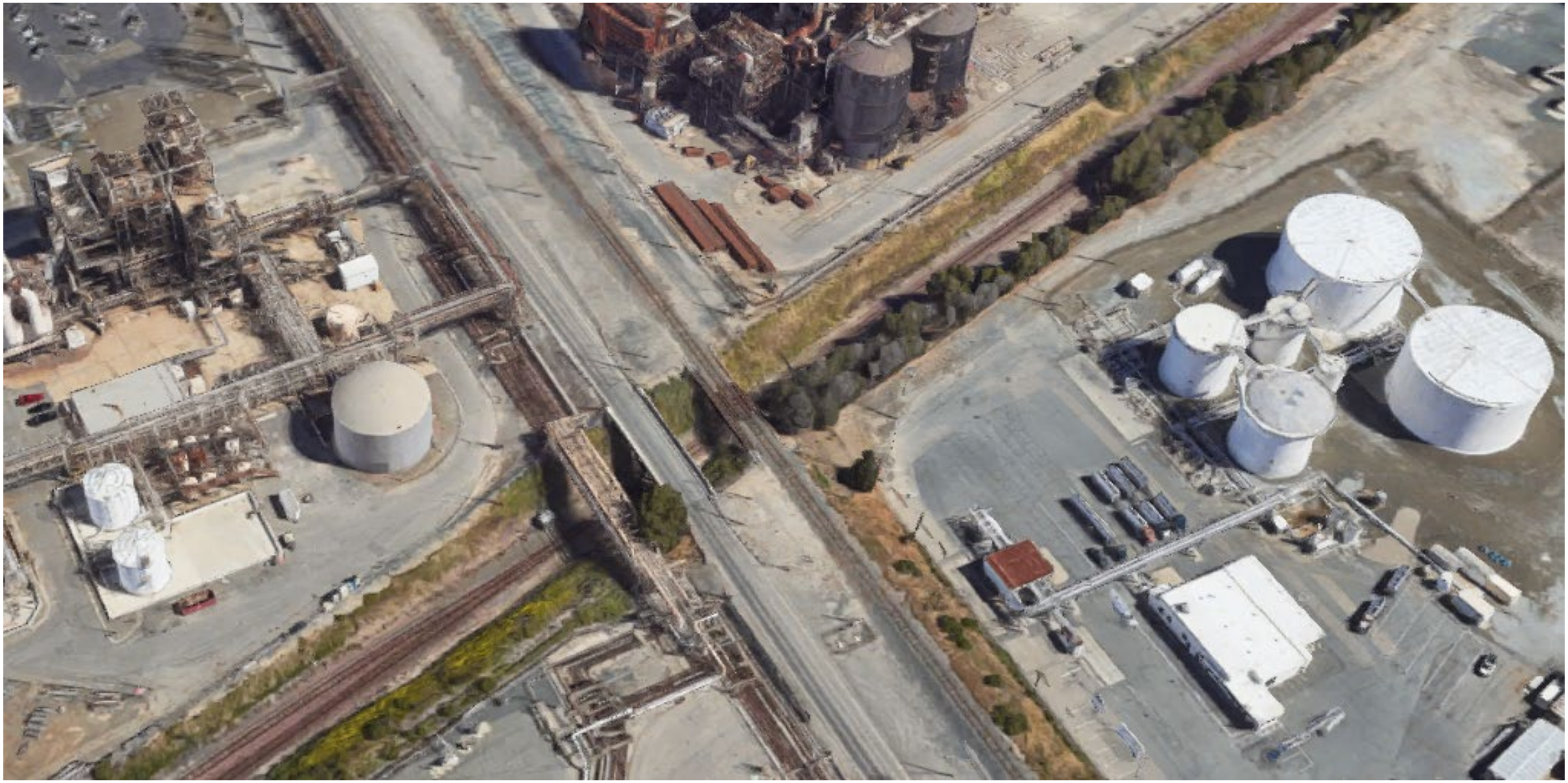


Energy Information Administration

Valero Refining Company, 3410 East Second Street Benicia CA 94510

Marathon Oil Company, 2899 Waterfront Rd, Martinez, CA 94553

Martinez Refinery Terminal,1801 Marina Vista Ave Martinez CA 94553



Chevron, 611 Solano Way, Martinez, CA 94553

Conoco-Phillips1300 Canal Blvd, Richmond, CA 94804

Conoco-Phillips1300 Canal Blvd, Richmond, CA 94804

Chevron USA Incorporated - Banta 22888 S. Kasson Road Tracy CA 95376

Chevron USA Incorporated - Banta 22888 S. Kasson Road Tracy CA 95376

Emergency Management roles in supply chain resilience

Pinch-Hitter

Replace flows
MREs
Bottled Water
Feeding Centers
CPODs
Cross-docks
Trucking

Sometimes competes with existing flow

Informer

Roads Open
Grid Status
Telecom Status
Fuel Status
Demand Dynamics

Big Picture

Gap-Filler

Using supply chain informed targeting:

Supplement flows
MREs
Bottled Water
Feeding Centers
CPODs
Cross-docks
Trucking
Fuel

Facilitator

Prioritizing
Debris Removal
Grid Recovery
Fuel Access
More Time
More Weight
Staging/Drop-and-go spaces
Generators
Deconfliction
Demand Signals

Disruptor

Close Routes
Close Rest Areas
Delay
Neglect
Confuse
Mislead
Compete
Delay
Delay
Delay

Module I: Discussion

- Raise your hand to ask a question

  - *9 to raise and lower hand on the phone

Module II Goals

Understand (at a high-level):

- The **scale** of the food and water needs for the population of the Bay Area
- The scale of major food and water **flows** into the area, and where they come from (food)/how they are sourced (surface water vs groundwater)
- How data can illustrate concentrations of demand, freight activity, and flow

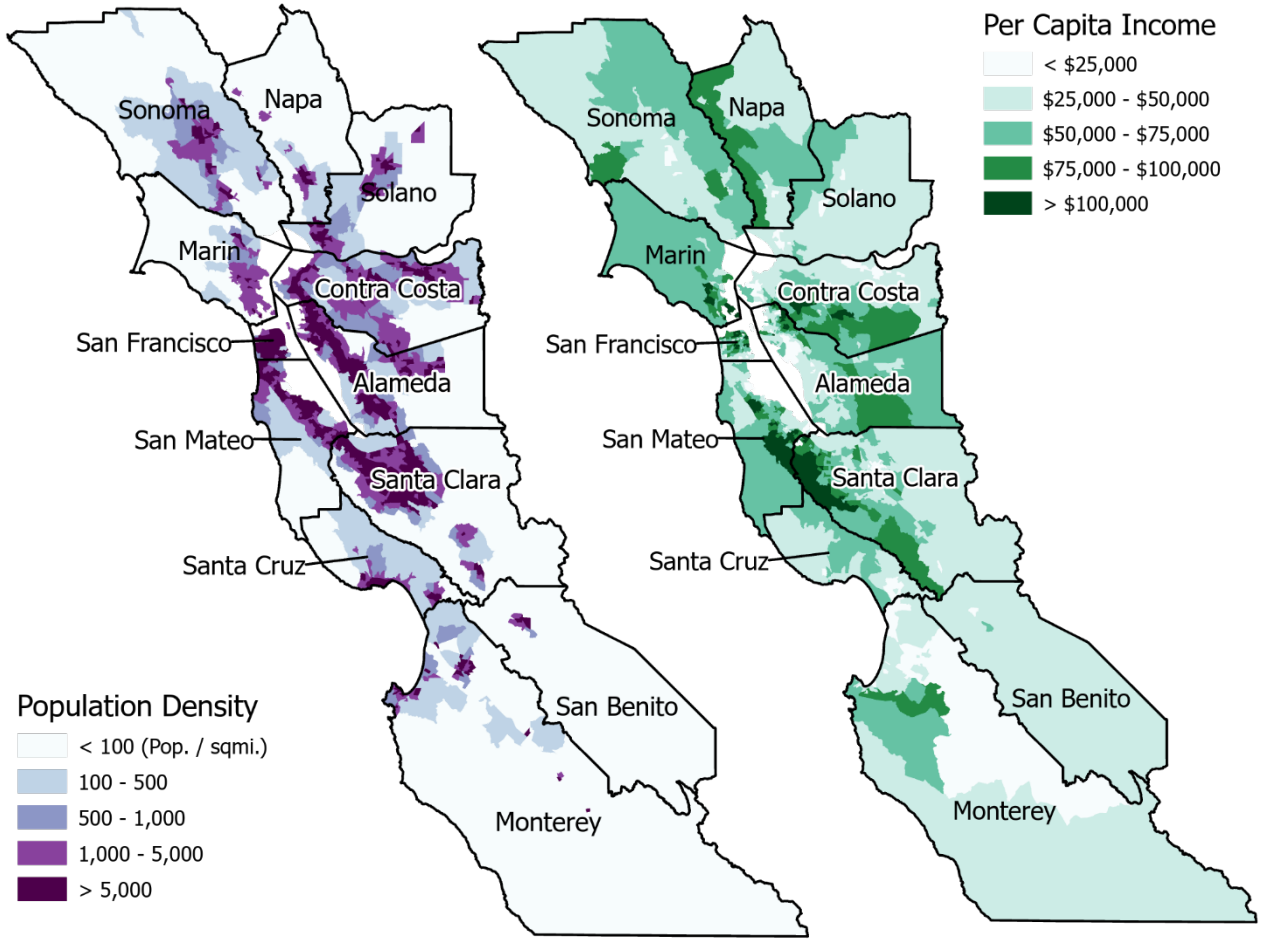
Looking ahead to next steps:

- Detailed investigation of food (grocery) supply chain (Seminar 3)
- Detailed investigation of public water supply systems (Seminar 4)
- Presentation of validated summaries of food and water to this group: Seminar 6

Population – Pulls on the Supply Chain

- **Start at the end** – Supply chains (and community lifelines) are ultimately driven by the needs of people, which establishes the "pull" on commodities.
- Estimated population: ~8.6M
- Population (density) **pulls**
- Wealth **pulls**

- Push capacity orients itself to meet demand pull.
  - Flow **concentrates** most *between* dense concentrations of push and pull



Estimating Total Food Demand (and Freight) for Basic Needs

A. Estimate Population — 8.6 M

B. Weight of food consumed per person per day — 5.03 lbs[a]

C. Estimated food waste rate — 40 %

D. Loaded weight per truck trailer — 44,000 lbs[b]

E. Pallets per truck — 26[c]

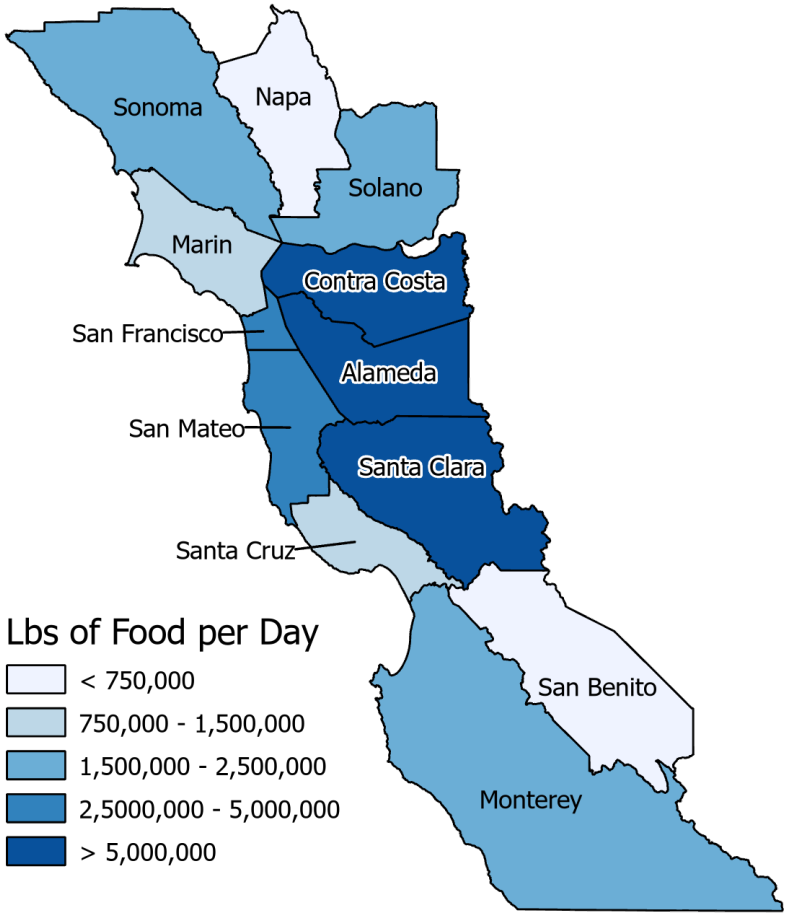
(A x B)/(1-C)= **72 M lbs/d** (~36 ktons/d)

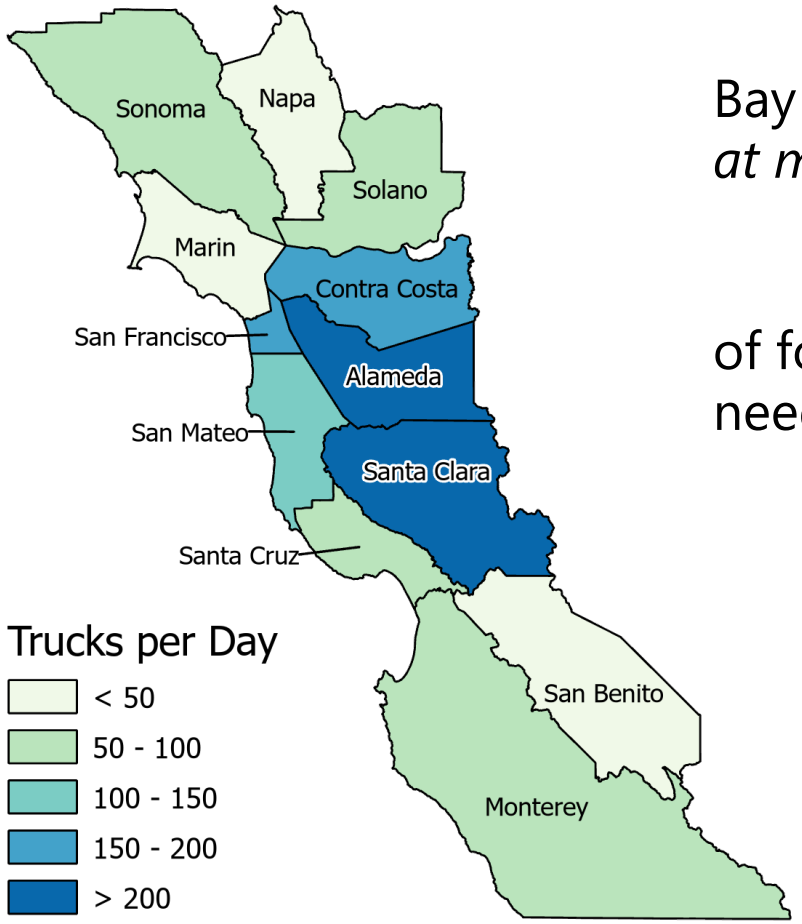
/D = **~1,650** trucks/d

***E =** **~42,000** pallets/d

[a]USDA Thrifty Food Plan - https://www.fns.usda.gov/sites/default/files/resource-files/TFP2021.pdf
[b]https://www.freightwaves.com/news/how-much-weight-can-a-big-rig-carry
[c]https://www.xtl.com/portal/much-freight-fits-full-truckload/

Food Demand for Basic Needs





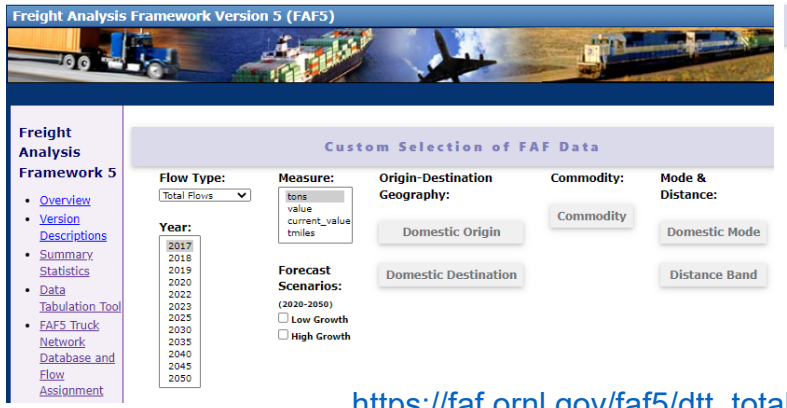
Bay Area UASI counties require *at minimum*:

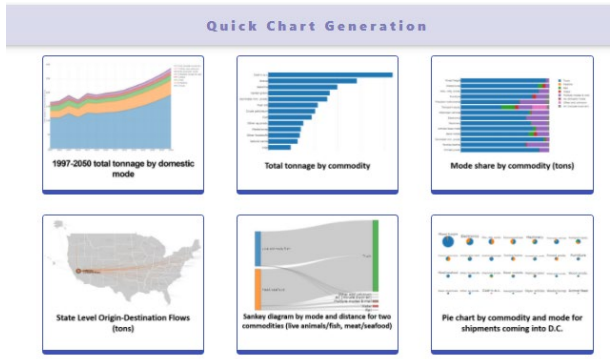
- **72 million pounds (36 ktons)**
- **1,650 truck trips**

of food every day to meet basic needs of the area's population

But how much food actually moves through the area?

Some tools for measuring freight flow

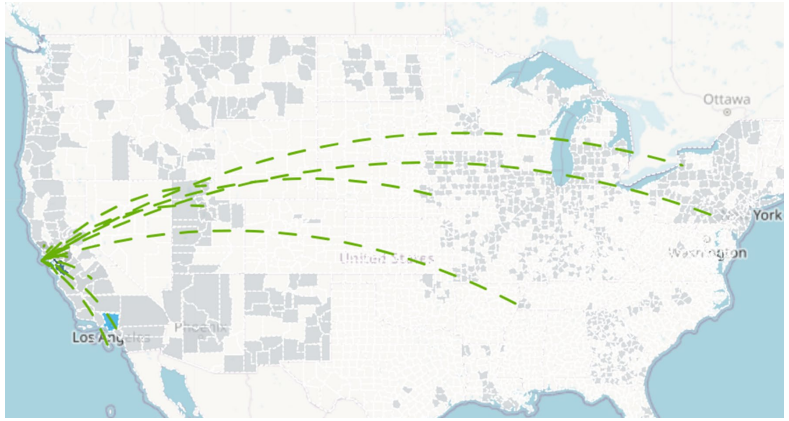




https://faf.ornl.gov/faf5/dtt_total.aspx

- Freight Analysis Framework (FAF) is an origin-destination flow tool based on survey data from the Commodity Flow Survey.
  - Geographies: State or "FAF Zones" (MSAs+ Rest of state areas)
  - Flow types: Total, Import, Export, Domestic
  - Units: Volume (tons), $ value, ton-miles
  - Commodities: Standard Classification of Transported Goods (SCTG)
  - Modes: Truck, Rail, Air, Ship, Pipeline, Multi-mode.
  - Data vintage: 2017 base year+ projections (1 and 5-year)
  - Usability: Exportable, native visualization

Source: ORNL/FHWA/BTS, *Freight Analysis Framework v5 (2021)*



FEWSION – FEW-View v1.3

- Geographies: County or state-level flows
- Units: $ value or tonnage (+ some analytics)
- Commodities: SCTG + water usage
- Modes: Not available
- Data vintage: 2010-2012
- Usability: Data not easily exportable

Source: FEWSION (Ruddell et al., 2021), https://fewsion.dtn.asu.edu/app/public?scenario_id=1

Food Flows to and within the Bay Area

- Freight Analysis Framework (FAF) allows examining the following food commodities:

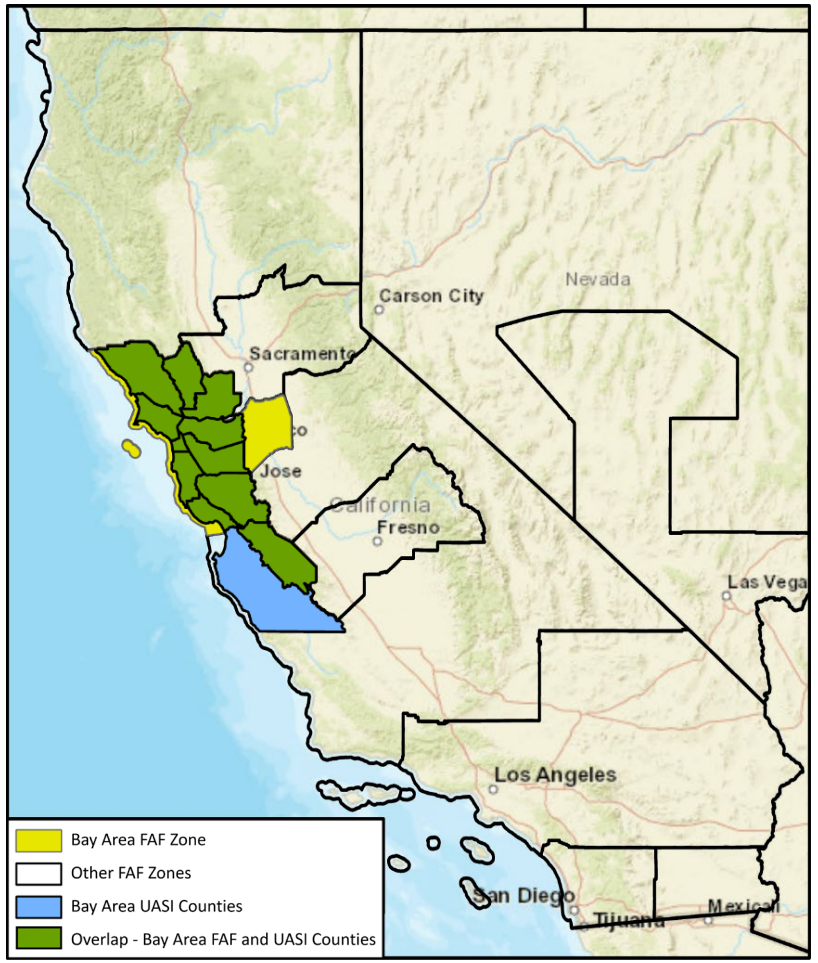
SCTG Commodity Code		Type
01-Live animals/fish		
02-Cereal grains		
03-Other ag prods.	*Includes produce*	
04-Animal feed		
05-Meat/seafood		
06-Milled grain prods.		
07-Other foodstuffs	*Most finished grocery products*	
08-Alcoholic beverages		
09-Tobacco prods.		

Agricultural Products
Food, Beverage, Tobacco

Source: ORNL/FHWA, *Freight Analysis Framework v5*

SCTG – Standard Classification of Transported Goods

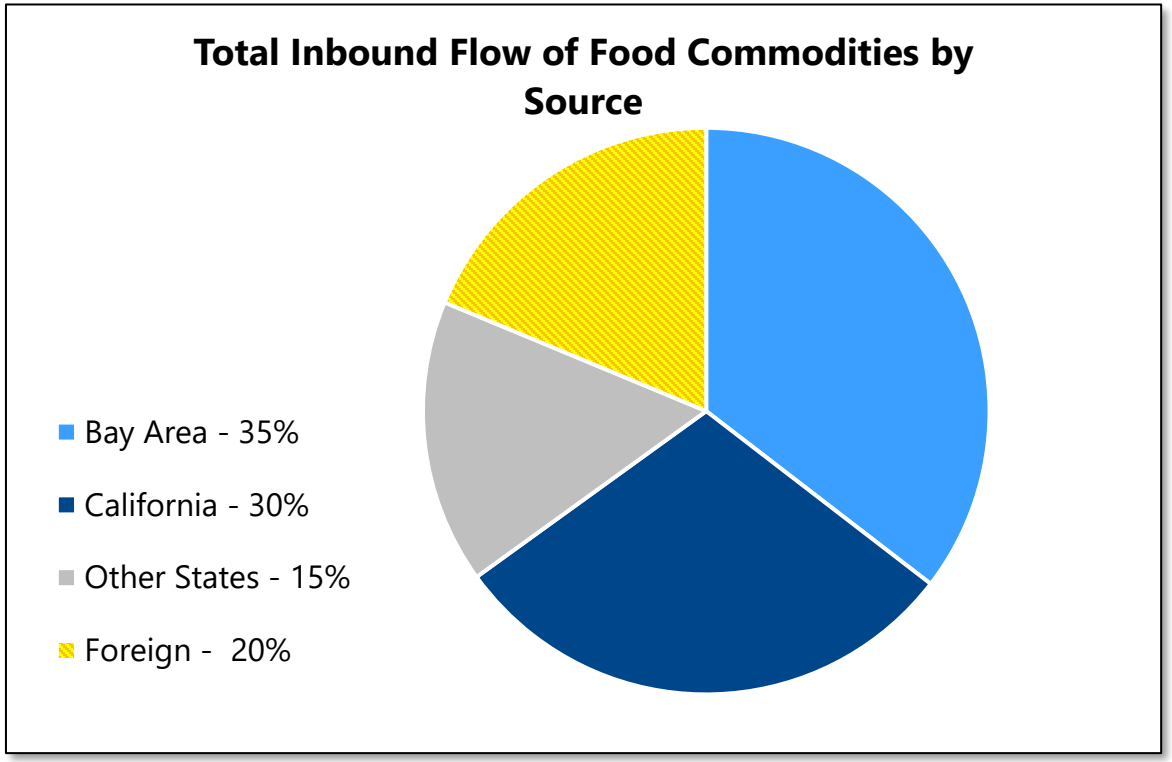
- Bay Area UASI Counties mostly (but not exactly) align with the FAF Bay Area Zone

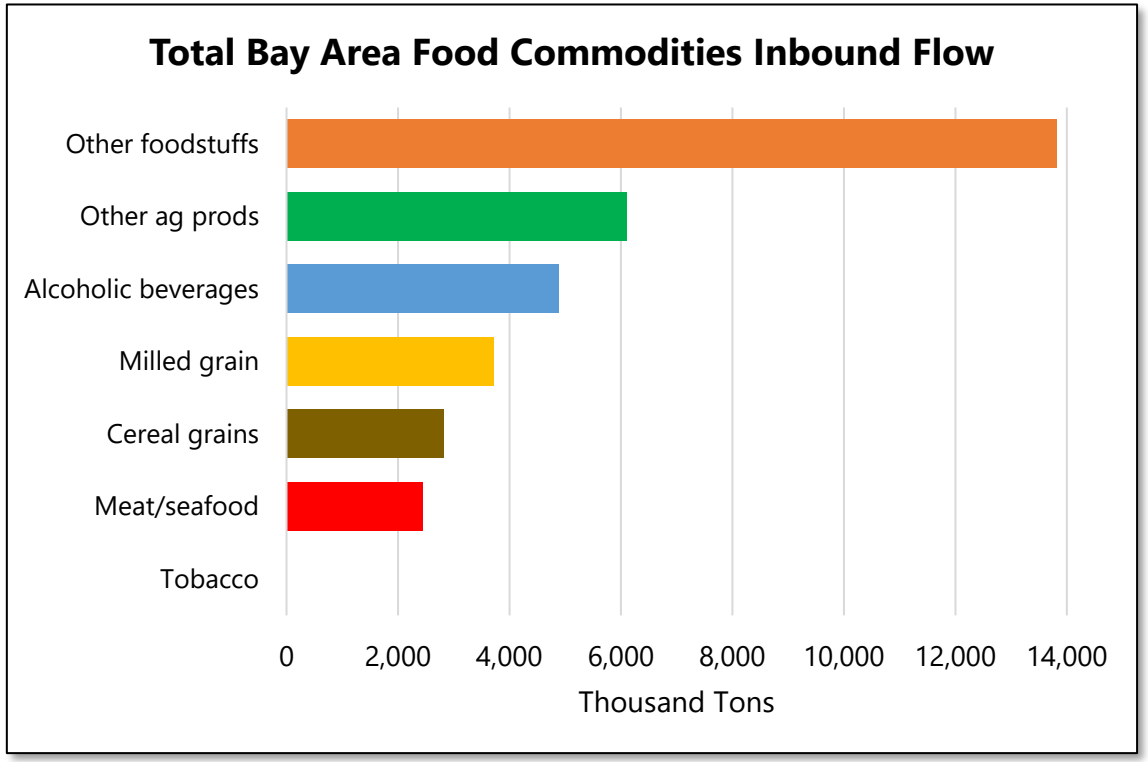


Food freight flow – Total Inbound Flows

Key questions: Where do flows that terminate in the Bay Area originate? What food commodities account for the greatest share of flow?

Key takeaways: >31,000 ktons per year of total food flows. ~2/3 originates within California. Other foodstuffs accounts for >40% of total, followed by Other ag products (produce), and Alcoholic beverages.

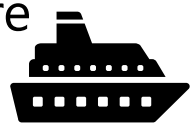




Source: ORNL/FHWA, *Freight Analysis Framework v5* (2017 conditions)

- ~80% of total by truck
- >90% of domestic flow by truck

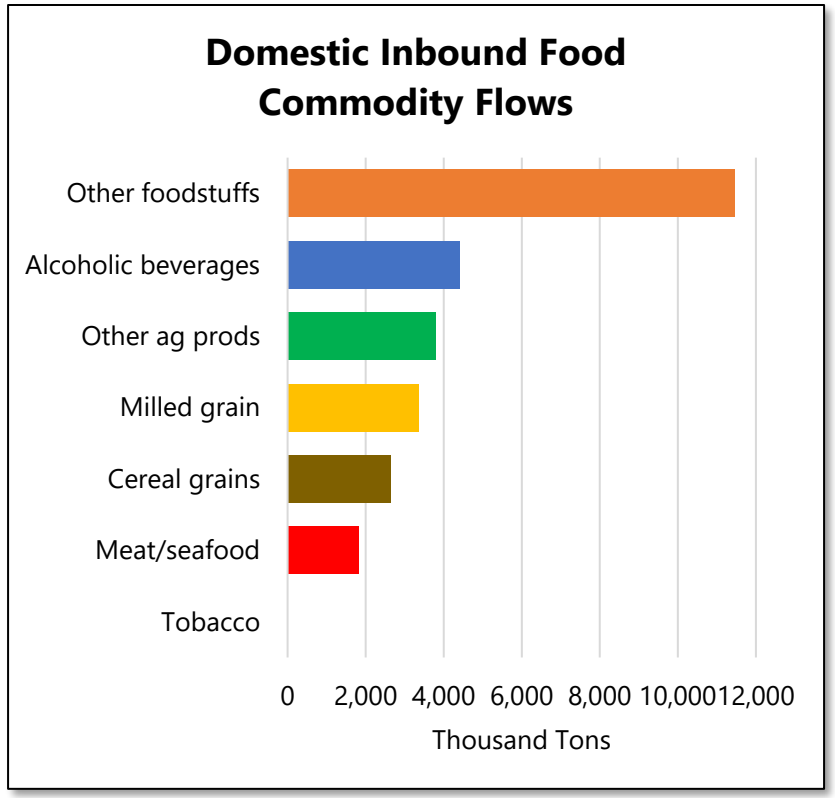
- >60% of foreign imports are transported by water

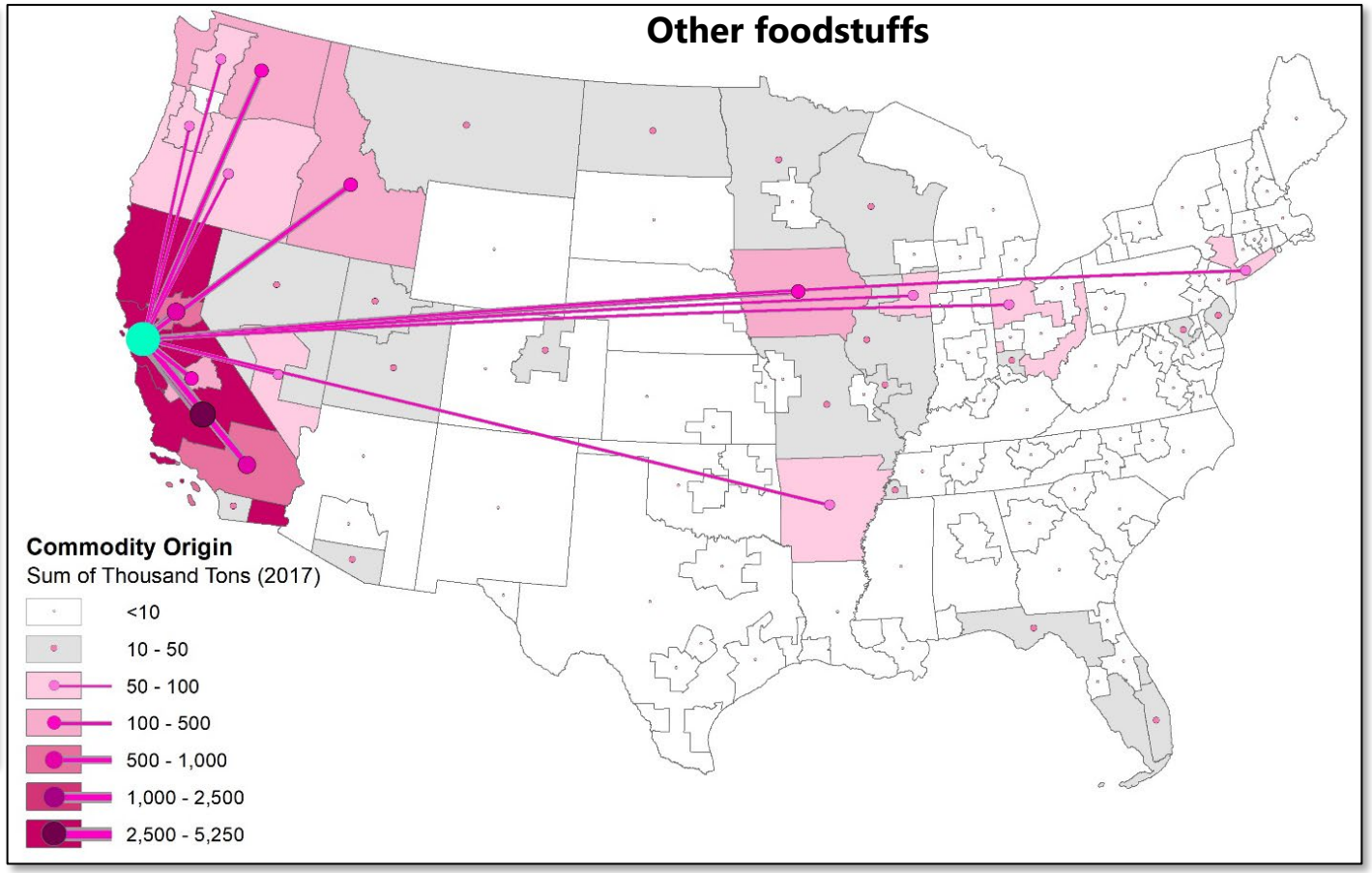


Food freight flow – Domestic Inbound Flows

Key questions: Where does domestic inbound flow originate? How much tonnage is being transported domestically?

Key takeaways: The Midwest, Pacific Northwest, and regions within California contribute the largest quantities of food commodities to the Bay Area.





Source: ORNL/FHWA, *Freight Analysis Framework v5* (2017 conditions)

Food flows – Basic needs versus actual freight

Key question: How does food for basic needs compare to total food flow into the region?

Key takeaways: At a ***minimum*** ~2.5x more food flows into the region than is required to meet basic need

Food by volume [ktons/yr]

What might account for the difference?

Truck trips [per day]

+ Less than truckload (LTL)?

+ Smaller vehicles?

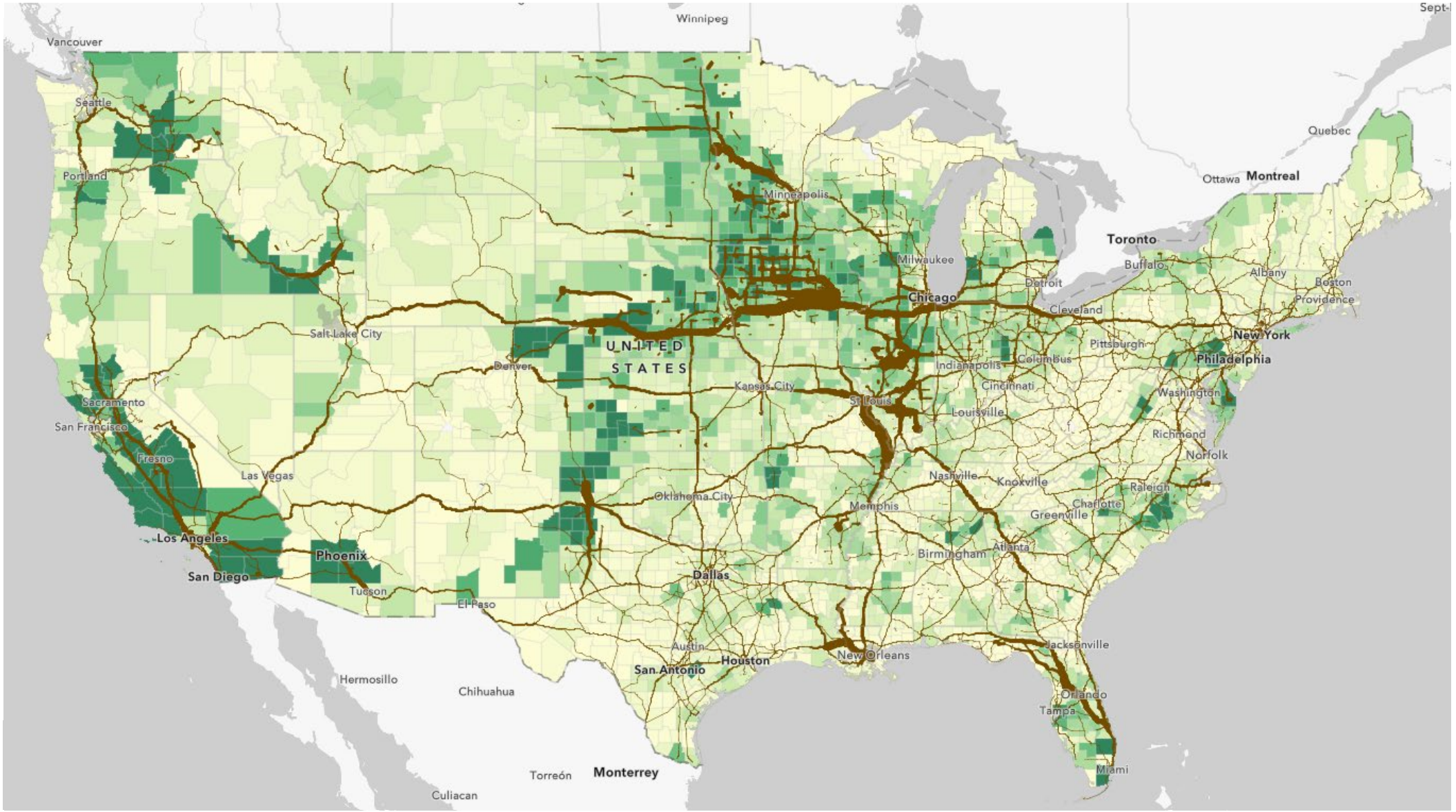
*Note: **~10,000 ktons per year** of food and agricultural products move *within* the Bay Area

Thousands of truck trips are involved in moving food every day in the Bay Area.

What's the most truck trips your agency, CalOES, or FEMA R9 has ever moved in a day for an emergency response?

CNA

Visualizing Concentration and Flow – Agricultural Commodities



Ag. And Farm products truck trips (FAF/FHWA, 2017)

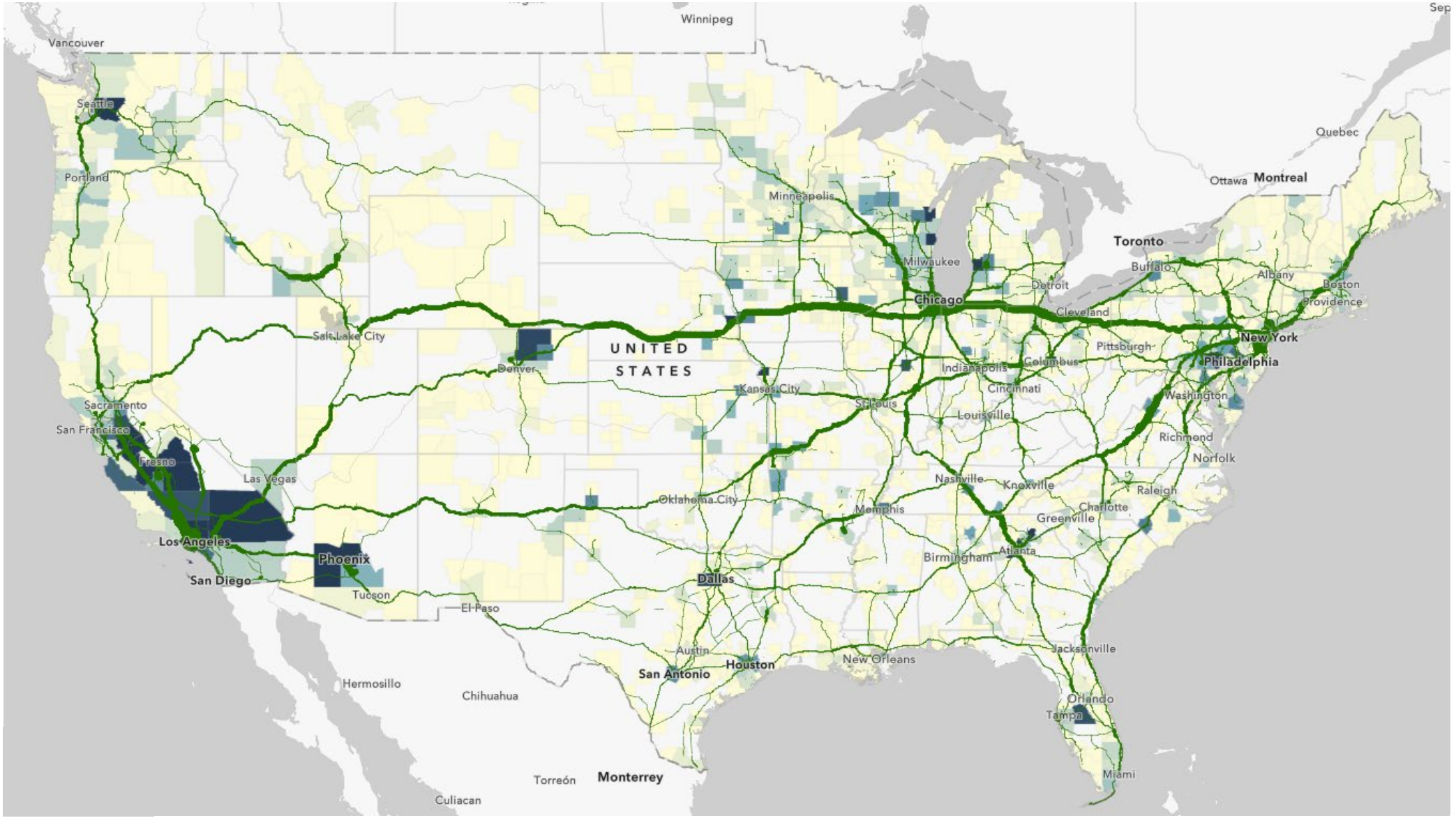
- > 2,000
- 1,500
- 1,000
- 600
- < 200

Total Ag. Sales (USDA Census of Agriculture - 2017)

Total Sales in US Dollars

- > 500,000,000
- 252,500,000
- < 5,000,000

Concentration and Flow – Food and Beverage commodities



Food and Beverage truck trips (FAF/FHWA, 2017)

Truck trips/d
- > 2,000
- 1,500
- 1,100
- 700
- < 250

Food processing sector revenue (Economic Census, 2017)

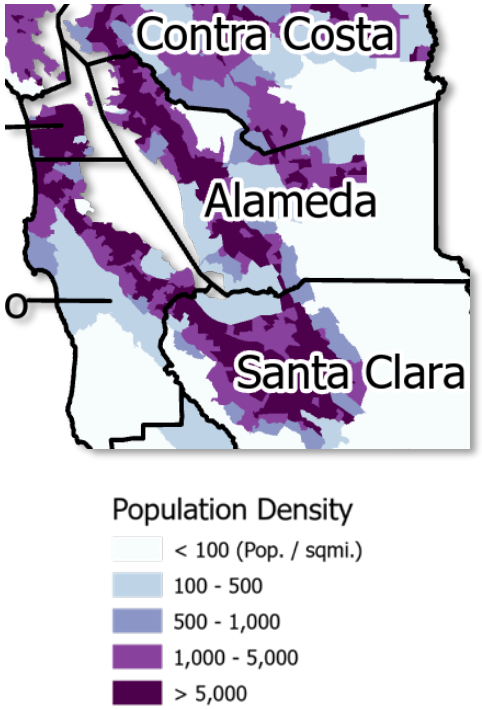
Revenue ($1000)
- > 4,000,000
- 2,000,000
- < 0

CNA

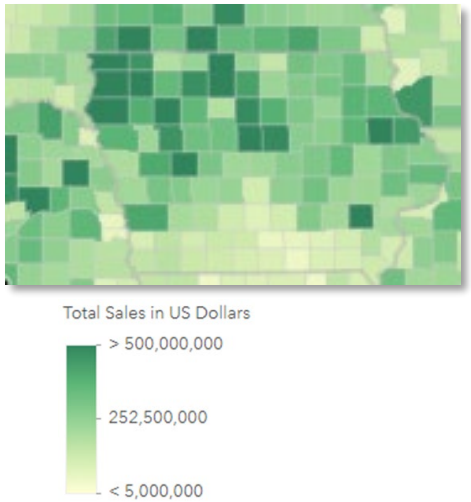
Demand, Concentration and Flow …with Data

The pictures you have already seen illustrate how data can show concentrations of activity, capacity and flow.

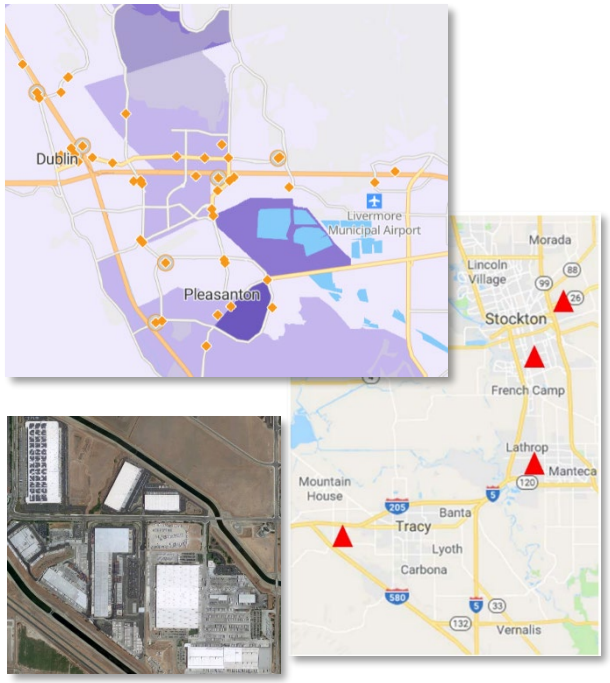
Demand concentration



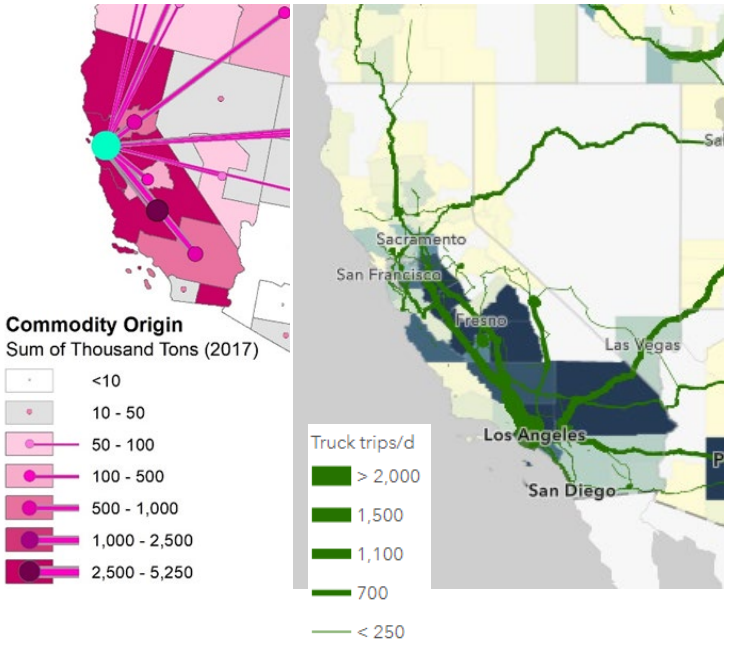
Production concentration



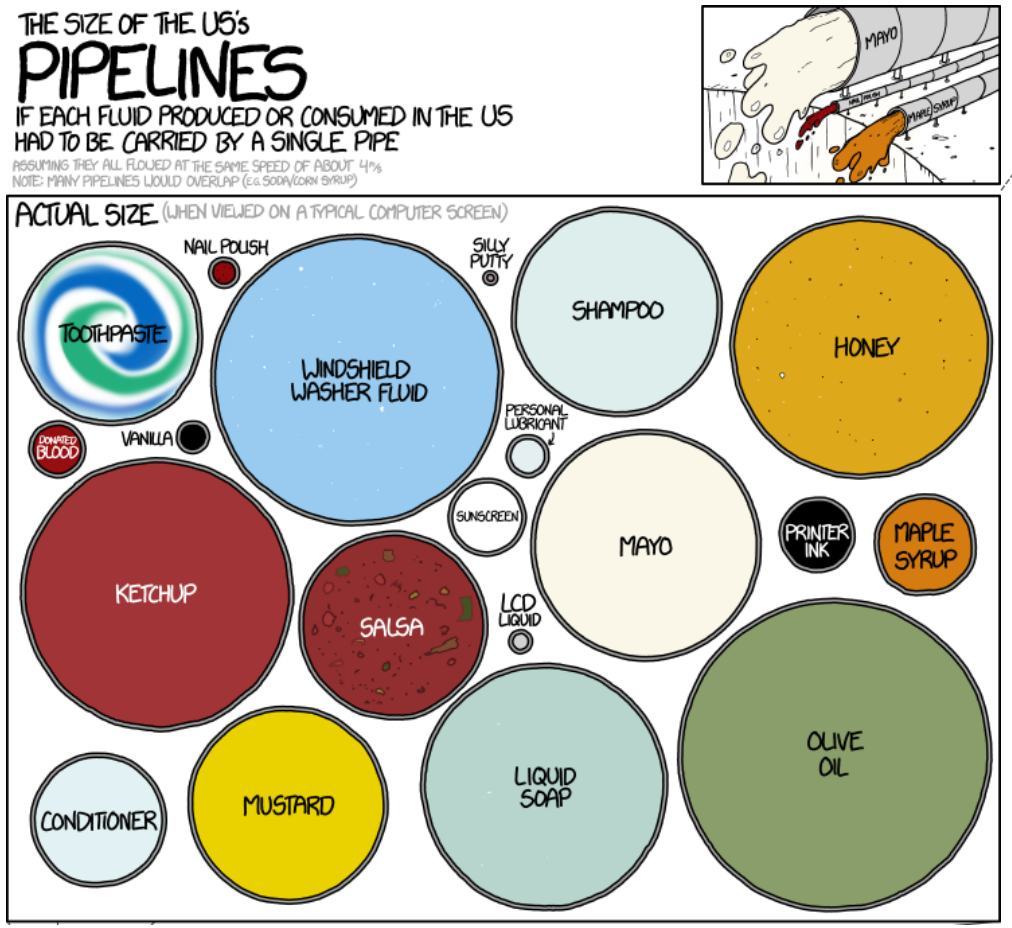
Facility (node) concentration

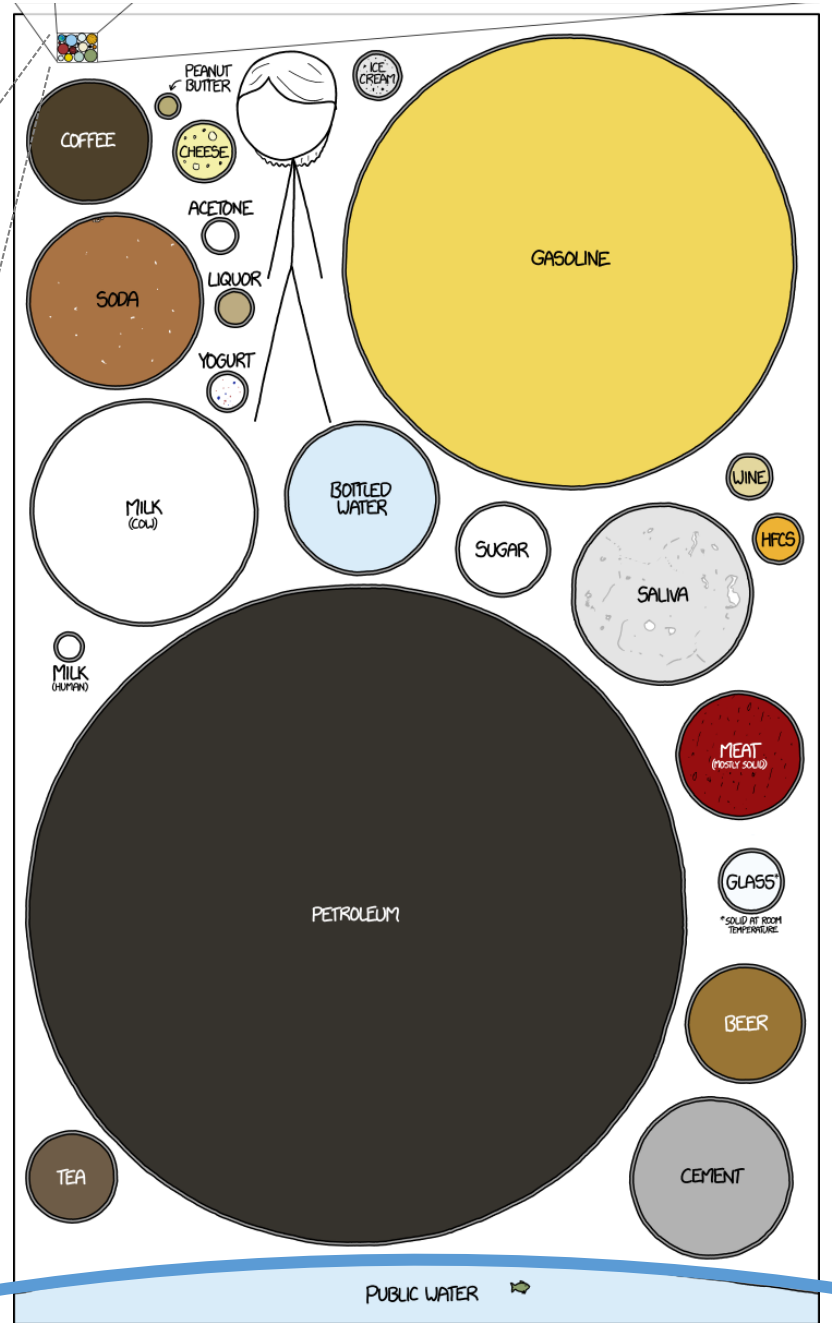


Flow



Water – Our Most Used Commodity



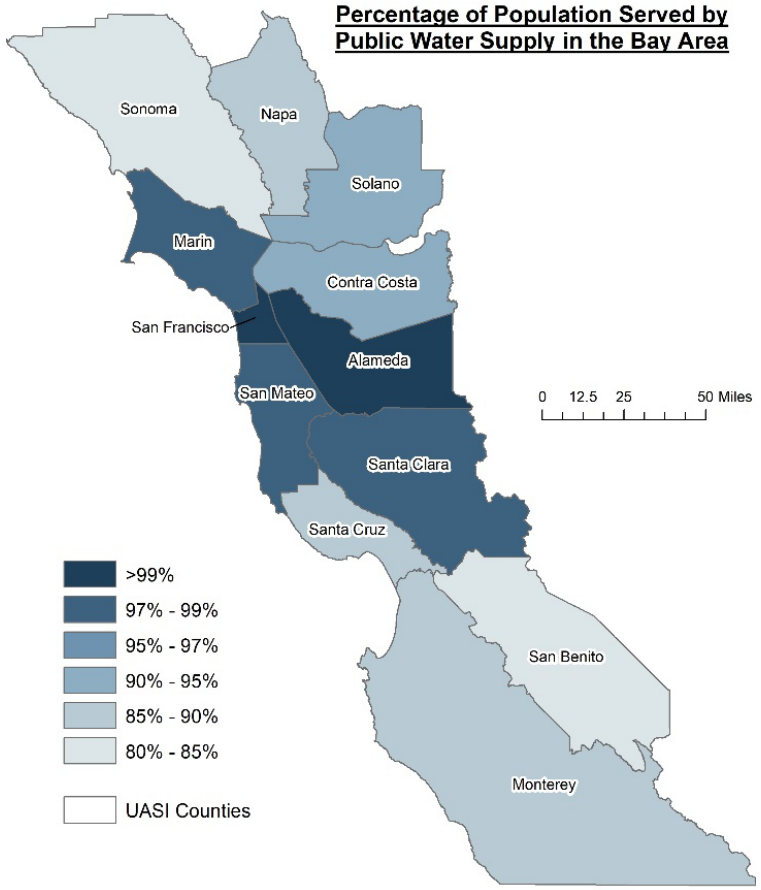


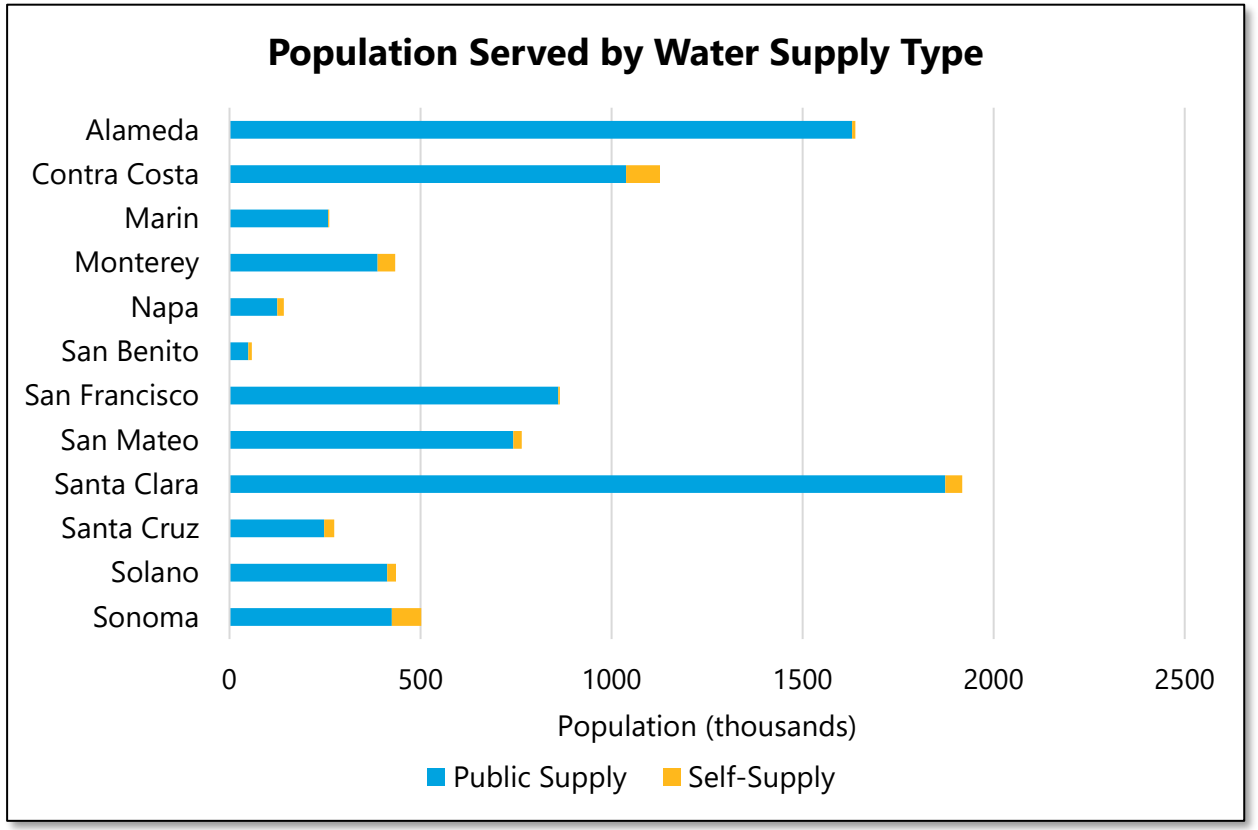
Source: xkcd

Sourcing by County – Public Supply vs Self-Supply

Key questions: What percentage of the population is being served by public water supply?

Key takeaways: >95% of the Bay Area's populations served by public water supply, the remainder of the population served by self-supply (i.e., own wells).



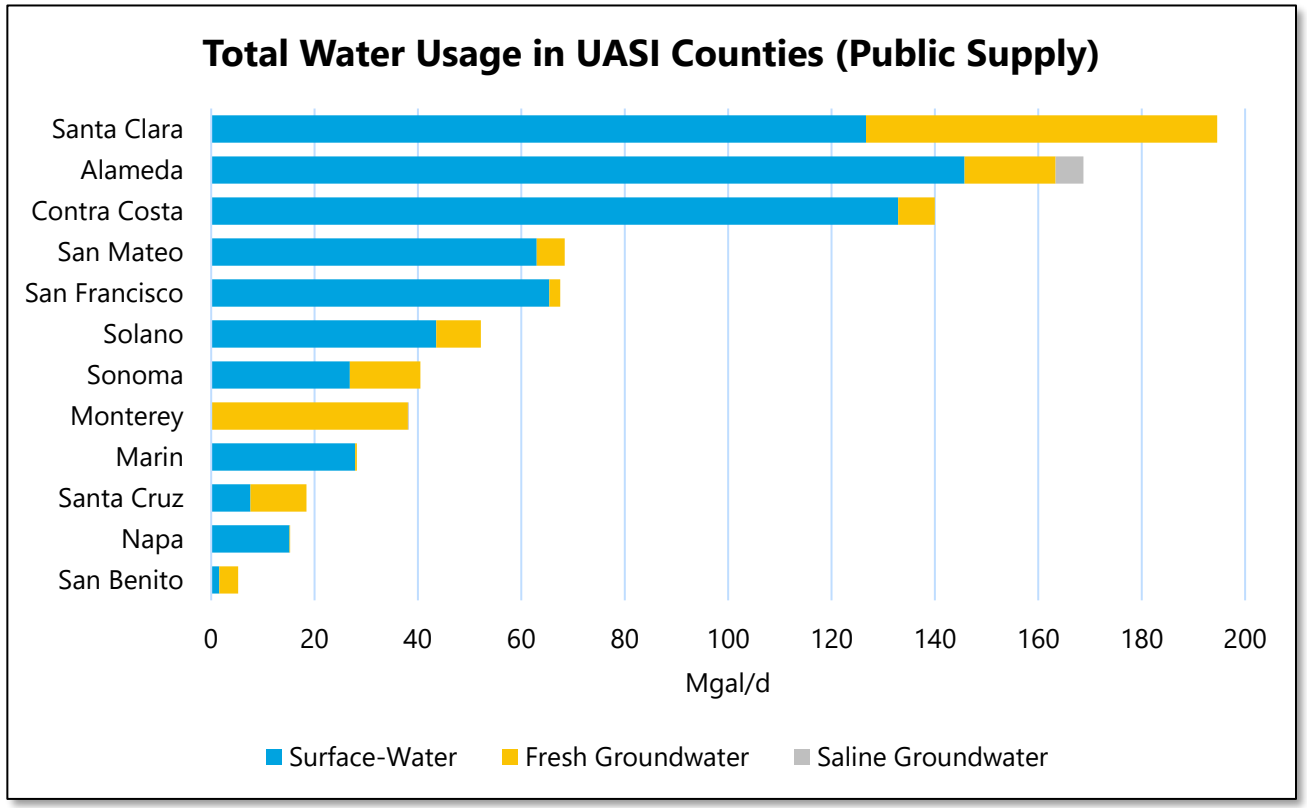


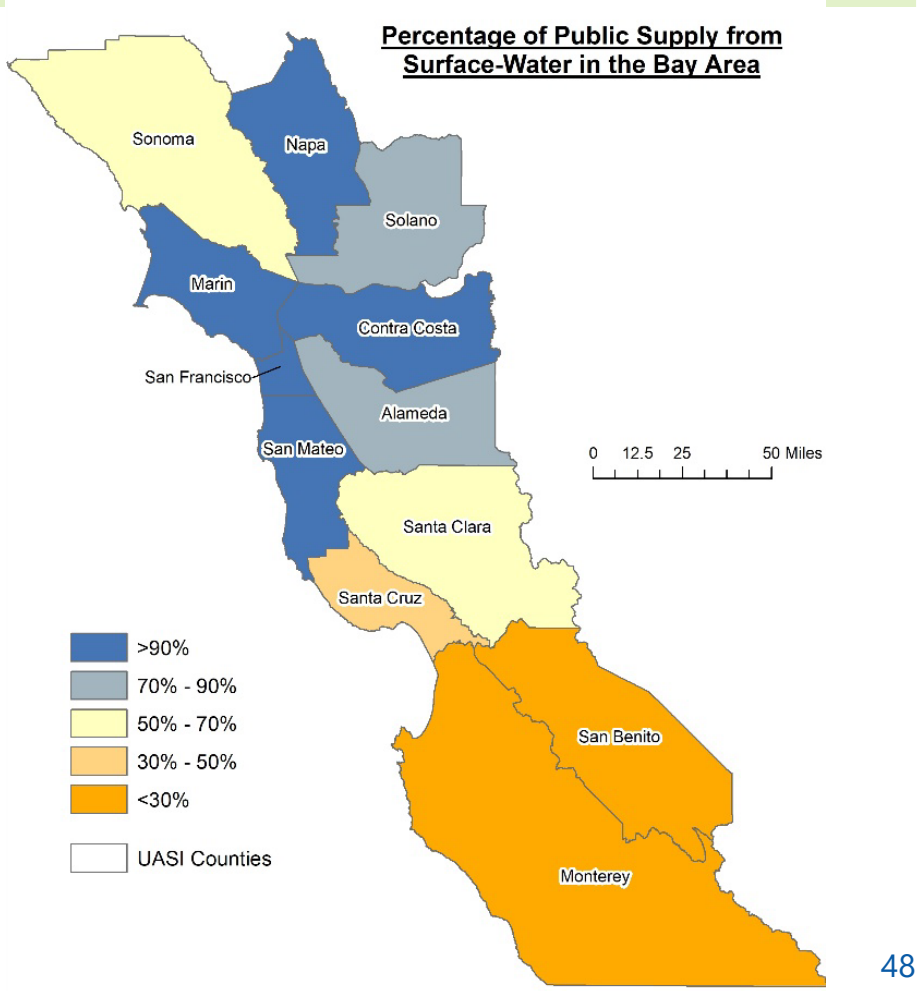
Source: USGS, *Estimated Use of Water in the United States* (2015)

Total Water Usage – UASI Counties

Key questions: What is the total water usage by UASI counties? Where is the water sourced from?

Key takeaways: Water usage totaled >800 Mgal/d by UASI counties in 2015. Surface water accounts for the majority of usage, but counties range from nearly totally supplied by surface water (San Francisco) to nearly wholly groundwater-supplied (Monterey).



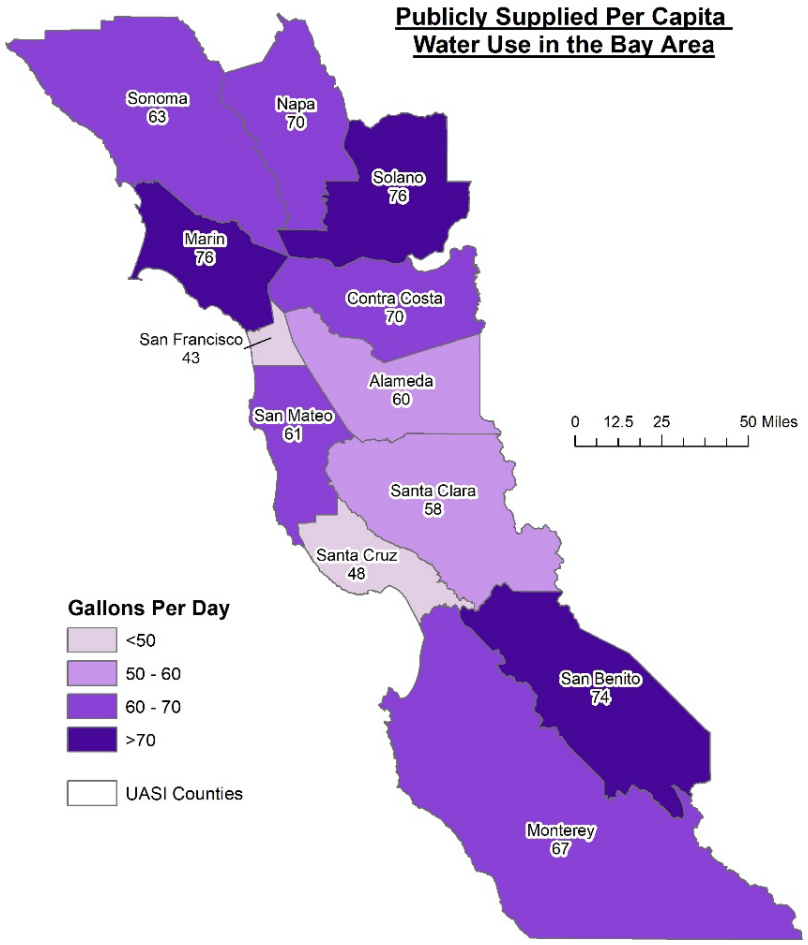


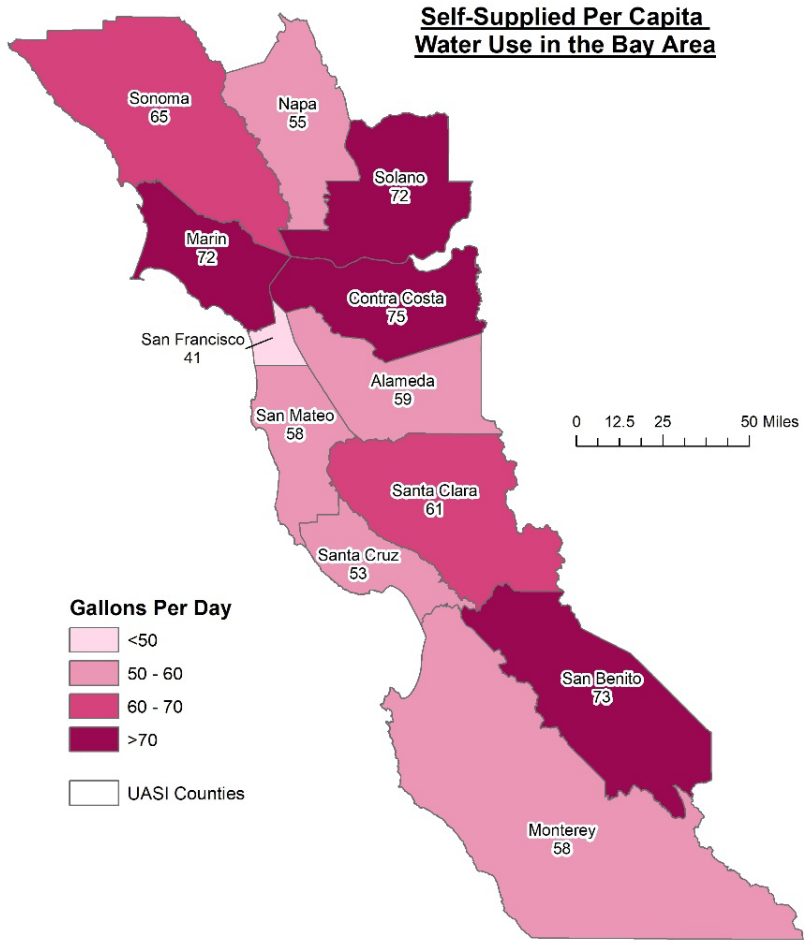
Source: USGS, *Estimated Use of Water in the United States* (2015)

Per Capita Usage – UASI Counties

Key question: What is the public supply and self-supply per capita use for UASI counties?

Key takeaways: Average publicly supplied per capita use for UASI counties was ~60 gallons/day (California average: ~80 - 90 gallons/day).





Source: USGS, *Estimated Use of Water in the United States* (2015)

Review

- **Big picture view**: As a rough estimate, the Bay Area's population uses at least 72M pounds of food, and over 800 M gallons of water per day just to meet basic, everyday needs for 8.6 M people.
- **Source types:** Food flow by commodity type; Groundwater versus Surface Water.
- **Source areas:** Primarily California for food, but other important domestic, international flows.

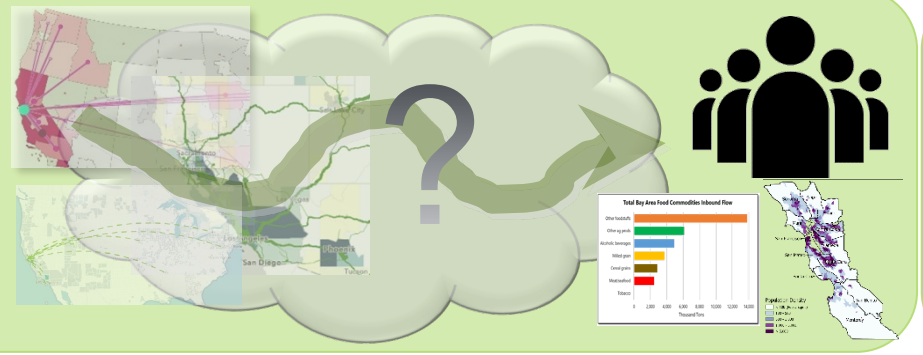
- **Visualizing data:** Concentration, capacity, flow.
  - Upcoming seminars will take this to a whole other level.

Path forward

- **Today** - examined the scale of the systems, and started to examine demand, source, & flow.
- **Next** - will assess the supply chain systems to get a much more detailed, validated picture of critical concentrations, flows, and key players within the region.

Food

Source



Water

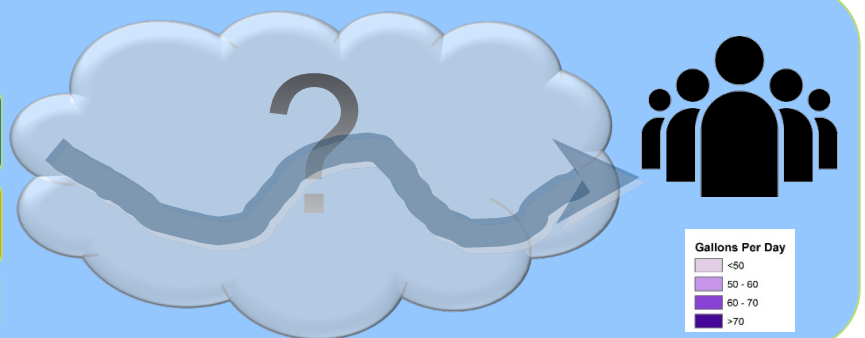
Source

Public

SW

GW

Self



Source

Produce | Process | Distribution | Retail | End User

…and much more

Seminar 3 (food validation)

Source

Source | Trans. | Treat | Trans. 2 | Distribution | End Use

…and much more

Seminar 4 (water validation)

Seminar 6 – Food and Water summary for *you*

Module II: Discussion

- Raise your hand to ask a question

  - *9 to raise and lower hand on the phone

Wrap-Up and Next Steps

- UASI Resource Library (link in chat)
  - Reminder of resources available, suggested readings
  - Recording will be available
- Complete the post-seminar assessment
- BA-UASI closing notes

Next Seminar is on **December 7, 2022 – Supply Chains and Disasters**
Link to register is in chat