

Unintended Environmental Impacts of Logistics Policies in Metropolitan Areas

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Outline

- Truck Load Increases
 - Methodology
 - Transportation Data
 - Environmental Data
 - Results and Policy Implications
- Off-Peak Trucking Operations
 - Diurnal atmospheric variation
 - Considering the effects of traffic congestion and emissions

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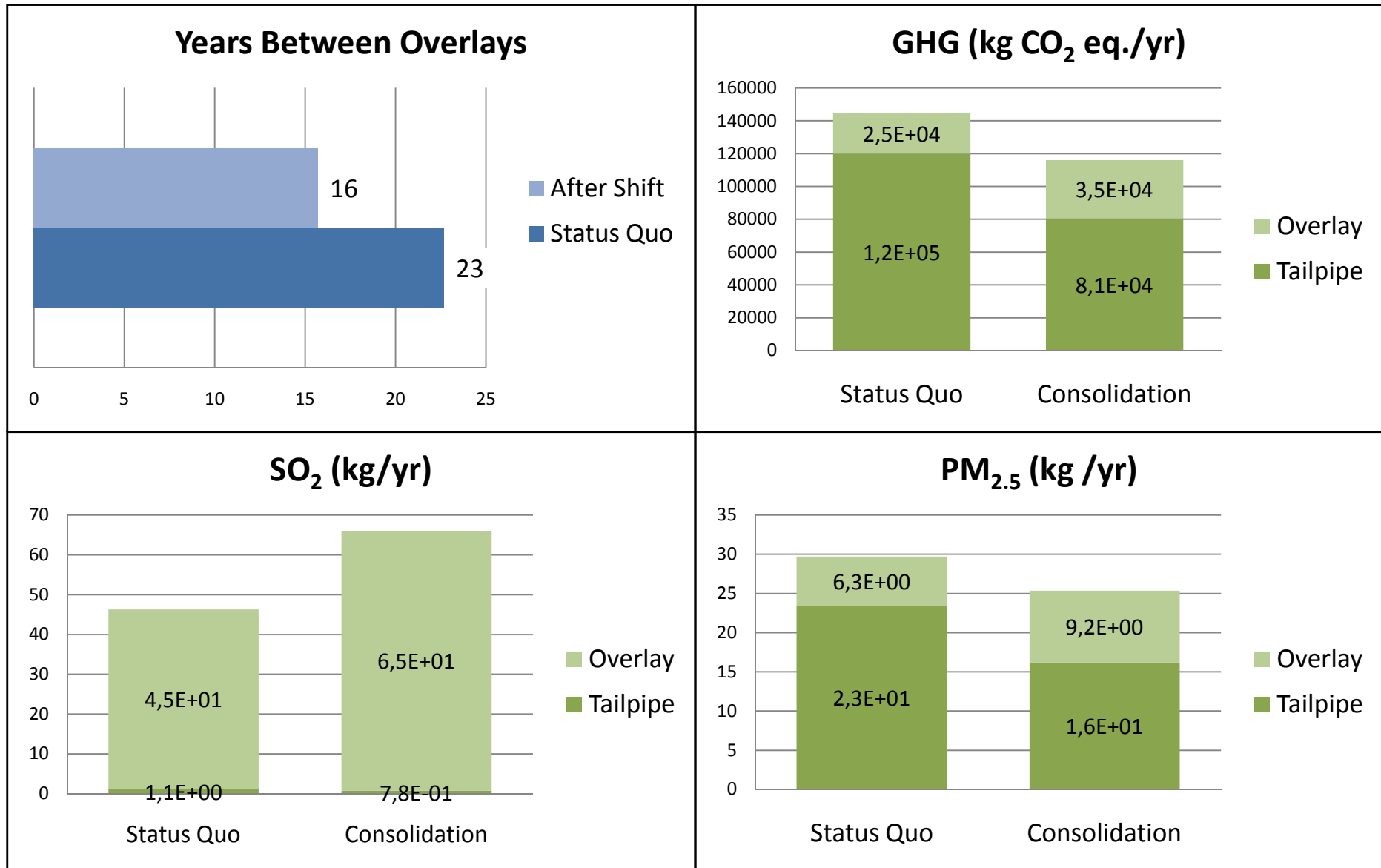
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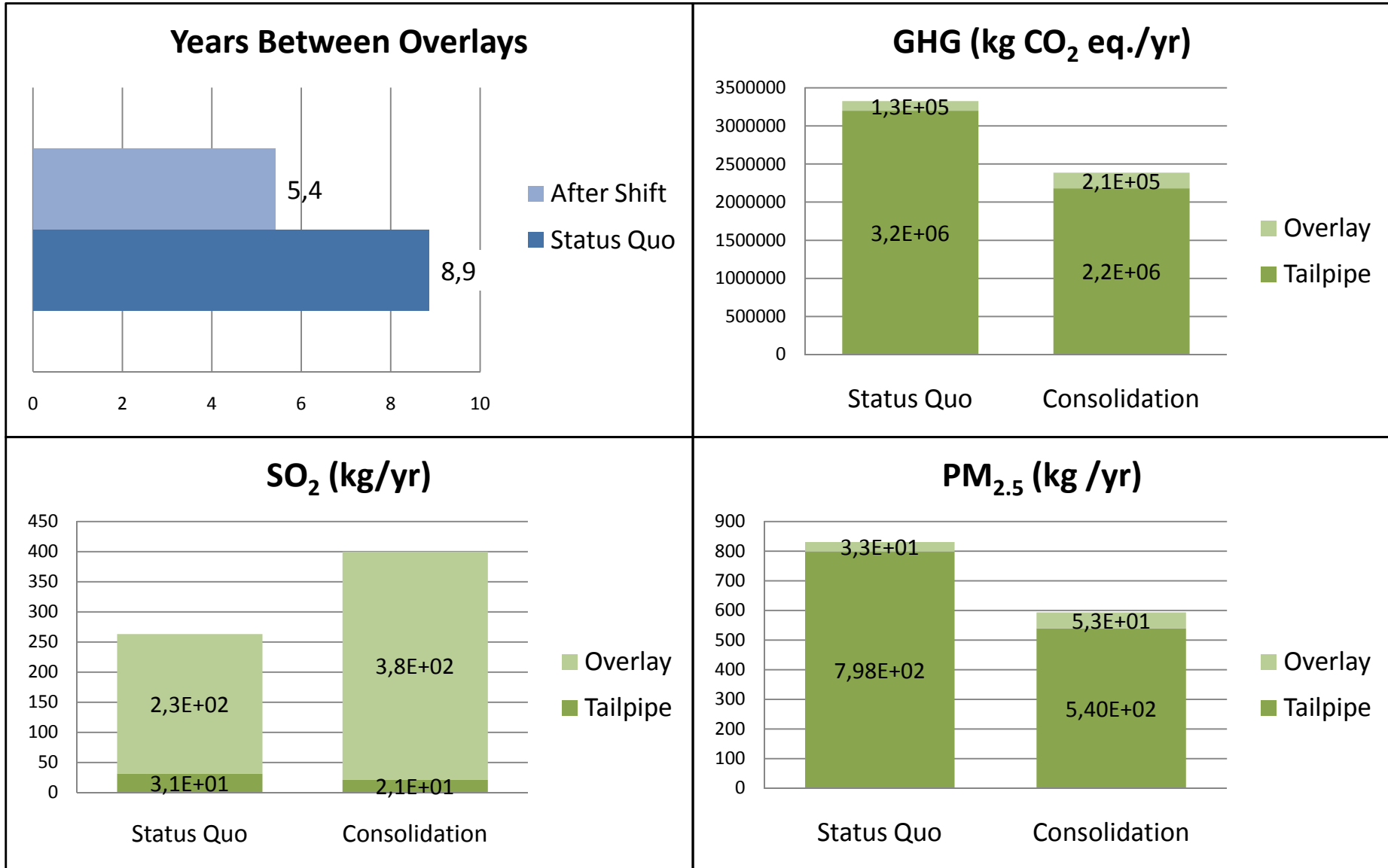
Methodology

- Develop traffic information:
 - Vehicle and cargo weights
 - Equivalent Single Axle Loads per Trip
- Use pavement deterioration model to estimate change in overlay frequency
- Estimate HMA overlay supply chain emissions
- Estimate tailpipe emissions
- Case examples contrast long-distance and local trucking issues

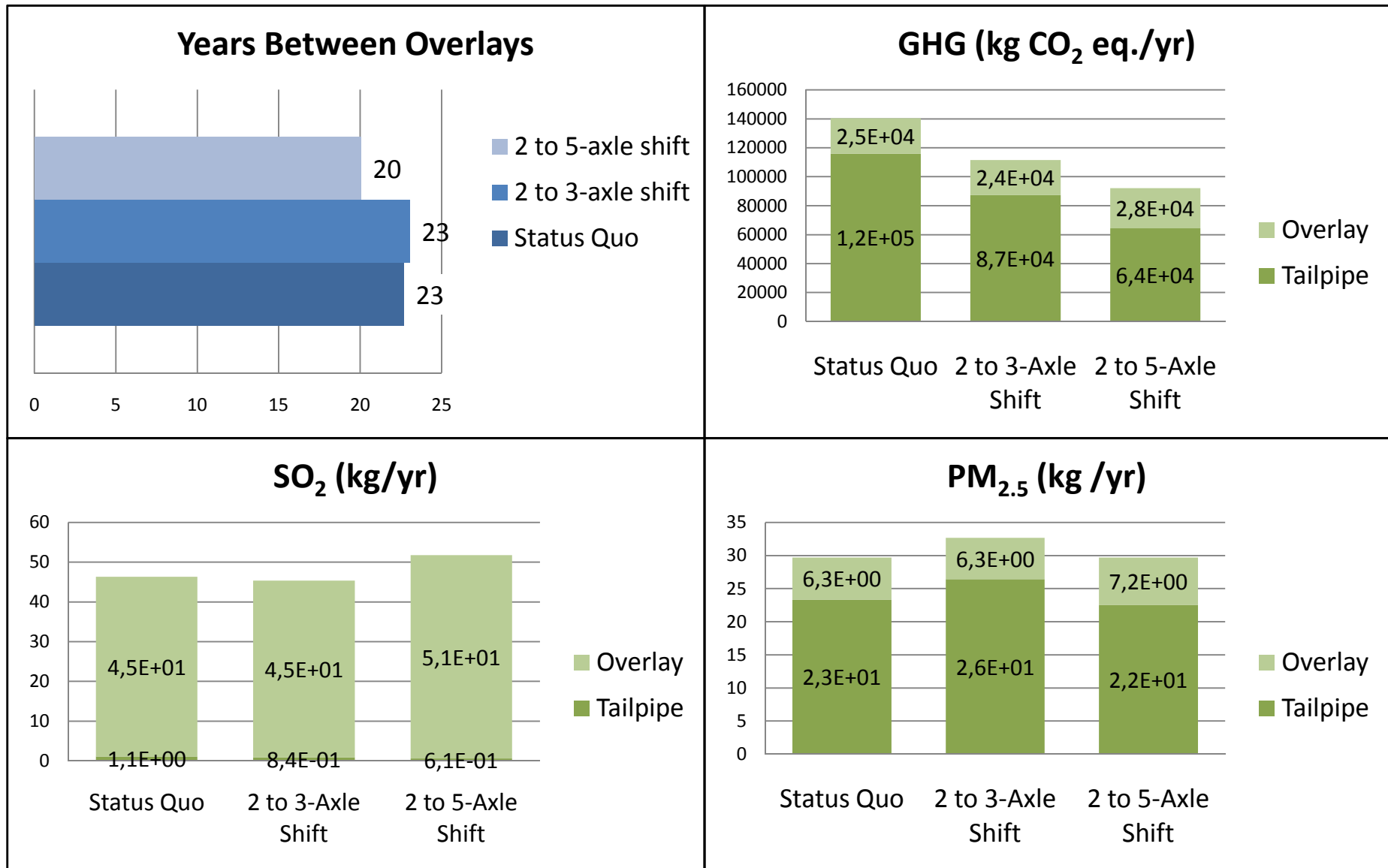
Within-Vehicle Class Consolidation on SR-13



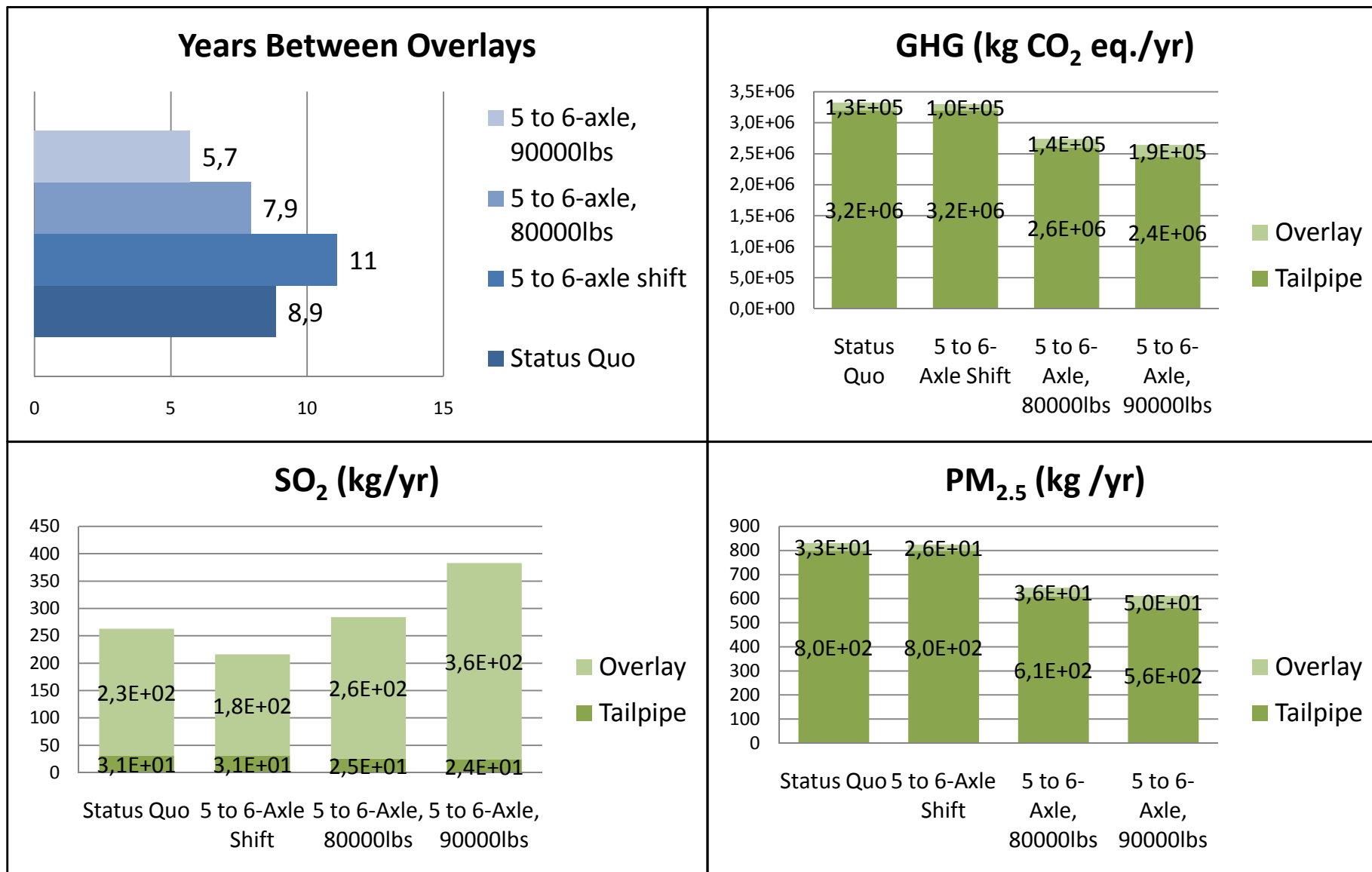
Within-Vehicle Class Consolidation on I-80



Consolidation to different truck sizes on SR-13



Weight Limits and Consolidation on I-80



Related Supply-Chain Considerations

- Other types of pavement MR&R activities have different supply-chain emissions
 - e.g. example, steel reinforcement has high associated Pb emissions (EIO-LCA)
- Effects of system boundaries
 - e.g. high SO₂, CO and Pb emissions associated with vehicle manufacturing, maintenance and decommissioning

Source: Facanha, C. (2006) *Life-cycle Air Emissions Inventory of Freight Transportation in the United States*. Doctoral Dissertation, Department of Civil and Environmental Engineering, UC Berkeley.

Effects Related to City Logistics Policies

- Indicates possibility of a trade-off between car and truck travel
 - e.g. consolidation of food industry in UK increased car VKT, but reduced truck VKT

Source: McKinnon, A. and A. Woodburn (1994) The Consolidation of Retail Deliveries: Its Effect On CO2 Emissions. *Transport Policy*, 1, 125-136.

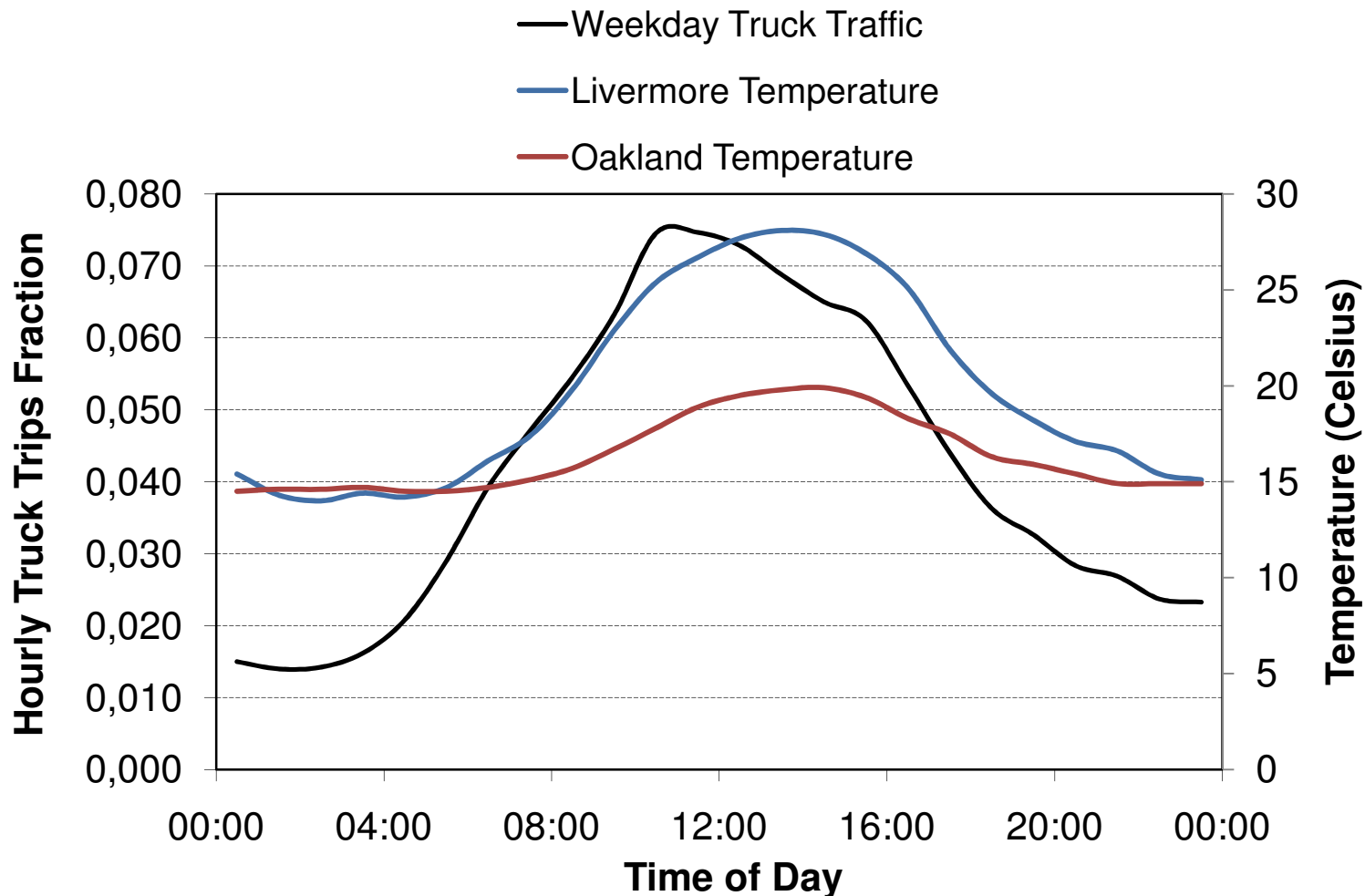
- Although there are tailpipe emissions benefits, eliminating empty trips may cause little change to supply-chain emissions
- Circumvention of bans on large trucks causes reversed trade off
 - e.g. Southern California proposed truck bans

Source: Campbell, J. (1995) Using Small Trucks to Circumvent Large Truck Restrictions: Impacts on Truck Emissions and Performance Measures. *Transportation Research Part A*, 29, 445-458.

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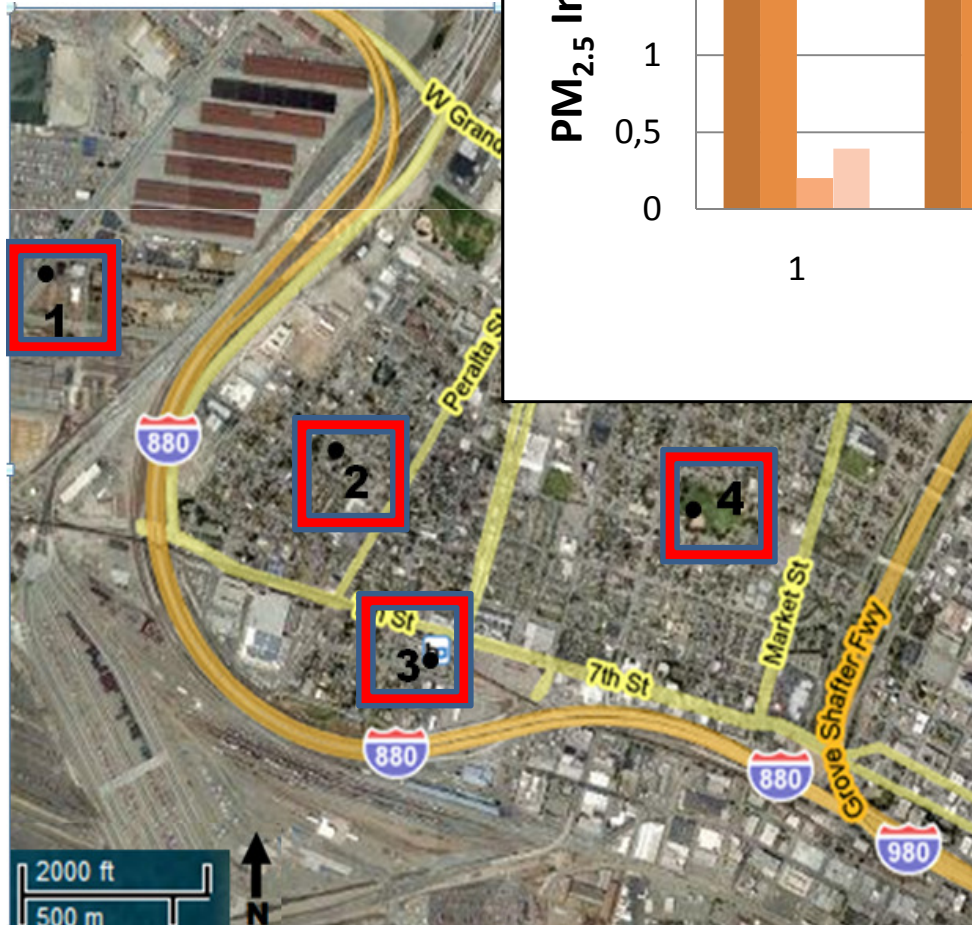
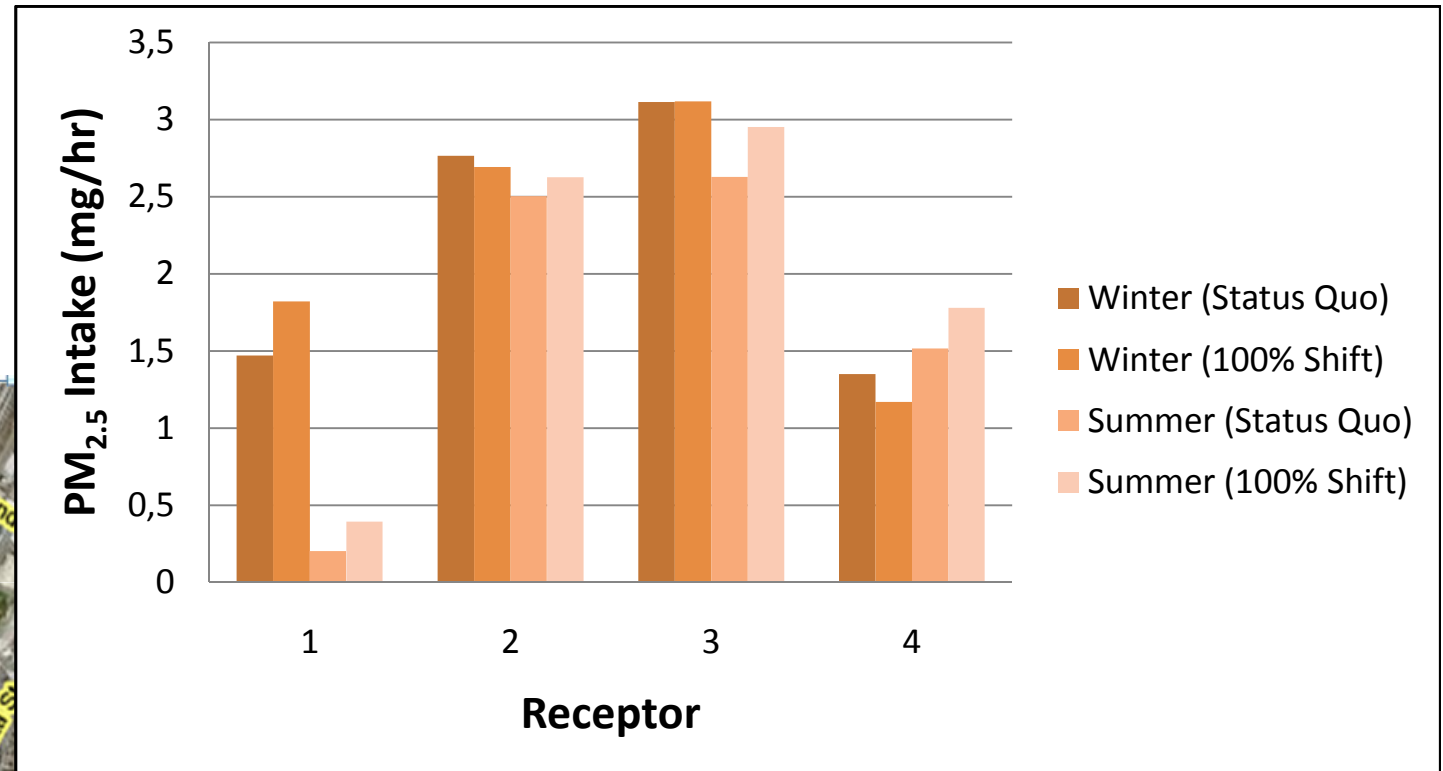
Diurnal Truck-Traffic Distributions and Air Temperature



Methodology

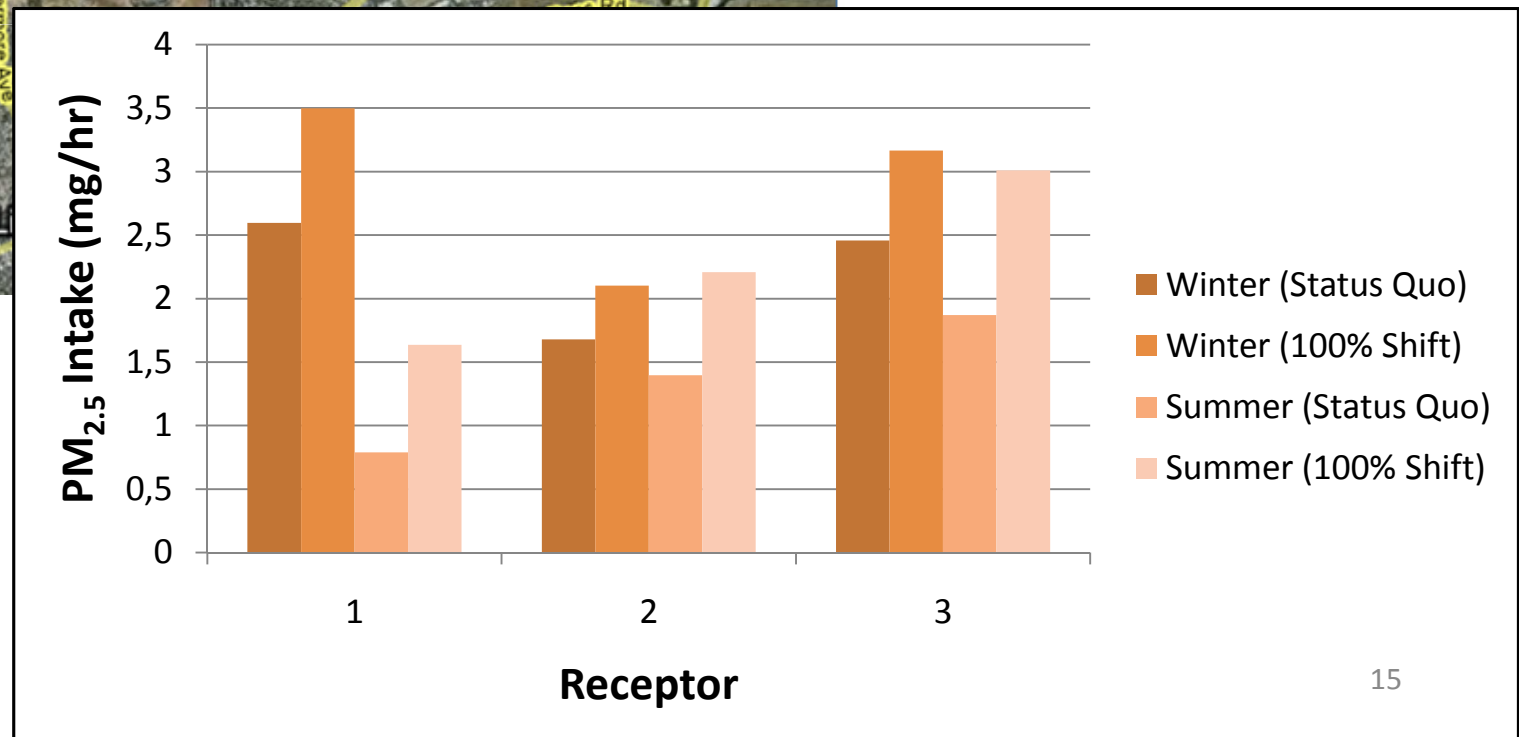
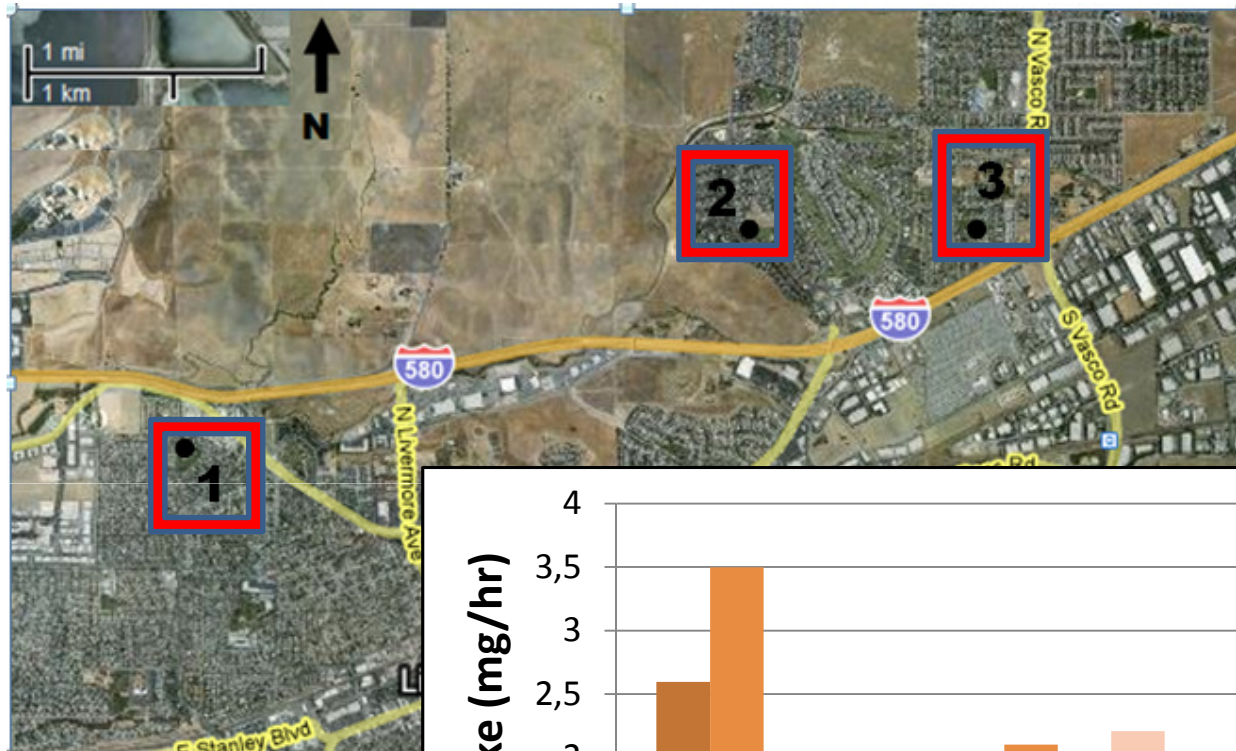
- Used Caltrans highway traffic data and CARB's EMFAC2007 to estimate emissions factors
- Caltrans dispersion model Caline4 for estimation of expected concentrations for each season using BAAQMD climate data
 - Joint PMF for stability class, wind direction, wind speed
- Estimation of human intake using assumed hourly breathing rates
Source: Marshall, J. D., W. J. Riley, T. E. McKone and W. W. Nazaroff (2003) Intake fraction of primary pollutants: motor vehicle emissions in the South Coast Air Basin. *Atmospheric Environment*, 37, 3455-3468.
- Case examples contrast climates with differing levels of diurnal variation:
 - Livermore (inland Bay Area suburb)
 - Oakland (coastal Bay Area city)

Effects of Atmospheric Stagnance in West Oakland

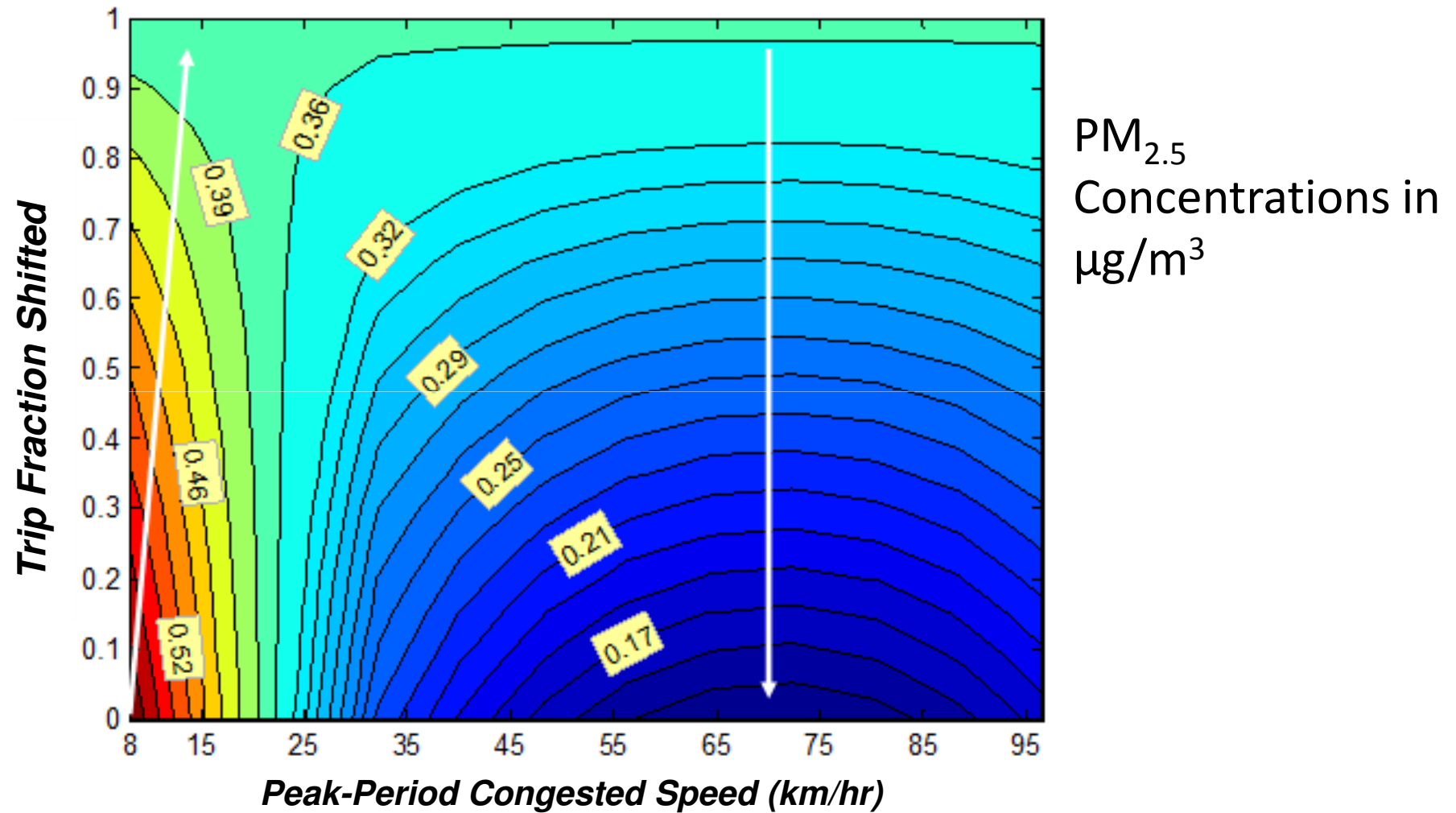


Effects of Atmospheric Stagnance in Livermore

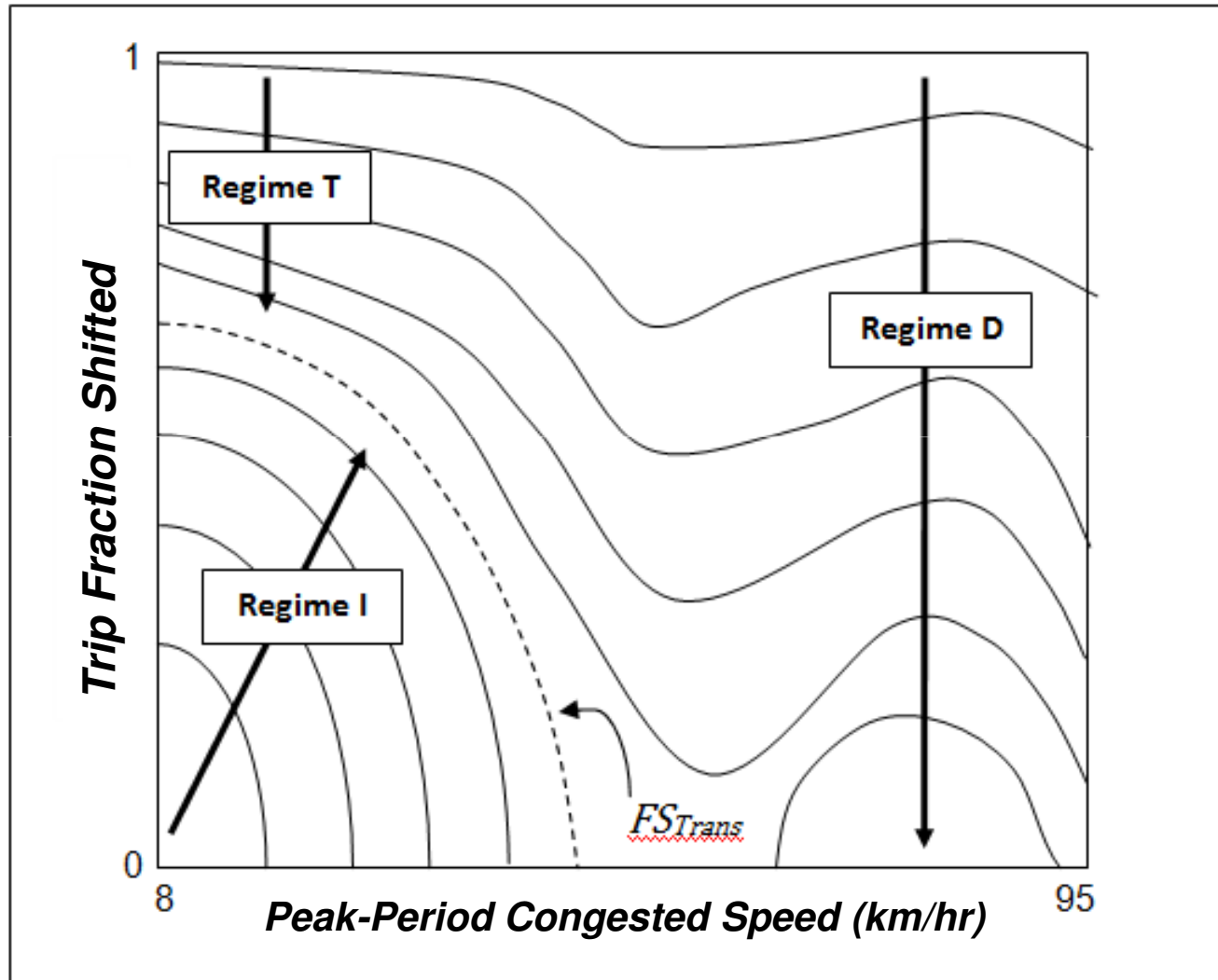
- Elasticity of 24-hr avg. concentrations and intake with respect to trips shifted is much higher



Livermore Summer Climate Conditions



Impact isopleth diagram



- Arrows point in directions of decreasing environmental impacts

- Isopleths are lines representing constant environmental impact

Conclusions

- Increasing loads is beneficial for many pollutants including GHGs, but can increase PM and SO₂ emissions
- In many contexts, nighttime logistics policies are likely to be ineffectual for reducing diesel exhaust intake
- Unintended environmental impacts should be accounted for in future freight policy analyses
- Policy assessments should incorporate the nuances of both environment and transportation

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