Improving Freight System Performance in California

持续改进加州货运系统

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The Freight System in California
加州货运系统

The freight system in general,

But…

Responding to growing challenges in California

货运系统，特别是应对加州在各方面增长的挑战：

- Environmental 环境
- Equity 公平
- Economic 经济
- Health 健康

Economy and Employment
经济与就业

- $650-740 billion 6500-7400亿美元
- 32% of the California economy占加州经济总量的32%
- ~5 million jobs in freight-related industries 约500万个货运相关就业岗位
- 33% of California jobs 占加州就业岗位的33%

Freight Transported
货运运输

- 2/3 Within California 2/3 州内运输

Ports of LA and Long Beach
洛杉矶港和长滩港

- 30% of US imported goods 进口货物的30%
- 60% in the West Coast 西海岸货运量的60%

Freight Transport Produced
货运交通产生

- 50% of diesel PM 50% 柴油颗粒物
- 45% of the nitrogen oxide 45% NOx
- 24.2% of GHGs 24.2% GHGs

Projections 2025
预计2025年

- 25% increase in volume 货运量增长25%
- 70% increase in commodity value 货物价值增长70%

Sources: Freight Analysis Framework Data by U.S. Department of Transportation 2012

EDD, Labor Market Information Division, 2014

Improving the System – Regulatory Environment
改进系统 –环境法规

Improving the Freight System – Key Regulations & Plans
改进货运系统—关键法规和规划

Trucks are a major source of emissions

There are many programs and regulations in place, or imminent, fostering the use of ZEVs in the State

Others have addressed emissions in different sectors

卡车是主要的排放源

有许多计划或法规正在或即将实施，以促进加州使用零排放汽车

其他还有许多法案解决不同部门的排放问题

AB/SB-32 California Global Warming Solutions ACT of 2006
AB/SB-32 加州全球温室气体行动（2006）

- Reduce GHG emission by 40% from 1990 levels by 2030
- 到2030年，加州GHG排放较1990年水平降低40%
- Cap-and-Trade Program 碳交易项目

Low Carbon Fuel Standards (LCFS) 低碳燃料标准（LCFS）

- Reduce carbon intensity of fuels 降低燃油碳强度
- Vehicle emissions standards 车辆排放标准

On-Road Heavy-Duty Diesel Vehicles (In-Use) (2006)
重型柴油车在用车管理（2006）

- Retirement of older vehicles (or retrofit them) 老旧车淘汰（或翻新）
- Have vehicles to be 2010 MY engine compliant by 2023 到2023年所有车辆需更新到2010年或更新的发动机

Clean Air Action Plan (CAAP) by the POLA/LB (2006)
洛杉矶港长滩港清洁空气行动计划（2006）

- Clean Truck Program 清洁卡车项目
- Drayage trucks to be 2014+ MY engine compliant by 2018
- 2018年所有港区卡车更换2014年或更新的发动机

CAAP Update 2017 清洁空气行动计划2017更新

- Fully operate zero emission equipment by 2035
- 2035年实现所有港区设备零排放

Improving the Freight System – Key Regulations & Plans
改进货运系统—关键法规和规划

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California Sustainable Freight Action Plan (2016)
加州可持续货运行动计划（2016）

- Improve freight system efficiency by 25%;
- 提升货运系统效率25%
- Deploy over 100,000 freight vehicles and equipment capable of zero emission operation; and
- 使用超过10万辆/台零排放运行的车辆和设备
- Foster future economic growth within the freight and goods movement industry
- 促进未来货运和物流行业经济增长

Mobile Source Strategy 移动源战略

California's 2017 Climate Change Scoping Plan
2017年加州气候变化界定计划

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Impact of Existing Regulations
已实施法规的影响

Ongoing policies will already generate significant reductions in GHGs and criteria pollutant emissions

现存政策已带来GHGs和传统污染显著减排

LT = Light Heavy-Duty Vehicles

轻型货车（约3855kg-8845kg）

MT = Medium Heavy-Duty Vehicles

中型货车（约8845kg-14968kg）

HT = Heavy Heavy-Duty Vehicles

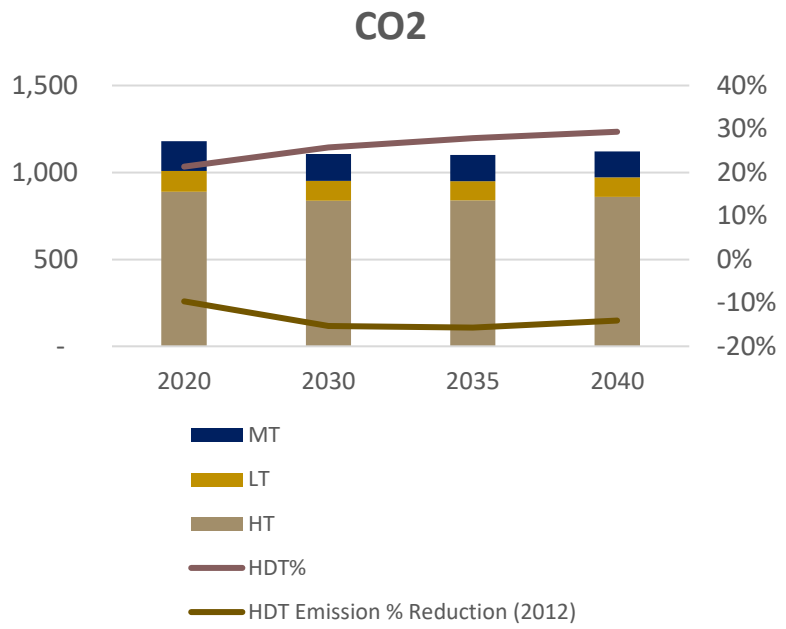
重型货车（约14968kg及以上）

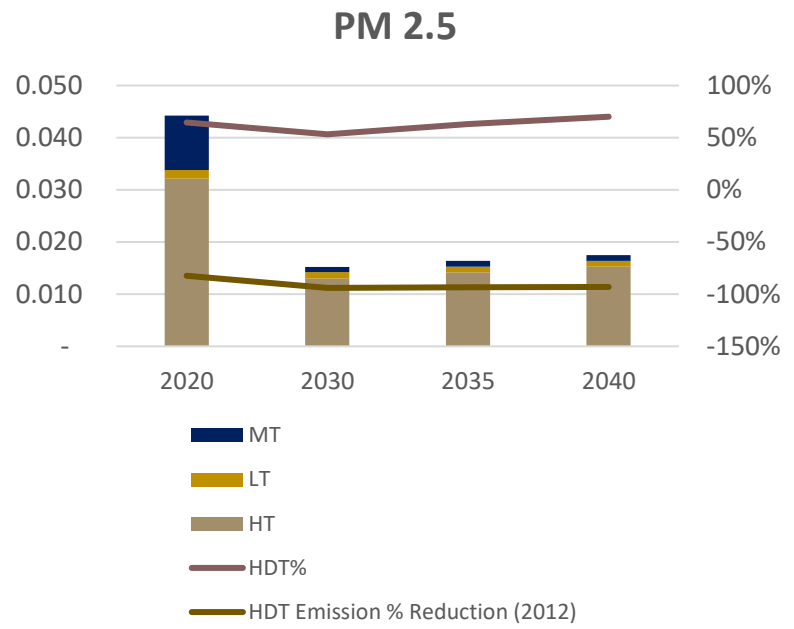
LD = Light-duty Vehicles

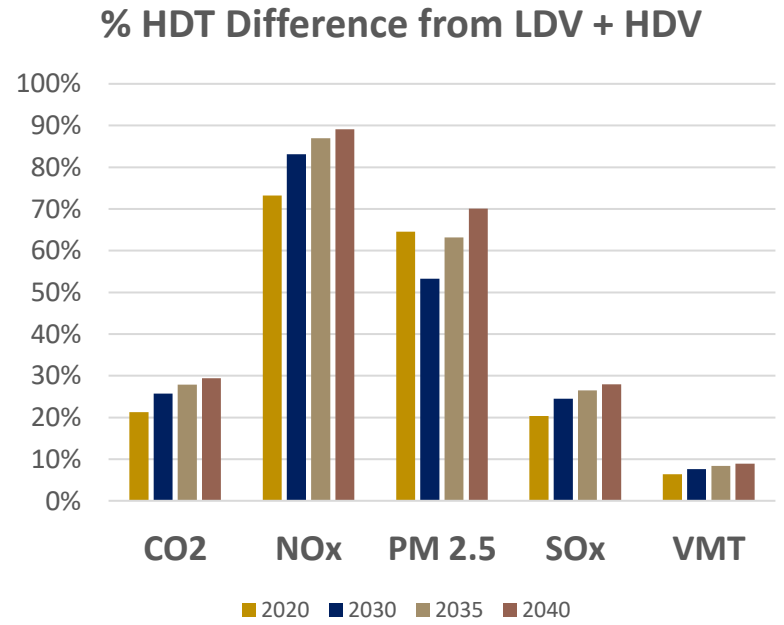
轻型车辆

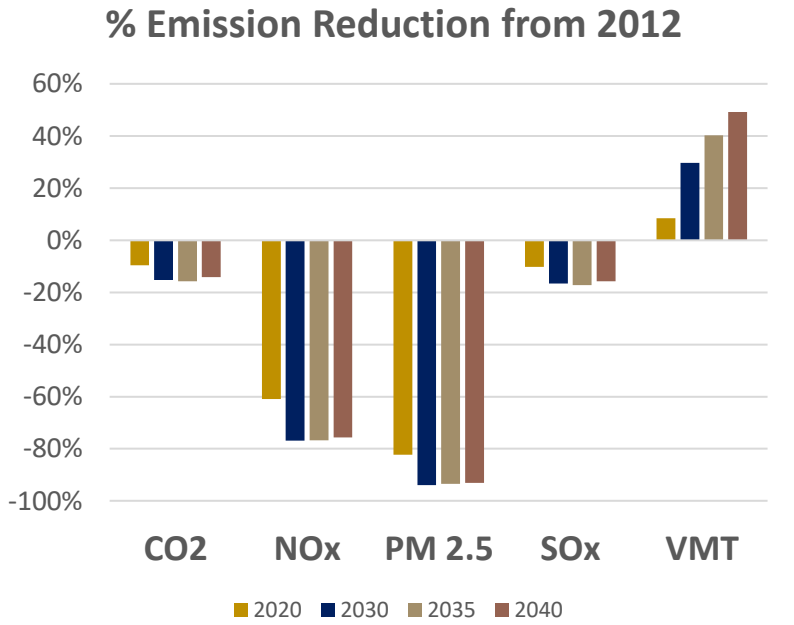
Estimates for Southern California

据南加州数据估算









Improving the Freight System – Recent Developments
改进货运系统—近期进展

Ongoing developments

目前进展

Advanced Clean Truck (ACT) Rule (2020)
先进清洁卡车法案 （2020）

- Manufacturer sales requirement (ZEVs as % of sales)
- 要求制造商销量（零排放车辆占销量比例）
- Large company and fleet reporting requirements (2021)
- 要求大企业和车队报告 （2021）

Executive Order N-79-20 执行法案 N-79-20

- All trucks sold to be zero emissions by 2045
- 到2045年，所有销售的卡车需为零排放车辆
- Drayage trucks timeline to 2035
- 到2035年，所有销售的拖车需为零排放车辆

Low-NOx Omnibus Rule 低NOx车辆法案

- Ensure combustion-powered vehicles are as clean as possible
- 确保燃油车辆尽可能清洁

Zero-Emission Fleet Rules 零排放车辆法案

- Drive adoption of zero-emission vehicles everywhere feasible
- 所有技术可行的车辆采用零排放车辆
- Fleet mandate
- 车队强制

Identifying Targets for Transition Priority
识别目标车型优先进行清洁转型

Example of different last mile delivery vocations

不同行业终端配送案例

Daily trip length distributions

日均里程分布

Short-haul: urban distribution, drayage are potential targets

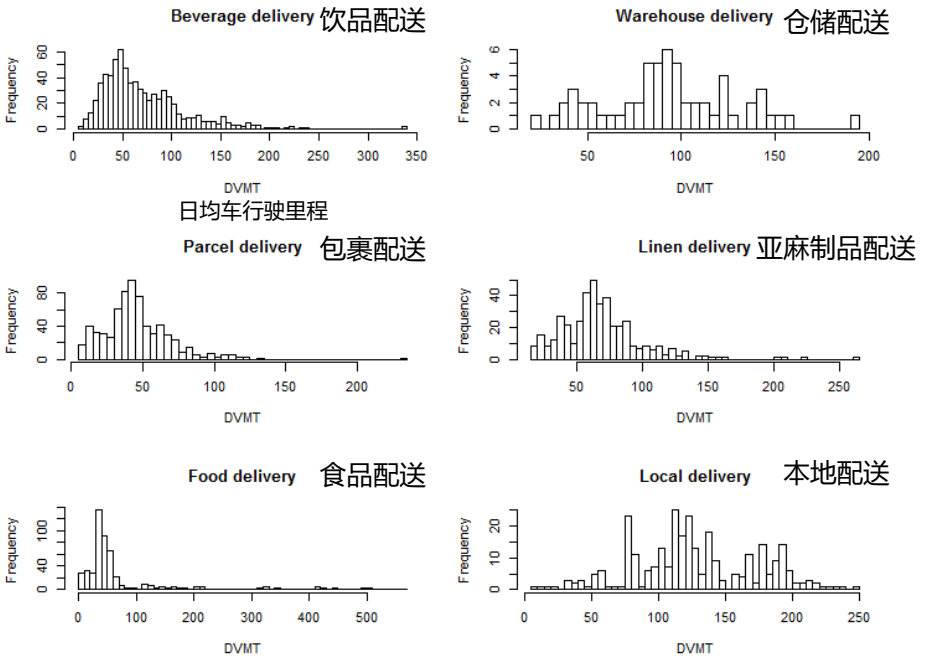
短途货运：城市配送、拖车是主要的目标车型

Long-haul: still some challenges, though there are incoming vehicle offerings

长途货运：尽管已有多个车型即将面世，仍面临一些挑战

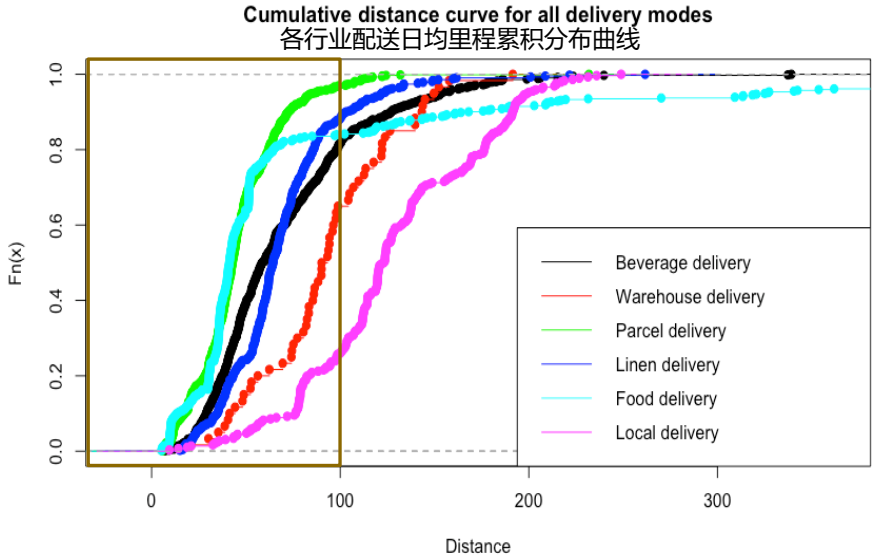
Different last mile delivery vocations have different patterns

不同载货种类的终端配送车辆运行特征不同



Parcel deliveries conduct a large number of stops per tour along shorter routes

快递车每程距离更短、停车次数更多



Advanced Clean Truck Rule
先进清洁卡车法规

California Air Resources Board

Establish pathway to 2045 carbon neutrality goal

Achieve 15% ZE fleet by 2035

Align with POLA/LB goals by 2035

加州空气资源委员会

建立到2045年实现碳中和目标的路径

到2035年实现零排放车辆占车队15%

与2035年洛杉矶港/长滩港目标协调

Source: Air Resources Board

Model Year (MY)	Class 2b-3	Class 4-8	Class 7-8 Tractors
2024	5%	9%	5%
2025	7%	11%	7%
2026	10%	13%	10%
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	**30%**	**50%**	**30%**
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035	**55%**	**75%**	**40%**

Impact of Decarbonization Scenario
减碳情景分析

Considers the implementation of the Advanced Clean Truck (ACT) Rule, and other policies

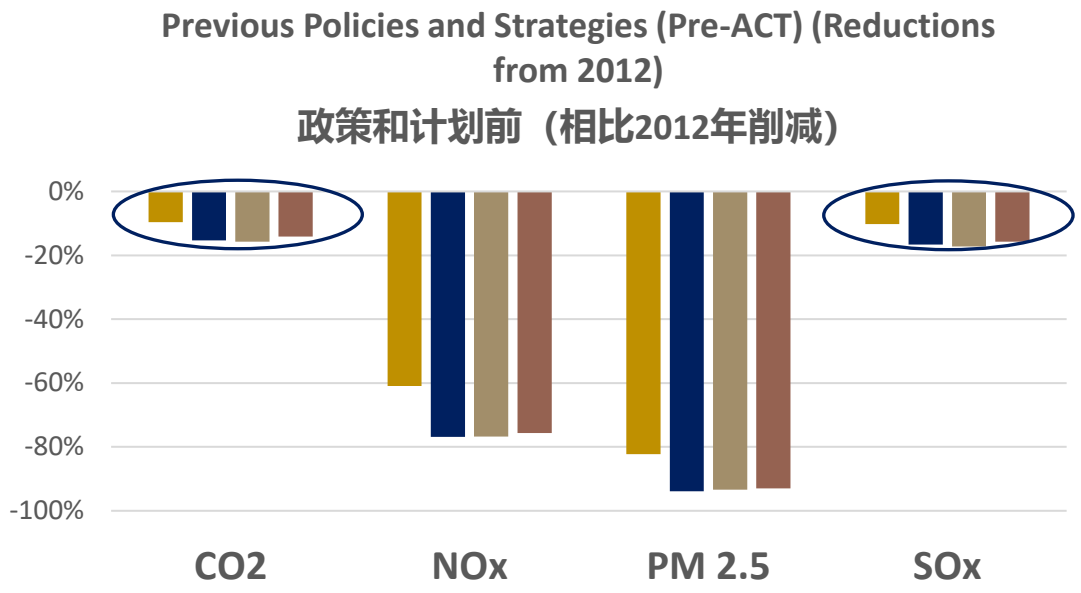
先进清洁卡车法规和其他政策实施要素

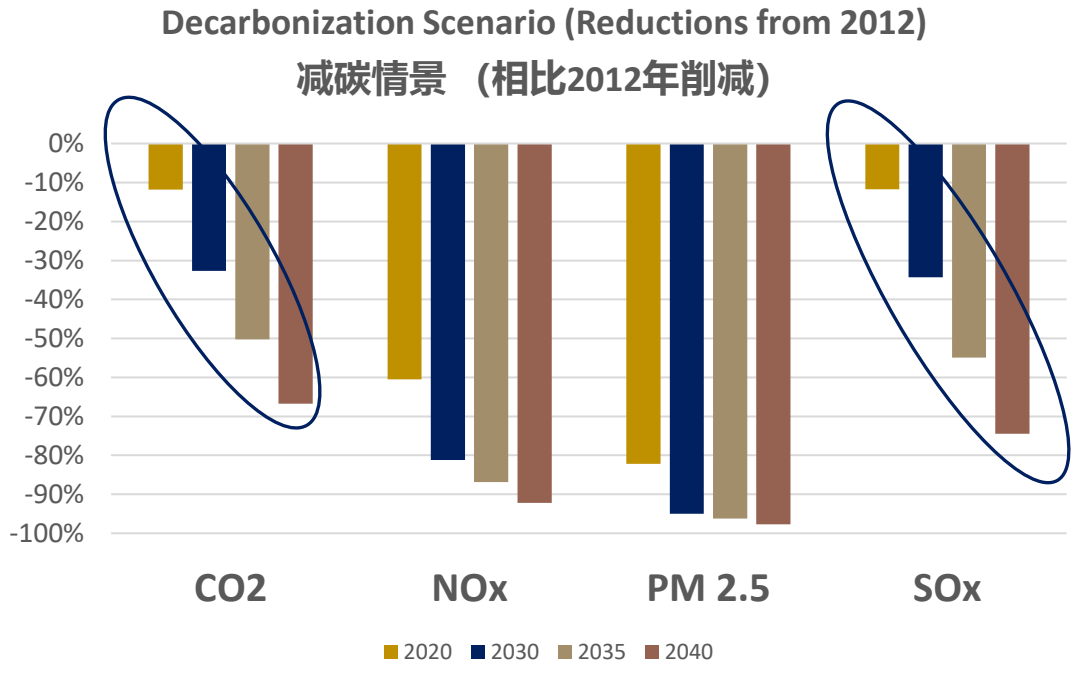
Introduction of ZEVs (battery electric, fuel cell)

零排放车辆引入（电动车、燃料电池车）

Estimates for Southern California

据南加州估算





What are key determinants to achieve adoption?
实现目标的关键因素是哪些?

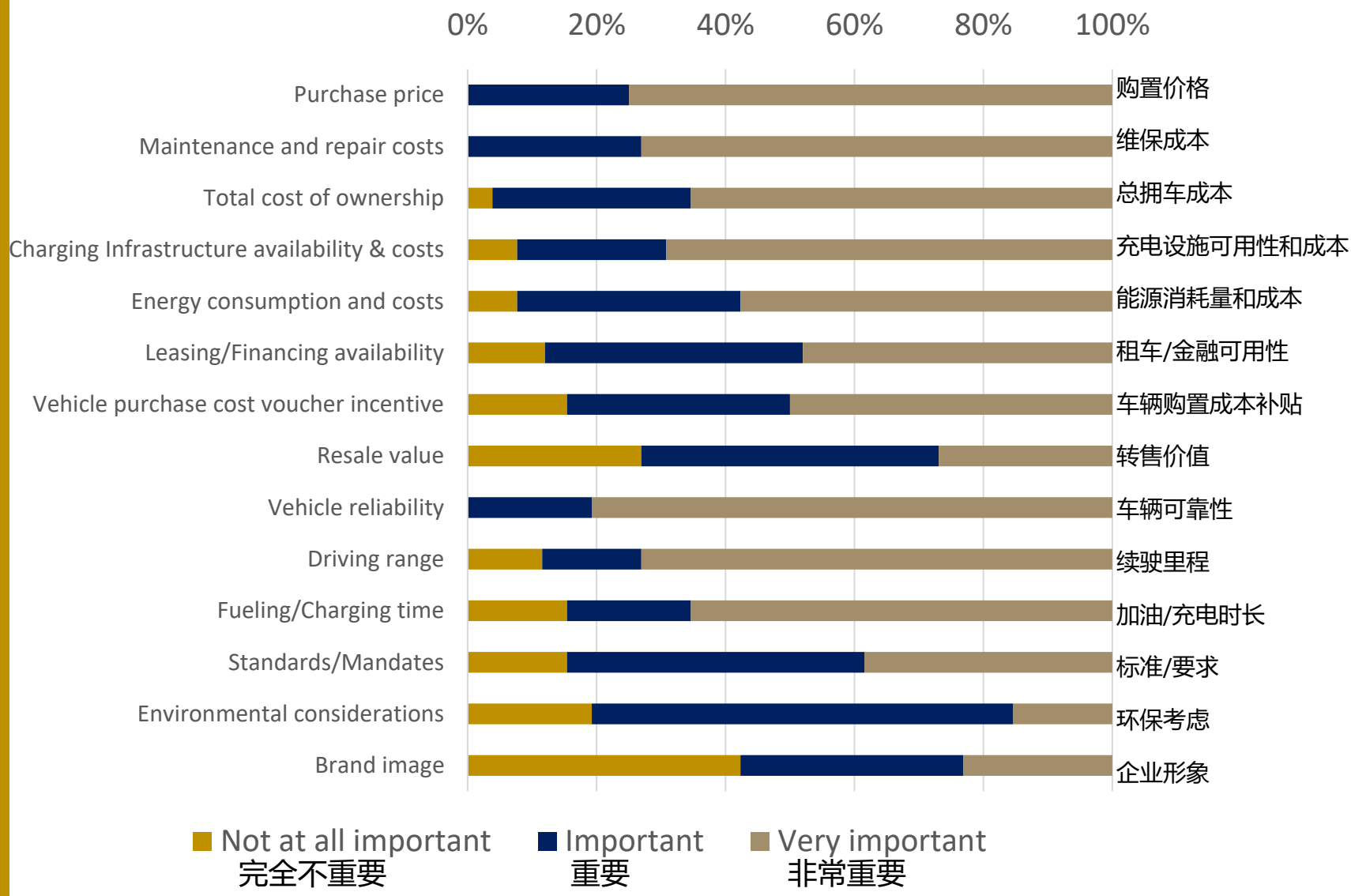
Jaller, M., L. Pineda, Y. Gueldas, F. Alemi, and I. Otay (2020). Fostering the Use of Zero and Near Zero Emission Vehicles in Freight Operations. National Center for Sustainable Transportation. Institute of Transportation Studies, University of California, Davis. https://escholarship.org/uc/item/64k579cv

Jaller, M. L. Pineda, and H. Ambrose (2018). Evaluating the Use of Zero-Emission Vehicles in Last Mile Deliveries. National Center for Sustainable Transportation. University of California, Davis. https://escholarship.org/uc/item/7kr753nm

How to Make it Happen?

如何使其发生?

What is important to companies? 企业看重的因素



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Role of Incentives 补贴法规

HVIP	VW	Carl Moyer	AB617
低NOx发动机，ZEVs和基础设施，先进技术	零排放卡车和大巴车更换	更清洁的发动机、ZEVs和基础设施	弱势社区的发动机更新和基础设施建设
18-19 财年，1.25亿美元	4.23亿美元	18-19财年，7900万美元	18-19财年，2.45亿美元

HVIP	VW	Carl Moyer	AB 617
Low NO_X engines, ZEVs plus infrastructure, advanced technology **FY 18-19** **$125 M**	Zero-emission truck and bus replacements **$423 M**	Cleaner engines & ZEVs plus fueling infrastructure **FY 18-19** **$79 M**	Engine replacement & infrastructure in DAC **FY 18-19** **$245 M**

Truck Loans	Utility Programs	LCFS
Helps small businesses with 10 or fewer trucks upgrade to newer trucks	Charging infrastructure service upgrades and electricity rates (SB350) **>$579 M**	Credits for using low carbon transportation fuels **Offsets Most/All Electricity Costs for Trucks and Buses**

卡车贷款项目	电力项目	LCFS
帮助车辆数10辆及以下的小企业更换新车	充电设施升级改造和电费补贴（SB350）	使用低碳交通燃料补贴
18-19 财年，1.25亿美元	超过5.79亿美元	抵消卡车和大巴车的大部分/全部电力成本

Once purchase requirements kick in…"no more" purchase incentives

一旦购置要求开始实施…“不再有”购置补贴

However… Transitioning to Zero Emission Vehicles will Take Time
但是，零排放转型需要花一些时间

Diesel vehicles dominate the market

柴油车辆占据主要市场

Zero emission vehicles 零排放车辆:

- Are not necessarily mass produced
- 有些没有大规模生产
- Pilots still ongoing
- 有些仍在试点
- There are still some technical challenges for various vocations
- 对于不同行业的车辆应用仍有些技术障碍

During the transition, we can…

转型过程中，我们可以…

- Implement tighter regulations on emissions standards
- 实施更严格的排放标准法规
- Design them better (e.g., drivetrain, powertrain)
- 更好地设计车辆（如，动力技术、驱动能量技术）
- Choose them better (e.g., right sizing)
- 更好地选择车型（如，正确的车辆大小）
- Drive them better (e.g., eco-driving, eco-routing)
- 更好地驾驶车辆（如，节能驾驶、环保路线）
- Manage how they perform (e.g., geo-fencing)
- 管理它们的表现（如，地理围栏）

we can also…

我们还可以…

- Use them differently by changing our distribution networks
- 通过变更运送网络来变更车辆使用方式
- Change our logistics systems
- 改变物流系统

Can we drive them better?
我们能更好地驾驶车辆吗?

Jaller, M., A. Pahwa, and M. Zhang (2021). Cargo Routing and Disadvantaged Communities. Pacific Southwest Region University Transportation Center. Institute of Transportation Studies.

Case Study – Southern California
案例分析-南加州

Southern California Association of Governments (SCAG) Region

南加州联合管理区域（SCAG）

Counties: Venture, Los Angeles, San Bernardino, Riverside and Imperial

含郡县： Venture, Los Angeles, San Bernardino, Riverside and Imperial

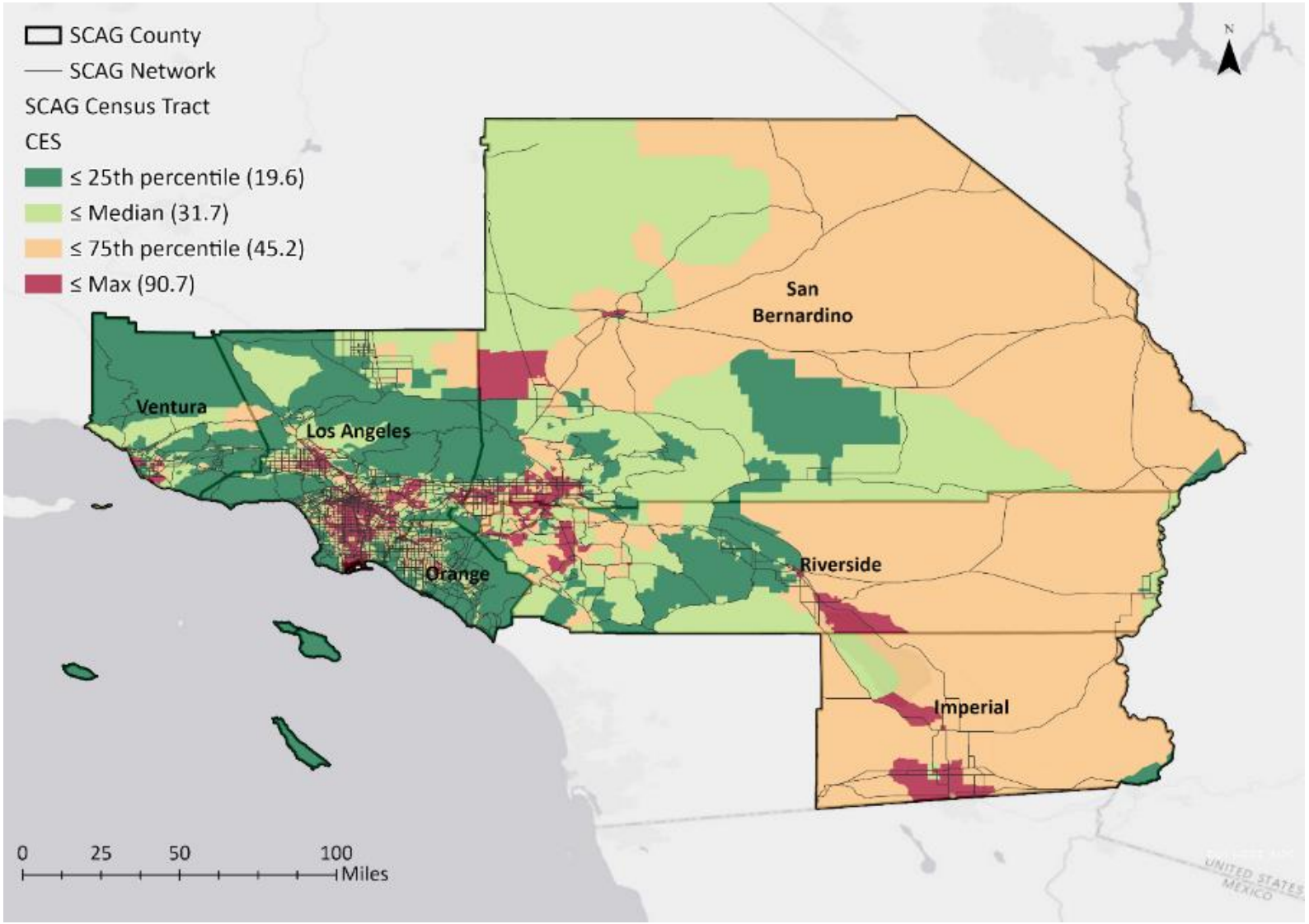
Home to the largest population centers in California ~ 18 million people

加州最大的居民区，约1800万居民

Home to the San Pedro Bay Ports 含圣保罗湾

CalEnviroscreen Score (CES) based on pollution burden and population characteristics

根据环境负荷和人群特征的加州环保打分 (CES)（分数越高环境越差）



Eco-routing and Geo-Fencing
环保路线和地理围栏

In simple terms简言之:

- Eco-routing is selecting the optimal route based on the minimization of emissions and the associated impacts, in addition to the traditional distance/time minimization strategies
- 环保路线是，基于排放和其他影响最小化，并结合传统的距离/时间最小化策略，来选择最优路线
- Geo-fencing is designating specific areas as “sensitive.” Similar to low emission zones, but could be expanded to other system and supply chain management operations
- 地理围栏是设计具体区域为“敏感区域”。与低排放区类似，但可拓展至其他系统和供应链管理措施。

Combining eco-routing and geo-fencing could bring about great benefits
环保路线和地理围栏相结合将带来显著效益

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System Impacts of Eco-Routing
环保路线系统影响

Multi-Class Traffic Equilibrium Effects

不同车型交通均衡影响

Options 选项:

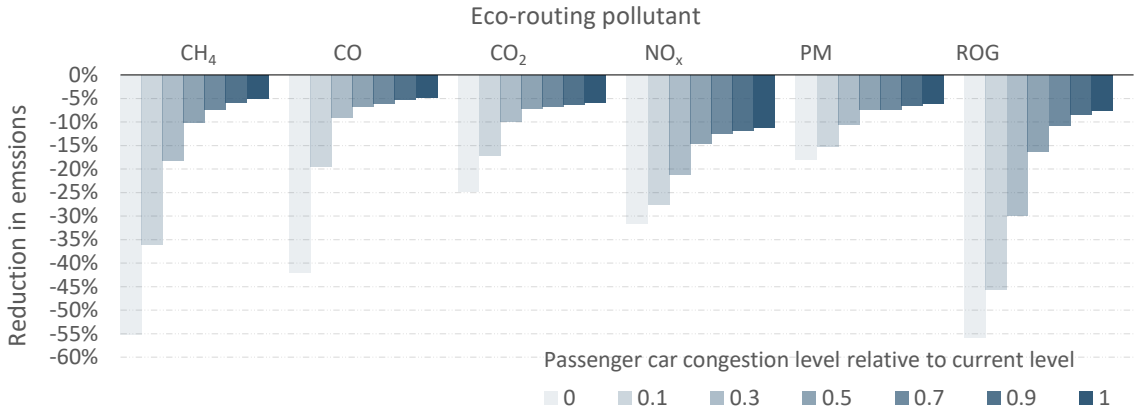
- Shortest Path (SP) 最短路径
- Fasters Path (FP)　最快路径
- Least-cost Path (LCP) 最低成本路径
  - Time, distance and energy 时间、距离、能源
- Least-emissions Path (LEP) 最低排放路径
  - CO2, NOx, SOx, PM, ROG, CO, CH4

Impacts of eco-routed HDV for different levels of LDV flows

不同轻型车流量下，环保路线的重型车影响效果

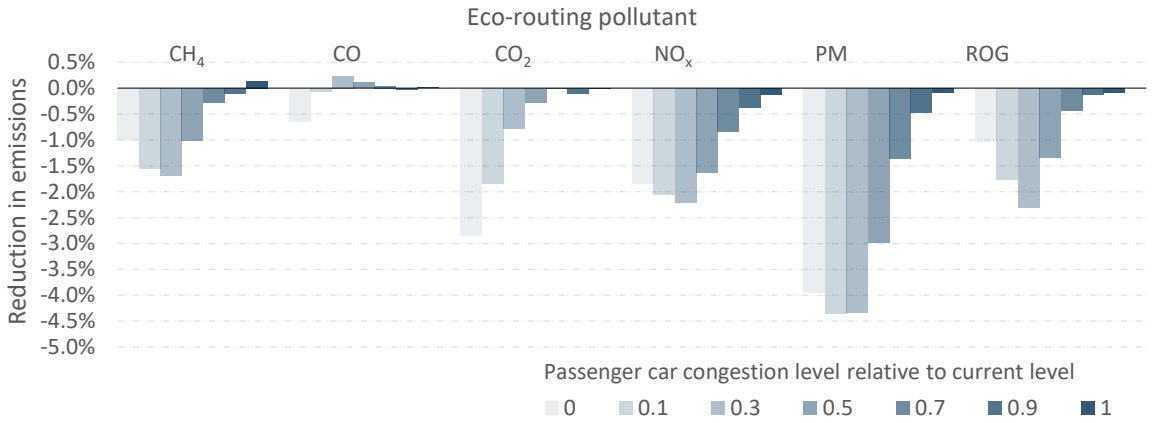
LEP vs. SP

低排放路线较最短路线



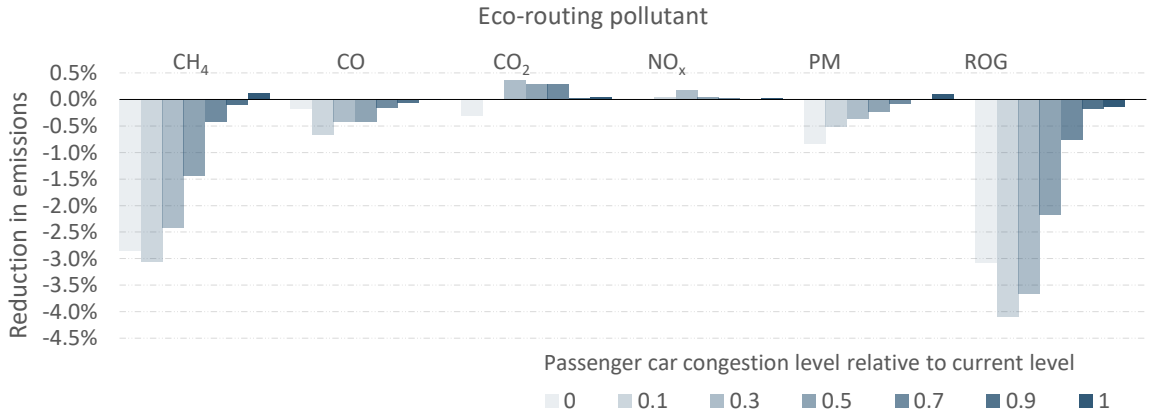
LEP vs. FP

低排放路线较最快路线



LEP vs. LCP

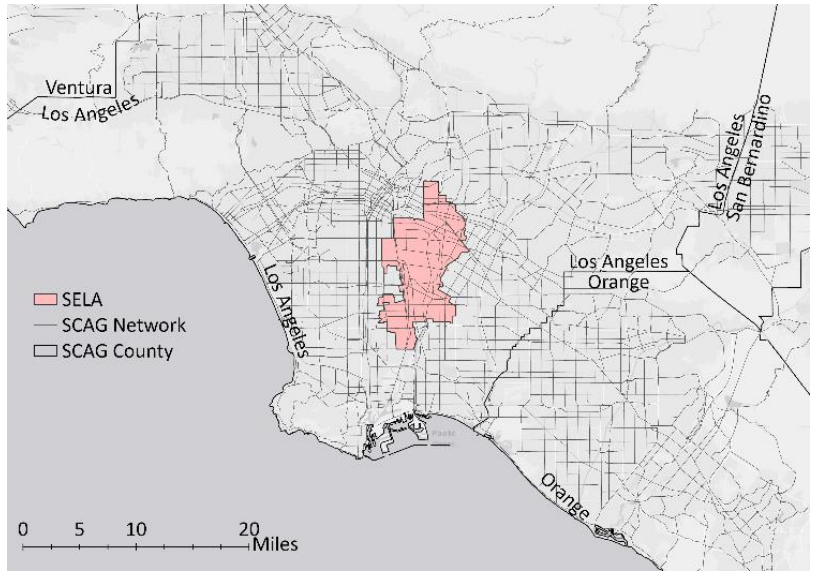
低排放路线较低成本路线



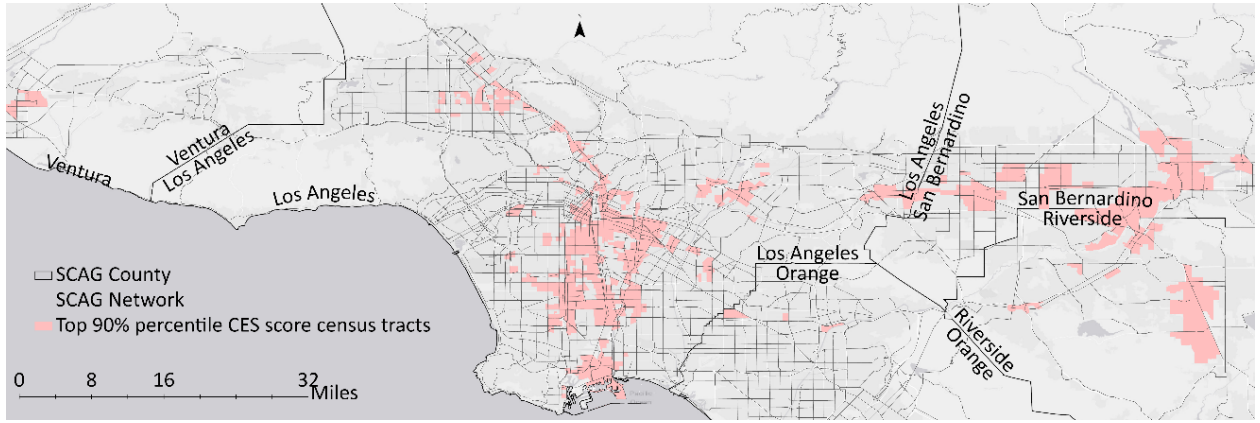
Geofencing Impacts
地理围栏影响

South East Los Angeles Region

洛杉矶东南区域



South East LA



High CES score census tracts

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SELA Geofence
洛杉矶东南区域地理围栏

Increased costs (extra fee) when traversing inside the geofenced region

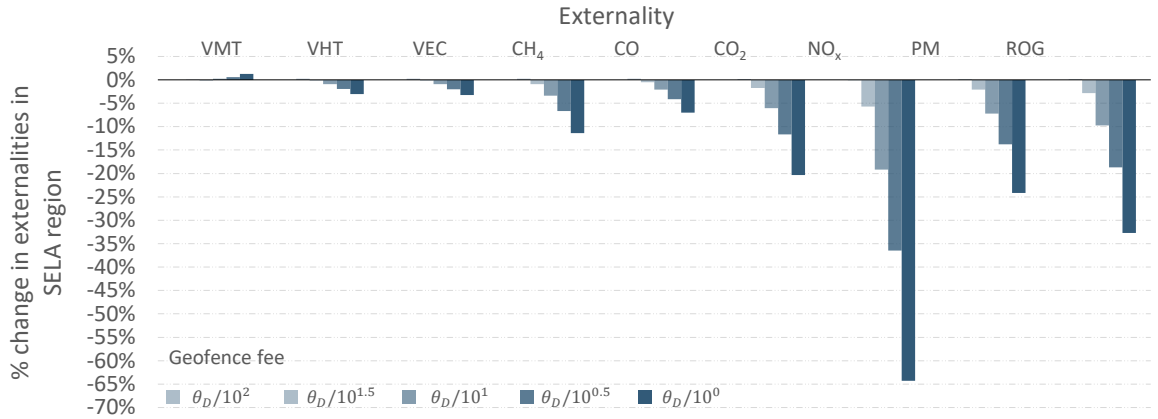
Extra fee evaluated up to twice of the regular cost (extra fee = $\theta/10^0$)

驶入地理围栏区域需支付额外费用增加成本

额外费用按日常成本的两倍计算

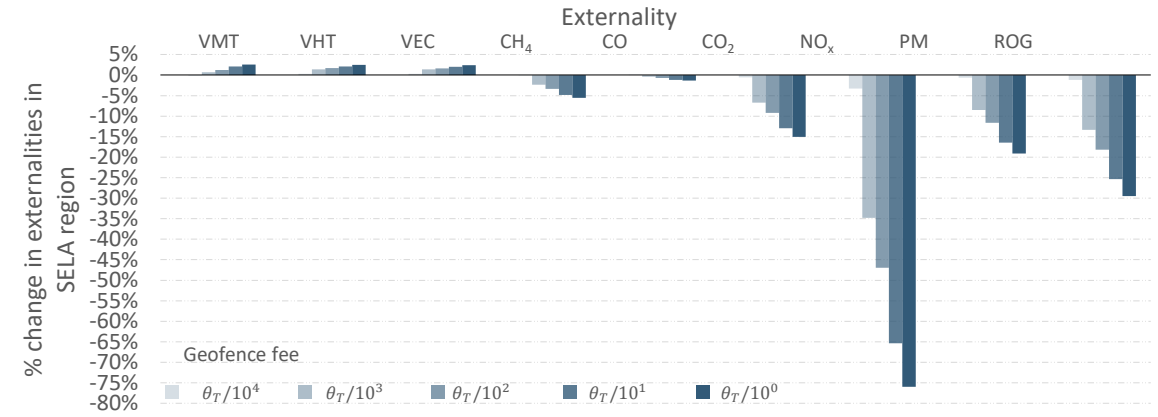
LEP vs. SP

低排放路线较最短路线



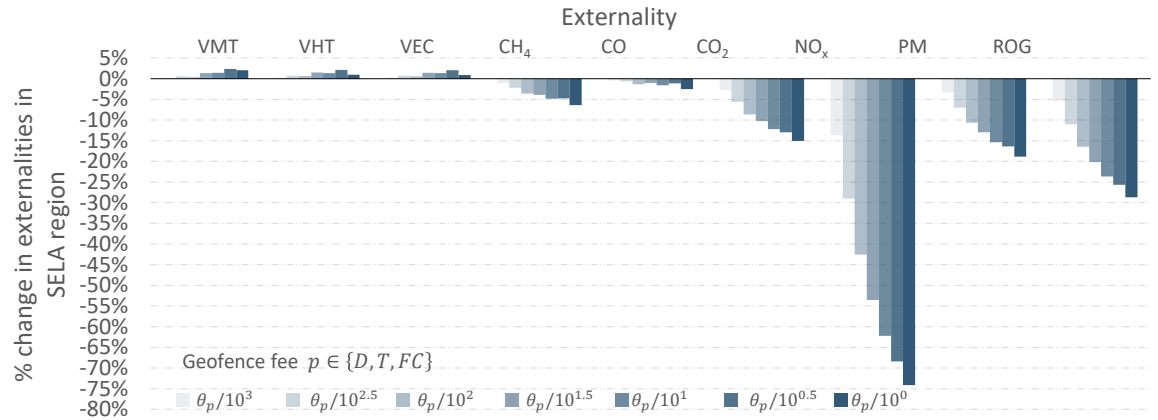
LEP vs. FP

低排放路线较最快路线



LEP vs. LCP

低排放路线较低成本路线



Insights 要点

- Long commitment to improve freight efficiency, introduce zero emission technologies, and improve economic competitiveness 提升货运效率、引入零排放技术和改善经济竞争力的长期目标
- Need for comprehensive strategies that foster需要综合战略来促进:
  - Behavioral changes 改变行为
  - Adoption of cleaner technologies 采用更清洁的技术
- Incentives are needed 需要激励政策
- Advanced Clean Truck (ACT) Rule – First ever truck OEM sales mandate 先进清洁卡车法规—史上首个要求卡车供应商销售量的法规
  - Aggressive zero-emission vehicle sales target 激进的零排放车辆销售目标
  - Will potentially need a “fleet” mandate 未来需要针对车队进行要求
- Eco-routing and Geofencing could be alternatives in the short-term 环保路线和地理围栏短期内可作为备选方案
  - Mitigate the impact to disadvantaged communities 减少对弱势社区的影响
  - Need to investigate private and system wide-impacts 需考察对企业和系统更广泛的影响

Questions! 欢迎提问

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