Dynamic Ridesharing Services: Potential Reductions in Vehicle Miles Traveled and Greenhouse Gas Emissions

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Introduction

- New vehicle & fuel technology needed, but not sufficient, to meet GHG goals
- Demand management (land use, transit, & auto pricing) also needed
- In California,
  - AB 32 strong GHG goals
  - SB 375 reductions from regional land use and transportation planning to meet AB 32 goals.

Demand Management

- Land Use and Transit
  - VMT reduced by 1.3% to 3.2% from BAU
- Auto Pricing
  - Most effective at high levels
- Both politically difficult to implement
- Recently, dynamic ridesharing also shows promise, but little research on travel effects at regional scale.

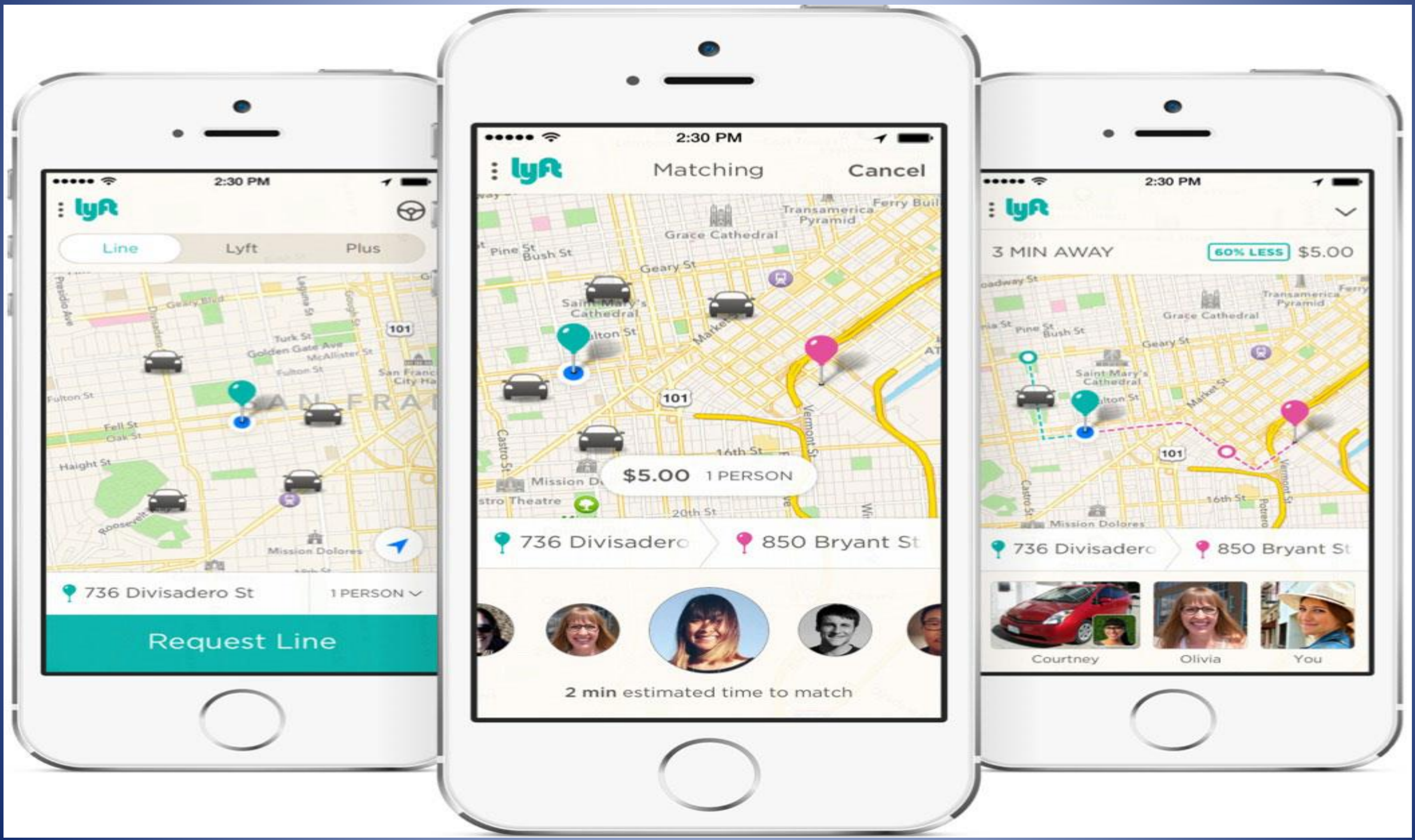
Case Study Questions

- San Francisco Bay Area Activity Based Travel Model (2010)
- What is the potential magnitude VMT reduction from dynamic ridesharing?
- How might land use, transit, and auto pricing interact with these services and change VMT/GHG reductions?

Background: What Is Dynamic Ridesharing?

- Match drivers and riders with similar spatial and temporal constraints
- Communicates match in advance or on demand (e.g., 15 to 60 seconds)

Smart Phone App: Lyft Line

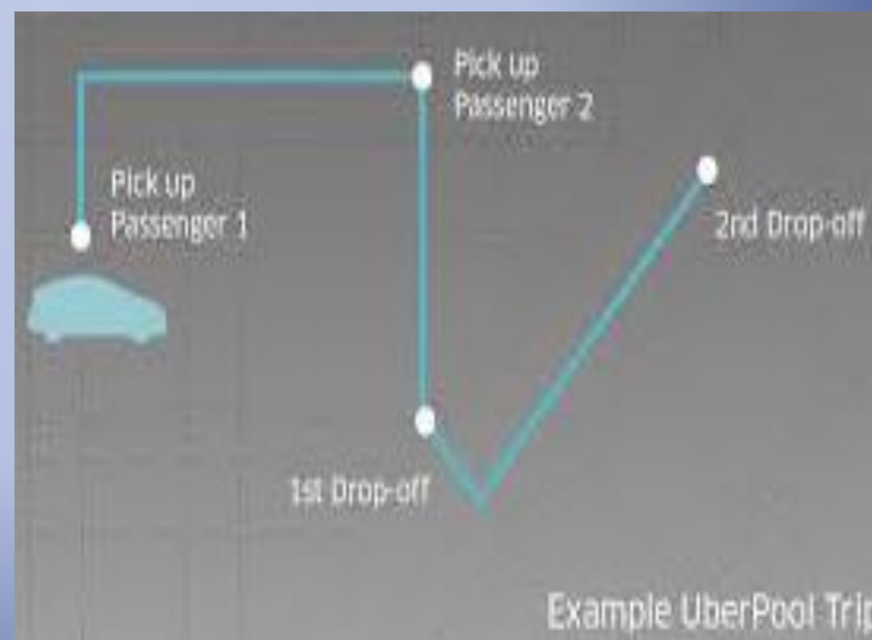


Peer-to-Peer Ridesharing

- Driver owns car and riders pay fee or entity pays flat service fee
  - Zimride
  - Carma

Taxi-Sharing Model

- Drivers licensed taxi drivers or independent contractors (e.g., UberPool and Lyft Line)
- Rider fees shared by driver and operator



Potential Travel Effects

- New mode at new travel time & cost price points to many destinations.
- May result in a series of complex & inter-related travel behavioral effects
- With both positive and negative effects on congestion & VMT/GHGs

Potential Synergisms: Land Use, Transit & Auto Pricing

- May increase the probability of ridesharing:
  - Transit & land use planning reduce spatial distribution of trip origins & destinations
  - Auto pricing could reduce travel costs for ridesharing drivers & passengers

Literature Review: Empirical

- Limited research evaluates the travel effects of dynamic ridesharing:
  - **Rayle et al. (2014):** Taxis and TNCs in San Francisco used as first/last mile modes and to access destinations faster than transit.
  - **Dill (2015):** Peer-to-peer carsharing services in Portland (OR) induced auto trips and substitutes for transit use.

Literature Review: Modeling

- Two studies use models to simulate dynamic ridesharing at the regional level:
  - **Agatz et al. (2011):** Morning commute VMT is reduced by 25% with low participation rates (2%) in Altlanta, GA
  - **Fagnant and Kockelman (2015):** Daily VMT is reduced by 10% when automated vehicles operate as a shared-use taxi service in Austin, TX

San Francisco Bay Area MTC's ABM

- 2000 Bay Area Travel Behavior Survey
- 2000 PUMs and 2010 Census
  - Households and population by four income quartiles, population by five age categories, high/grade school enrollment and six employment categories
- Tours (unit of analysis):
  - Four mandatory tours: work, university, high school and grade school
  - Six non-mandatory tours: escort, shop, other maintenance, social/recreational, eat out and other discretionary

MTC's ABM: Transportation Supply

- Transportation analysis zones & road/transit networks
  - Modes: drive alone free and pay, shared ride free and paid, walk, bike, and transit (with walk, bike, and drive access/egress modes)
  - 1,454 zones
  - Time periods: early off-peak, morning peak, midday, PM Peak, and off-peak late

Methods: Induced Travel

- Applied elasticity from literature instead of the complete convergence process.
  - 0.64 VMT with respect to mean MPH, Cervero, 2003
- Post-processing dynamic ridesharing code more complex and computer run significantly longer.
- Converged 2010 Base Case with one run for alternative scenario.
- Allowed simulation of more scenarios and exploration of uncertainty model parameters for dynamic ridesharing.

Dynamic Ridesharing Scenario Analysis

- Potential dynamic ridesharing market and VMT reduction given a set of assumptions about the qualities of trips that may be "ride-sharable."
- Does not explicitly model individuals' willingness to use the service given travel time and cost of the service. Instead, we apply participate rates.
- Objective is to gain insight into magnitude of possible reductions in VMT from dynamic ridesharing.

Rideshare Conditions

- Minimum and maximum # of people *(group size)* –fixed 2-5
- Presence of one *driver* –fixed
- Percent of rideshare trips within a tour (*trips/ tour*) –fixed 50%
- Maximum tour stops (*max tour stops*) –fixed >6
- Maximum individual *income* level –fixed $500K
- Rate of ridesharing (*participation rate*) –variable
- Maximum miles between trip origin zones (*proximity*) –variable
- Maximum number of trips miles *(max trip length)* –variable
- Maximum wait minutes (*flexibility)* –variable

Scenarios: Dynamic Ridesharing

Minimum, Moderate & Maximum Use Values

Variable	Minimum	Moderate	Maximum
Participation	20%	50%	100%
Trip Length	30 miles	10 miles	5 miles
Proximity	1 mile	5 miles	15 miles
Flexibility	15 minutes	30 minutes	60 minutes

Scenarios:
Transit Oriented Development

Percentage Change from Base Case

TOD Scenarios	Households	Population
10%	0.44%	4.28%
20%	0.76%	8.07%
50%	1.53%	14.93%

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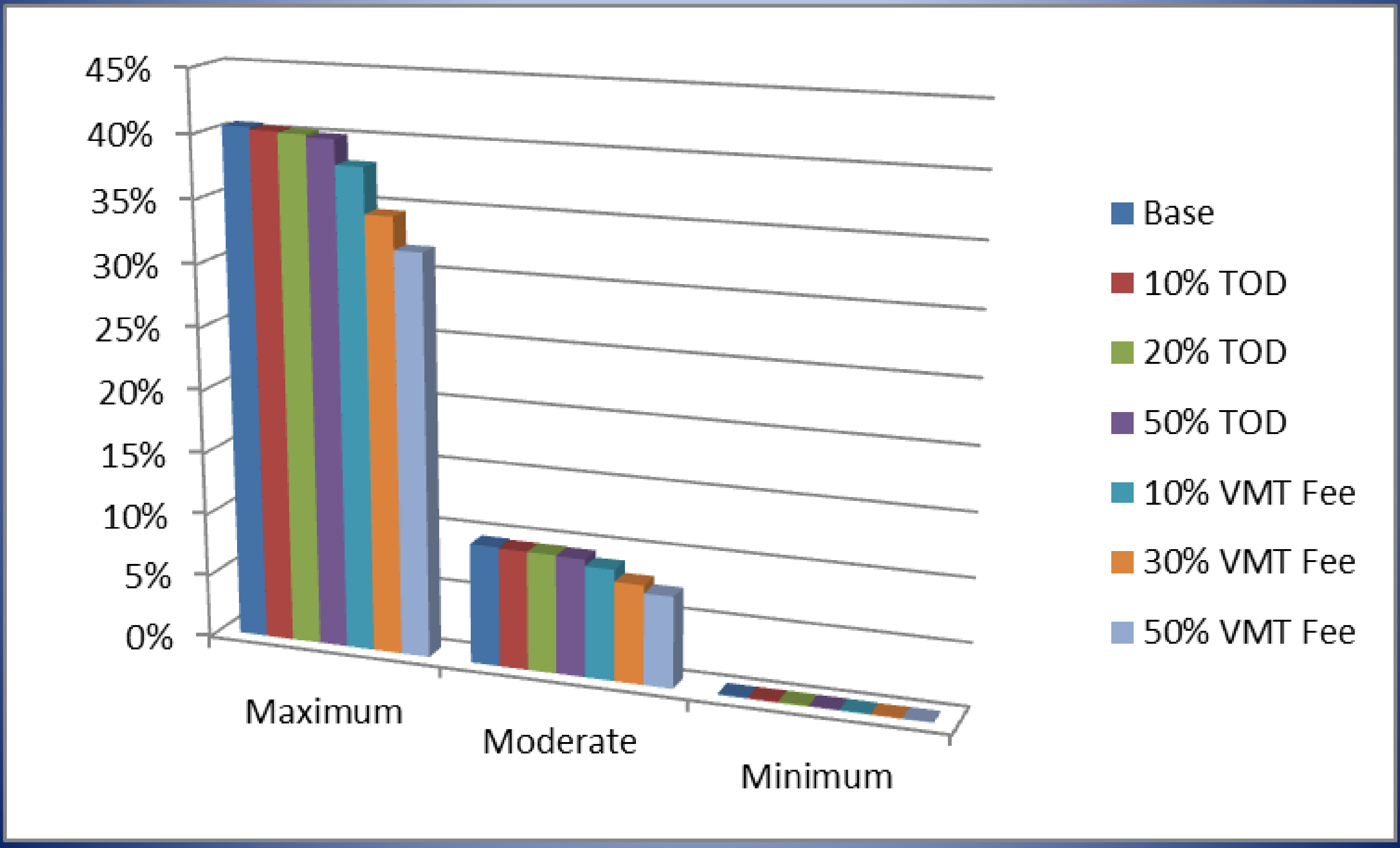
Scenarios: VMT Fee

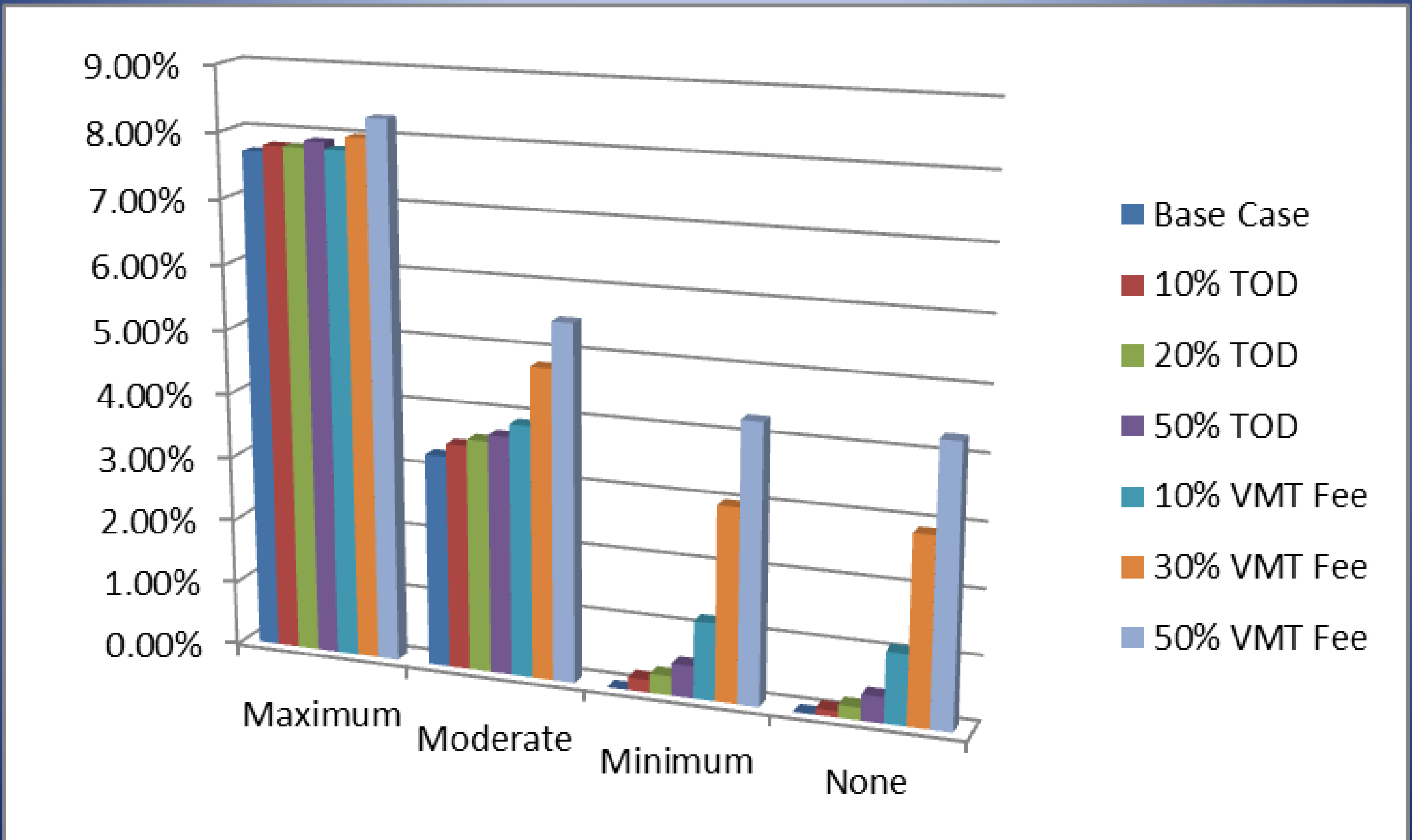
Percentage Change from Base Case

VMT Fee Scenarios	Per Mile Operating Cost
Base	17.90 cents
10%	25.40 cents
30%	40.40 cents
50%	55.40 cents

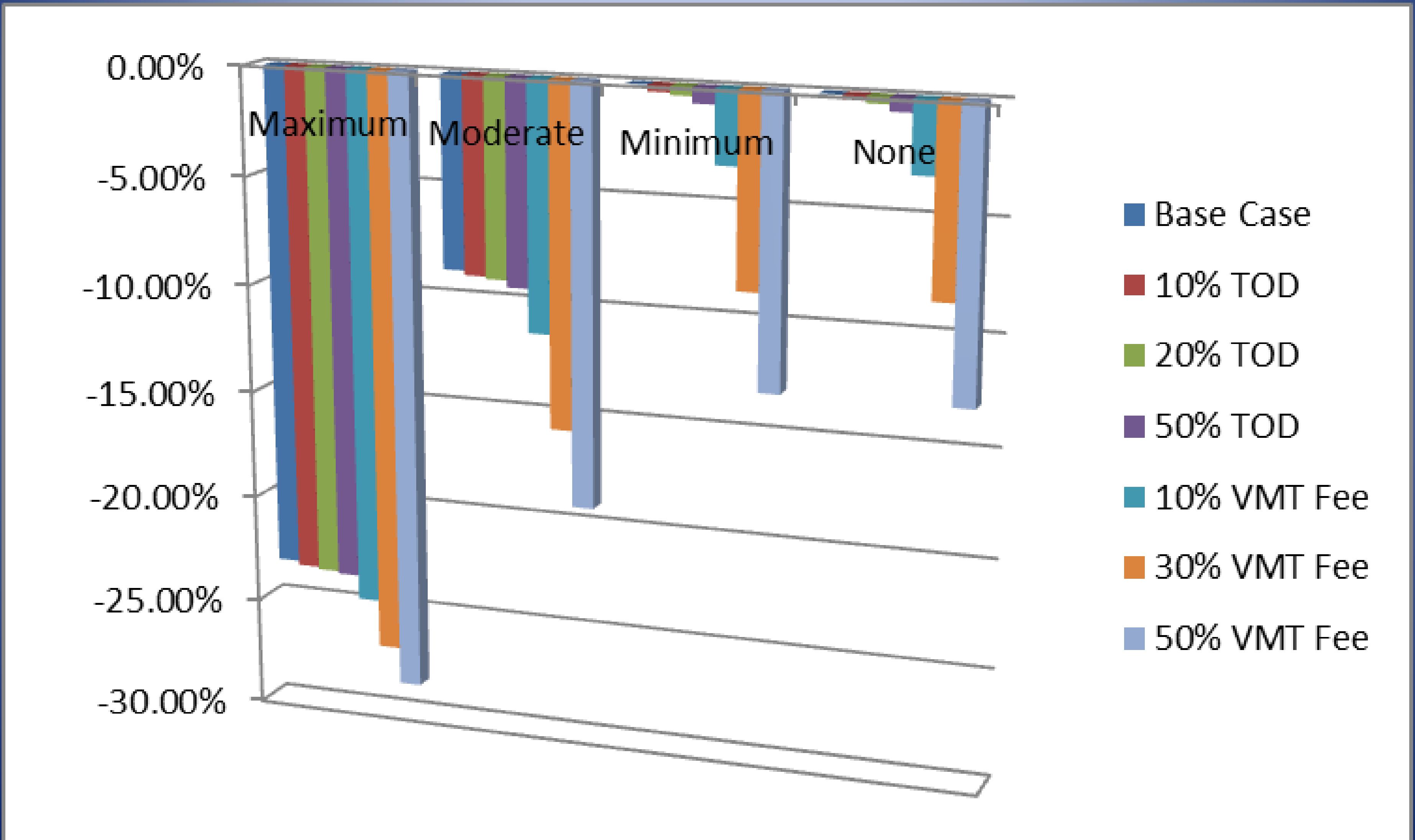
Ridesharable Trips Relative to Total Trips from Base



Percentage Change in Daily Mean Weighted MPH from Base



Percentage Reduction in VMT from Base



Conclusions

- Relatively large VMT reductions possible from ubiquitous dynamic ridesharing at regional level:
  - Moderate levels 9% reduction in VMT
- Combined ridesharing with TODs & VMT Fee suggest more feasible policy options:
  - A moderately used regional dynamic ridesharing with 10% increase in VMT fees may produce reductions in VMT on the order 11%

Future Research

- Factors Associated with Higher Use
  - Individual Attributes
  - Characteristics of Tours and Trips
  - Time and Cost of Dynamic Ridesharing
- Modeling Travel Effects More Explicitly
  - Auto Ownership
  - Mode Choice
  - Destination Choice
  - VMT from Taxi-Sharing

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Questions?