# Three Revolutions in Urban Transportation:

## *Future scenarios and the relative costs of mode choices and vehicle use cases in California*

***2018 Urbanism Next Conference***

***Portland, OR***

***March 5th, 2018***

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UC Davis

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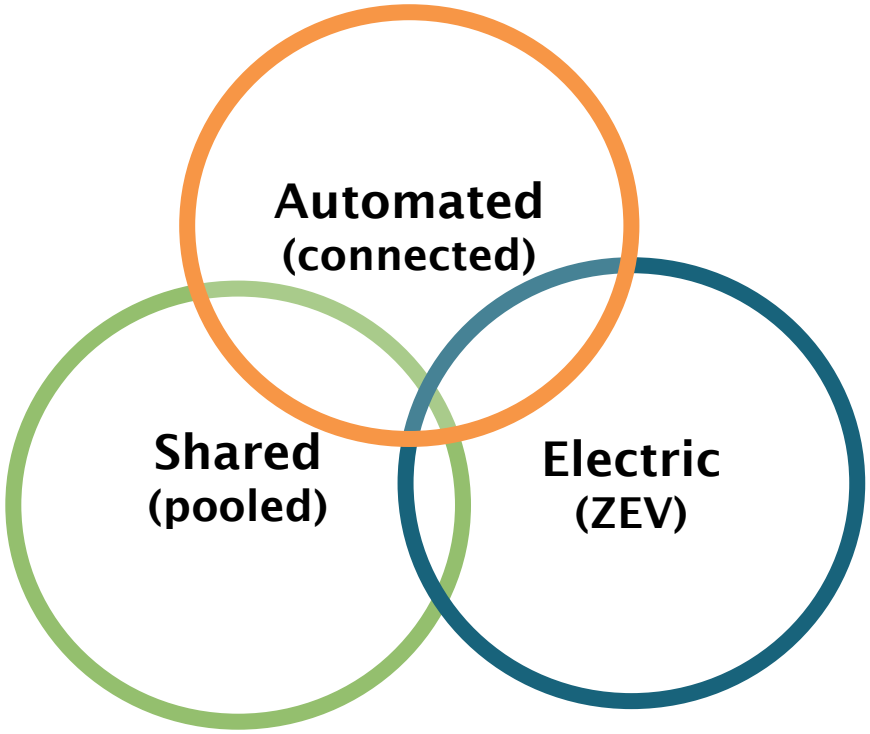
# UC Davis ITS 3 Revolutions Program

MISSION: There is an urgent need for *rigorous* ***research*** *and impartial* ***policy analysis*** *to understand the social and environmental* ***second-order impacts*** *of these transportation revolutions, and to* ***guide industry investments*** *and* ***government decision-making*** *to maximize public benefits.*




3 REVOLUTIONS
SHARED·AUTOMATED·ELECTRIC



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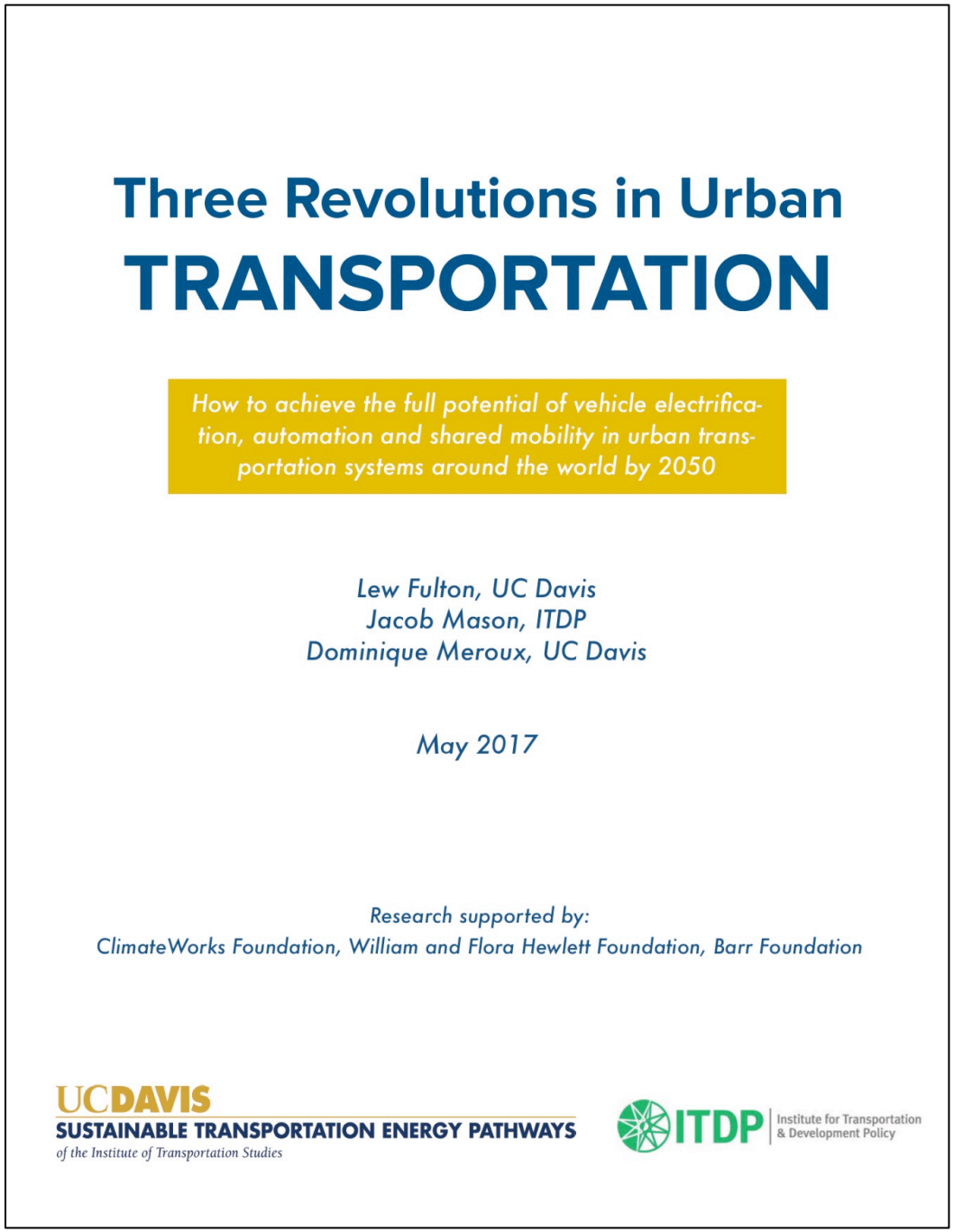
**Research undertaken by UC Davis and ITDP, part 3 of a series**

**Global scenario study to 2050 focused on potential 3 Revs impacts on CO2, energy use, costs**

**Study supported by UC Davis STEPS Consortium and by Climate Works, Hewlett Foundation, Barr Foundation**

**https://steps.ucdavis.edu/three-revolutions-landing-page/**



# Three Revolutions in Urban TRANSPORTATION

*How to achieve the full potential of vehicle electrification, automation and shared mobility in urban transportation systems around the world by 2050*

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*Dominique Meroux, UC Davis*

*May 2017*

*Research supported by:*
*ClimateWorks Foundation, William and Flora Hewlett Foundation, Barr Foundation*

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# Some questions and conflicts

- **Automation: lower per-trip costs, lower "time cost" for being in vehicles**
  - Just how much cheaper will it be?
  - Private automated vehicles = longer trips?
  - Empty running (zero passengers) of vehicles
  - Resulting relative costs of private vehicles, shared mobility, transit?

- **Electrification goes with automation – does it really?**
  - Can get the job done with upgraded electrical system (such as hybrids)
  - But electric running will be much cheaper – and durable?

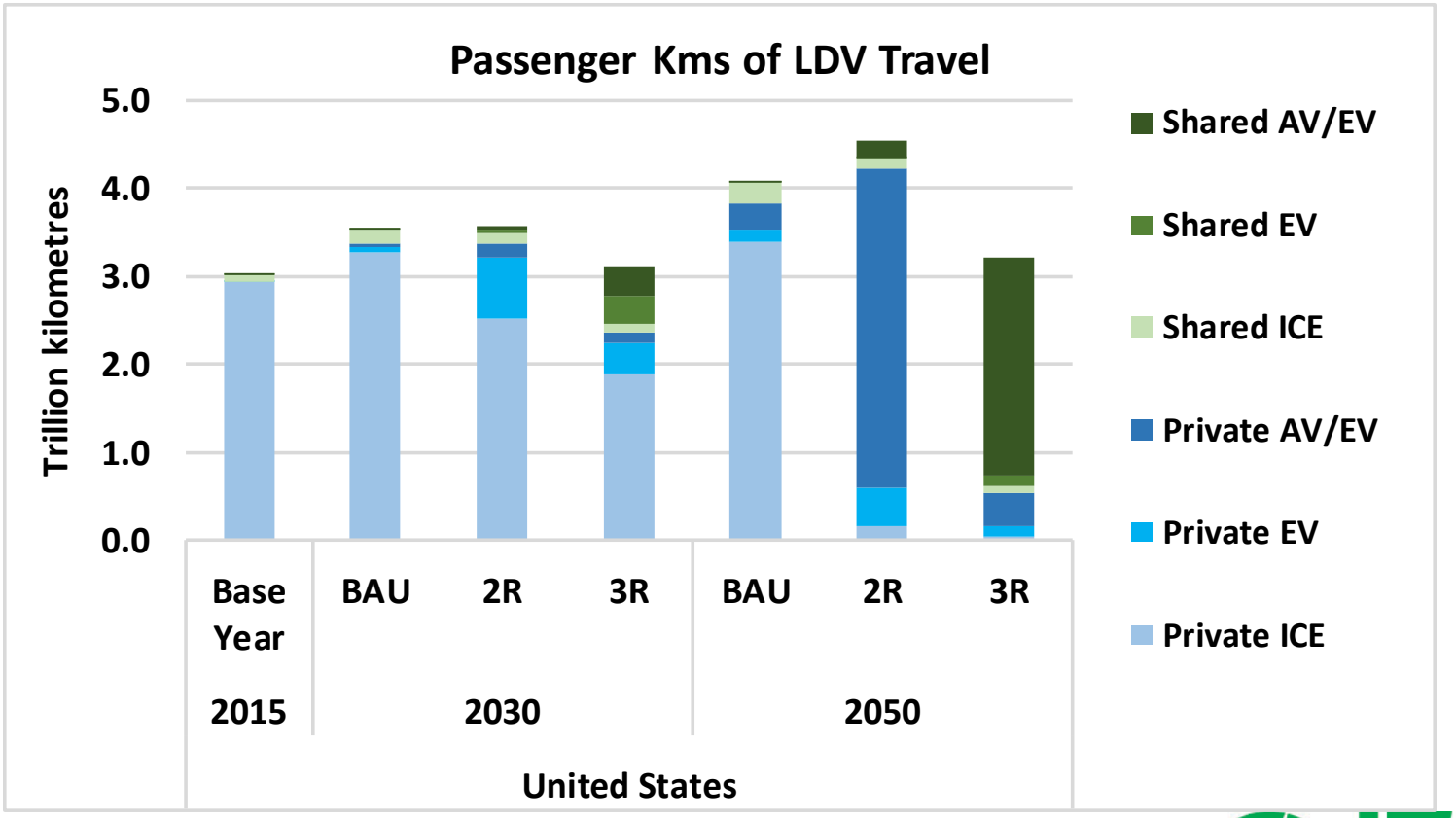
- **Ride hailing: cost savings v. convenience and risk**
  - Complementary or at conflict with public transit use?
  - Will lower costs reduce the incentive to ride share?

# Our report covers three scenarios

| | Auto-mation | Electrifi-cation | Shared Vehicles | Urban Planning/ Pricing/TDM Policies | Aligned with 1.5 Degree Scenario |
|---|---|---|---|---|---|
| Business as usual, Limited Intervention | Low | Low | Low | Low | No |
| 1R Automation only | HIGH | Low | Low | Low | No |
| 2R With high Electrification | HIGH | HIGH | Low | Low | Maybe |
| 3R With high shared mobility, transit, walking/cycling | HIGH | HIGH | HIGH | HIGH | YES |

# Urban LDV passenger kms by scenario, USA

- Electric vehicle travel reaches nearly 1/3 of PKMs by 2030
- Automated vehicle travel not significant by 2030 in any scenario, but dominates in 2R and 3R 2050. Results in much higher travel in 2R

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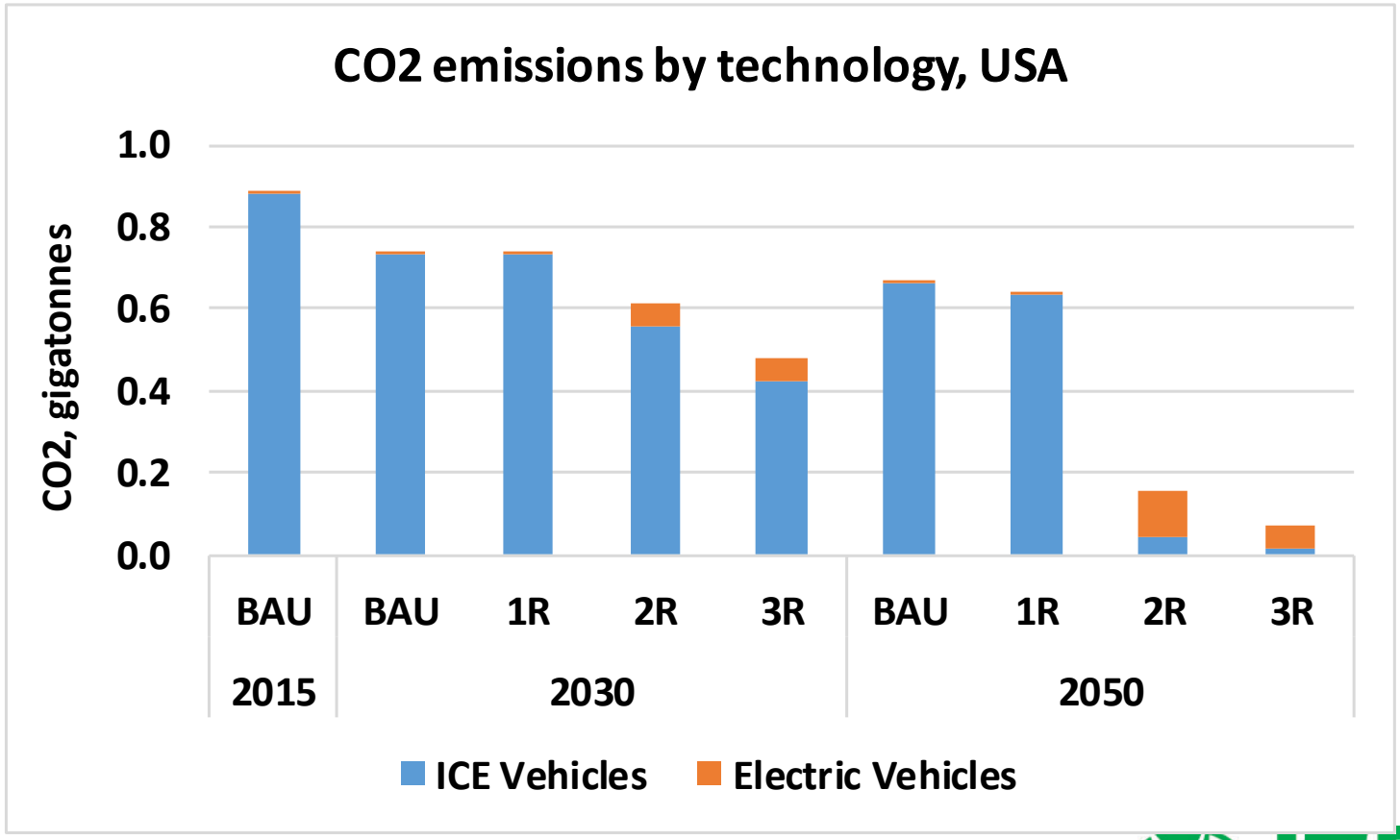
# Well-to-wheels CO2 by scenario/technology, USA

4DS electricity shown; in 2DS, CO2 from electricity drops to near zero in 2050

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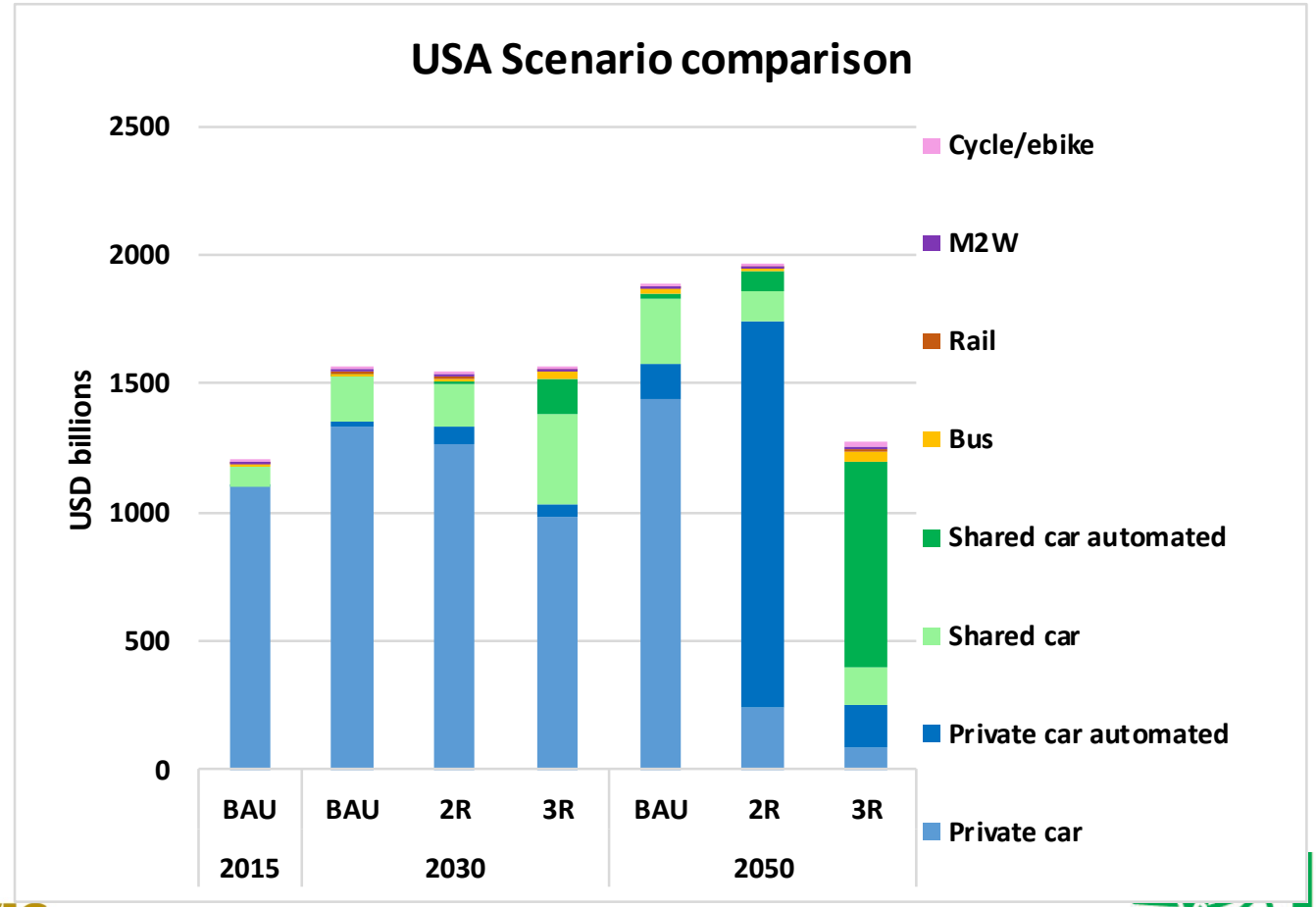
# Total cost by scenario and mode, USA

- Total societal (out-of-pocket) 3R cost in 2050 is only 2/3 of BAU or 2R cost, thanks to deep cuts in car ownership, energy use, and road/parking requirements

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# The wide range of costs related to mobility choices

## Out-of-pocket Costs

- Vehicle purchase
- Vehicle maintenance
- Fuel
- Insurance
- Cleaning
- Parking
- Driver
- MaaS fees
- Tolls
- Registration-related fees

## Hedonic costs

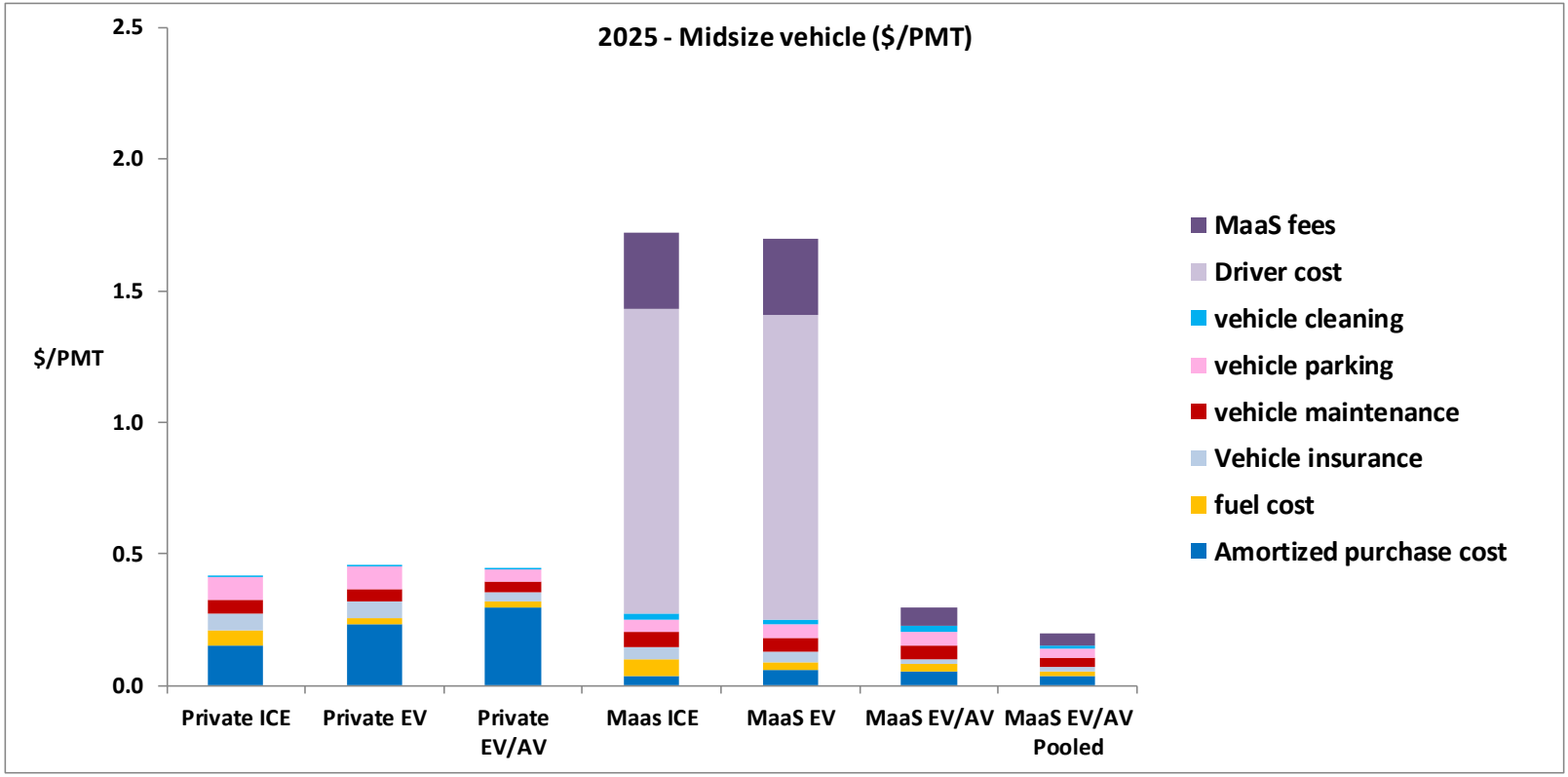
- Travel time (driving)
- Travel time (passenger)
- Parking search time
- Walking time
- Driving stress
- Shared trips (e.g. lack of privacy)
- EV range, charging anxiety
- Car ownership negatives (maintenance, registration, inspections etc.)
- Car ownership positives (car pride, guaranteed ride; can leave personal belongings in the car)

# A more detailed cost comparison: California in 2025

- The following presentation assumes widespread availability of electric vehicles (EVs) and electric, connected automated vehicles (or AV/EVs)
- Comparison here is the cost per mile of:
  - Private ICEs, EVs, and AV/EVs
  - MaaS (Mobility as a Service, such as Uber) versions of EVs and AV/EVs
  - Pooled services included, in later slides
- Start with looking at vehicle costs per mile, then consider passengers
- For some aspects need to assume specific trip lengths

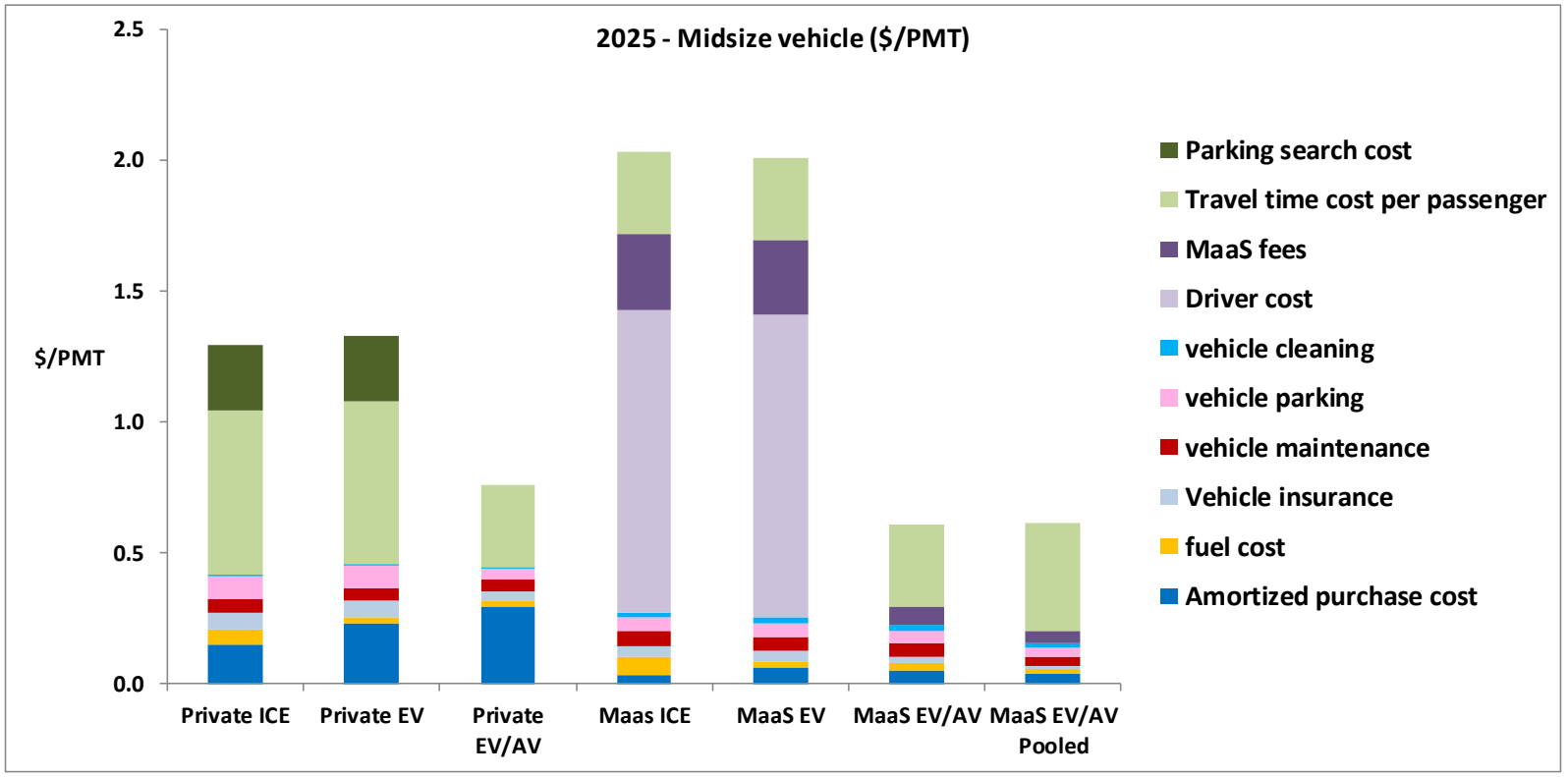
# Out-of-pocket costs: Comparison of modes

- ***Driven MaaS vehicles are premium service, automation makes these competitive***
- ***Pooled mobility is a good deal***



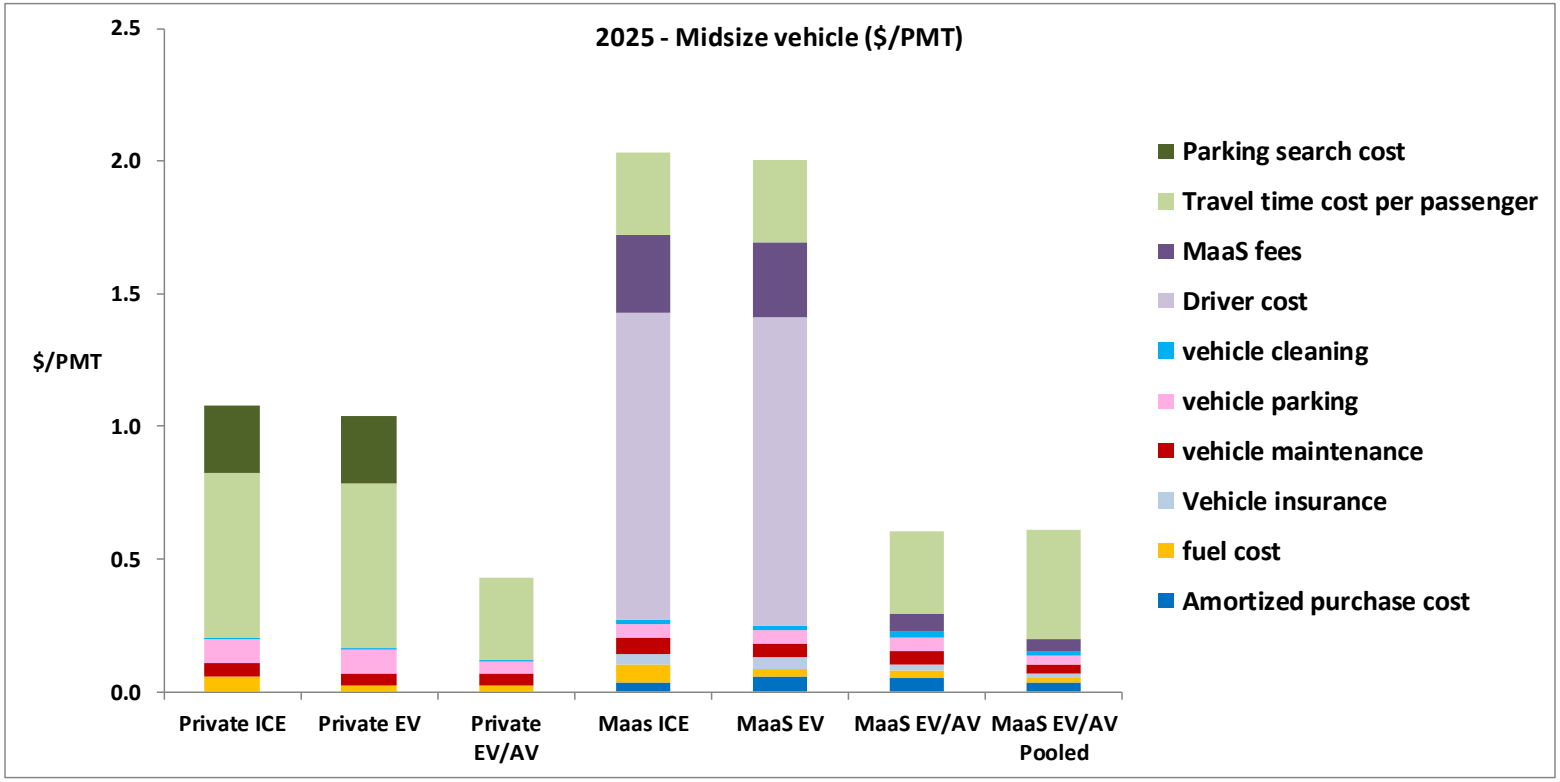
# Added a value of time for driving, travelling, parking

- ***Time costs are equal to or in some cases far greater than the out-of-pocket costs***
- ***Pooled mobility advantage disappears***



# Included only variable costs (daily decision)

- Ignore private car purchase, insurance cost
- ***The AV/EV private car becomes cheaper than shared mobility options***



# Supportive Policies – critical to success of the scenarios

- 3R Scenario (Automation + Electrification + **Sharing**):
  - Compact Urban Development policies
  - Efficient parking policies
  - Heavy investment in transit/walking/cycling
  - VKT fees (incl. congestion & emission factors):