Three Revolutions in Urban Transportation:

How will these affect the costs of trips?

STEPS Symposium

UC Davis

December 7, 2017

Lew Fulton, Co-Director
Sustainable Transportation Energy Pathways Program (STEPS)
UC Davis

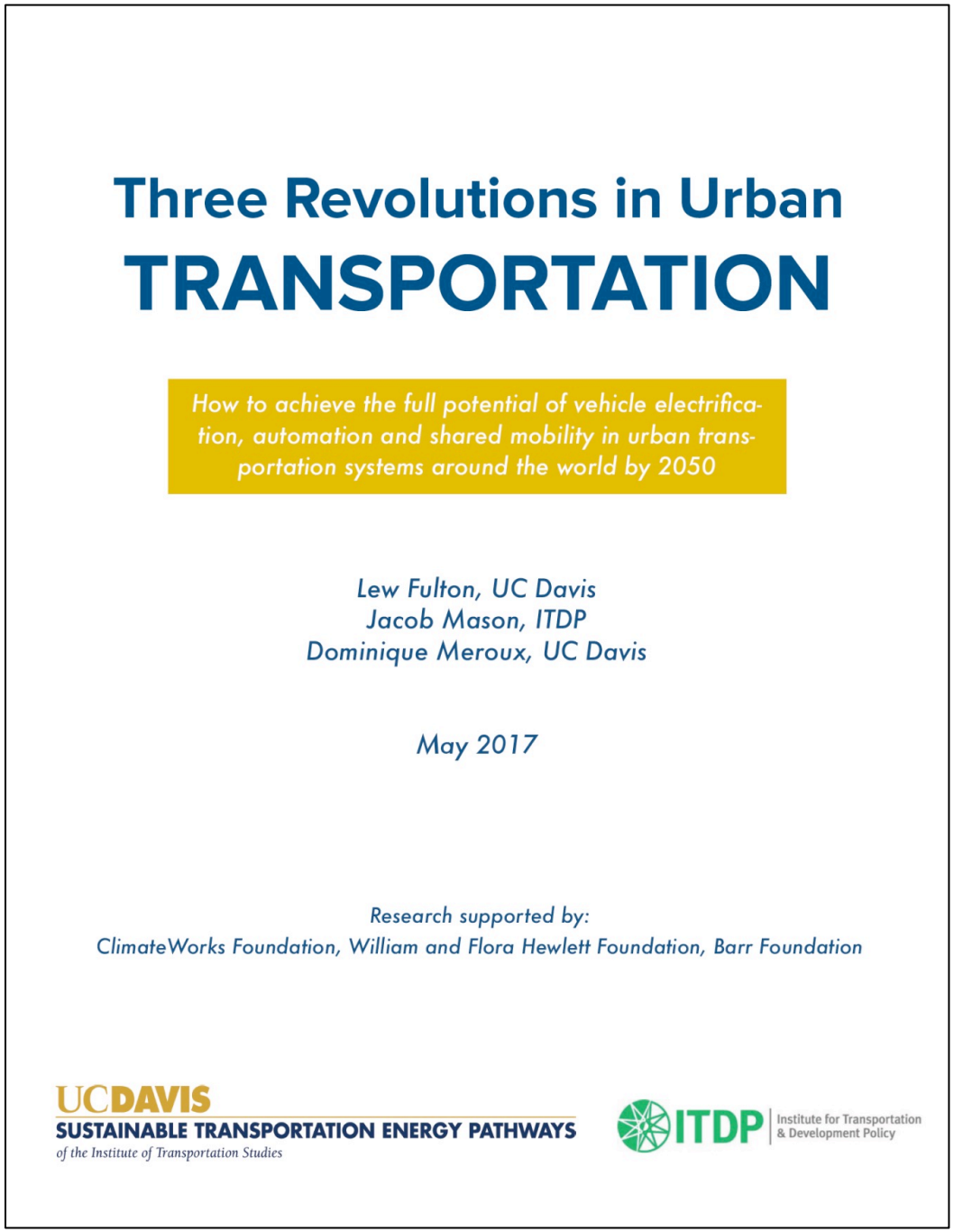
ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

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/



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?

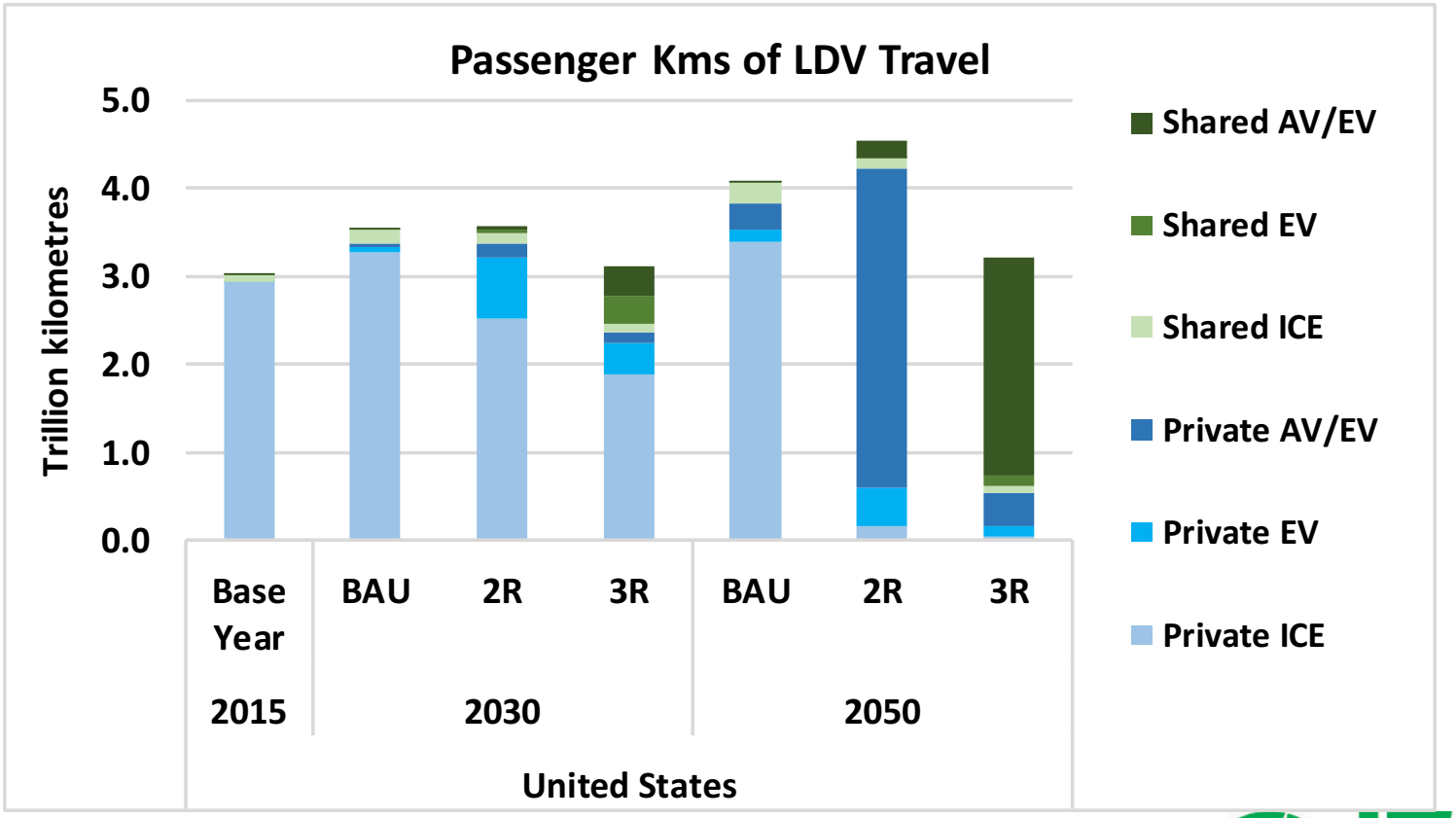
- **Ride hailing: cost savings v. convenience and risk**
  - Complementary or at conflict with public transit use?
  - Will lower costs reduce the incentive to ride share?

Rough guide to the 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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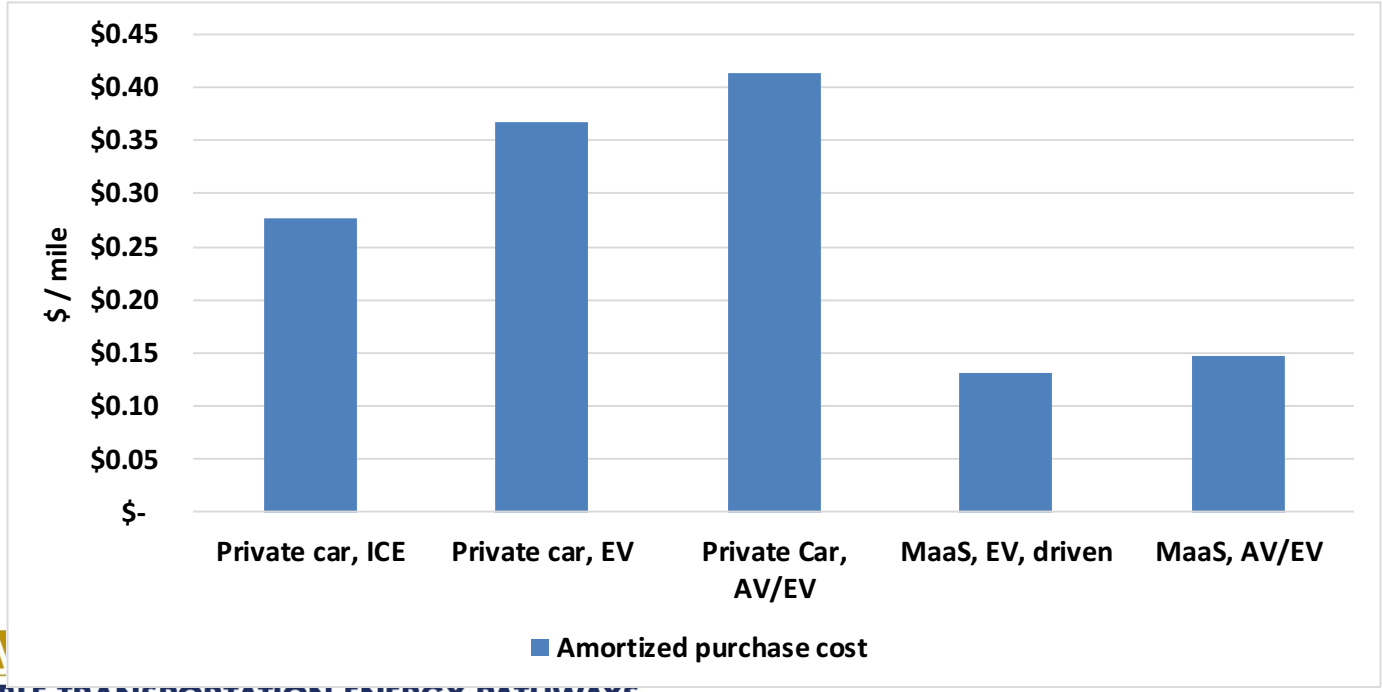
A more detailed cost comparison: California in 2025

- Junia Compostella working on this with me (see her poster)
- 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

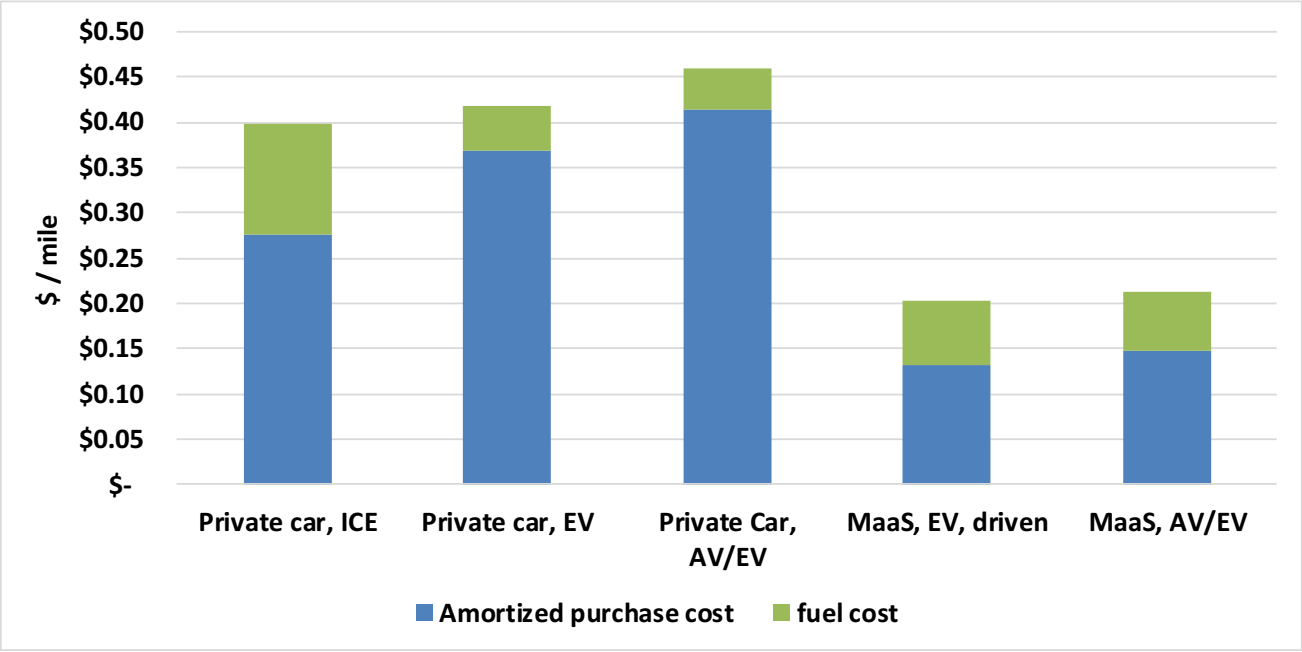
STEP 1: Purchase cost of vehicles

- Midsize car, $30k in 2025, 40 MPG
- EVs cost about $10,000 more than ICEs
  - EV battery costs at $150/kWh, 0.25 kWh/mi, 65 kWh capacity, 250 mile range
- AV/EVs $5000 more than EV, 10% better efficiency
- Private vehicles travel 13,000 miles per year, MaaS vehicles 50,000
- Some residual value for private vehicles after 5 years, none for MaaS vehicles



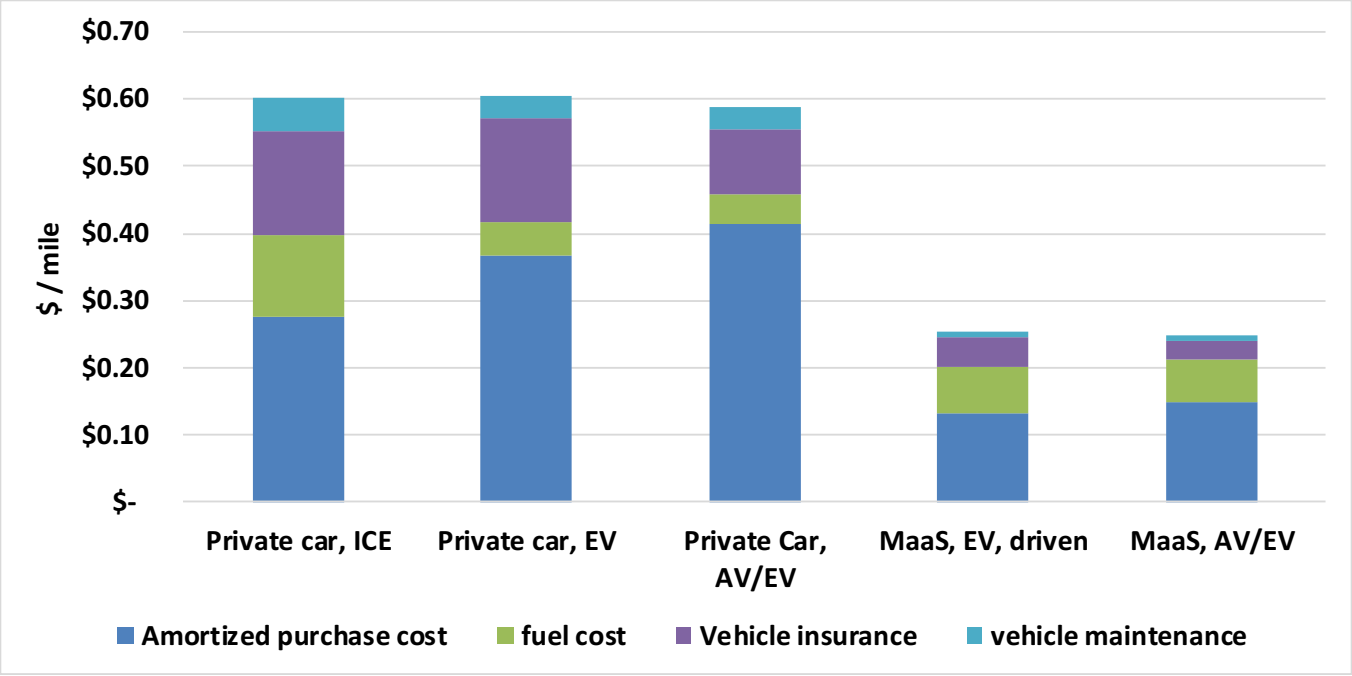
2: add fuel costs

- Gasoline: $4.00/gal; Private electricity: $0.17/kWh; Public electricity: $0.25/kWh
- ICE: 40 MPG; EV: 0.25 kWh/mi; AV/EV: 0.22 kWh/mi



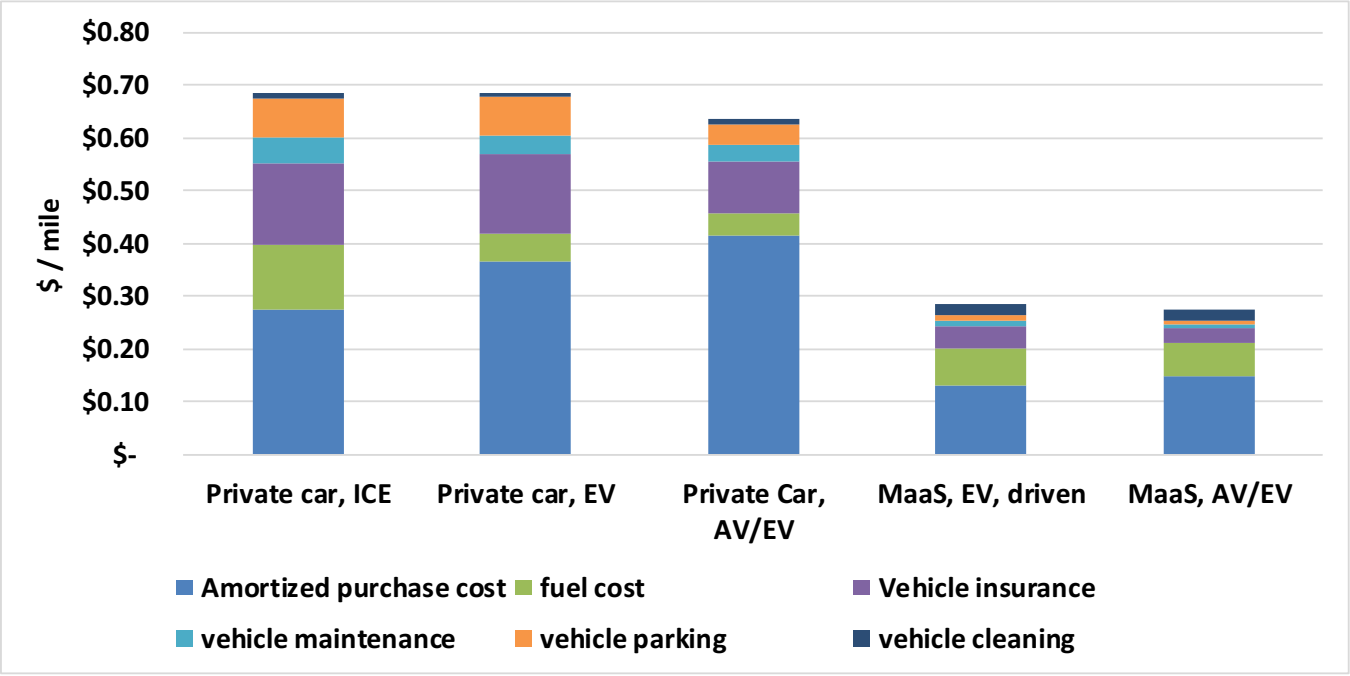
3: add insurance and maintenance

- Insurance cost is about $1900 per vehicle/yr for ICE and EV; 1/3 less for AV/EV
- MaaS similar as private (lower rate per mi but 4x miles/yr)
- Maintenance cost (motor, oil, tires, etc) 40% lower for EV and AV/EV than ICE



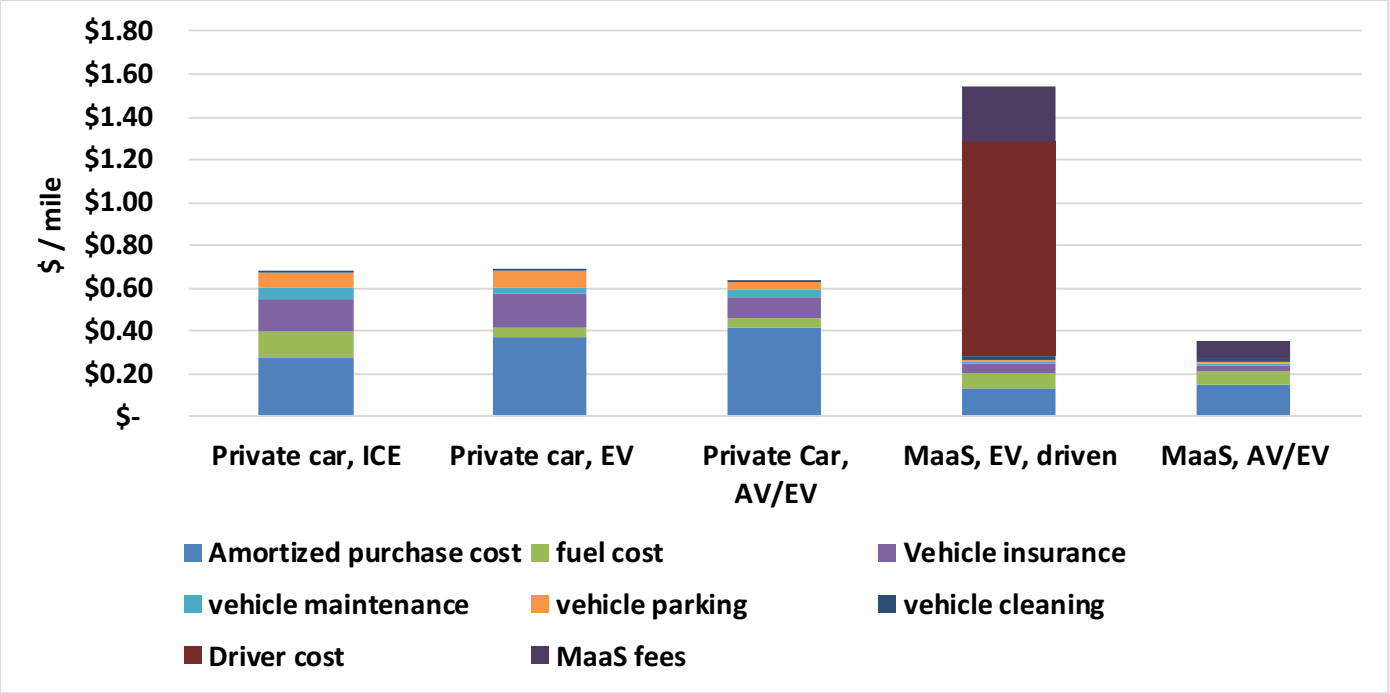
4: add parking and cleaning

- Assumes parking at $5/day, 200 days per year = $1000 for private ICEs and EVs
  - 50% less for MaaS vehicles
  - 50% less again for AV/EVs
- Cleaning about $150 for private vehicles, $1000 for MaaS vehicles



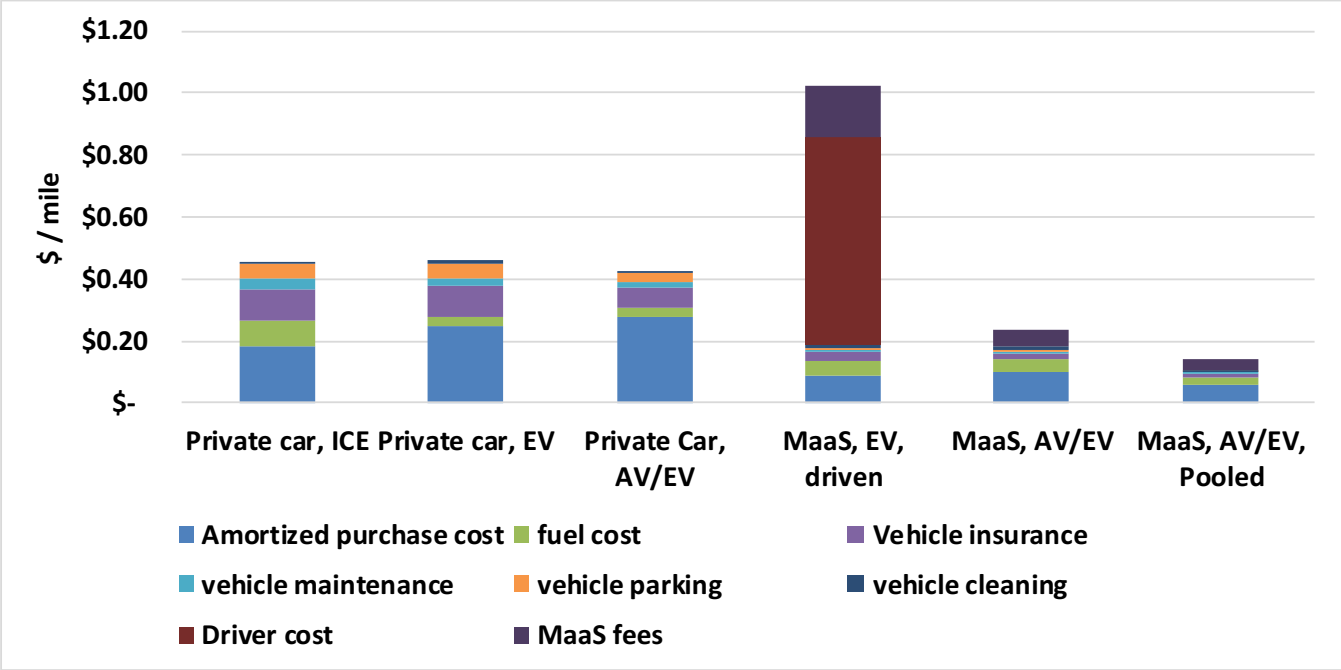
6: add driver cost and MaaS overhead fees

- Drivers assumed to earn about $1.00/mile ($50k for 50,000 miles) after all expenses
  - For an average speed of 20 MPG, this is $20/hr
- MaaS fees assumed to be 20% of revenues (which equal all the costs in the figure)
  - This rises to 30% with no driver



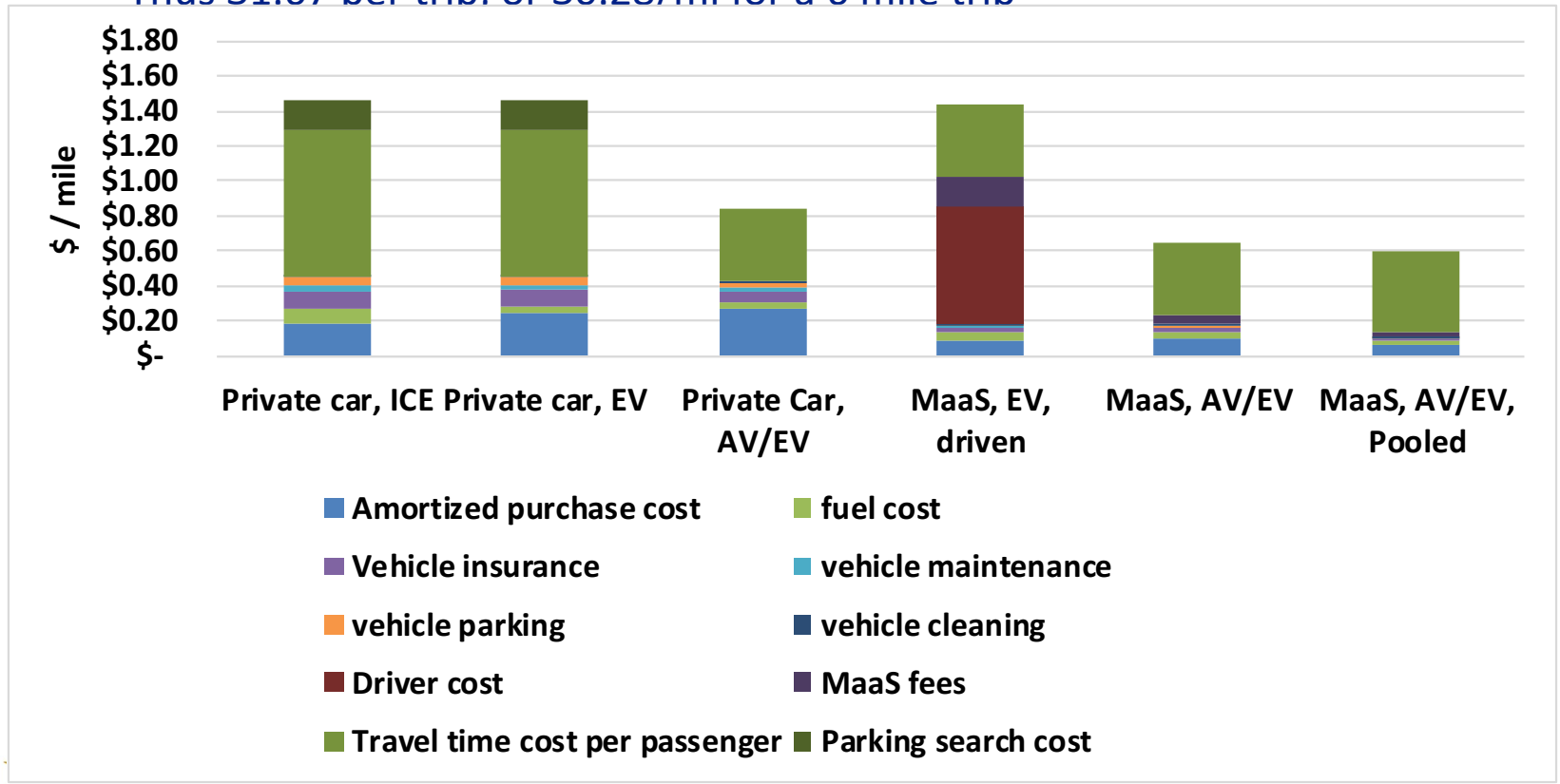
7: add passengers

- Assume 1.5 passengers per private car and MaaS trip
- Assume 2 passengers at 60% price each for MaaS pooled trip; trip 10% farther



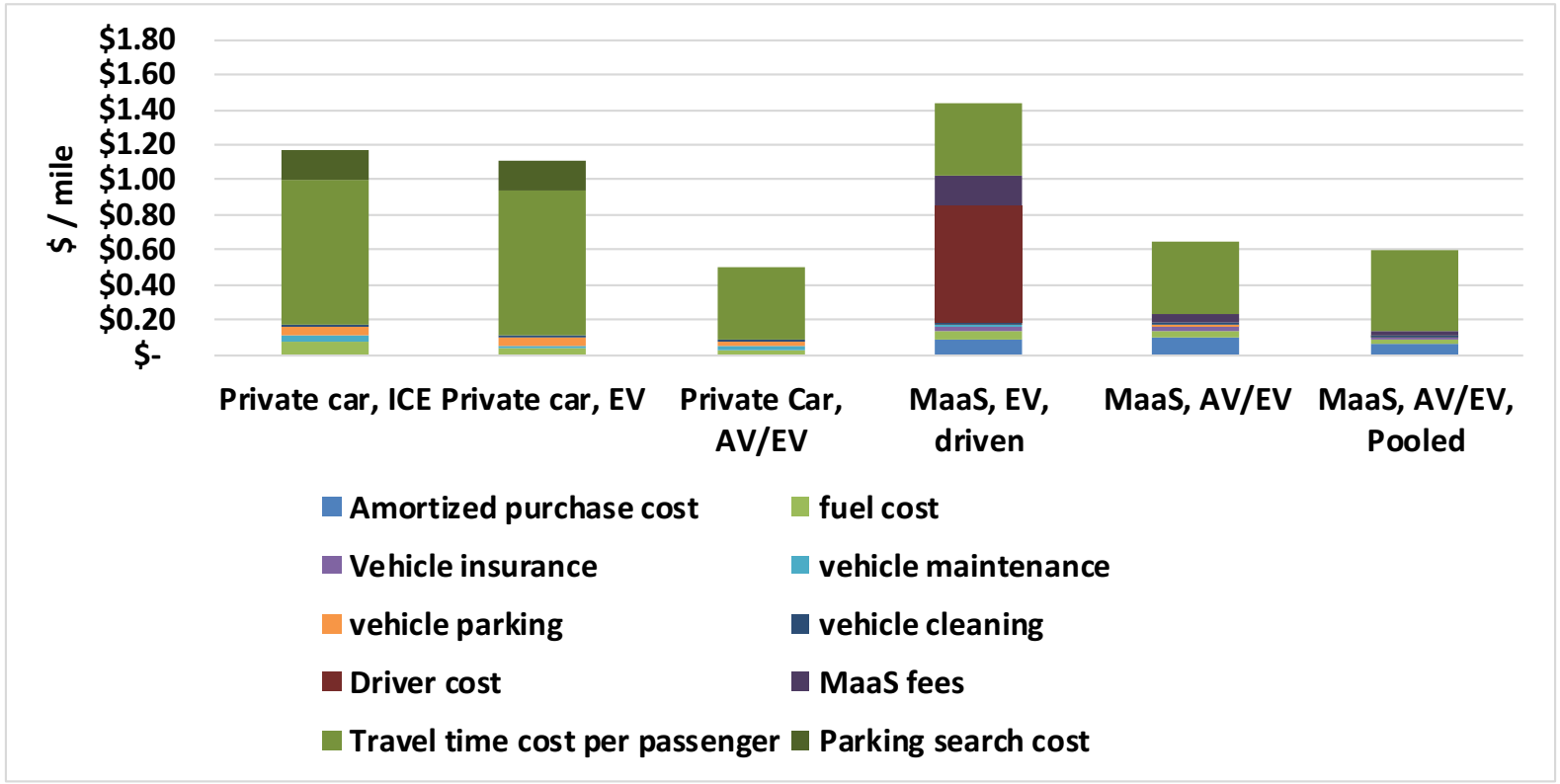
8: Add a value of time for driving, travelling, parking

- Time cost for drivers set to $20/hr, or $0.80/mi for a 15 minute, 6 mile trip
  - Time cost for non-drivers (whether AV or not) 50% lower
- Parking search / walking to destination if not door-to-door: 5 minutes
  - Thus $1.67 per trip, or $0.28/mi for a 6 mile trip



9: Include only variable costs (daily decision)

- Ignore private car purchase, insurance cost



Next STEPS

- More use cases, (more modes, more trip lengths, city vs. suburban trips?)
- More sensitivity analysis with assumptions
- Do for different countries
- Deeper exploration of non-cost attributes
  - Possible survey work to better understand how people value both cost and non-cost aspects, how they might travel in AVs?
- Add these data into a spatial model to better test real mode choices?