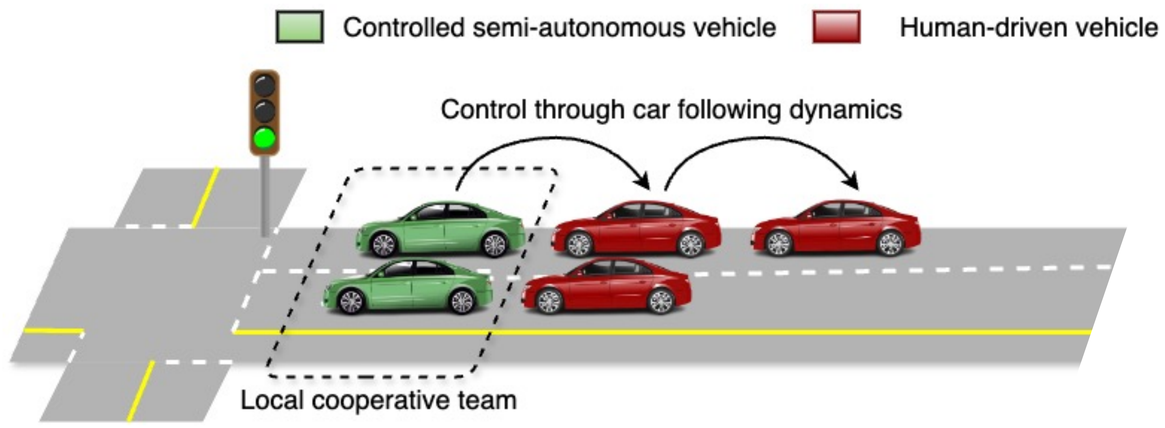
Mitigating Metropolitan Carbon Emissions with Dynamic Eco-driving at Scale

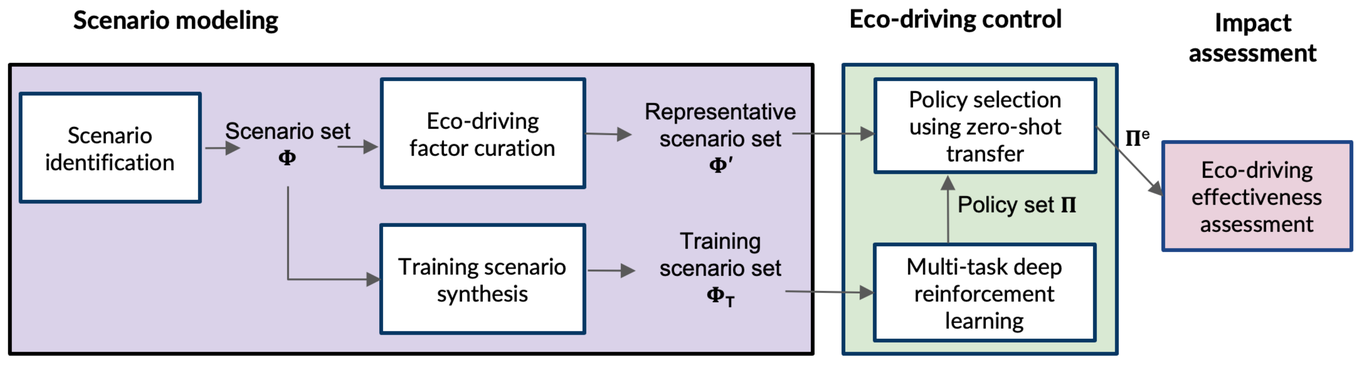
TL;DR: Learned dynamic eco-driving behaviors can cut city-wide intersection carbon emissions by 11-22% without harming throughput or safety, but implementing such strategies requires careful planning.

- **Goal:** Can semi-autonomous vehicles **programmed to mitigate stop-and-go traffic and carbon emissions** move the needle on climate change mitigation goals?
- **Approach**: **A prospective impact assessment of eco-driving** at signalized intersections by **representative traffic scenarios modeling** and **multi-task deep reinforcement learning to optimize for eco-driving behaviors.**



Representative scenario modeling: **One million traffic scenarios** in **6000 signalized intersections**, considering **33 eco-driving factors** across San Francisco, Los Angeles, and Atlanta.

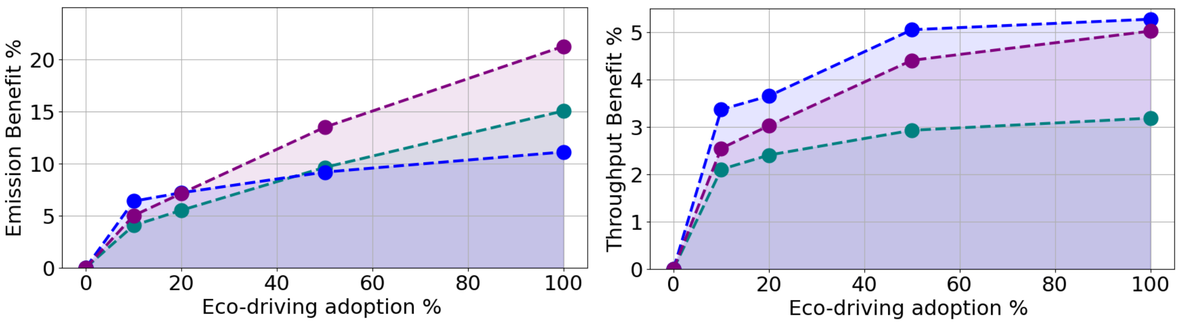
Eco-driving control: **Multi-task deep reinforcement learning** with **zero-shot transfer learning** to solve a million eco-driving control problems across traffic scenarios.



Prospective Impact Assessment

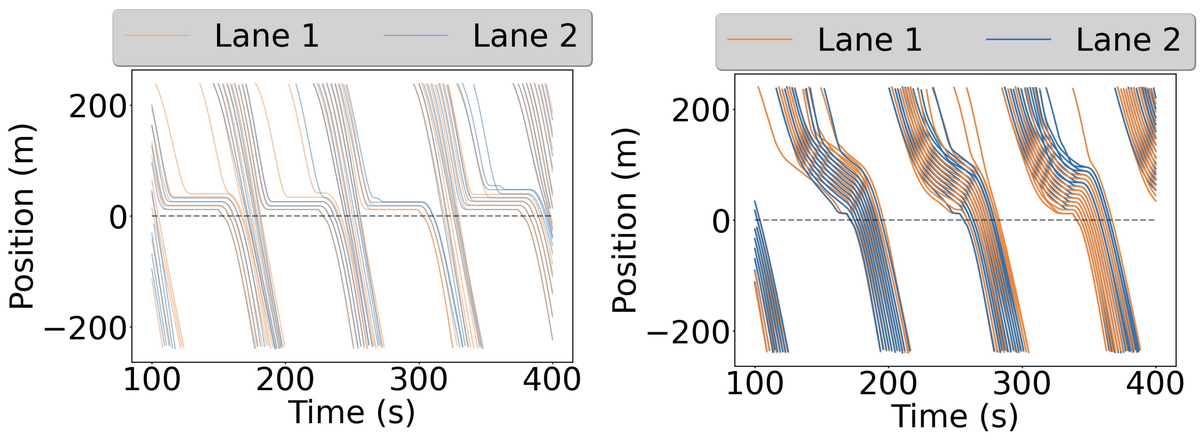
1 Annual emission benefits

Vehicle trajectories optimized for emissions can cut city-wide intersection carbon emissions by 11-22%.

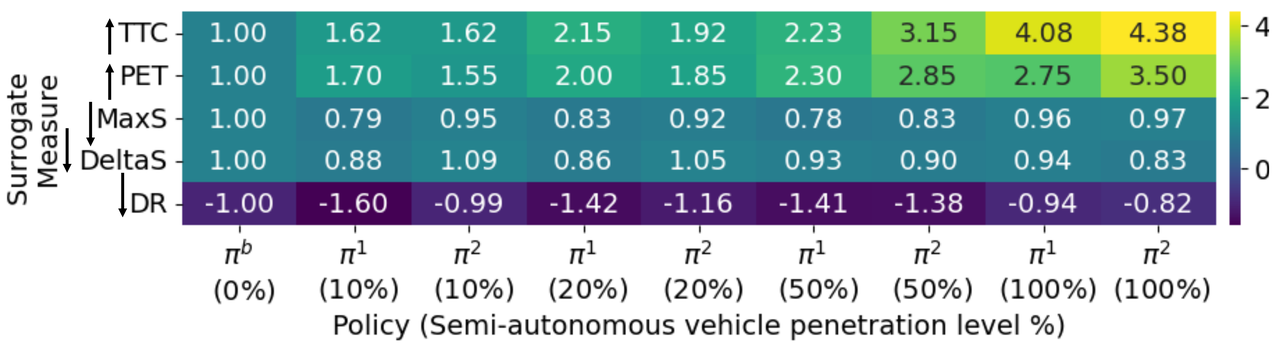


2 Eco-driving behavior and fleet-level safety

Human-like driving behavior (left) vs 100% eco-driving behavior (right)

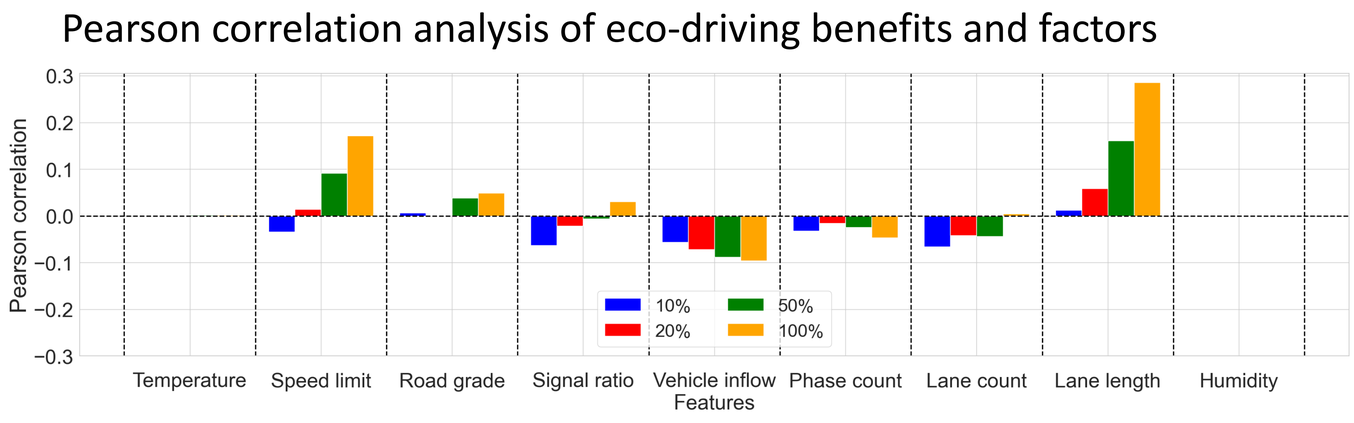


Fleet-level safety is the same as with human-like driving, measured using safety surrogate measures.



3 Factor impact

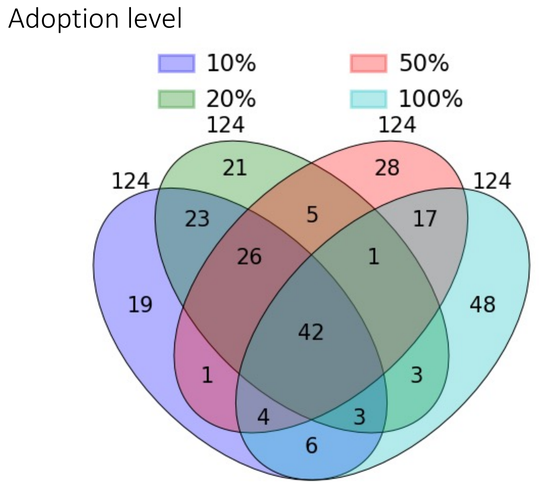
Factors that affect emission benefits change with eco-driving adoption level.



4 Intersection compatibility

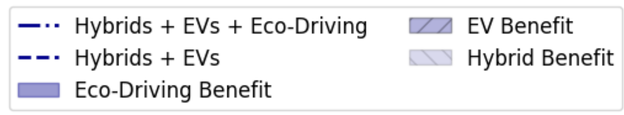
Nearly 70% of emission benefits come from just 20% of intersections, but the specific intersections vary, with minimal overlap as eco-driving adoption increases.

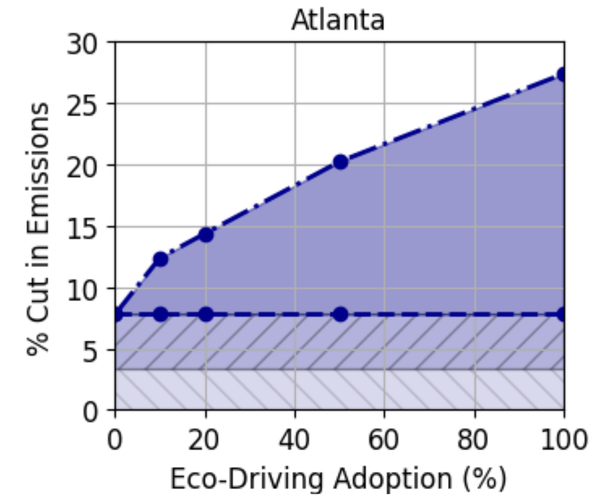
Venn diagram of 20% highest-benefit intersections



5 With electric and hybrid vehicles

Eco-driving complements the benefits of electric and hybrid vehicles.





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