# Using Surveys, Statistical Modeling, and Transportation Simulations to Forecast Impacts of Emerging Technologies

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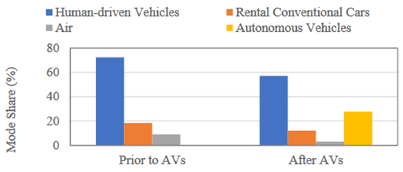
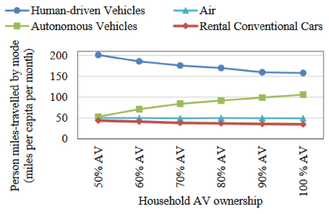
## Why forecast & simulate?

- **Transportation infrastructure** delivers our goods & connects one another.
- Understanding **investment decisions & future technology effects** come from scenario planning & analysis (on top of the BAU).
  - Would **I-35 expansion alleviate congestion** & how?
  - How might **self-driving vehicle fleets replace SOV** trips downtown?
- **Surveys** ask **intention to adopt** new technologies, behaviors.
  - Would you **fly** between AUS-DFW or travel **door-to-door** in a **private AV**?
- **Simulation** can be **behaviorally realistic** (i.e., how does traffic flow across a city vs a network on the computer?)

## Forecasting Travel Behaviors

- **1,000+ Americans** (45% Texans) provided **2019** (pre-COVID) & **2020** **long-distance** trip data & **future** expectations.
  - Would **you ride in an AV, assuming same travel time as cars now?**
- Apply **Travel Demand Models** (trip purpose, mode choice, destination choice, party size, trip frequency) & survey data (**long-distance AV use**) to estimate **mode shifts** & **travel distances**.

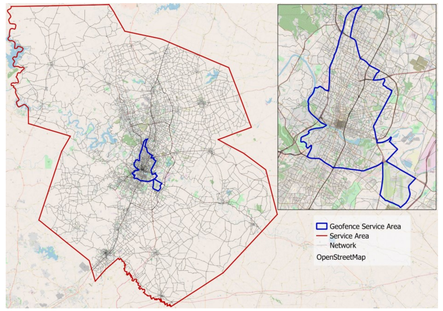


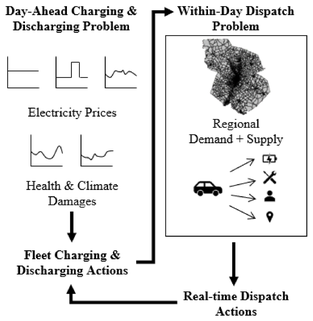




- Ongoing survey of **1,000+ Americans** to understand acceptance of utility-controlled **smart charging of EVs** (incentives needed), monetary **value of discharging** EV power to worksite tools, camping equipment, or even the home.
  - **Human actions** influence the **transition** to **EVs** & **zero-carbon** renewables!
- Use **survey data** (adoption, policy incentives, technology prices) to model impacts of **smart charging algorithms** to **reduce emissions & pollution**, **improve power grid reliability** & **reduce power costs**.

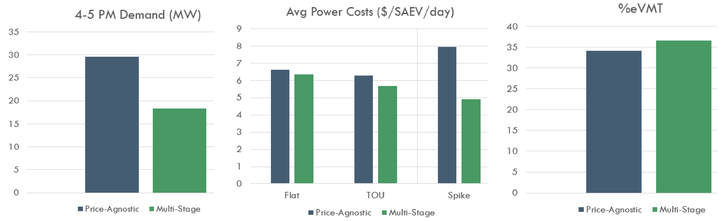
## Simulating the 6-County Austin Metro

- 5,300 sq-mi **6-County Austin** region & smaller "**downtown+**" 60.3 sq-mi service area served with a 300-mi SAEVs per 125 residents.
- Synthesize **2M residents** & their **daily trips** (school, work, recreational, civic), use a planning-level **road network**, & **adapt travel behaviors** to study impacts of SAEV fleets.
  - How can we **reduce unoccupied travel** from SAEVs through vehicle dispatch decisions?
  - How can we **reduce charging costs** for SAEV fleets while **reducing climate & health damages** from electricity generation? AND still serve passenger demand?
  - How do **innovative curb use** pick up & drop off (**PUDO**) points affect SAVs?

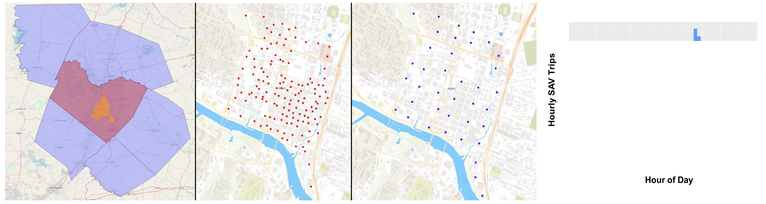



- **Optimization-based dispatch** decisions **increase fleet profits**, **reduce wait times**, & can **help the power grid/society**.
  - Modeling **power prices** & **pollution costs** reveal how prices influence joint transport-power behaviors.




- SAEV fleets paying **retail electricity prices** have **higher power bills** than days with **spikes in wholesale power prices** (hour with 62.7x higher $/kWh than daily avg).
- **Demand fees** ($/kW) for max charging power **reduces the peak** but can increase **upstream emissions**.
- Modeling **maintenance & cleaning trips** can increase % unoccupied travel (22% → 34% of vehicle-miles) for large regions like the 6-County metro.
  - **Pricing % unoccupied travel** that exceeds a **cap** could subsidize low-income mobility credits (where **paratransit → on-demand SAEV service**). A **$0.05/mi surcharge** could generate **$0.88/SAEV/day**.
- **PUDOs** modeled for downtown grid: BAU (no curb use rules), PUDOs **1 block apart vs 3 blocks**. **# of parking spaces** per PUDO & **fleet size** varied for sensitivity analysis.
  - **Trade-offs in spacing PUDOs** (less curb space needed, unoccupied travel declines, but SAV demand falls with longer walks).




Left to right: SAV service region (orange) within Travis County (red) within 6-County Austin metro (blue), PUDOs spaced 1 block apart, PUDOs spaced 3 blocks apart

## Conclusions

- Combining **travel forecasting** & **simulation** tools can reveal insights for the **power** & **transportation** sectors.
- **Human behaviors** (willingness to pay, intention to use, frequency of actions) are critical to understand & model to inform *early* **policy interventions** & **incentives**.
- **Collaborating** with transportation planners, fleet operators, & stakeholders can improve & usher in more affordable, safer, and cleaner mobility for us all!

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