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U.S. DEPARTMENT OF ENERGY
SMARTMOBILITY
Systems and Modeling for Accelerated Research in Transportation

ENERGY AND MOBILITY IMPACT OF SMART MOBILITY TECHNOLOGIES

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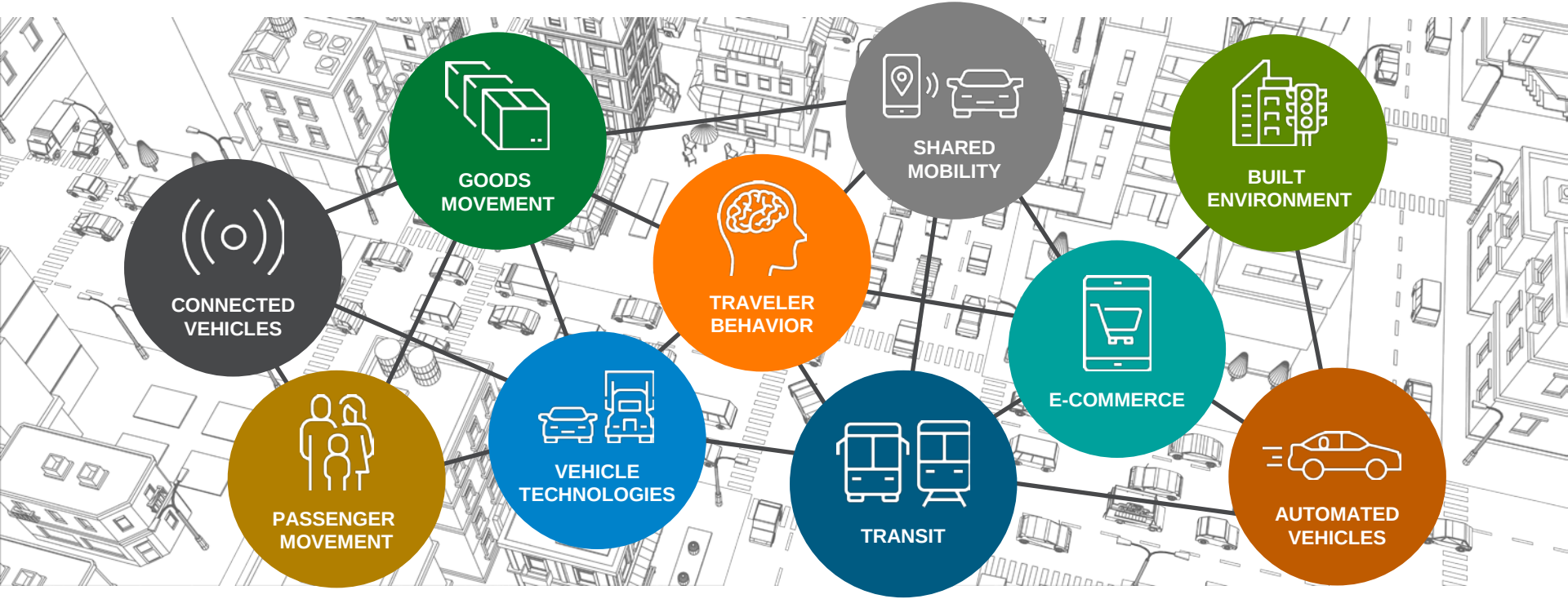
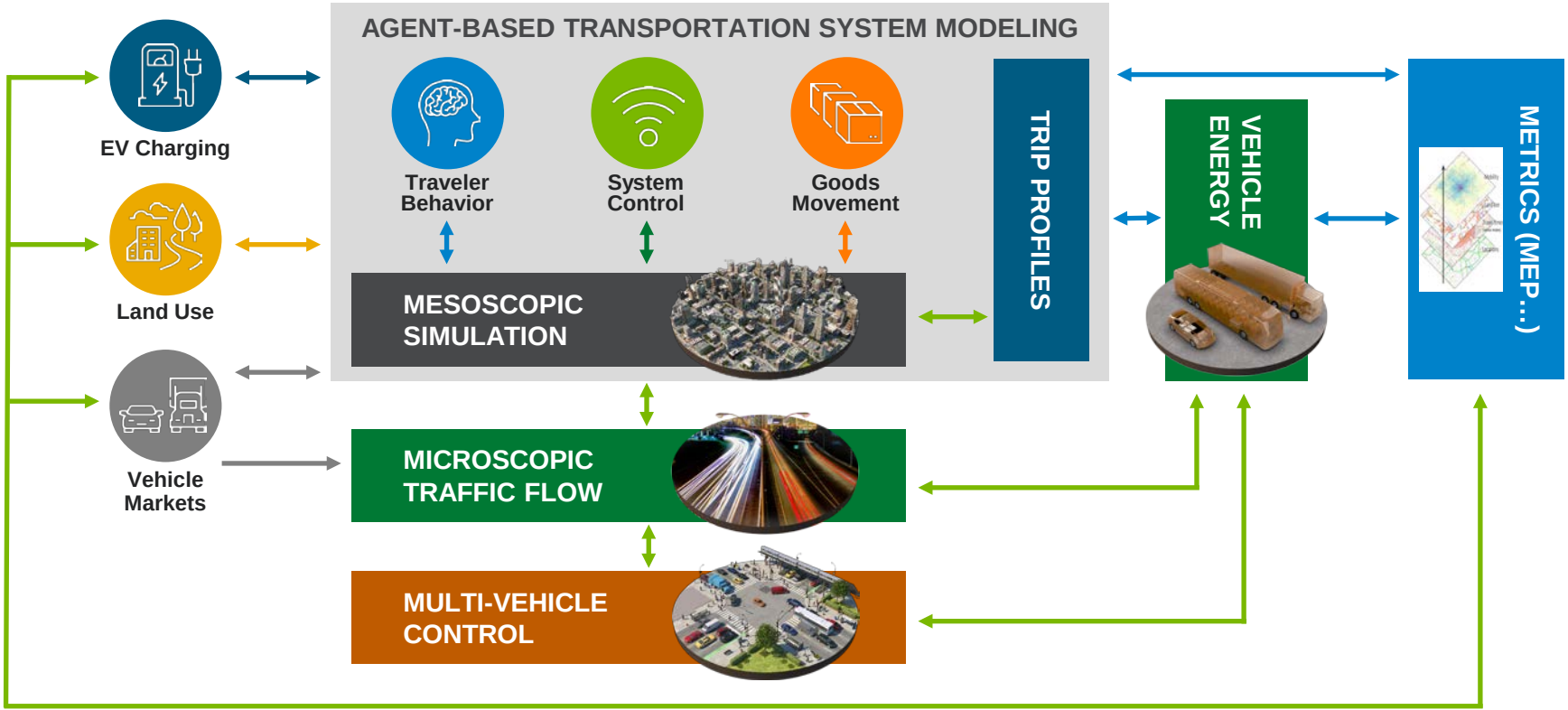
TRANSPORTATION IS A SYSTEM OF SYSTEMS

Research Portfolio



END-TO-END MODELING WORKFLOW



WORKFLOW IMPLEMENTATION USING POLARIS IS UNIQUE

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POLARIS

- **Key modeling features:**
  - Full-featured **activity-based** model
  - Includes **freight** shipments and local deliveries
  - High-fidelity **vehicle energy** consumption
  - **Integrated** demand, network assignment and traffic flow
  - **EV charging** and **grid** integration
  - Connection to **UrbanSIM** land use
  - Traveler behavior impacts of **VOTT** across many choices

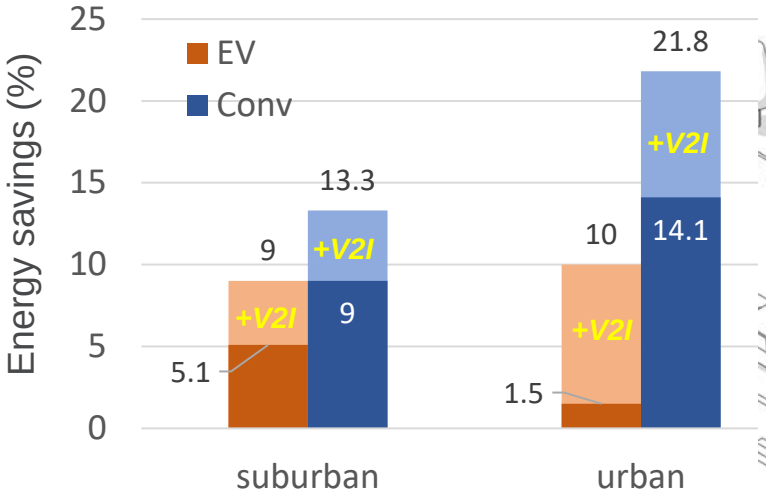
Computational performance:

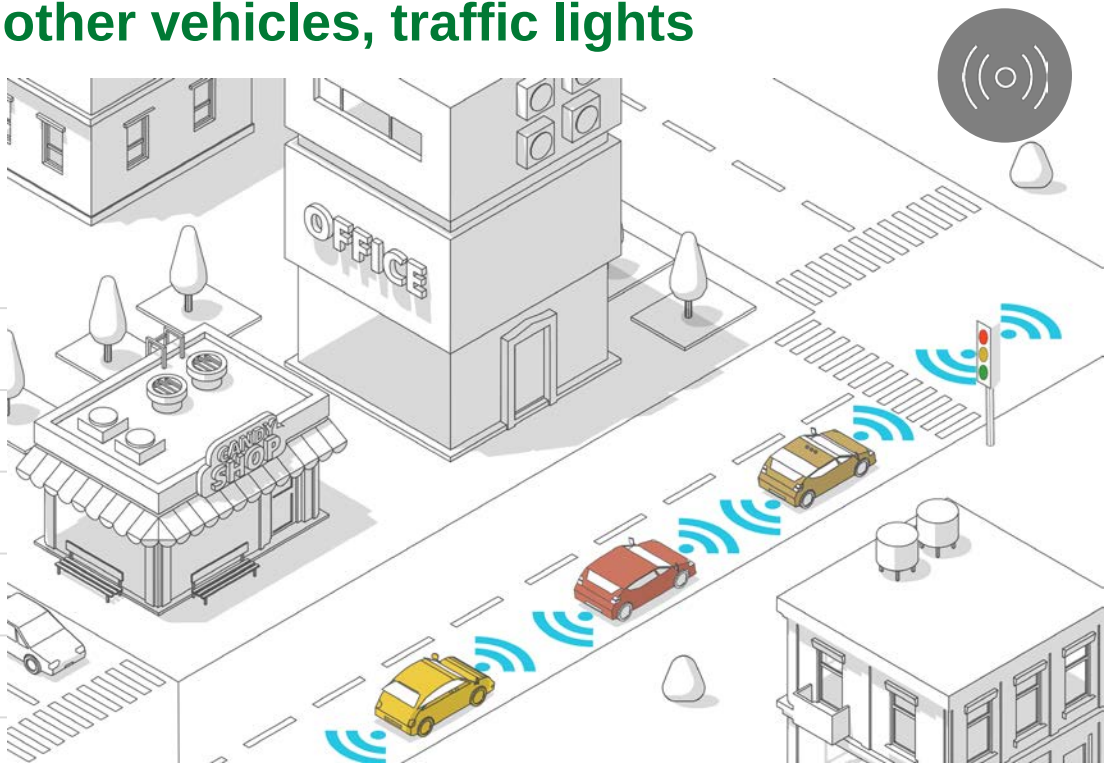
- Fully **agent-based**
- Integration with external **optimization** solvers (CPLEX, Gurobi, GLPK)
- High-performance **C++ codebase**
- Large-scale models with **100% of agents**
- **4-6 hr runtime** for up to 10 million agents
- Cross-platform implementation can run on Linux **HPC** clusters

VEHICLE AND POWERTRAIN CONTROL OFFER SIZABLE BENEFITS

Adaptation to conditions, other vehicles, traffic lights

UP TO 20% INDIVIDUAL VEHICLE FUEL CONSUMPTION REDUCTION





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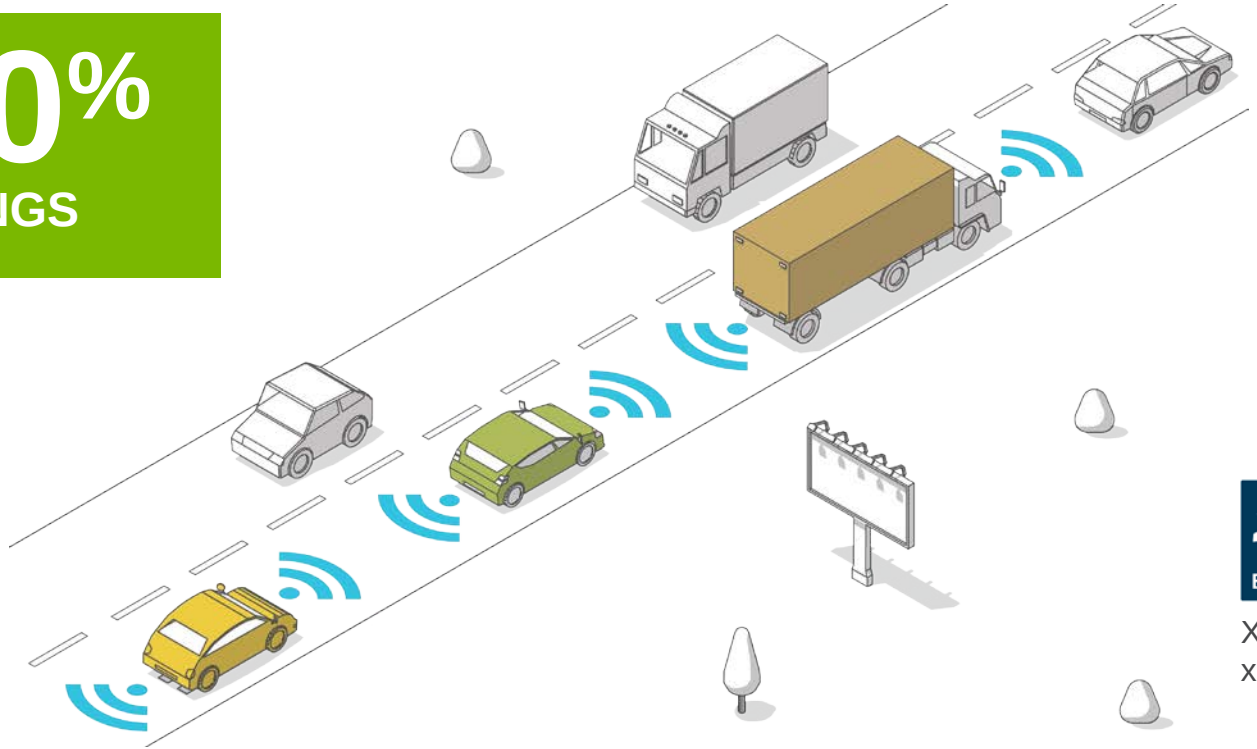
CACC HELPS TRAFFIC FLOW, LOWERS ENERGY USE

Vehicle communication + automation improves traffic flow

UP TO 20% FUEL SAVINGS



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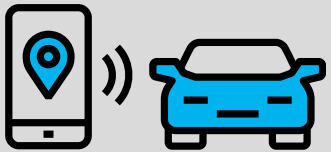
SCENARIOS CONSIDERED

A world of

HIGH SHARING, PARTIAL AUTOMATION (Sharing)

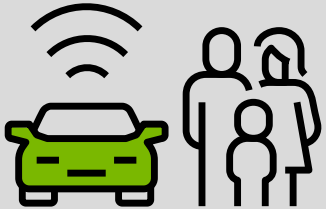


New technology enables people to significantly increase the use of **transit, ride-hailing** and **multi-modal travel. Partial automation** is introduced and is primarily used on the highway.

HIGH SHARING, HIGH AUTOMATION (SAV)

Technology has taken over our lives, enabling **high usage of fully automated driverless vehicles, ride-hailing and multi-modal trips**, which are convenient and inexpensive. As a result, **private ownership has decreased** and **e-commerce has increased**.

LOW SHARING, HIGH AUTOMATION (Private-AV)



Fully automated privately owned driverless vehicles dominate the market. The ability to own AVs leads to **low ride-sharing** and an expansion of urban/sub-urban boundaries, while **e-commerce has increased.**

SHARED FLEET CAVS ENABLE HIGH SYSTEM EFFICIENCY

Compared to personally owned CAVs

CHICAGO

23% Energy	18% VMT	0% PMT		17% Speed

High Sharing / Low Automation

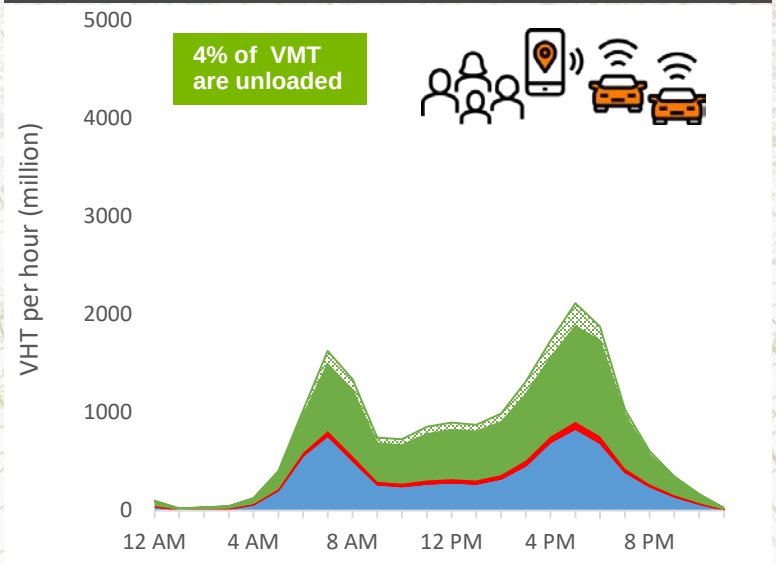
22% Energy	25% VMT	7% PMT		18% Speed

Low Sharing / High Automation

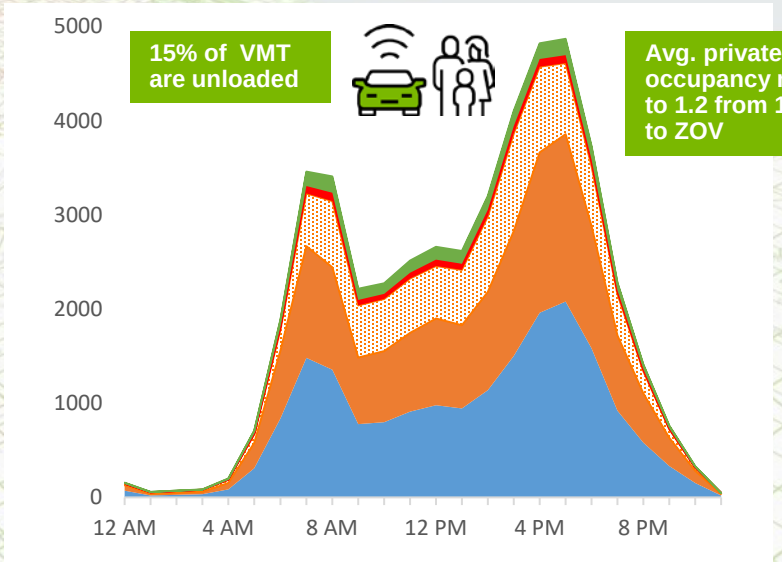
OPERATIONAL DIFFERENCES BETWEEN SAV AND PRIVATE AV ARE KEY

CHICAGO

High-Sharing, High-Automation (SAV)



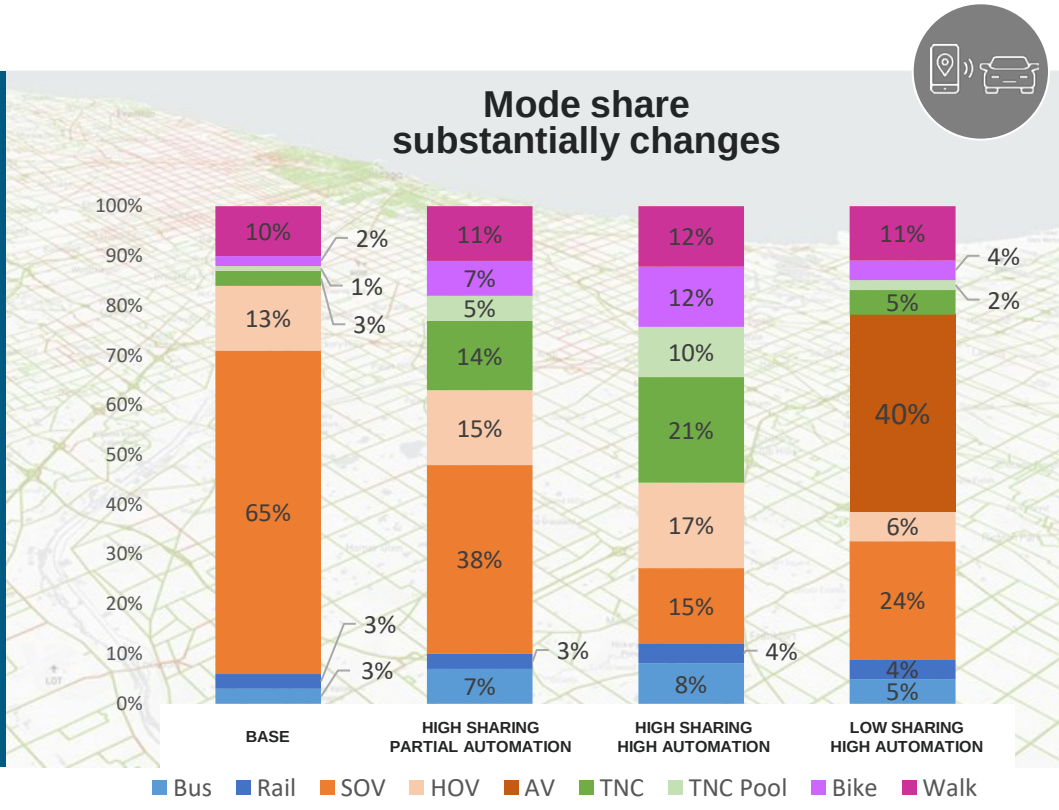
Low-Sharing, High-Automation (Private-AV)



SOV AV ZOV TNC TNC-empty SAV SAV-empty

INDIVIDUAL TRAVEL BEHAVIOR CHANGES ALSO DRIVE OUTCOMES

- Transit use grows from 6% to 12% mode share as HH dispose vehicles
- Private-AV encourage additional SOV trips
- Urban households shift to transit, suburban shift to TNC if disposing vehicle

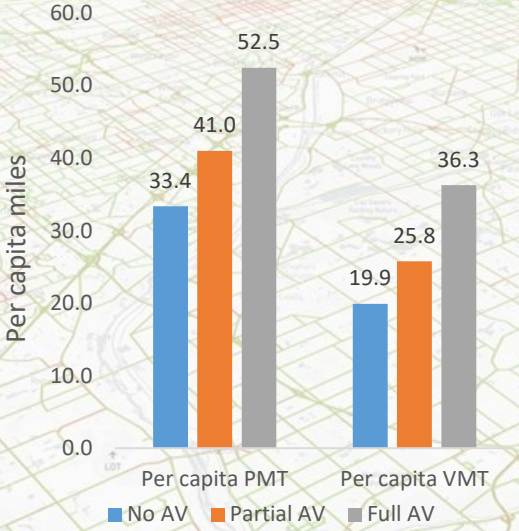


HOUSEHOLDS WITH AV BEHAVE MUCH DIFFERENTLY

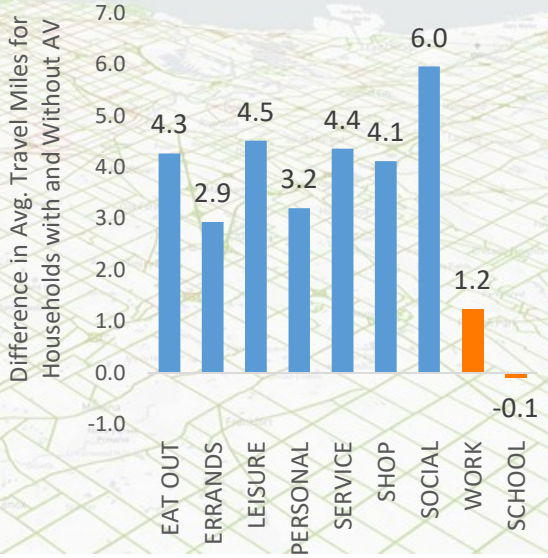
Up to 82% VMT increase in households owning an AV

- Discretionary activity trips 3–6 miles longer (+30%)
- Additional trips concentrated in PM peak
- Persons with AV spend up to 30 minutes more in travel per day

Households with AV drive more than others



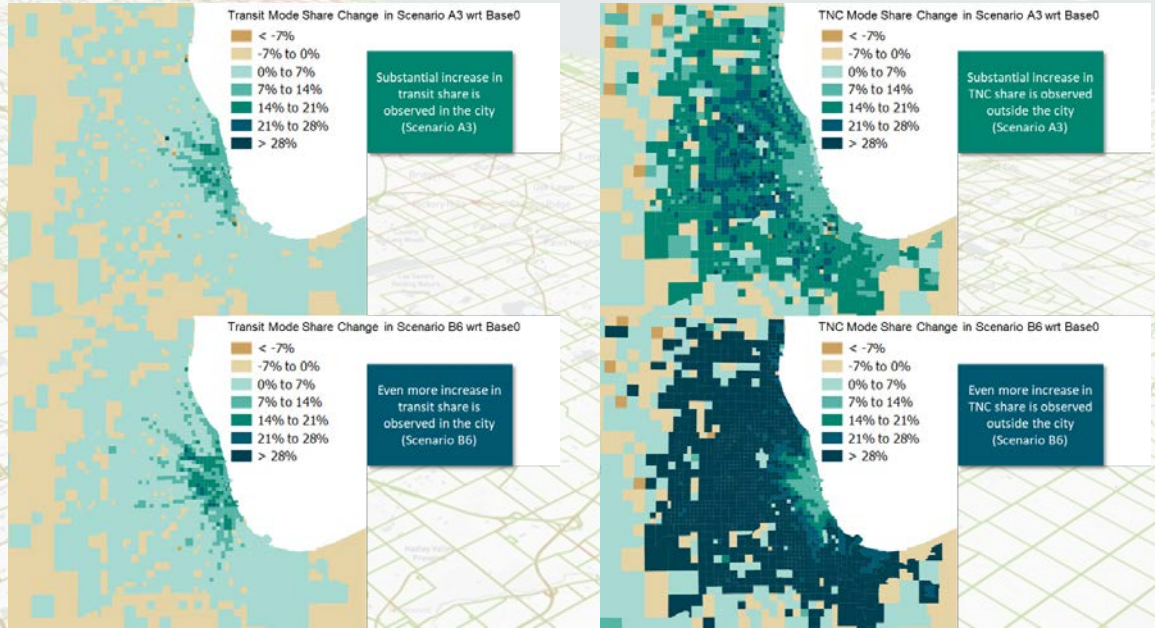
Driven by increased travel to discretionary activities



TRANSIT AND RIDE-HAIL CAN BE COMPLEMENTARY

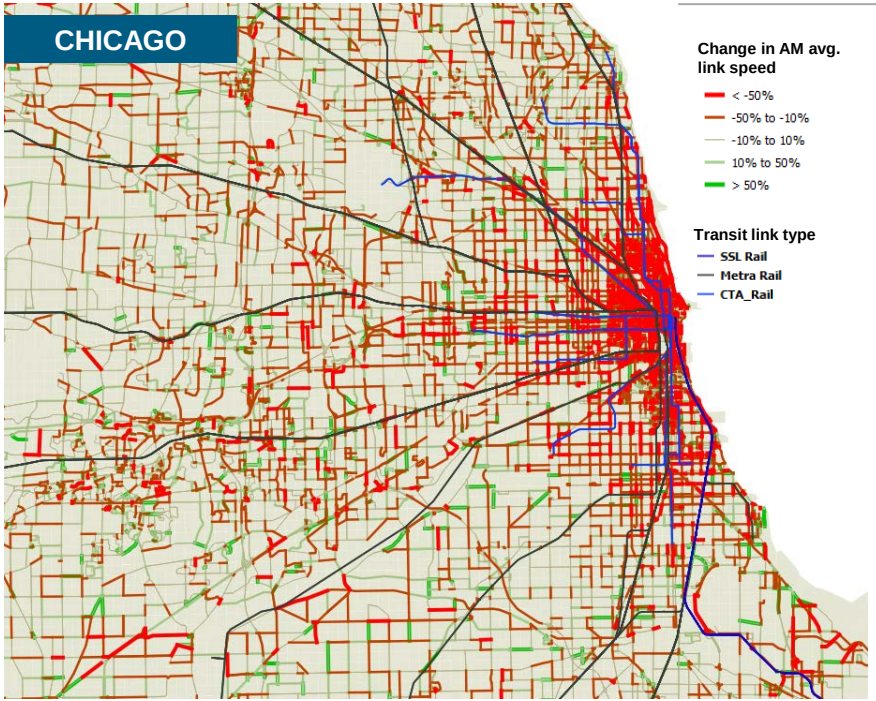
Transit provides key mobility in urban core, TNC serves suburbs

- Transit ridership grows as vehicle disposal rate increases
- Increase in transit along hub and spoke lines, even as TNC increases
- Limited increase in TNC use in high-quality transit areas

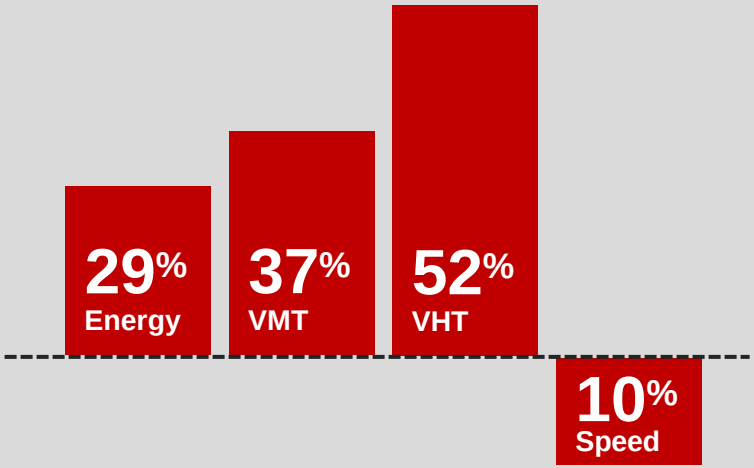


TRANSIT IS CRITICAL TO MOBILITY

Absent transit, energy use and congestion increase



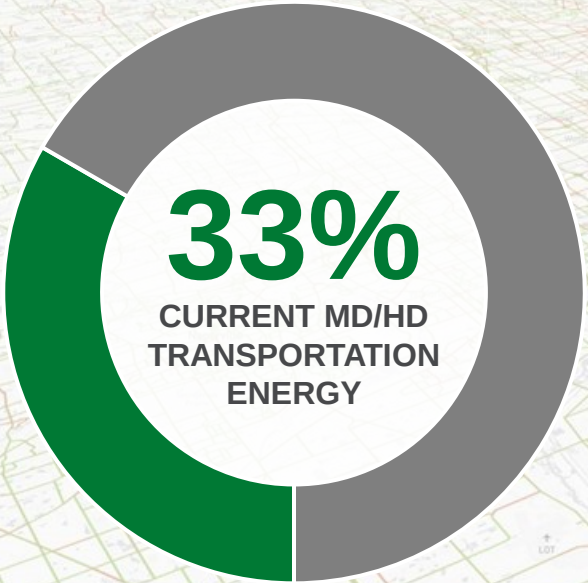
CITY OF CHICAGO
WITHOUT TRANSIT SYSTEM

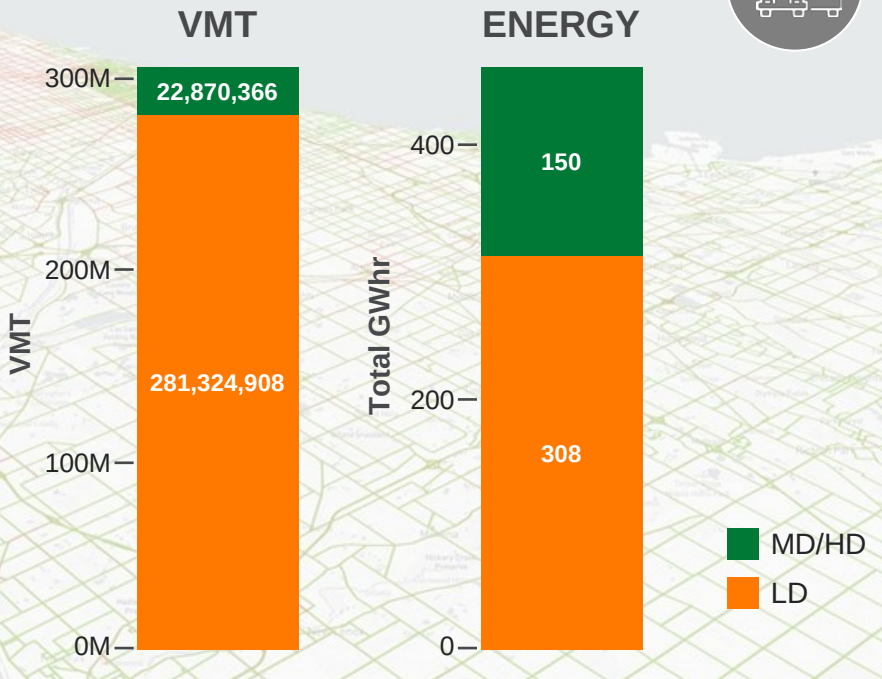


FREIGHT MOVEMENT WILL BE INCREASINGLY IMPORTANT

Due to increased light duty electrification and freight demand

CHICAGO





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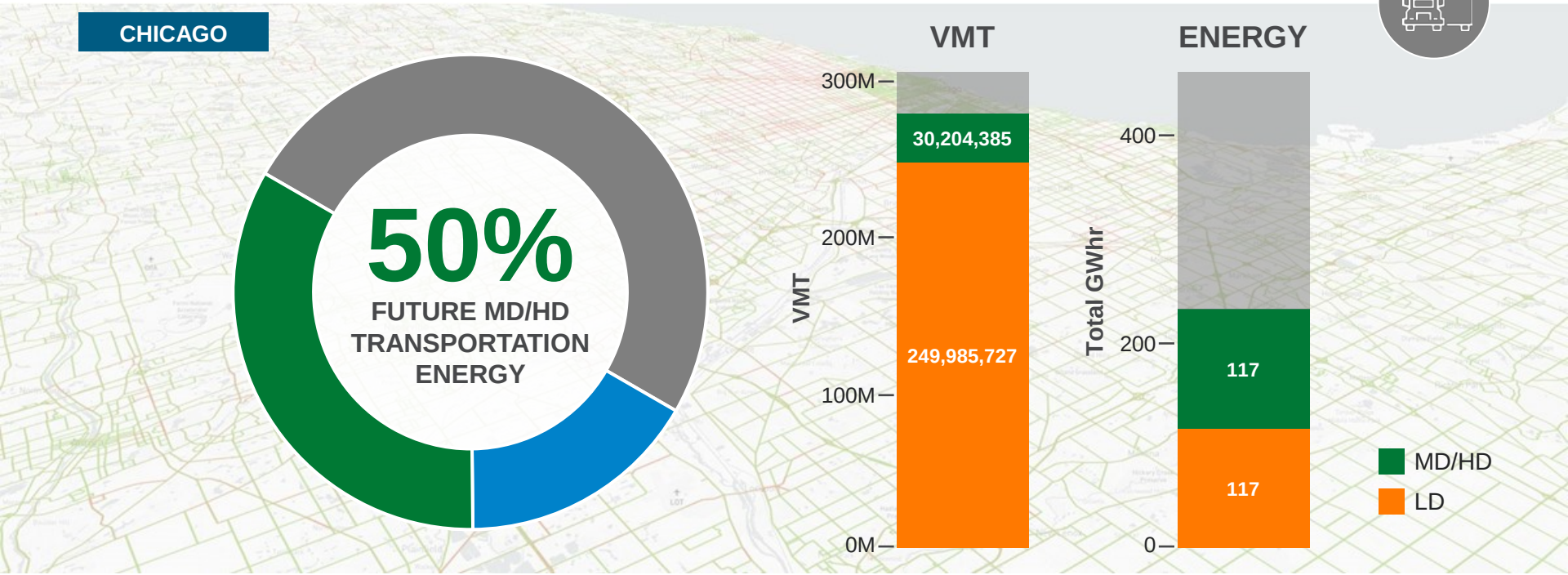

INCREASE IN E-COMMERCE LOWERS OVERALL SYSTEM VMT AND ENERGY

Fewer shopping trips, more deliveries make the difference

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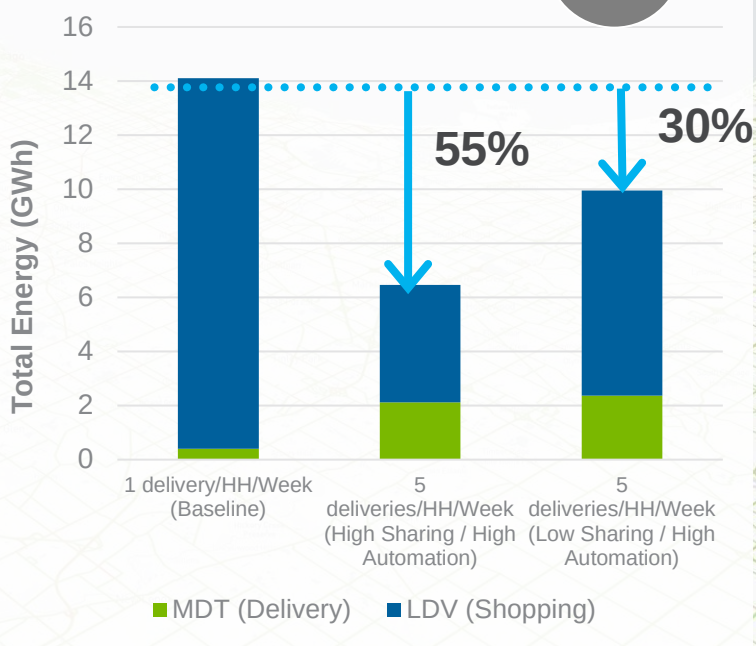
CHICAGO

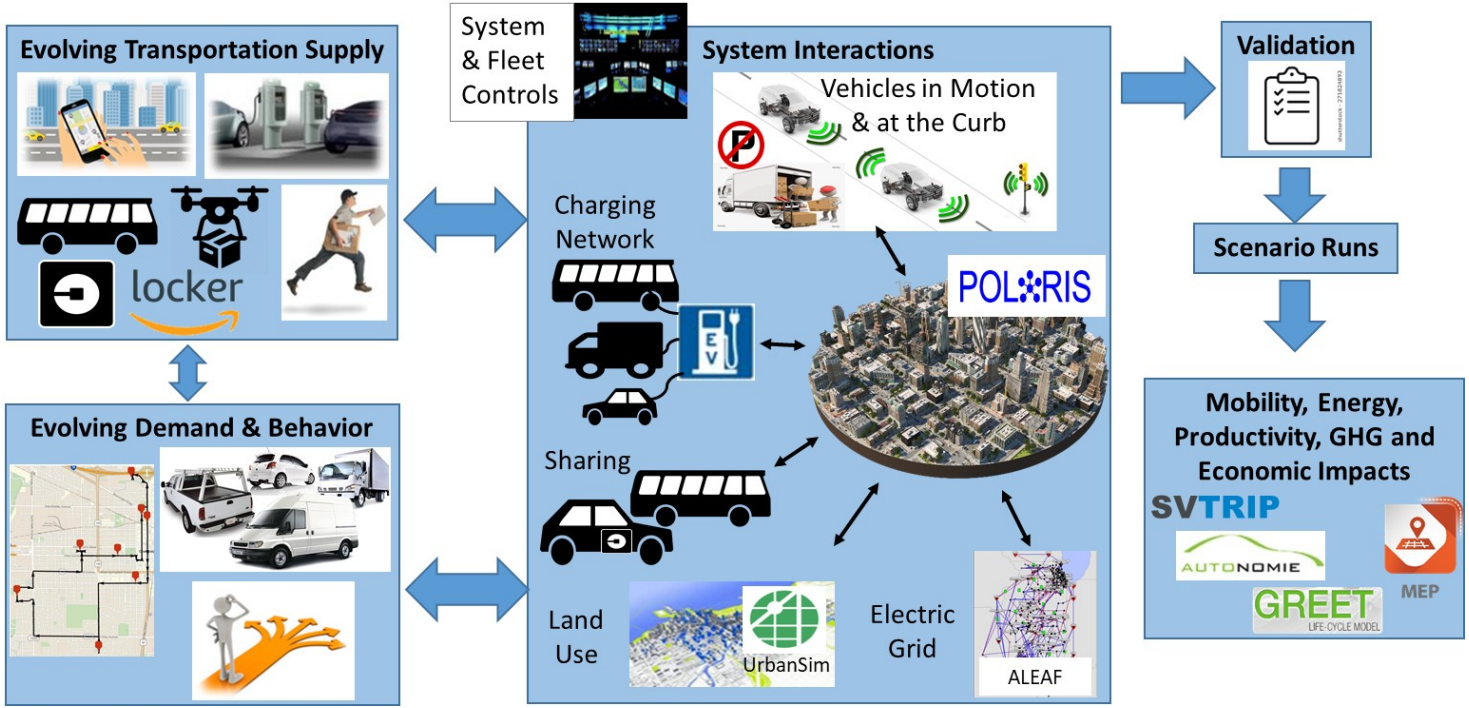
SHOPPING TRIP = 7 to 8 miles, each way

DELIVERY TRIP **1 ADDED STOP = 0.4 mile**



PROPOSED FUTURE RESEARCH

Significantly expand the number of scenarios considered and validate through deployment



For any questions, please contact:
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