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MULTI-SCENARIO MULTI-CITY SIMULATIONS WITH STAKEHOLDER-DRIVEN LEVERS TO ASSESS MOBILITY, COST, AND ENERGY IMPACTS

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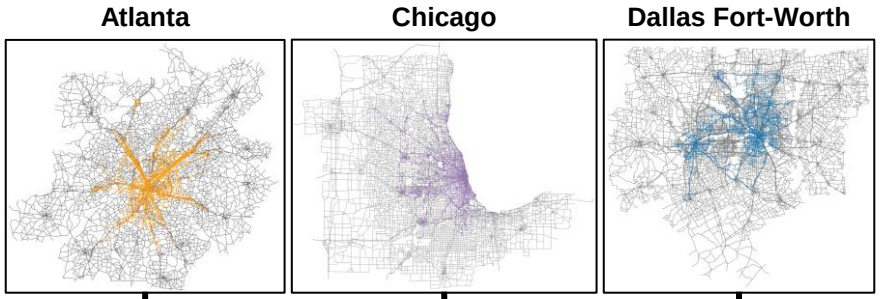
Large Scale, Multi-City Study Setup

Atlanta, Chicago, & Dallas Forth-Worth regions are forecasted with 6 independent strategic levers in 2050 with a full-factorial study

- Congestion Pricing
- New Transit Lines
- Telecommute
- EV Penetration
- Freight Intermodal
- Transit-Oriented Development



Study Setup

- Regional models **calibrated with NHTS** & **validated** with big data
- Converged 2050 runs used as **stable population, demand, & network** state input
- **192 scenarios** launched across HPC network

Analysis Workflow

- Three categories of key Performance Indicators (KPIs) created

- Regression of KPIs from 192 scenarios x 15 iterations of data
- Temporal & spatial dimensions of KPIs evaluated

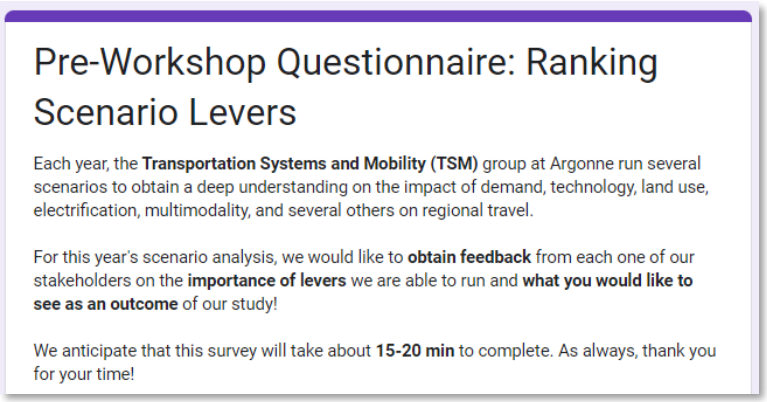
LEVER IDENTIFICATION PROCESS

QUESTIONNAIRE AND DISCUSSION WORKSHOP TO OBTAIN ADDITIONAL INPUT ON PRIORITIES

Key topic areas evaluated

- Demand &Land Use
- Transit & Multimodal
- Ridehailing & Ride-sharing
- Traffic Control & Vehicle Technology
- ITS & TDM
- Electrification
- Freight & Delivery

Discussion workshop held on 7/1 to review rankings



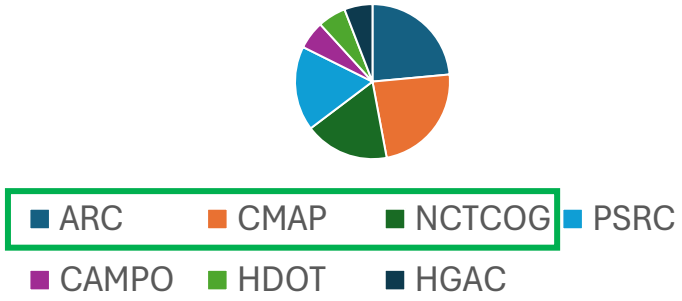
Pre-Workshop Questionnaire: Ranking Scenario Levers

Each year, the **Transportation Systems and Mobility (TSM)** group at Argonne run several scenarios to obtain a deep understanding on the impact of demand, technology, land use, electrification, multimodality, and several others on regional travel.

For this year's scenario analysis, we would like to **obtain feedback** from each one of our stakeholders on the **importance of levers** we are able to run and **what you would like to see as an outcome** of our study!

We anticipate that this survey will take about **15-20 min** to complete. As always, thank you for your time!

17 staff from 7 MPOs participated



DISCUSSION AFFIRMS TELECOMMUTING, PRICING, & TRANSIT AS KEY FOCUS AREAS

Key findings from stakeholder surveys

MPOs receive several questions about telecommuting

They find it realistic to include consistently going forward

Congestion pricing & tolling models are of interest

Feasibility was raised as a point to be included for this lever – lessons learned from NYC example

Implementing such a policy, especially when revenue managed by state bodies could be challenging

Max toll levels needed to effect change is useful to know

Shared mobility of interest ONLY as access/egress modes to transit

MPOs not having policy control over shared mobility operations not interested in studying it

Certain MPOs do not think mode shares will ever be high enough to study – was primarily of interest pre-pandemic

ELECTRIFICATION & FREIGHT HAVE NUANCES TO STUDY, EQUITY METRICS ALSO IMPORTANT

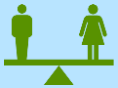
Key findings from stakeholder surveys

Electrification is of interest, with caveats

- Several fixed infra transit is already electrified
- Perhaps no requirement for air emissions analysis –> not a priority
- EVSE business models are not interesting but the cost of electricity could be

Freight interest is region-specific

- Off-hour delivery and parking that is related to freight turned up as top priorities
- Alternative fuel sources for trucking/freight is interesting, but with low turnover rate, there is concern around forecastability



Equity metrics across all topics discussed were of interest to a majority of stakeholders

EXAMPLE DETAILS BEHIND SCENARIO LEVER DESIGN AND IMPLEMENTATION

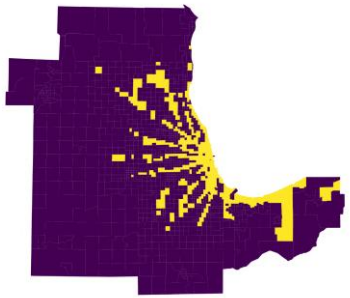
TRANSIT ORIENTED DEVELOPMENT

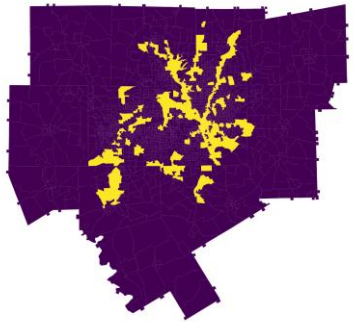
Designed to boost transit ridership and lower reliance on auto

	Chicago	Dallas-Fort Worth	Atlanta
2050 rail network size	Extensive	Extensive	Minor
Developments in buffer area	High density urban areas	Moderate density urban areas	Moderate density urban areas
TOD treatment in zones with Rail / BRT stop buffer			
Population density	50% increase in population density, if not already a TOD zone	50% increase in population density	Increase in population density to match densities in Chicago
Car disposal probability	20%	40% (higher baseline vehicle/hh)	20%

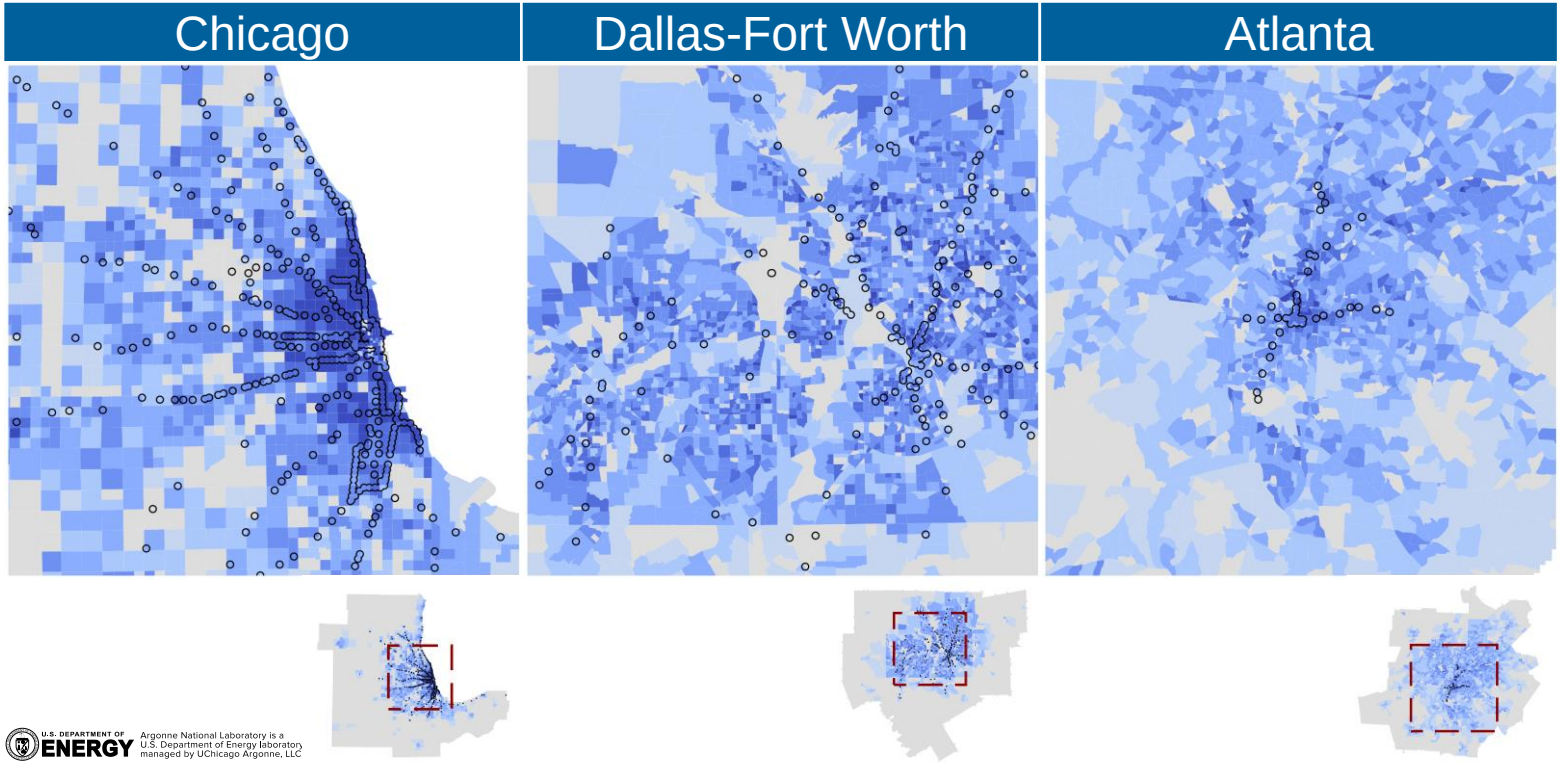
< 0.5 mi walking distance of rail & BRT stop

> 0.5 mi walking distance of rail & BRT stop

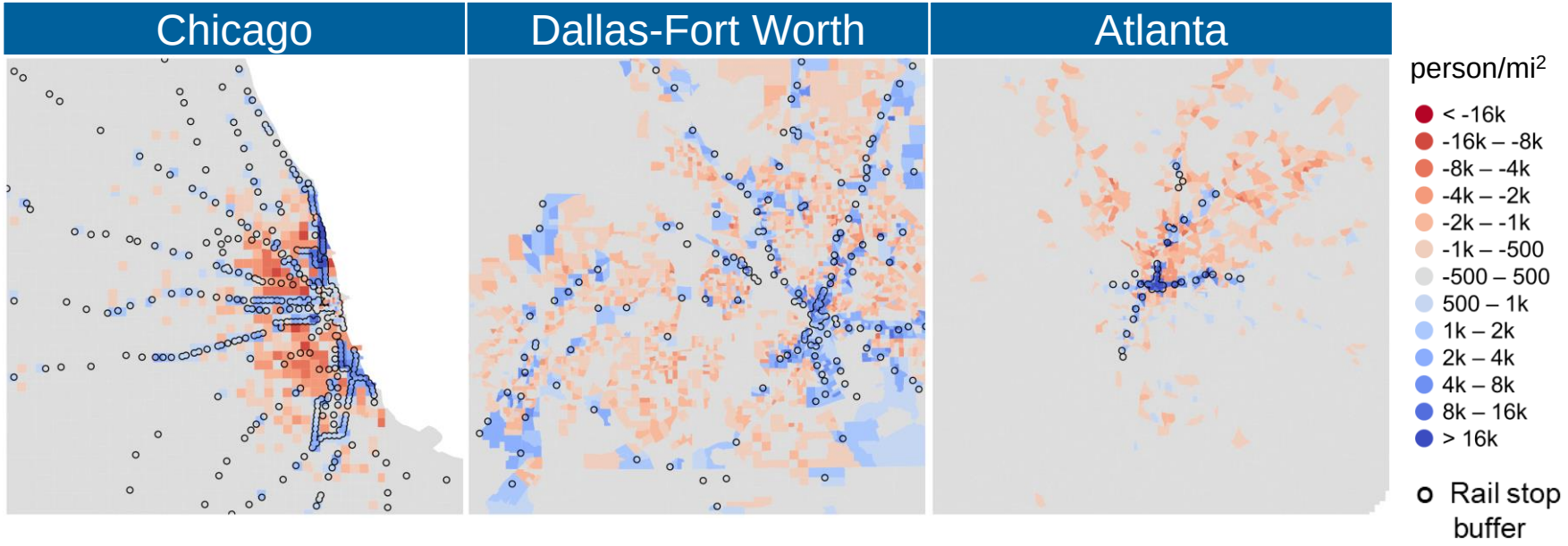




PERSON DENSITY IN 2050 BASE



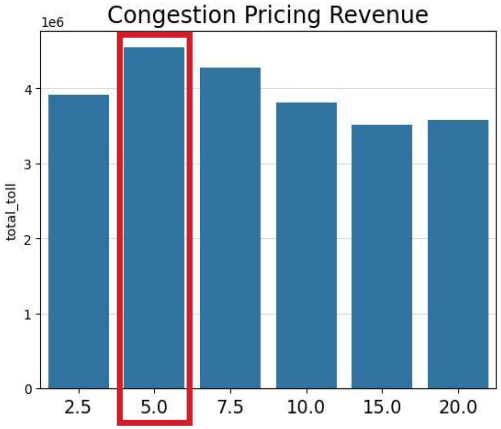
TOD LEVER CHANGE IN PERSON DENSITY



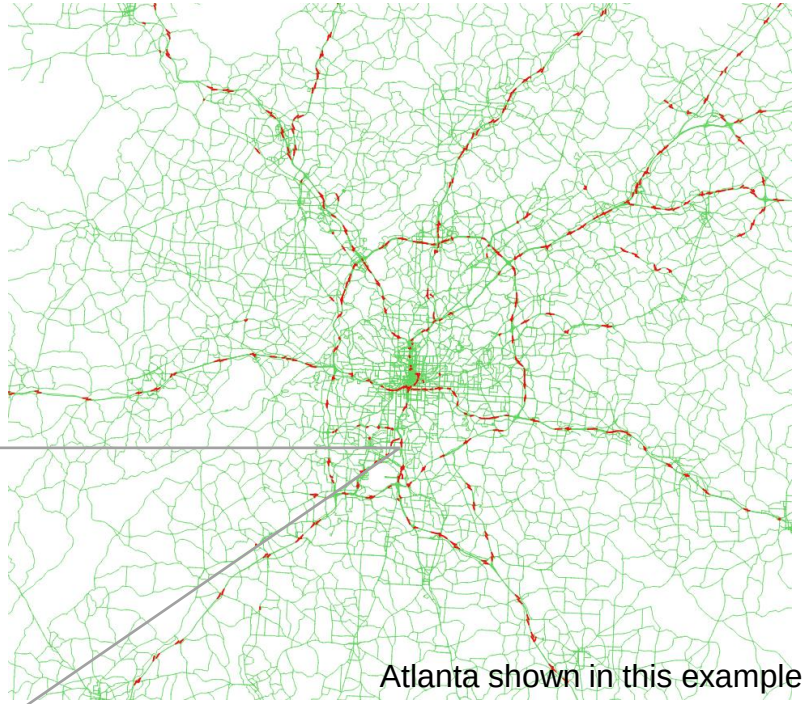
MANAGED LANES / CONGESTION PRICING

Designed to reduce expressway congestion & maximize revenue

- Single flat entry fee for using the highway system in each city
- Add a toll pricing entry for each on-ramp
  - Currently set to $5 from analyzing revenue in $2.50 increments
  - Operates from 6AM and 8PM
- Needed new network parsing code to identify appropriate ramps – i.e. no non-highway, no flyovers, etc.

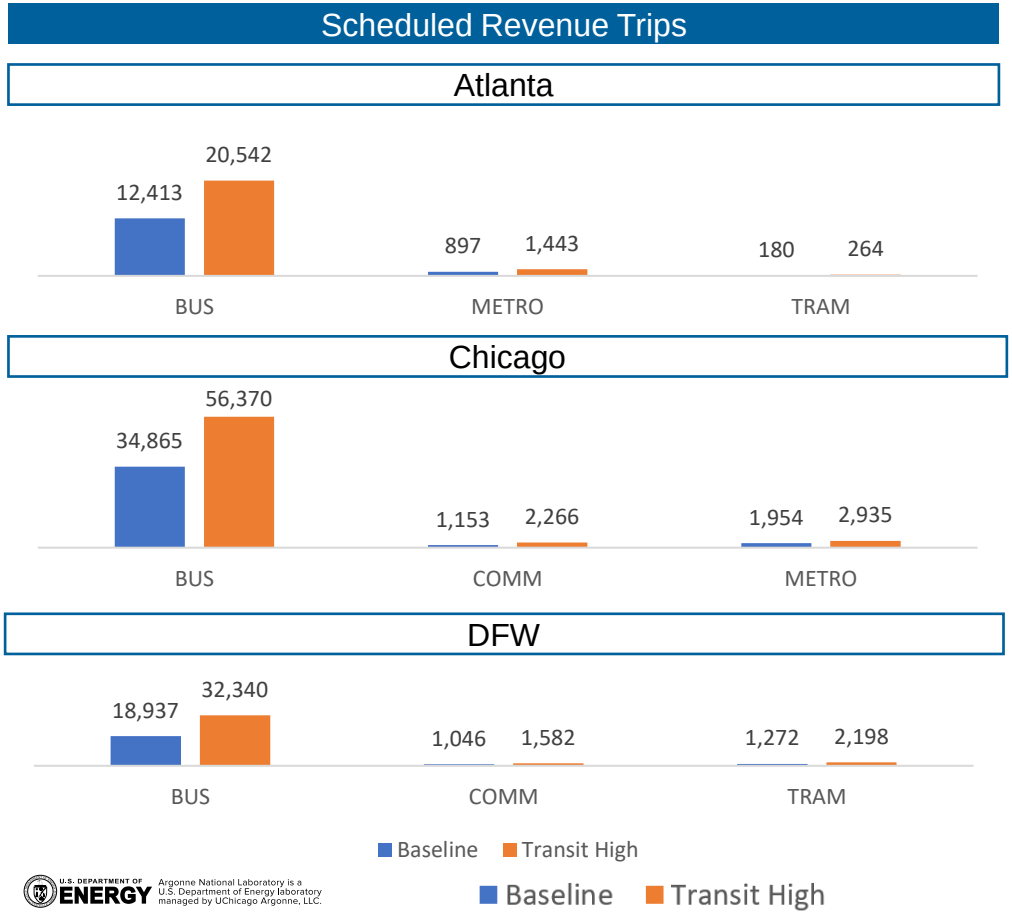


Tolling Points



Atlanta shown in this example

TRANSIT EXPANSION TO IMPROVE SERVICE



- Added bus rapid transit (BRT) routes:
  - 1 in Atlanta
  - 4 in Chicago
  - 3 in DFW
- Frequency increase (~65%):
  - ~65% for buses
  - ~75% for commuter rail
  - ~54% for metro
  - ~70% for tram
- Speed increase:
  - 20% speed increase for the top 40% ridership routes
- Lane reduction for cars on speed-improved corridors

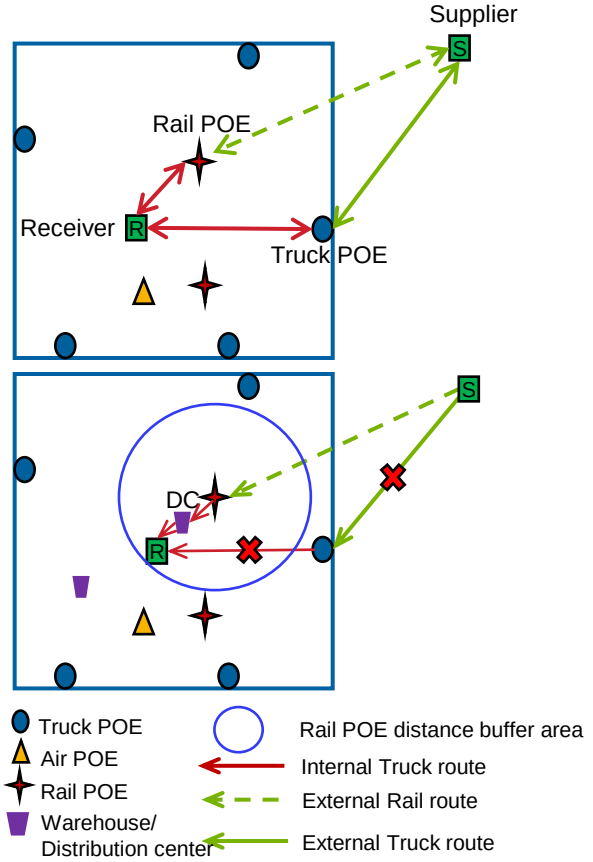
INTERMODAL TRANSPORTATION SHIFT TO RAIL

- **Point of entry (POE) is the initial location where shipments enter or exit to/from model area**
- Point of entry locations in POLARIS by mode:
  - **External locations-Truck**
  - **Airport locations-Air**
  - **Terminal locations-Rail**
- External-internal (EI) shipments reach to POE by main mode then proceed to destination within internal area by the truck mode
- Internal-external (IE) shipments start from the internal area to the POE by truck, then to the destination by the chosen main mode

In this study, 10% of external truck shipments shifted to rail mode then the original transportation chain preserved with an additional warehouse/distribution center stop

- The rail POE distance buffer area is designed to incentivize the modal shift for businesses within near proximity to rail terminals

Buffer Zones: 



RESULTS SUMMARIZED THROUGH REGRESSION

AFFORDABLE: HIGHEST COST SAVINGS WITH EV USE AND VEHICLE IMPROVEMENTS

Effect of Strategic Levers on Transportation Costs (Operation + Tolls)

- Increased EV penetration is most effective at reducing transportation costs
- Next highest reduction from:
  - Improved transit in Chicago and Atlanta
  - Improved vehicle technologies in DFW
- Effectiveness of vehicle technology improvement less pronounced with high EV penetration
- Significant cost reduction from telecommuting
  - Telecommuting further reduces cost increase from congestion pricing

	Chicago	DFW	Atlanta
Base ($/household)	$8.29	$11.04	$8.14
Congestion Pricing	5%	25%	15%
Transit	**-8%**	0%	**-9%**
TOD	3%	-2%	1%
Freight	0%	1%	-1%
Telecommute	**-4%**	**-6%**	**-4%**
EV Penetration	**-9%**	**-14%**	**-12%**
VTO High	**-5%**	**-7%**	**-7%**
Interaction Effects			
Congestion Pricing : EV Penetration		1%	
Congestion Pricing : Telecommute	-2%	-5%	-3%
Congestion Pricing : Transit			7%
EV Penetration : VTO High	3%	4%	4%
Freight : EV Penetration		-2%	
Telecommute : EV Penetration			2%
Transit : EV Penetration			2%

CONVENIENT: VARIATION IN VHT IMPACT IS HIGH WITH ATLANTA SAVING 13.5% VEHICLE HOURS FROM CONGESTION PRICING

VHT Impacts

- VHT reduction is higher in regions with higher VHT per capita, with DFW and Atlanta significantly higher than Chicago
- Higher VHT reduction caused by congestion pricing and telecommuting in Atlanta and DFW likely due to higher auto mode shares compared to Chicago
- Increase in VHT from transit expansion due to lane reduction in speed-improved corridors
- EV adoption and freight levers only have a marginal impact on VHT across regions
- Transit expansion + TOD more effective than Transit or TOD independently → integrated policies can yield non-linear benefits

Base Levers	Chicago	DFW	Atlanta
Congestion Pricing	**-8.5%**	**-11.4%**	**-13.5%**
Adding New Transit Lines	**2.0%**	**2.2%**	**11.7%**
Transit-Oriented Development	0.4%	**2.4%**	1.4%
Freight	-1.7%	-1.1%	-1.0%
Telecommuting	**-6.3%**	**-11.9%**	**-7.5%**
EV Adoption	-0.2%	-0.5%	-0.2%
Interactions (Synergistic Change)			
Congestion Pricing + Transit	-0.7%	-1.4%	-2.0%
+ TOD	-0.3%		-1.4%
+ Telecommute	1.1%	2.8%	3.1%
Transit + TOD	-0.3%	1.5%	
+ Telecommute			0.8%
TOD + Telecommute	-0.3%	1.5%	

Efficient: Energy Savings up to 62% with EV Adoption & VTO R&D Program Success

- Much of the energy reduction is driven by electrification: 44%-48% at 75% electrification
- VTO Technology and Mobility Systems Impacts Account for 25% of Benefits
- Mobility levers add delta savings – optimal energy savings cannot be realized without pricing freeways
- Shifting freight in freight-heavy regions like Chicago, and allowing for telecommuting flexibility also allow for energy improvements
- Optimal pathways vary by regional context
- ***Omitted levers at right COUNTER savings***

VTO R&D Program Success Could Lead to Annual Cost Savings of $23B to Households

Multi-Region impact of VTO High-Tech Case for BAU and High Electrification

- Overall, households spend an **average of $7 on travel costs** (fares and vehicle operating costs), and about **$38 on generalized travel time cost** (non-monetary cost of travel time)
- VTO R&D high tech case can **save average household $182** per year in BAU electrification case, and $71 in a high electrification case – up to $23 billion per year in cost savings if averaged across the US
- This represents a **3-8% cost savings** on direct monetary costs, depending on city and electrification level

Scenario		Avg Daily Cost per Household By Type				Cost Savings Due to VTO High Tech		
City	EV Pen.	Travel Time	Toll / Fare	Operating Cost [VTO-BAU]	Operating Cost [VTO High]	Annual Savings	% of All Cost Saved	% of Op.Cost Saved
Atlanta	BAU	$37.75	$1.41	$5.02	$4.54	$173.07	1%	7%
Chicago	BAU	$36.20	$2.71	$4.40	$3.97	$155.85	1%	6%
DFW	BAU	$39.47	$1.30	$6.48	$5.88	$219.51	1%	8%
Atlanta	High	$37.76	$1.51	$4.21	$4.03	$65.86	0%	3%
Chicago	High	$36.54	$2.80	$3.69	$3.52	$61.35	0%	3%
DFW	High	$39.80	$1.09	$5.44	$5.21	$84.75	1%	4%

THANK YOU! QUESTIONS OR COMMENTS?

PLEASE CONTACT US AT:

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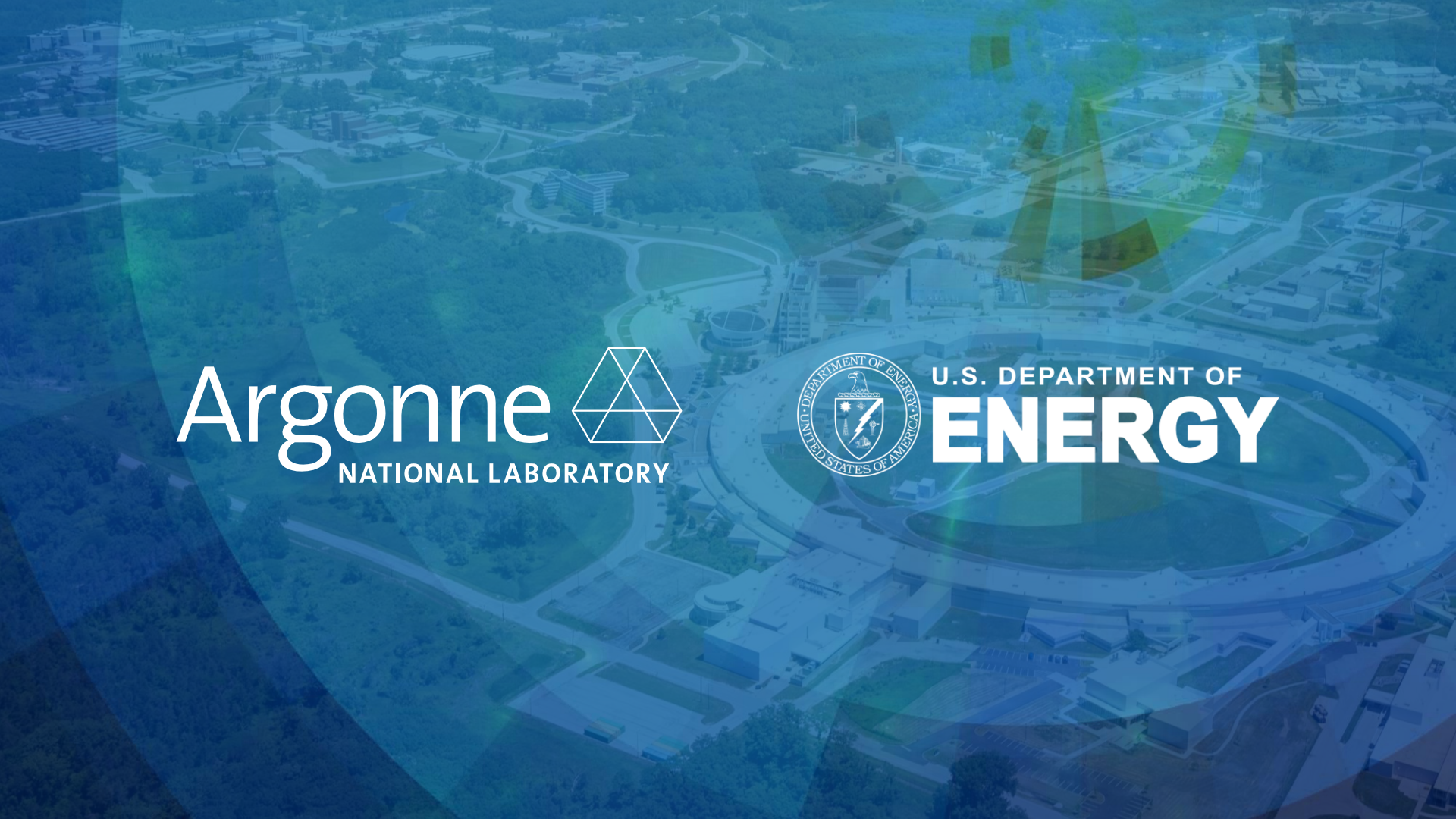
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