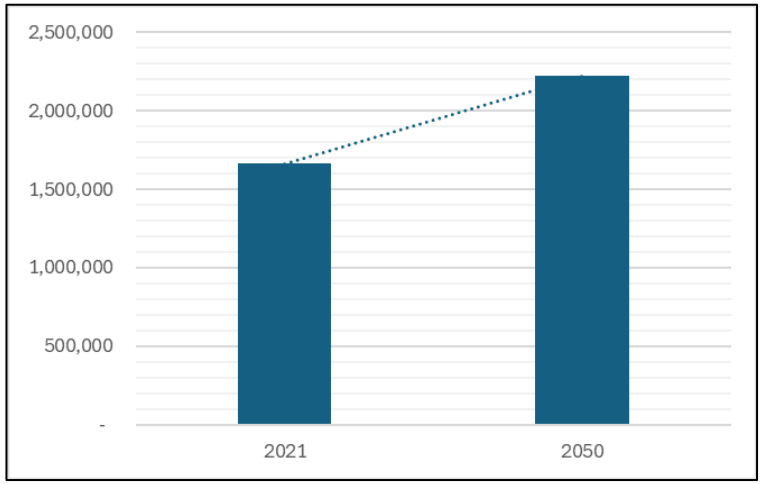
MID-OHIO REGIONAL
MORPC
PLANNING COMMISSION

Evaluating Emissions Reduction through Bus Rapid Transit in Central Ohio: An Activity-Based Approach

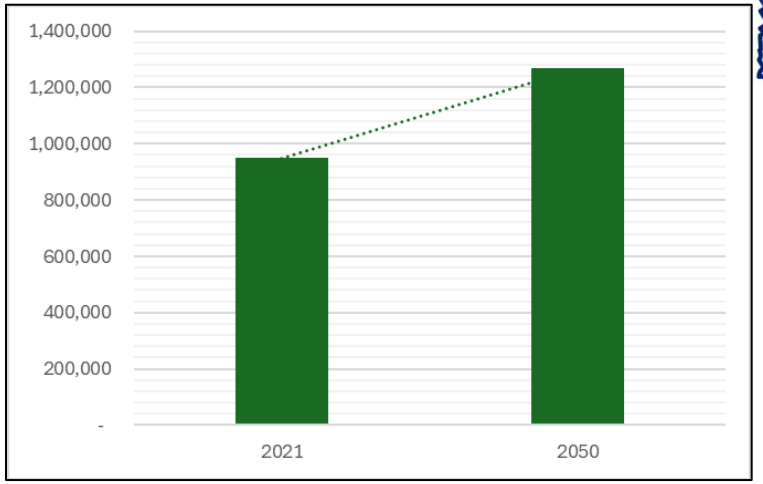
Raj Roy, PE, AICP

What is MORPC?

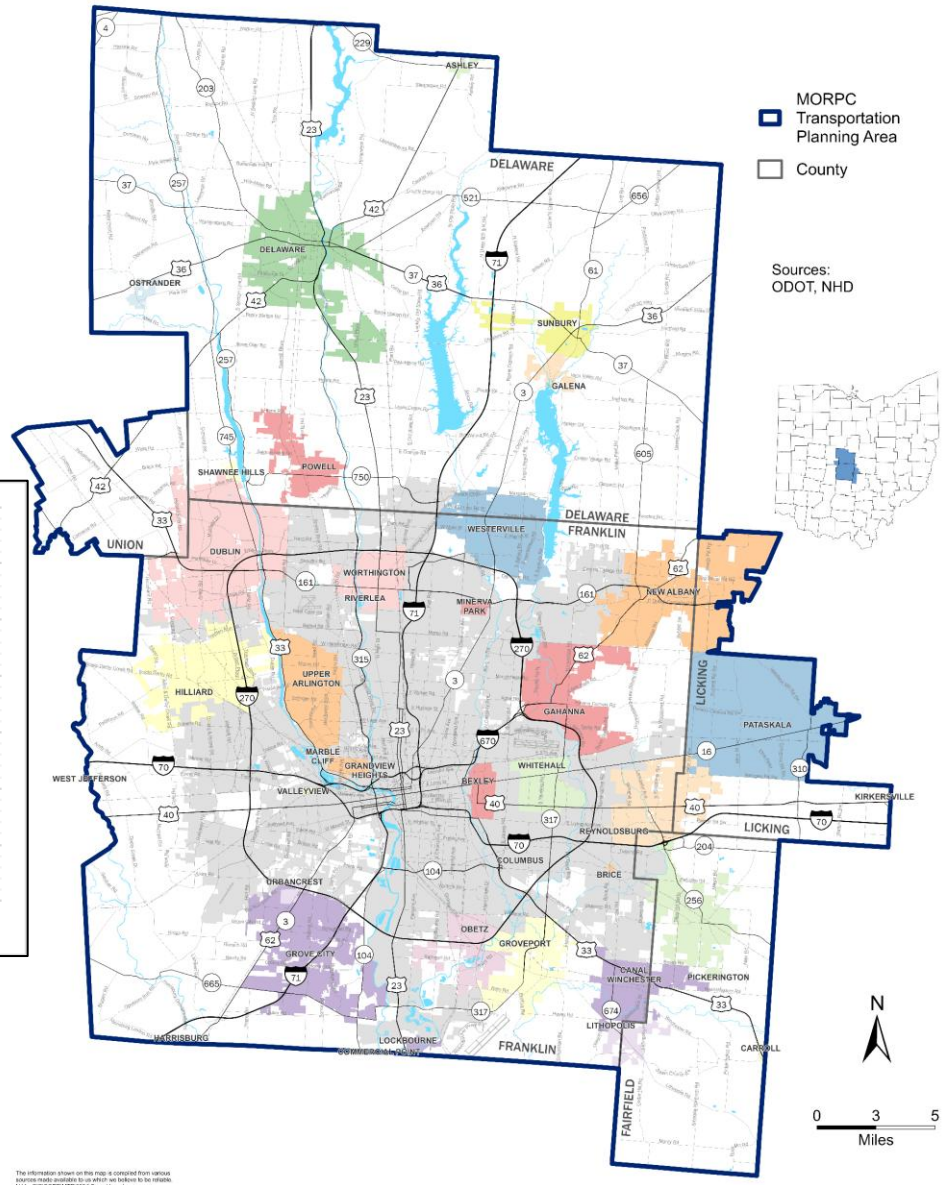
- Designated MPO for Columbus UA, OH
  - 2 full and 3 partial counties (~ 1,200 sq. miles)



Population

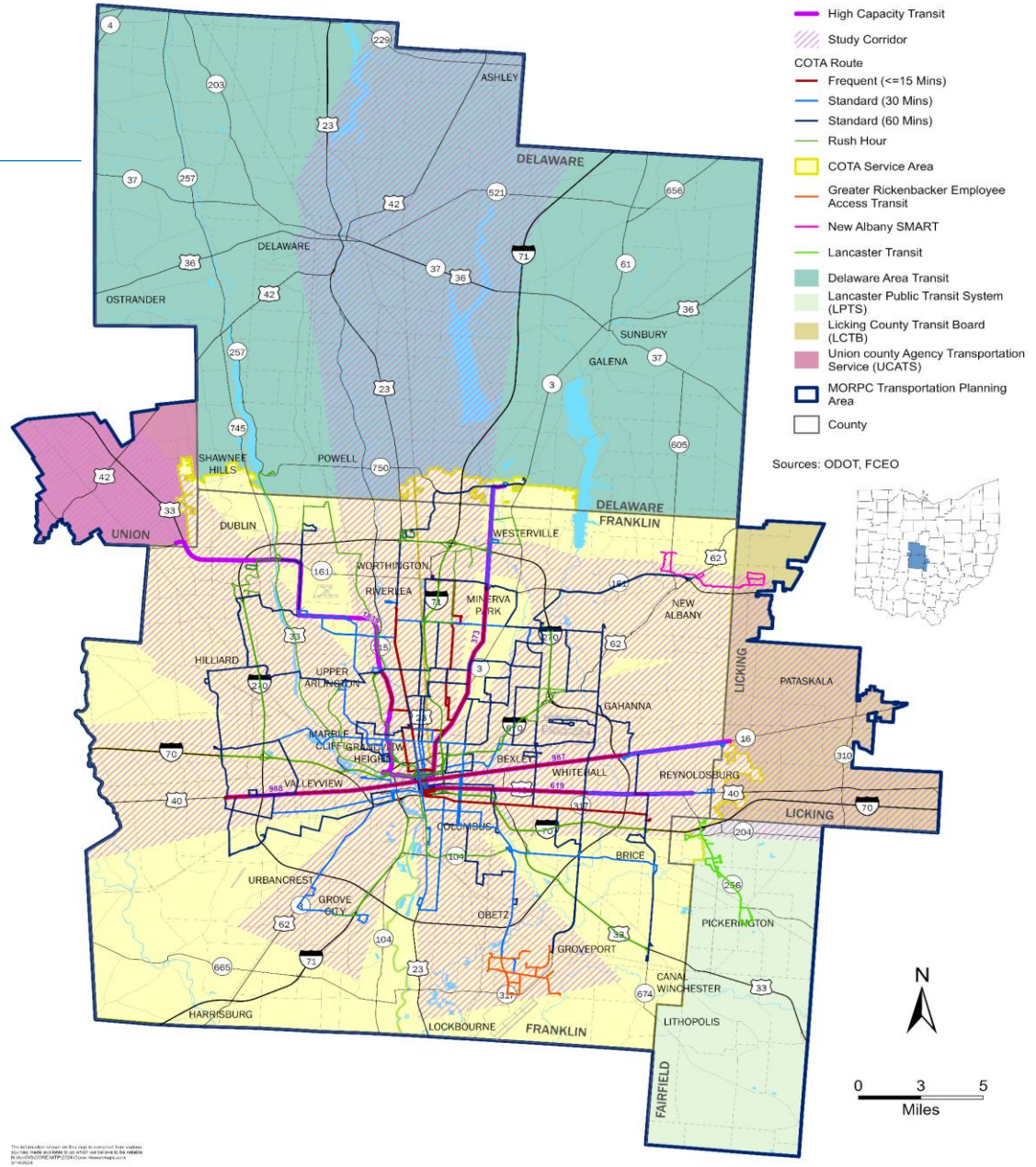


Employment

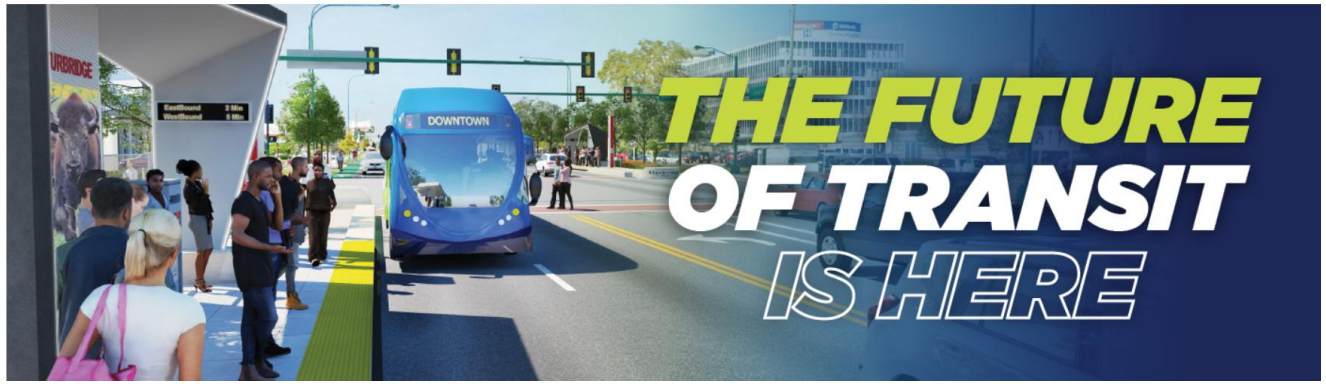


- Conducts regional transportation studies
  - LinkUS

Transit Infrastructure



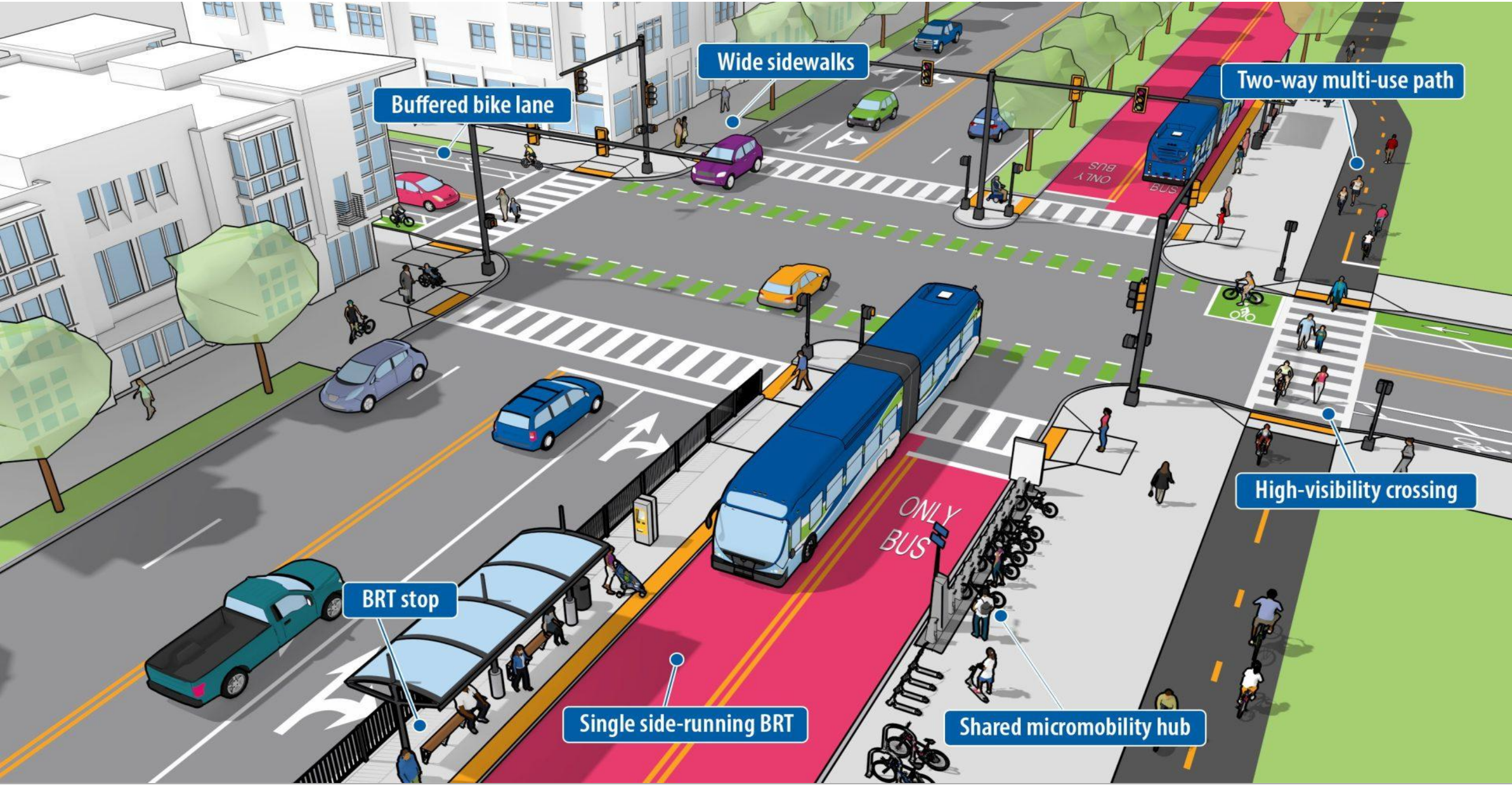
What is LinkUS?



Modernize the Transit System

Expand Sidewalks, Trails and Bikeways

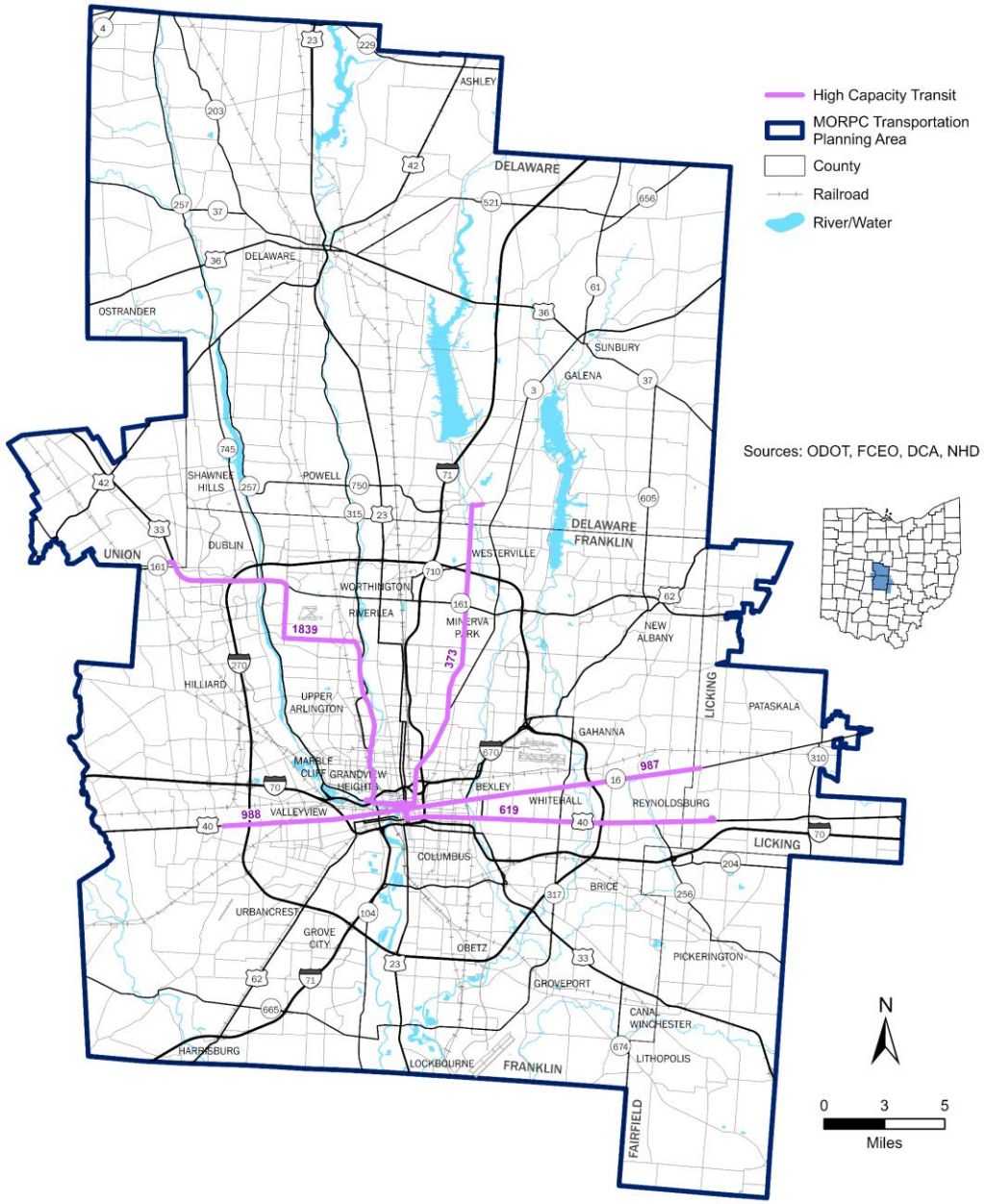
- Significantly expand COTA services by 45%
- 5 rapid transit lines
- 8 new COTA//Plus zones
- 14 new or improved transit lines
- Increased existing service with more frequency
- 500+ miles of sidewalks, bikeways and trails
- New and improved transit amenities including transit centers, park and rides, shelters and more


Buffered bike lane
Wide sidewalks
Two-way multi-use path
ONLY
BUS
BRT stop
Single side-running BRT
Shared micromobility hub
High-visibility crossing

5 Rapid Transit Lines

Activity Centers / Trip Generators

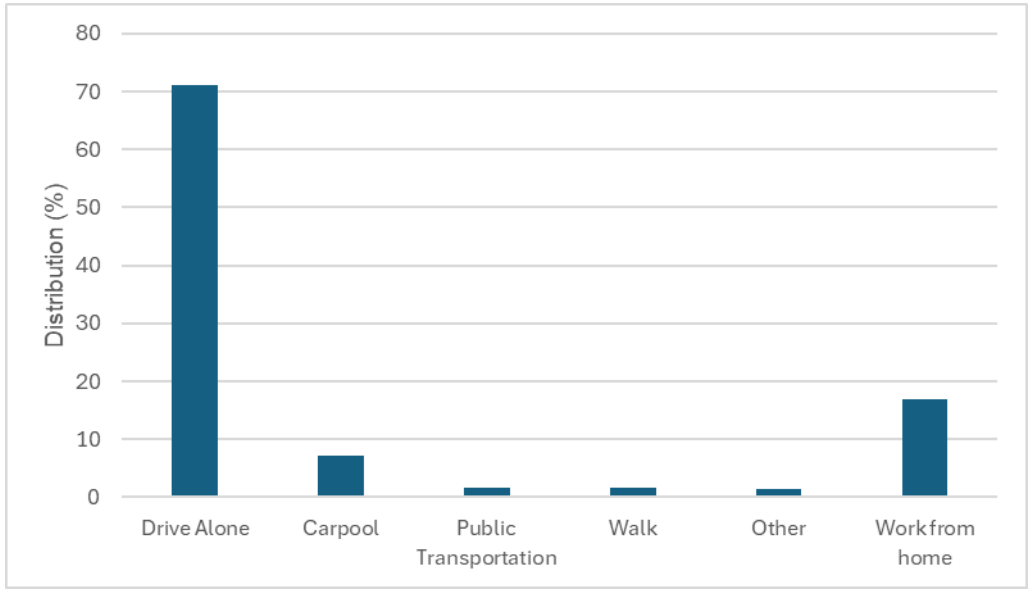
1. OhioHealth Doctors Hospital
2. Hollywood Casino
3. Wilson Road Park
4. Hilltop Branch Library
5. Ohio Department of Transportation
6. Ohio Department of Public Saftey
7. Mount Carmel Hospital
8. Center of Science and Industry (COSI)
9. Veterans Memorial
10. Scioto Mile
11. Palace Theatre
12. Ohio Statehouse
13. Capital University Law School
14. OhioHealth Grant Medical School
15. Columbus Metropolitan Library
16. Columbus College of Art & Design
17. Columbus Museum of Art



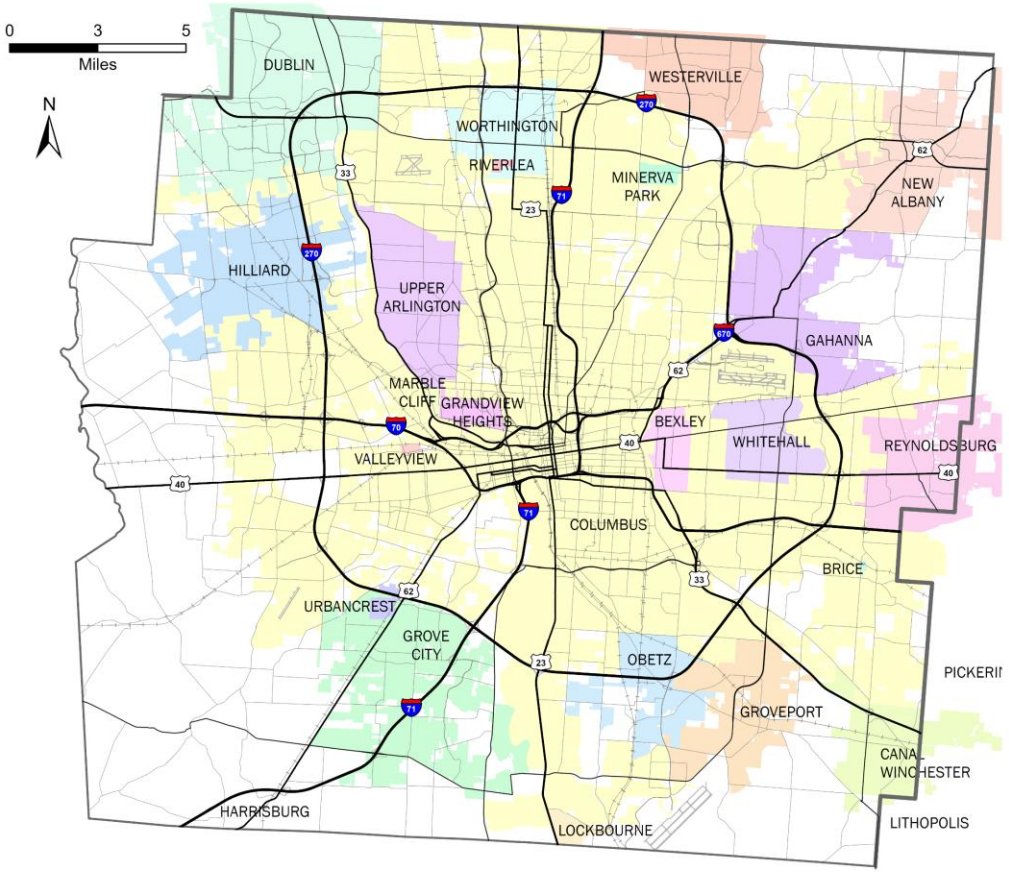
Study Area

- Total Roadway Lane-Miles: ~10,500
- Total Transit Route Miles: ~3,000
- Population: ~1.3M
- Employment: ~800K

Modal Distribution



*Based on ACS 5-Year estimates (Table B08141)



Franklin County, Ohio

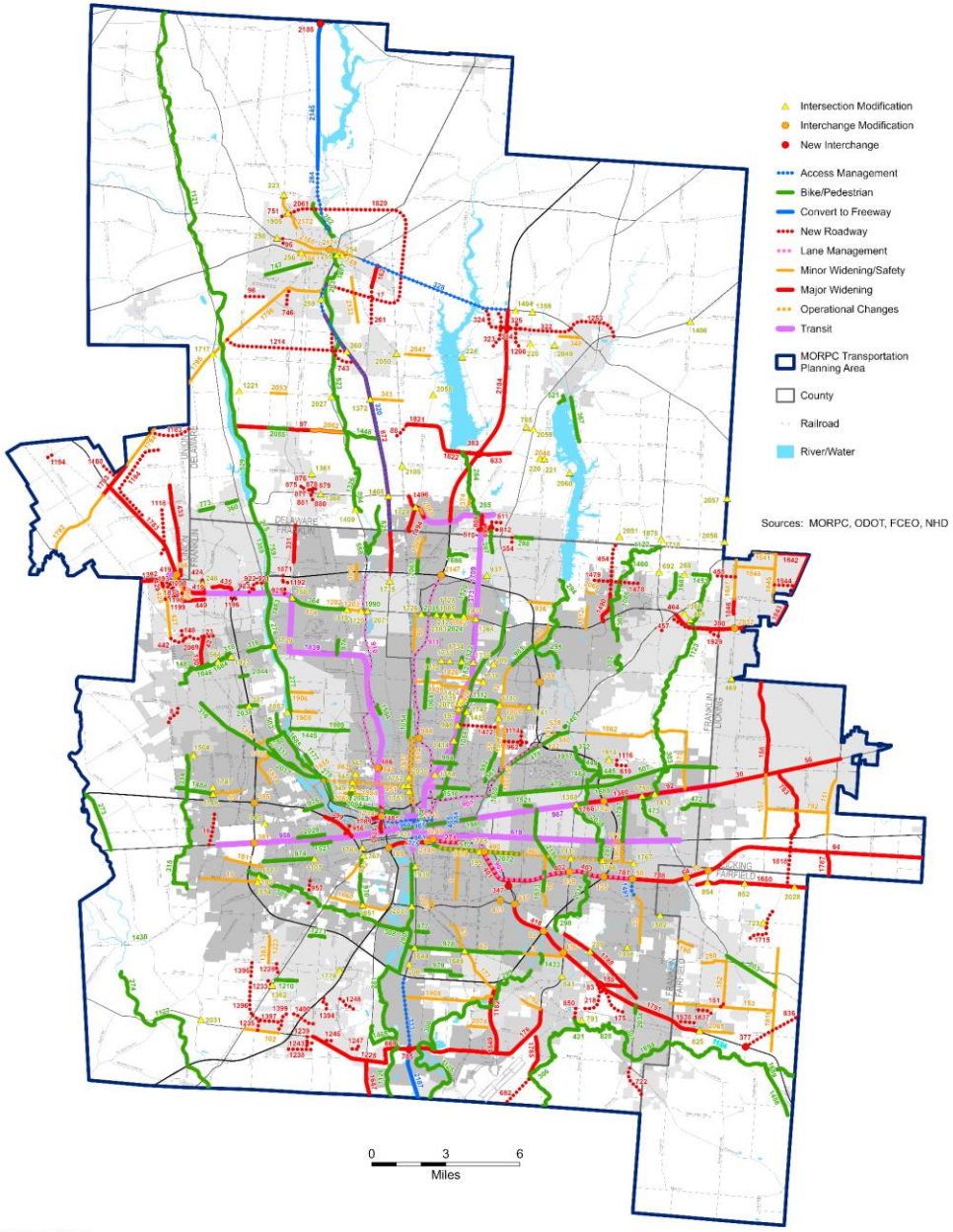
Methodology

- MORPC's regional activity-based travel demand model used to simulate two 2050 scenarios: BRT build and no-build
- Reasonable assumptions made for stop locations and lane configurations
- Metropolitan Transportation Plan (2024-2050 MTP) projects are included
- VMT projections combined with local and default data sources used in US EPA MOVES4 modeling
- Air Quality Conformity Analysis: VOC and NOx (Ozone standards)
- GHG emissions: CO2 equivalent

Overview of MTP

$35 billion in strategies and projects

- Widen 48 miles of freeways
- Convert 17 miles of four-lane divided roadways to freeways
- Modify 23 freeway interchanges
- Add 7 new interchanges
- Add 94 miles of through lane additions
- Add 95 miles of new roadway connections
- Include 122 roadway miles with minor widening
- Modify 117 intersections
- **Add five high-capacity transit projects covering 50 miles**



AQ Conformity Analysis

Study area is in nonattainment for 8-hour ozone standard (VOC and NOx)

Required to perform Transportation Conformity Procedures

- Distribute 24-hour model volumes into hourly directional components
- Calculate an hourly, directional speed for the link based on V/C ratio
- Apply MOVES emission factors to calculate link based and intrazonal trips emissions

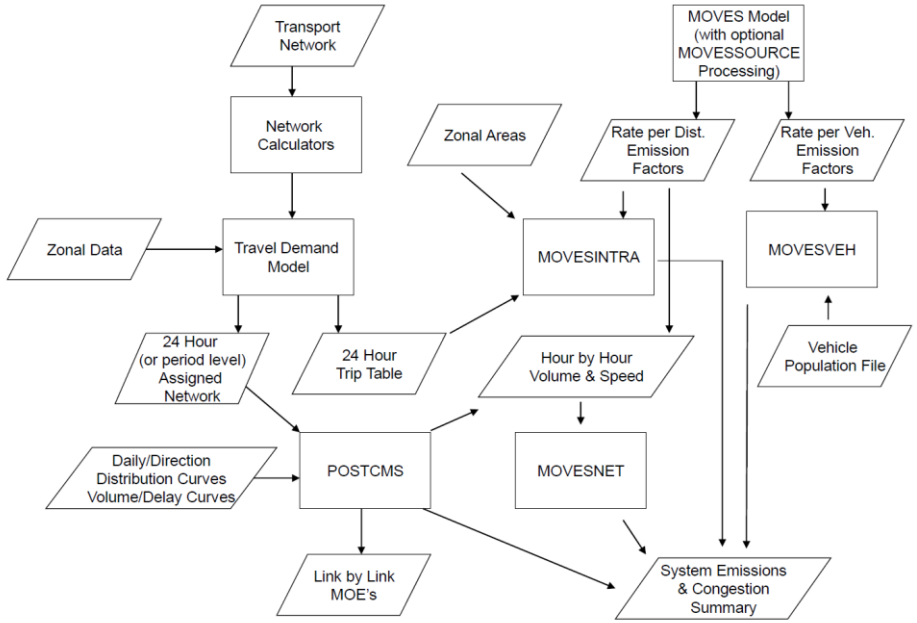


Figure 1. Overall CMAQ Proces

* Courtesy: Gregory Giaimo

AQ Conformity Analysis

- July Weekday
- AQ Season Factor: 8% higher than model VMT
- Weekend ADT 78% of Weekday (Based on StreetLight OD analysis)
- No. of Weekdays and Weekends by month in 2050 (using LLM)
- Emission factors from MOVES4 modeling (Ohio DOT)
- Estimate yearly emission for BRT build and no-build scenarios

Year: 2050

Month	Total Days	Weekdays	Weekends
January	31	23	8
February	28	20	8
March	31	21	10
April	30	22	8
May	31	23	8
June	30	21	9
July	31	**21**	**10**
August	31	22	9
September	30	21	9
October	31	23	8
November	30	21	9
December	31	22	9
Total	365	260	105

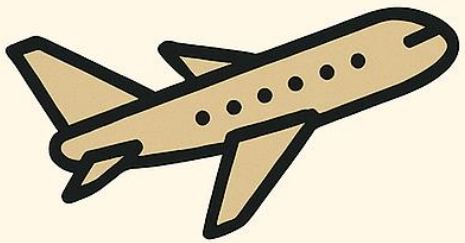
* Courtesy: M365 Copilot

~ 500 kg of VOC and ~2,800 kg of NOx emission will be reduced per year

What does that mean?

600
PASSENGER VEHICLES
DRIVEN FOR ONE YEAR

10
DIESEL TRUCKS
DRIVEN FOR ONE YEAR



100
FLIGHTS
FROM NEW YORK TO LA

175 HOMES' ENERGY USE
FOR ONE YEAR

* Courtesy: M365 Copilot

GHG Emission Analysis

Input Database

- Meteorology Data
- Source Type Population
- Age Distribution
- Vehicle Type VMT
- Average Speed Distribution
- Road Type Distribution
- Fuel (Supply, Formulation, Usage Fraction, AVFT)
- I/M program, Starts, Hotelling…

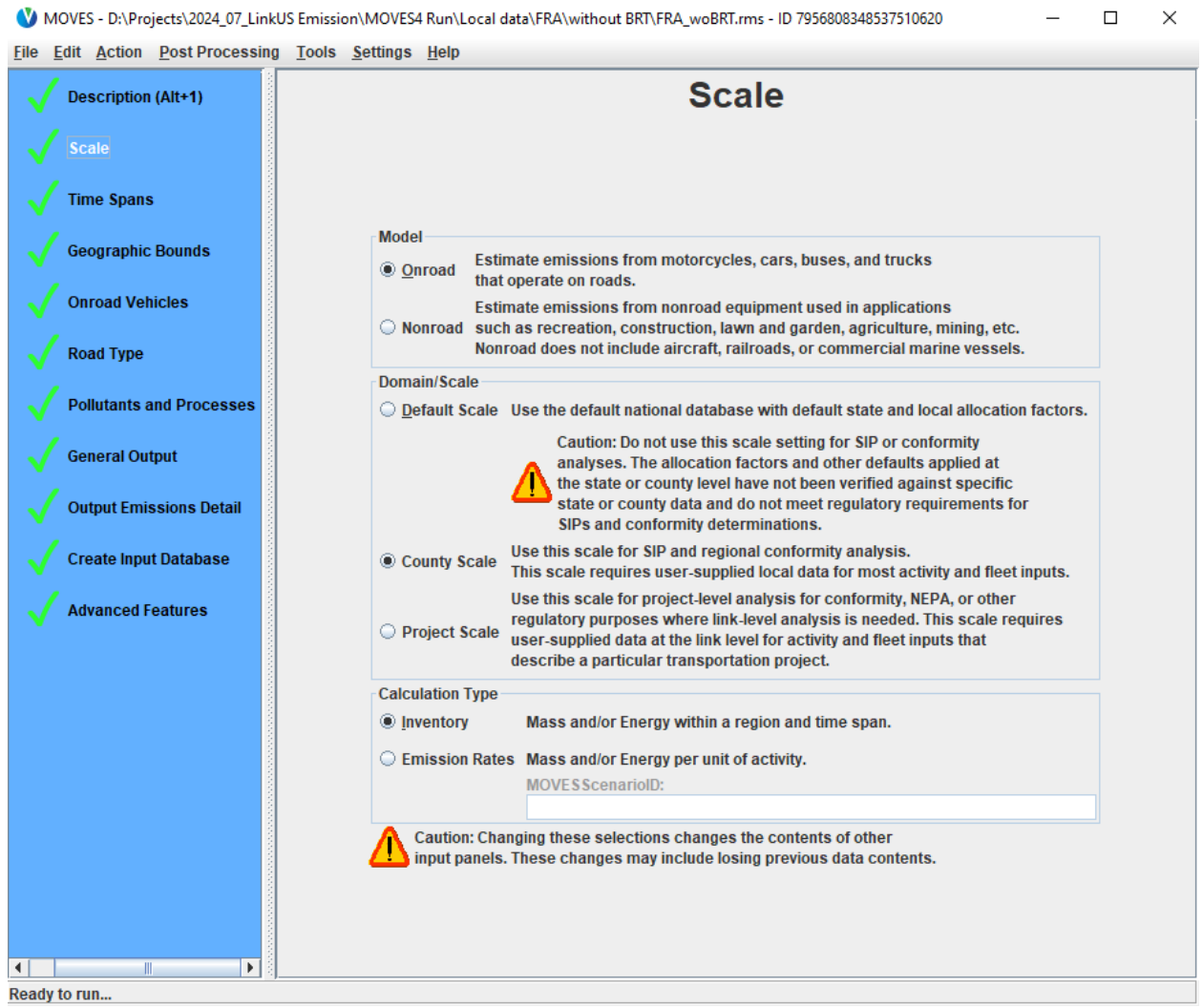


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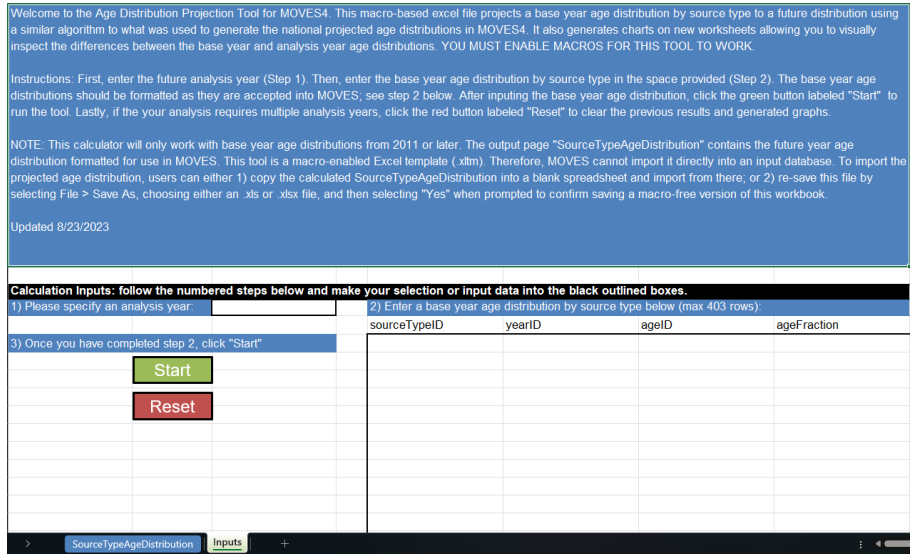
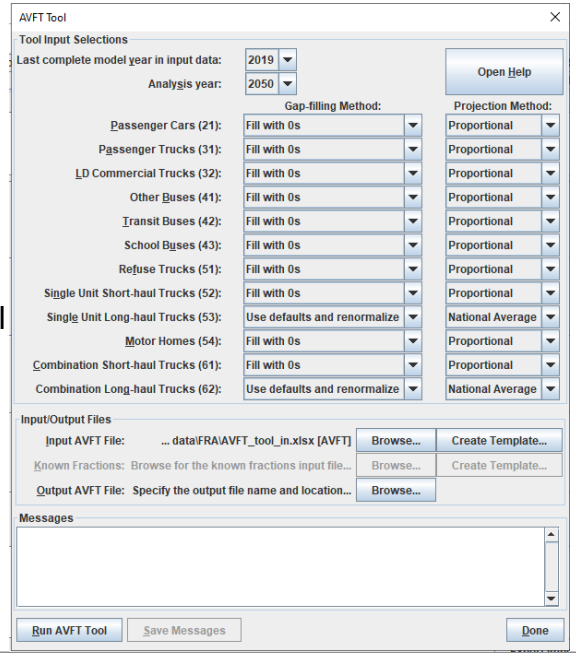
Table 4-1: MOVES Source Types and HPMS Vehicle Type

MOVES		HPMS	
Source Type ID	Source Types	Vehicle Type ID	Vehicle Type
11	Motorcycle	10	Motorcycles
21	Passenger Car	25	Light Duty Vehicles
31	Passenger Truck		
32	Light Commercial Truck		
41	Other Buses	40	Buses
42	Transit Bus		
43	School Bus		
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck		
53	Single Unit Long-haul Truck		
54	Motor Home		
61	Combination Short-haul Truck	60	Combination Trucks
62	Combination Long-haul Truck		

Age Distribution Projection Tool



AVFT Tool



GHG Emission Analysis

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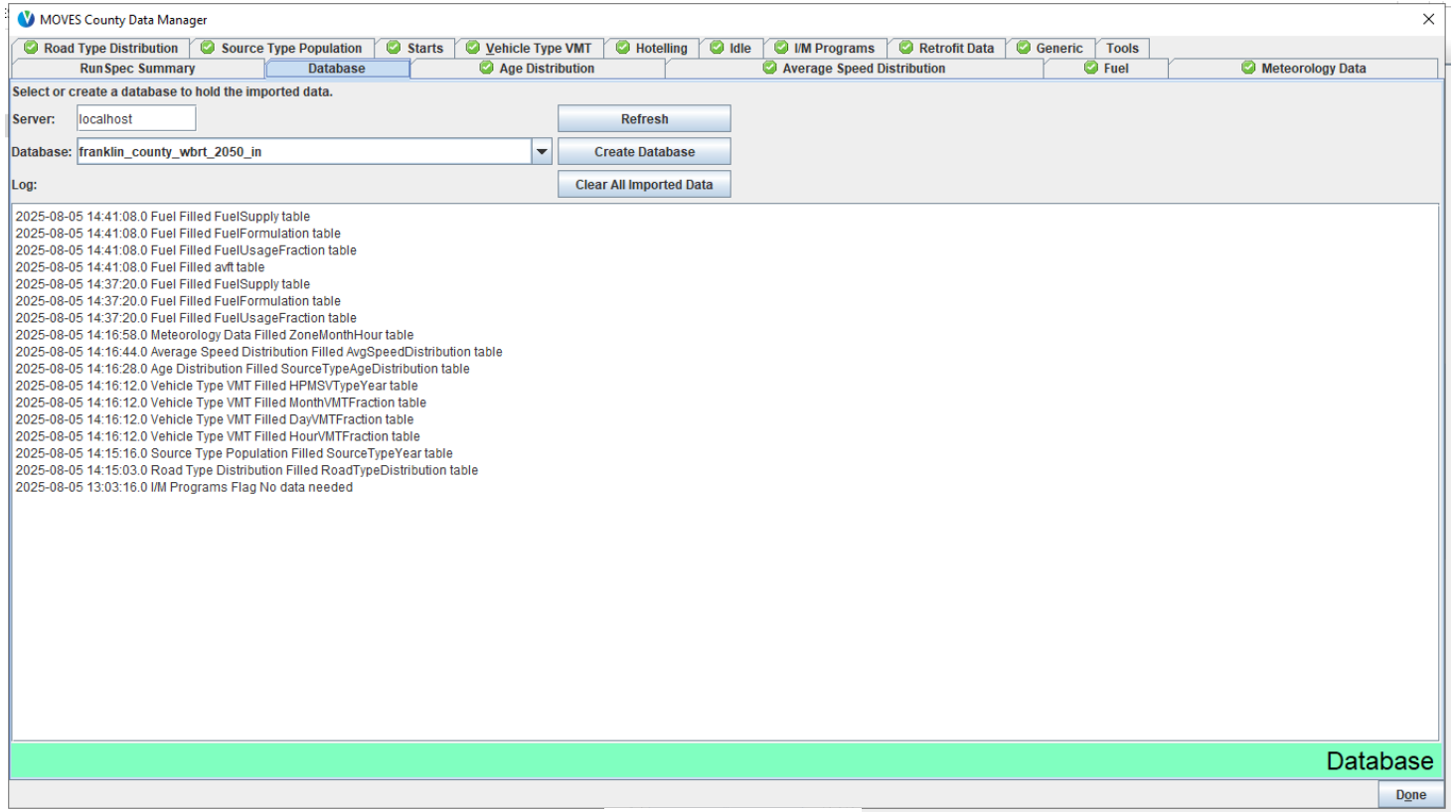
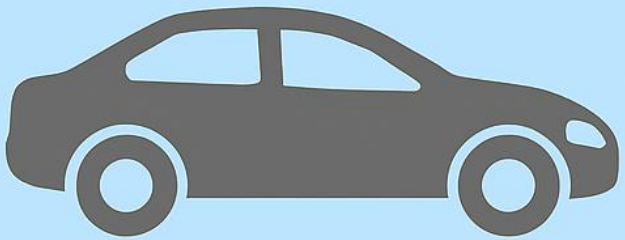


Table 3-3: CO_2 Equivalence Factors in MOVES

Pollutant	CO_2 Equivalent[35]
CO_2	1
Methane (CH_4)	25
Nitrous Oxide (N_2O)	298

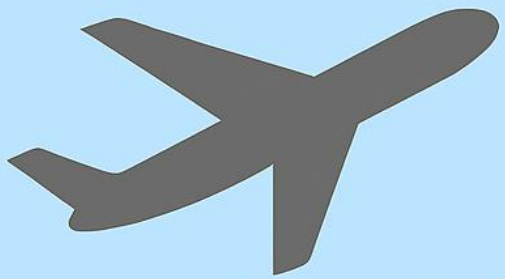
~2,100 Metric tons of CO_2 Equivalent emission will be reduced per year

How big is 2100 metric tons of CO_2e?



456 passenger vehicles driven for one year

280 homes' energy use for one year



2100 round-trip flights from New York to London

256 million smartphone charges

* Courtesy: M365 Copilot

How many trees are needed for offsetting?

95,454 trees

* Courtesy: M365 Copilot

Final Remarks

- Can BRT reduce emission? Yes
- Models (Modelers) are useful
- Transit Supportive Infrastructure: 500+ miles of sidewalks, bikeways and trails – not part of modeling
- Providing yearly emissions helped clear the air with policymakers!

"Everyone wants transit, for the other guy"

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