International Border Crossing Emissions Phase II

El Paso Metropolitan Planning Organization

FEBRUARY 2024

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

The preparation of this report was financed through grants from the State of Texas through the Texas Commission on Environmental Quality. The content, findings, opinions and conclusions are the work of the author(s) and do not necessarily represent findings, opinions or conclusions of TCEQ.

CENTER FOR TRANSPORTATION INFRASTRUCTURE SYSTEMS

Outline

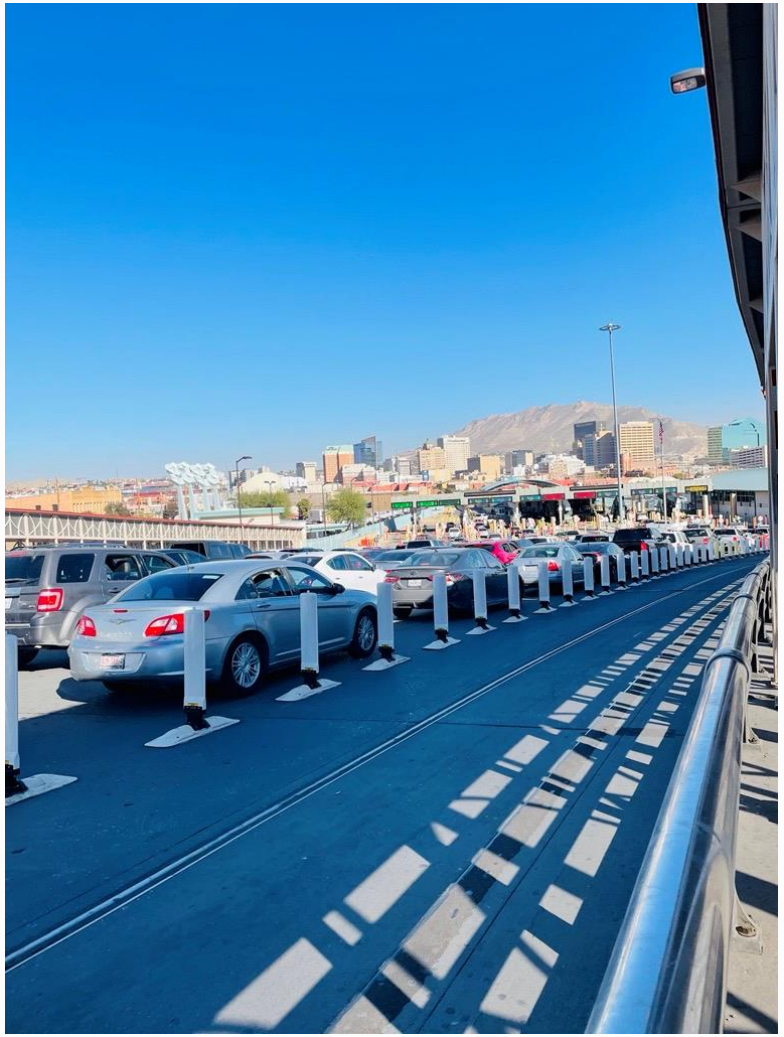
- Background
- Objective
- Surveys at International Border Crossings (IBCs)
  - Passenger vehicle & pedestrian trips
  - Commercial vehicle trips
- IBC traffic and emissions evaluation
  - Macro level tools
  - Micro level tools
- Conclusion

Background

- Congestion at international border crossings (IBCs) generate emissions from idling.
- TCEQ awarded a Rider 7 grant to the El Paso MPO to better estimate such emissions (ozone precursors).
- This project builds on the development of the BEEM tool (Phase I), to estimate NOx and VOC from current conditions and from improvements at the IBCs.

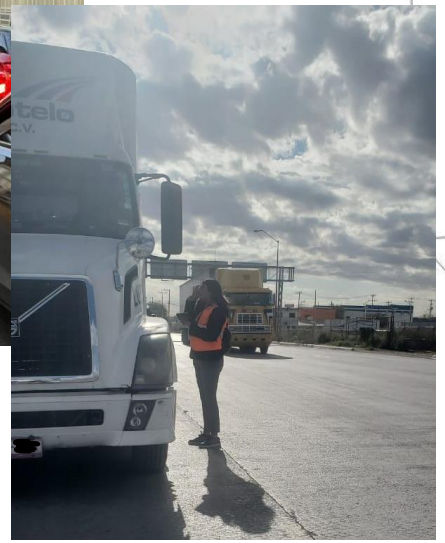
Objective

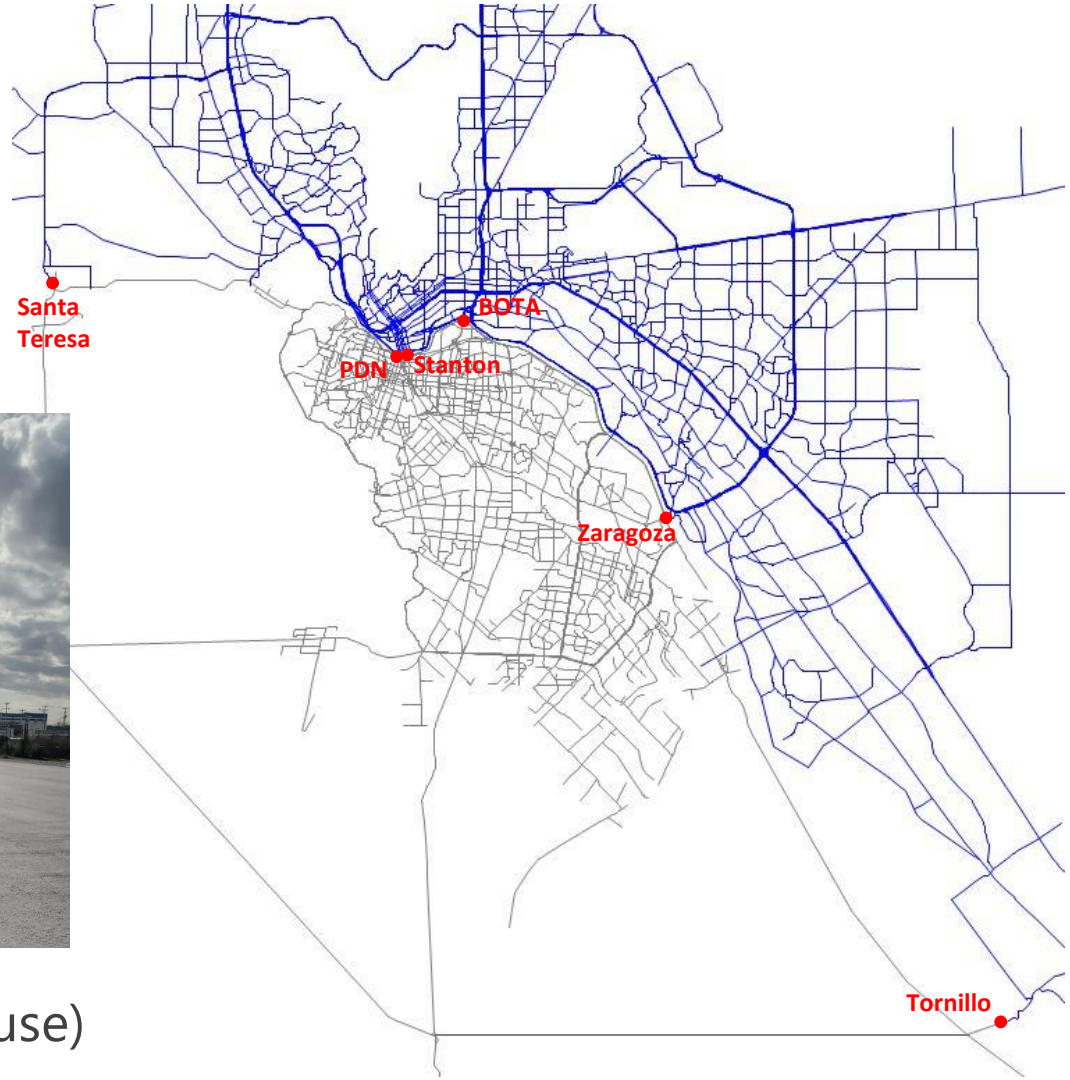
- Collect data at IBCs to improve the inputs of travel and traffic models.
- Combine emissions outputs from macro and micro levels from cross-border traffic activity.
- Develop different scenarios and test the tools.



Surveys at IBCs

- Participating agencies: CTIS, COLEF, EPMPO.
- Five IBCs:
  - ✓Santa Teresa
  - ✓Paso del Norte
  - ✓Stanton
  - ✓BOTA
  - ✓Zaragoza
  - ✓Tornillo (not surveyed-closed to trucks)
- Modes:
  - ✓AUTO: cars, motorcycle, trucks, vans (non-commercial use)
  - ✓PED: pedestrians
  - ✓TRUCK: commercial vehicles





Survey Instrument: PED

	Pedestrian 1
1. Time	____:____am ____:____pm
2. In what city and state do you live?	[ ] Cd. Juárez [ ] El Paso [ ] other:_____ city / state
3. ¿What was the last place you visited before coming here? (nearest street intersection/place and city)	
3a. At what time did you leave this place?	____:____am ____:____pm
3b. What was the purpose of this trip?	[ ] home [ ] work/work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/resataurants/gasoline [ ] Leave or pick up someone [ ] other_____
3c. From that place, what trasnportation mode you use to arrive to this international bridge?	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc
4. What is your next destination? (nearest street intersection/place and city)	
4b. What was the purpose of this trip?	[ ] home/ returning home [ ] work/ work related [ ] school [ ] medical services [ ] social/entertainment/vacations [ ] shopping/eating out/gasoline [ ] Leave or pick up someone [ ] other_____
4c. What trasnportaion mode will you use to go to your next destination?	[ ] walking [ ] bus [ ] taxi [ ] auto, pick-up, moto, etc

5. To measure the number of trips you have made, we need to know what places you've visited today :	
5a. Where did your fisrt trip started? (nearest street intersection/place and city)	
5b. From that place, what was your next destination? (nearest street intersection/place and city)	
5c. Where did you go next? (nearest street intersection/place and city)	
5d. Where did you go next? (nearest street intersection/place and city)	
5e. Where did you go next? (nearest street intersection/place and city)	
5f. Where did you go next? (nearest street intersection/place and city)	
5g. How many other places did you stop at today?	
6. Household montly income	$_____dollars/month
7. Including yourself, how many people live in you household?	_____people
Mexican Residents Only 8a.How much did you spend in US today? (shopping, gasoline, banking, medical services, etc.)	$_____dollars
Mexican Residents Only 8b Wait time spent in lane to cross to USA today	__ : ___ cruzó a pie [ ]Yes [ ]No (hr : min) DCL (auto) [ ]Yes [ ]No
Mexican Residents Only 8c We are interested on knowing the demand of crossing Indicate what waiting time would make you decide not to cross the border TODAY (for any time, international bridge, and transportation mode)	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No

Survey Instrument: AUTO

	Passenger vehicle 1
1. Time	____:____am ____:____pm
2. Number of passengers in the vehicle (including driver)	
3. Vehicle type	[ ] car [ ] taxi [ ] moto [ ] pick-up [ ] van [ ] other_____
4.In what city and state do you live?	[ ] Cd. Juárez [ ] El Paso [ ] other:_____ city / state
5. Last place where you got into your vehicle (nearest street intersection/place and city)	
5a. At what time did you leave this place?	____:____am ____:____pm
5b. What was the purpose of this trip?	[ ] home [ ] work / work related [ ] school [ ] medical services [ ] social/entretainment/vacations [ ] shopping/eating out/gasoline [ ] Drop off or pick up someone [ ] other_____
6. ¿What is your next destination? (nearest street intersection/place and city)	
6b. ¿What is the purpose of this trip?	[ ] home/ back home [ ] work/ work related [ ] school [ ] medical services [ ] social/entretainment/vacations [ ] shopping/eating out/ gasoline [ ] Leave or pick up someone [ ] other_____

7.To measure the number of trips you have made, we need to know what places you've visited today :	
7a. Where did your fisrt trip started? (nearest street intersection/place and city)	
7b. From that place, what was your next destination? (nearest street intersection/place and city)	
7c. Where did you go next? (nearest street intersection/place and city)	
7d. Where did you go next? (nearest street intersection/place and city)	
7e. Where did you go next? (nearest street intersection/place and city)	
7f. Where did you go next? (nearest street intersection/place and city)	
7g. How many other places did you stop at today?	
8. Household montly income	$_____dollars/month
9. Including yourself, how many people live in you household?	_____people
Mexican Residents only 10a.How much did you spend in US today? (shopping, medical, gasoline, banking.)	$_____dollars
10b. Wait time spent in lane to cross to USA today	__ : ___ walking [ ]Yes [ ]No (hr : min) DCL (vehicle) [ ]Yes [ ]No
10c We are interested on knowing the demand of crossing Indicate what waiting time would make you decide not to cross the border TODAY (for any time, international bridge, and transportation mode)	0:15 [ ]Yes [ ]No 1:45 [ ]Yes [ ]No 0:30 [ ]Yes [ ]No 2:00 [ ]Yes [ ]No 0:45 [ ]Yes [ ]No 2:15 [ ]Yes [ ]No 1:00 [ ]Yes [ ]No 2:30 [ ]Yes [ ]No 1:15 [ ]Yes [ ]No 2:45 [ ]Yes [ ]No 1:30 [ ]Yes [ ]No 3:00 [ ]Yes [ ]No

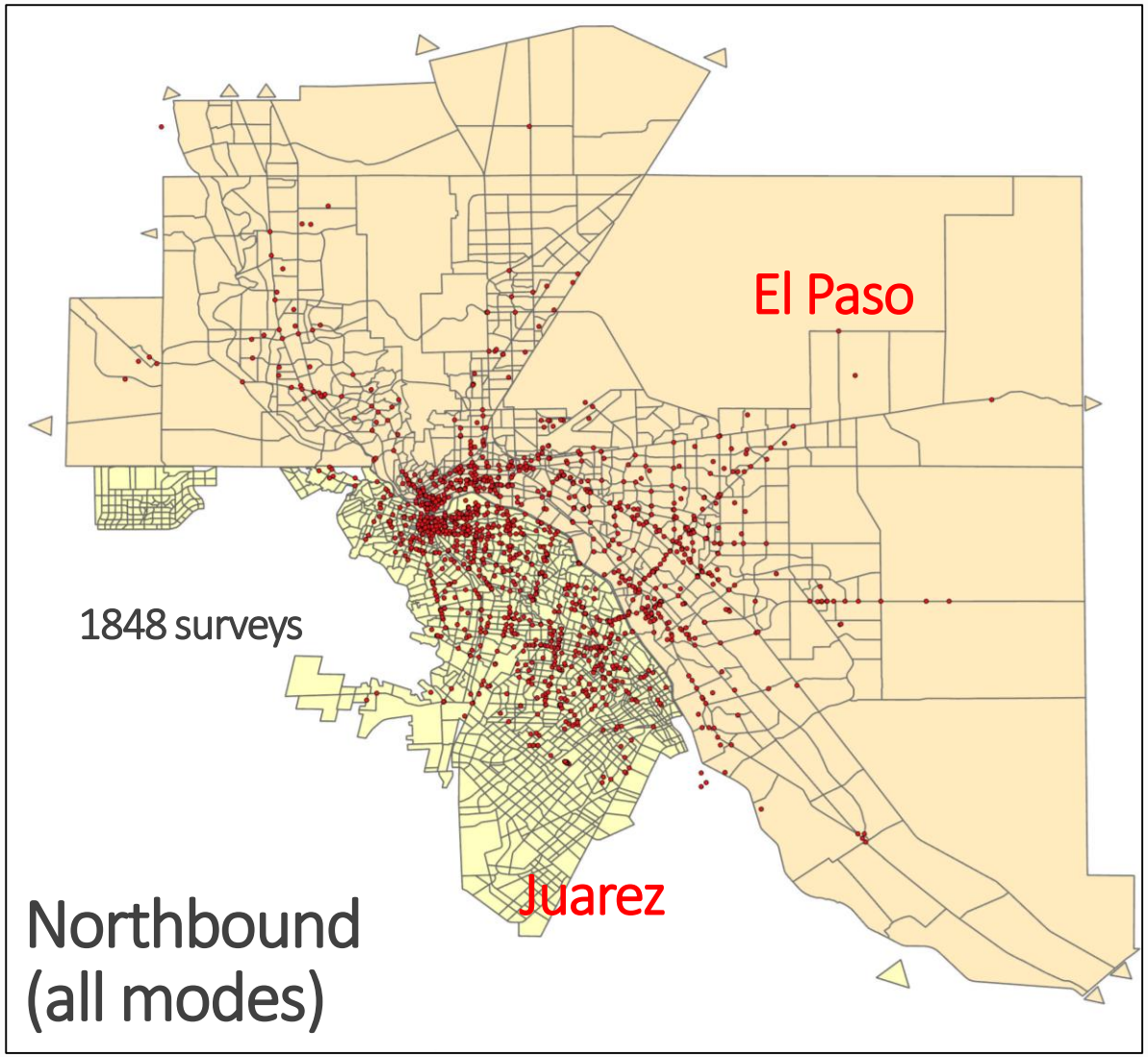
Survey Instrument: TRUCKS

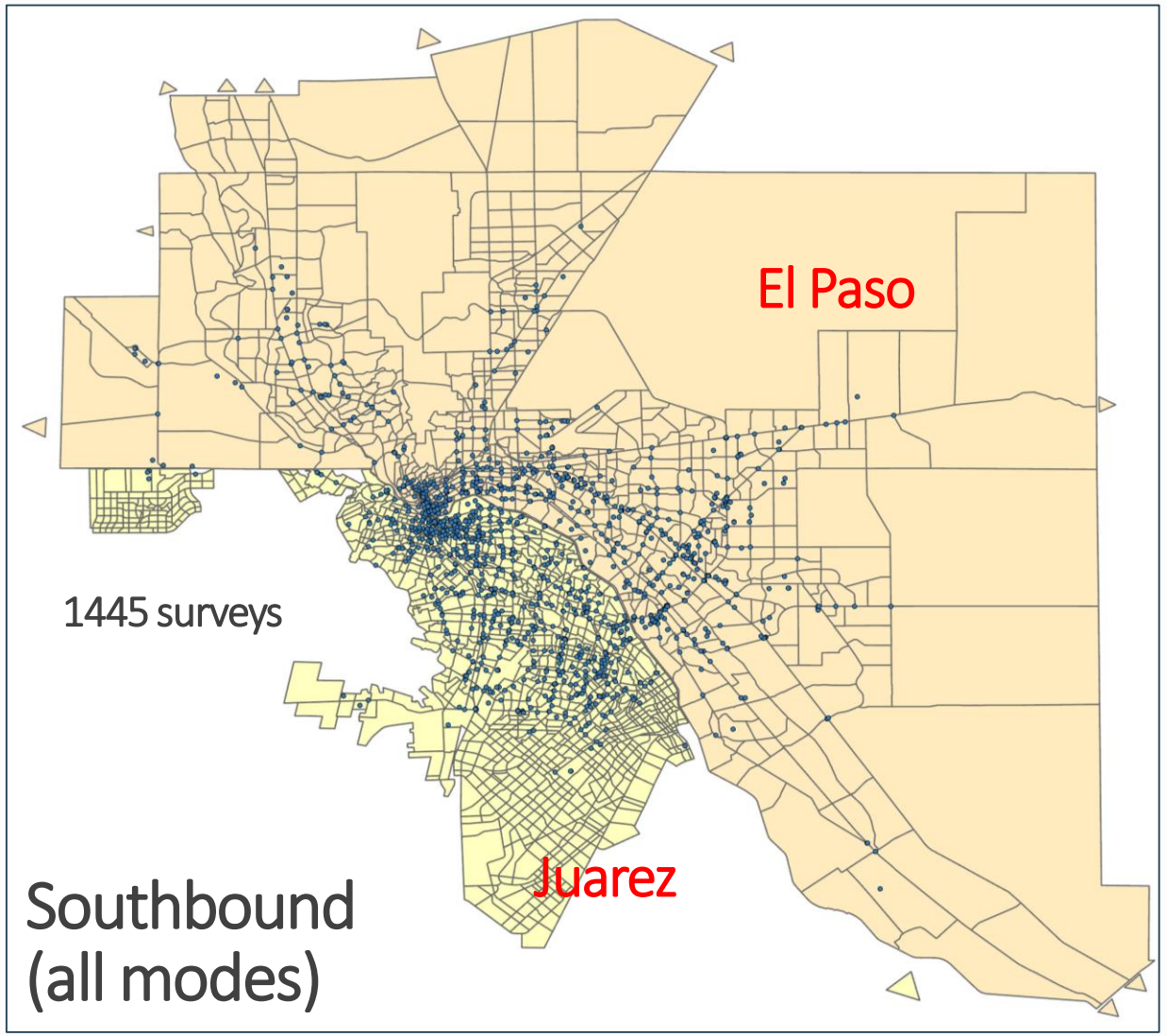
	Commercial Veh 1
1. Time	____:____am ____:____pm
2. Number of people in the vehicle	
3. Vehicle classification (Vehicle code)	
4. Cargo type (Cargo code)	_____ [ ]empty cargo
5. ¿Where did you pick up the shipment? (nearest street intersection/ place)	
6. ¿Was this place an intermodel station or a custom broker?	[ ] Yes [ ] No [ ] not sure
7. How was cargo tranferred at the location? (Transfer code)	
8. Where would you leave the cargo? (nearest street intersection/ place)	
9. Is the place a intermodel transfer stationor a custom broker?	[ ] Yes [ ] No [ ] not sure
10. How will the load be transferred at that location? (Transfer classification)	
11. Last place where you got into the vehicle (nearest street intersection/ place)	
11a. At what time did you leave this location??	____:____am ____:____pm
11b. What type of place it was? (PLACE code)	
11c. What was the purpose of being at this location? (PURPOSE code)	
12. What is your next destination? (nearest street intercetion/ place)	
12a. What was the purpose of this trip? (PURPOSE code)	
To measure the number of trips you have made, we need to know what places you've visited today :	
13. Where did you first trip started today? (nearest place/location/ city)	
14. Where did you go from there? (nearest place/location/ city)	
15.Where did you go next? (nearest place/location/ city)	
20. How many other places did you stop at today?	

Vehicle classification

1. auto/pick-up/van	
2. Two axle single unit (6 tires)	
3. Three axle single unit (10 tires)	
4. Four axle unit (14 tires)	
5. tractor-trailer	 …or larger vehicle type (more axles, double unit, etc.)

Cross-border ODs from surveys





Generic trip purposes: PED & AUTO

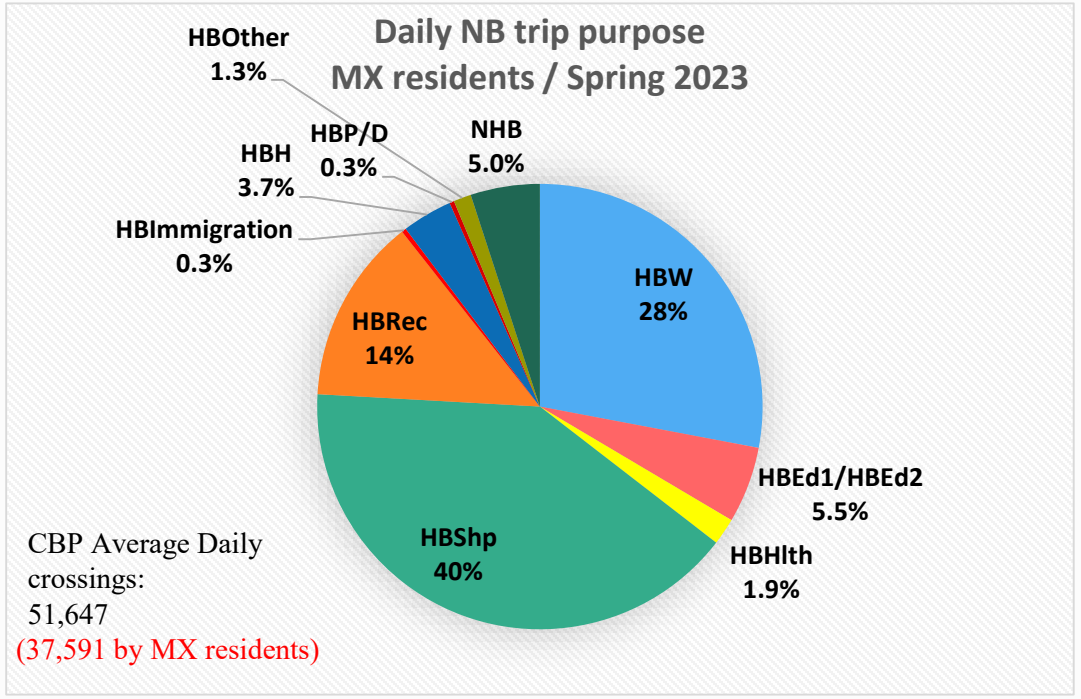
- TDMs classify trips at least into three generic trip purposes: HBW, HBNW, NHB.

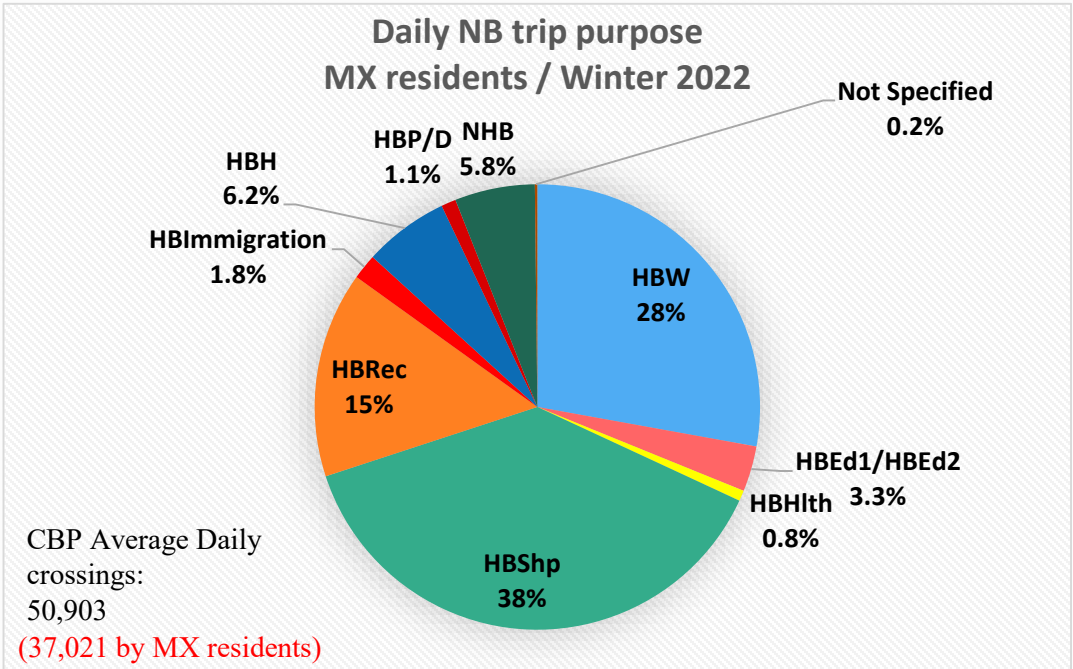
- For a careful review of cross-border purposes, the HBNW purpose was broaden into eight.

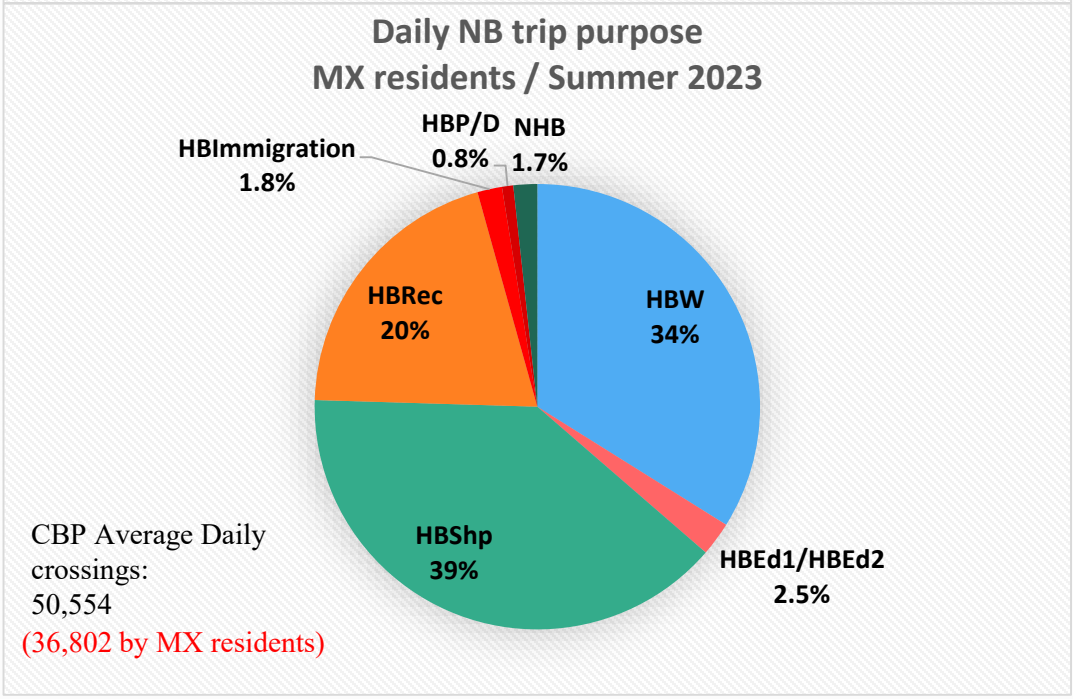
Code	Trip Purpose Description
HBW	Home-based work
HBEd	Home-based education
HBHlth	Home-based health (health services)
HBShp	Home-based Shop
HBRec	Home-based recreational
HBImmigration	Home-based immigration
HBH	Home-based home
HBP/D	Home-based serving passengers (pick up/drop off)
HBO	Home-based other
NHB	Non-Home-based
Not Specified	Not Specified

IBC Survey Results:

Daily NB PED+AUTO trip purposes
MX residents

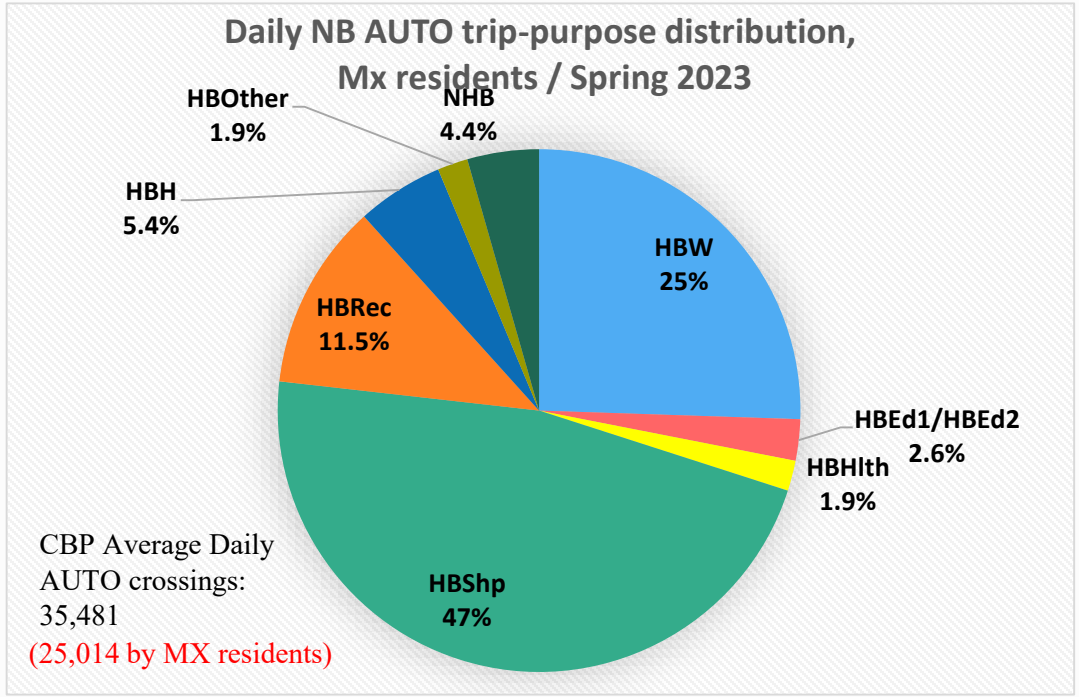


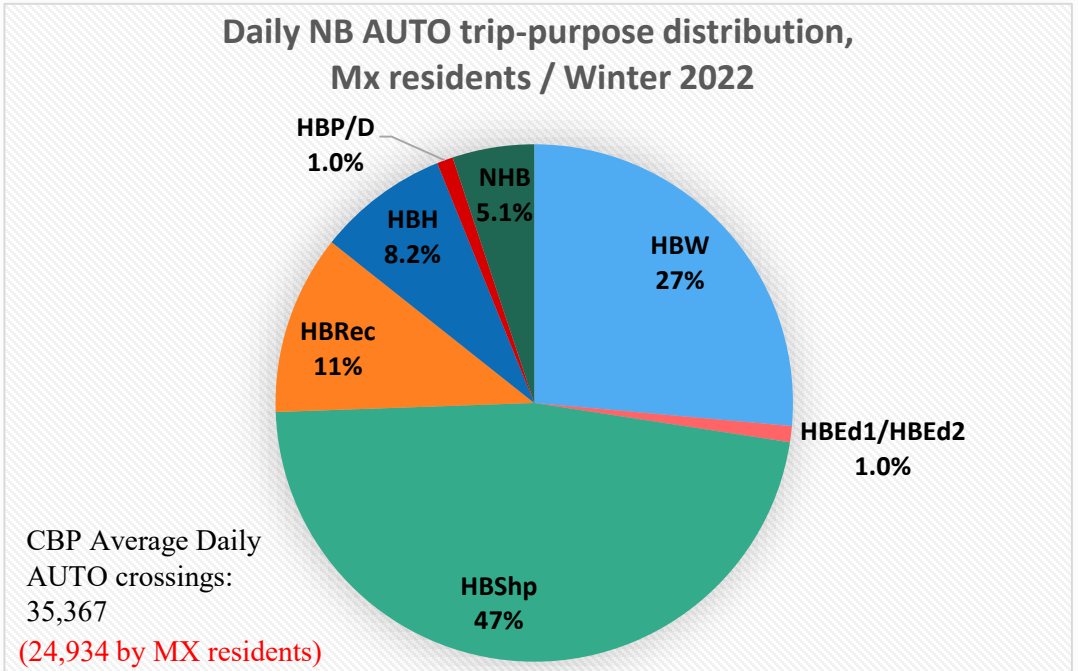


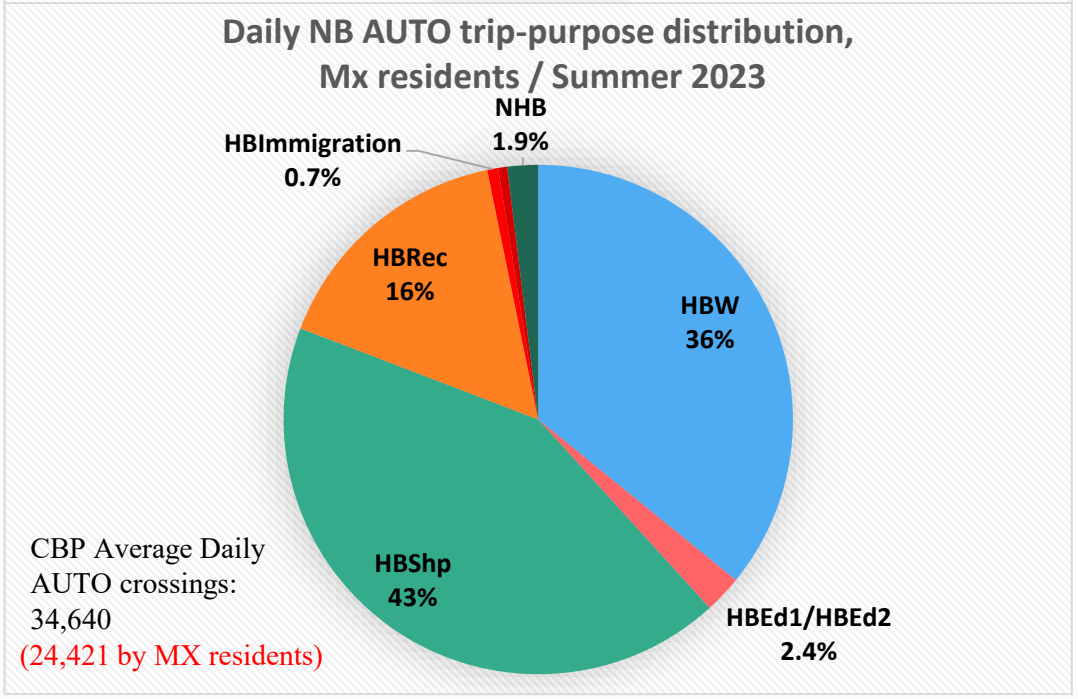


IBC Survey Results:

Daily NB AUTO trip purposes
MX residents

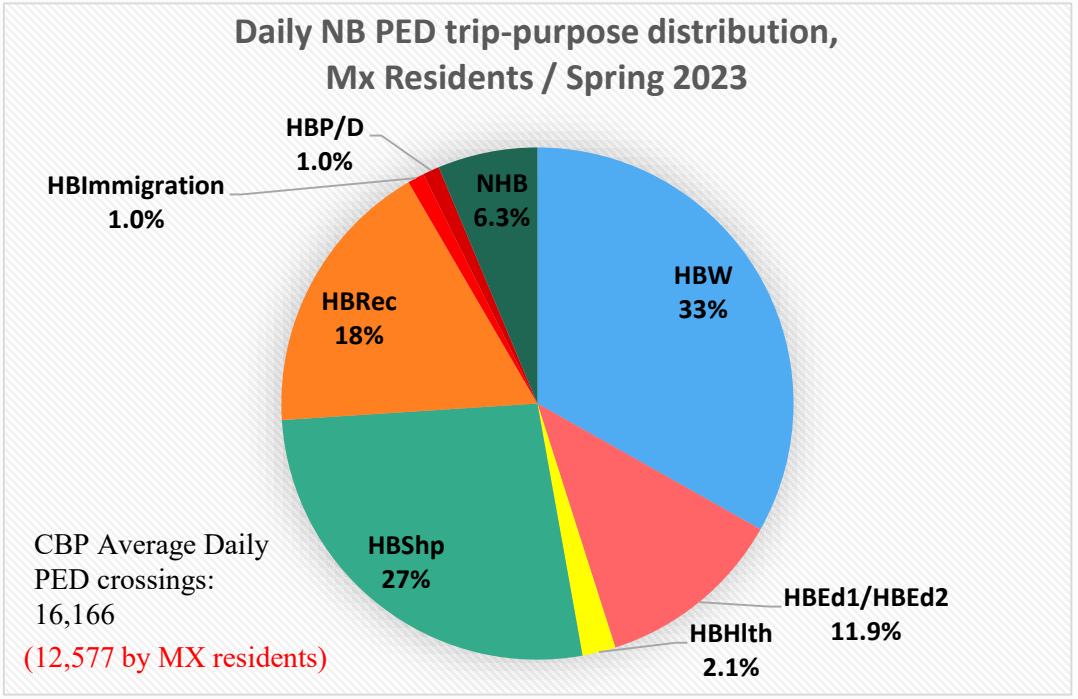


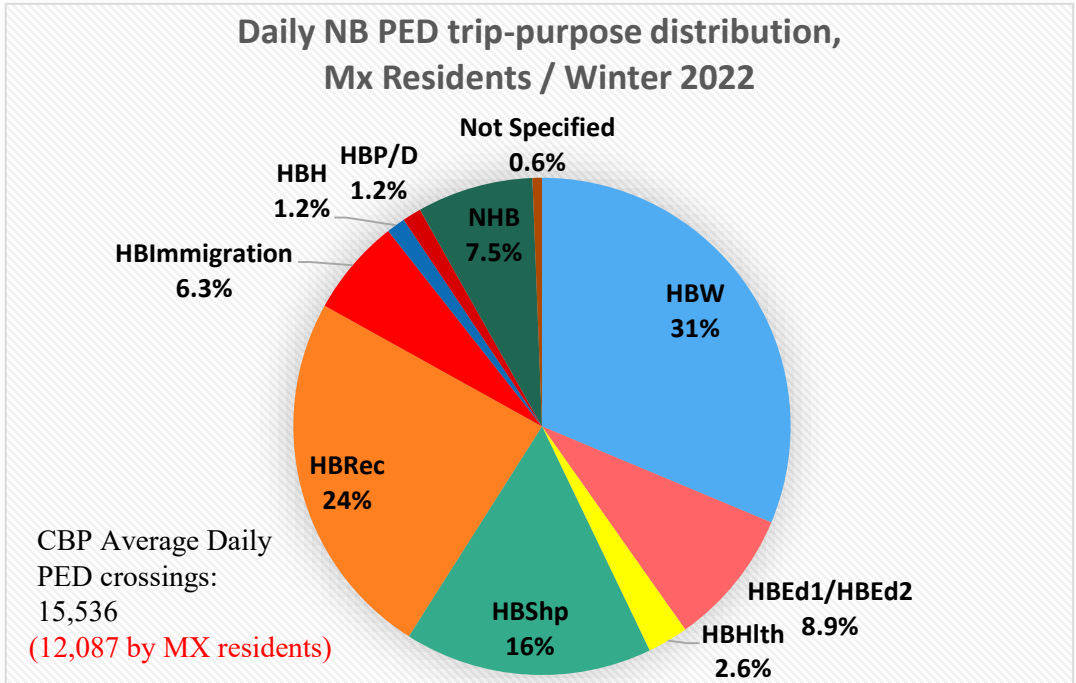


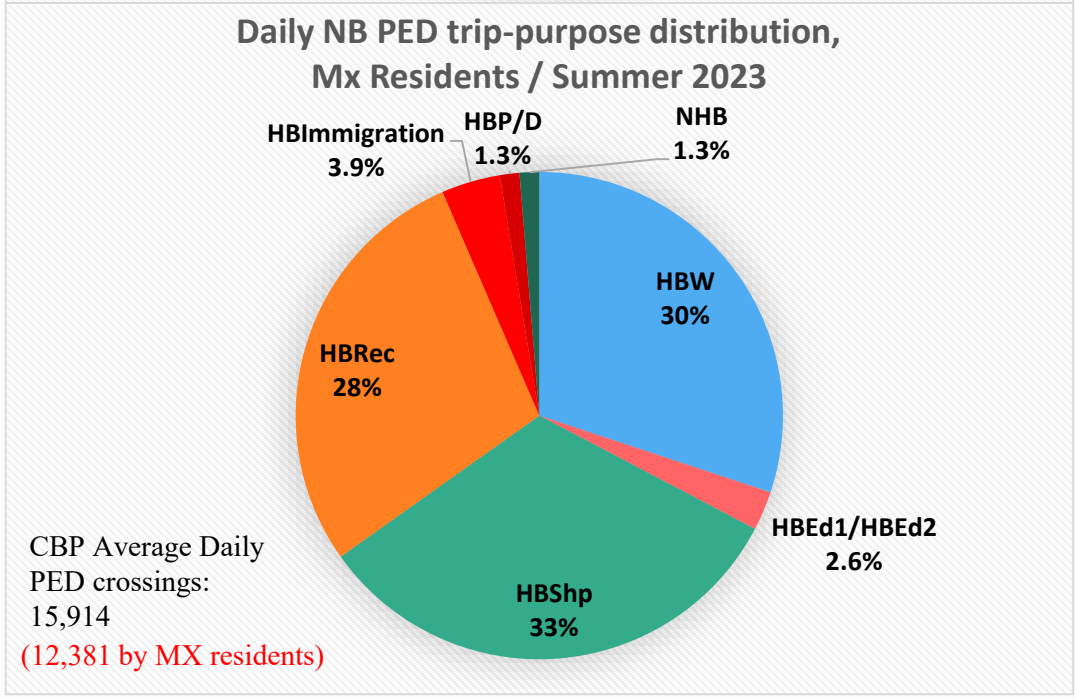


IBC Survey Results:

Daily NB PED trip purposes
MX residents

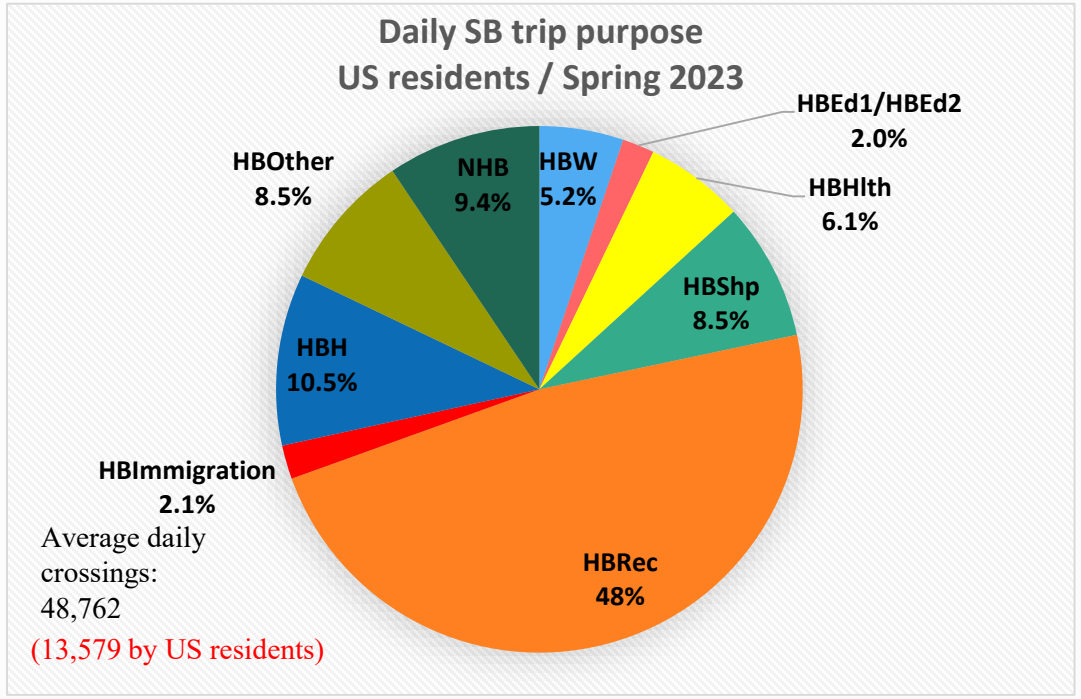


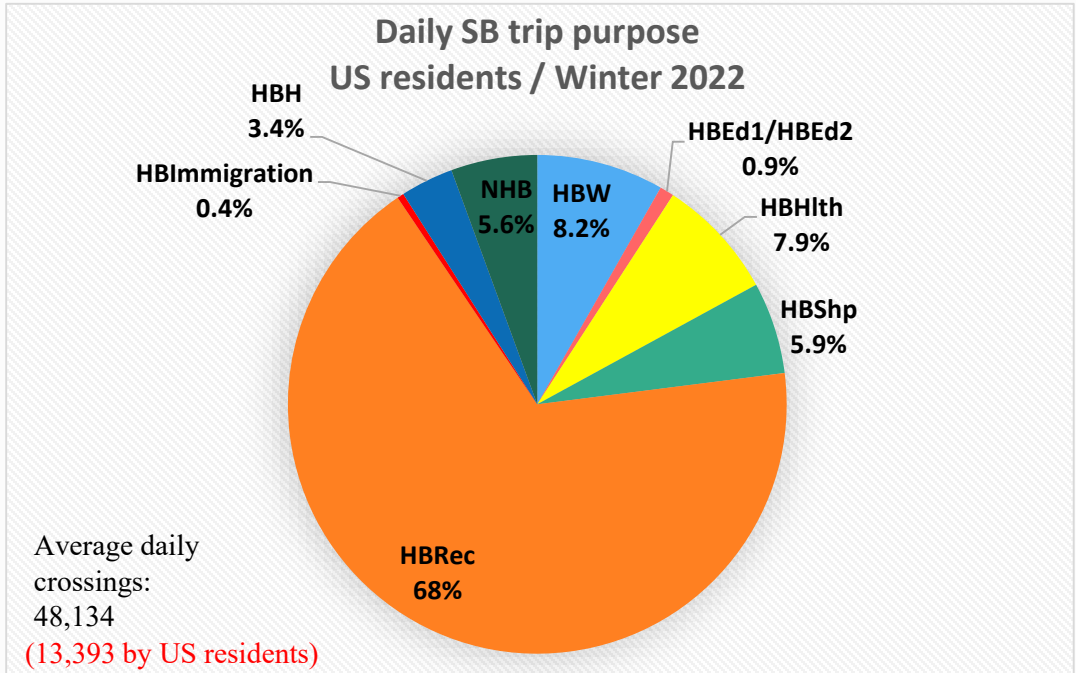


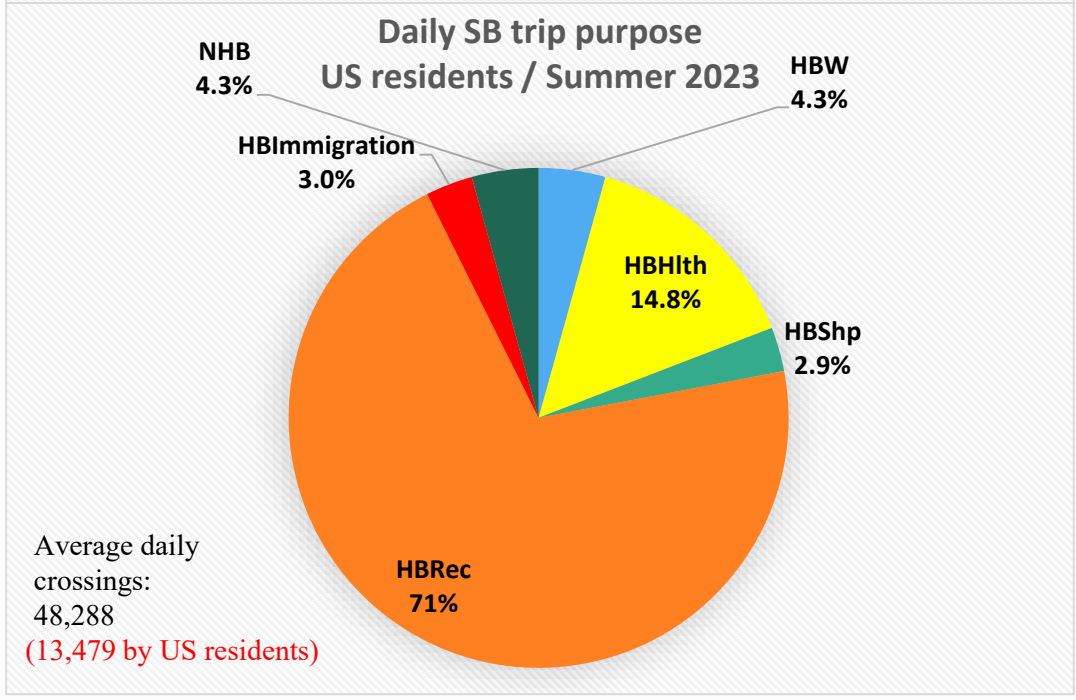


IBC Survey Results:

Daily SB PED+AUTO trip purposes
US residents

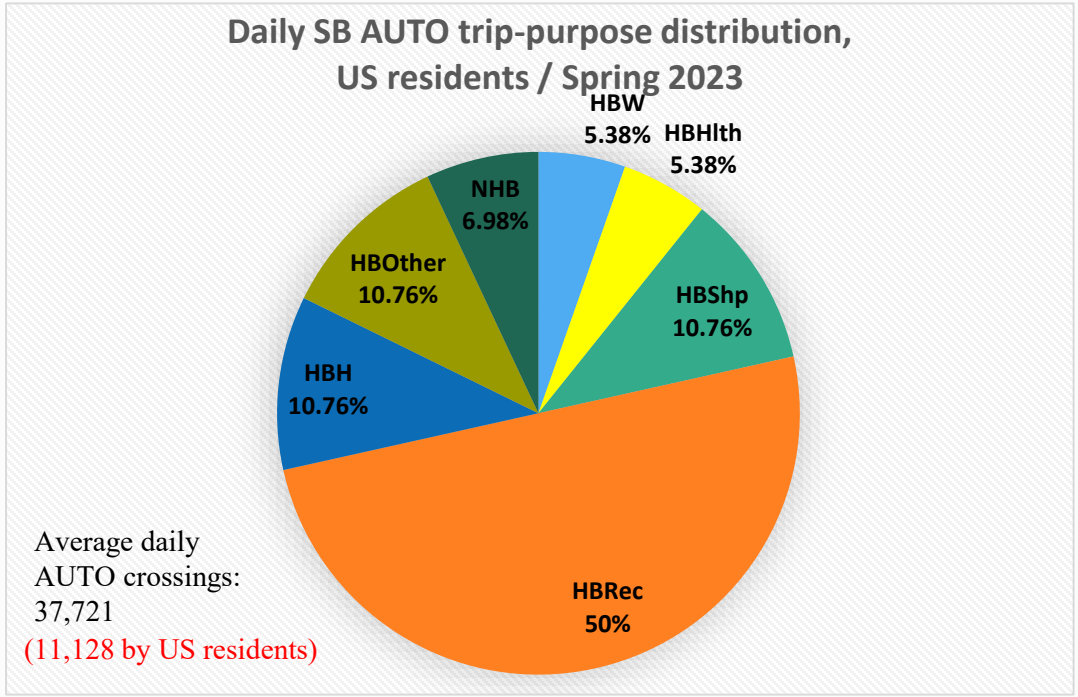


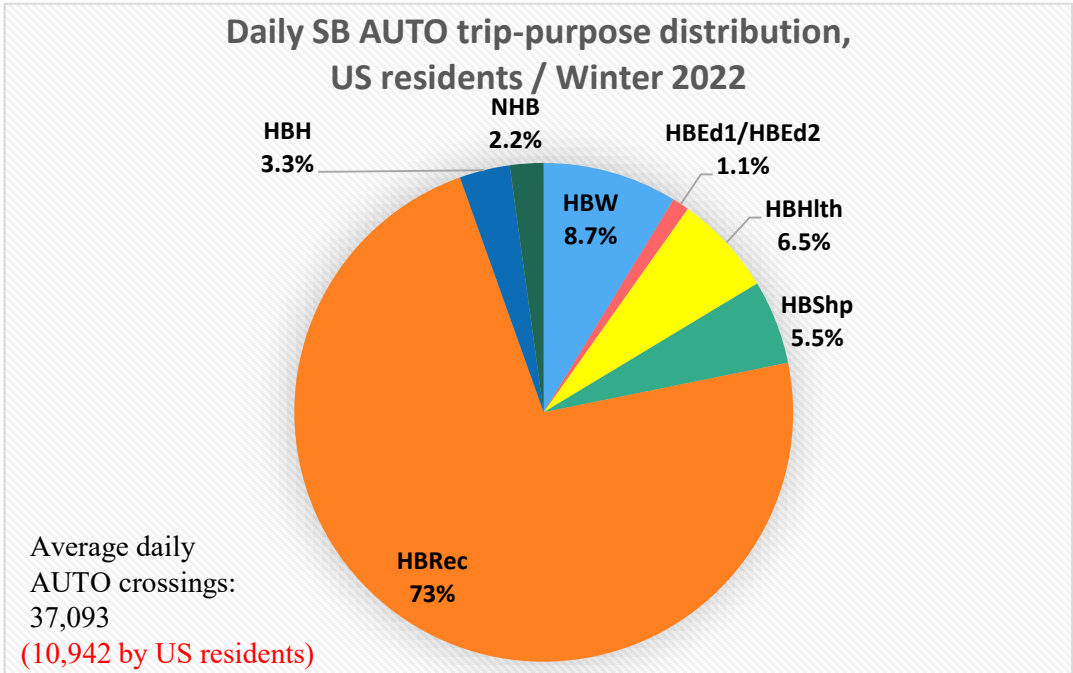


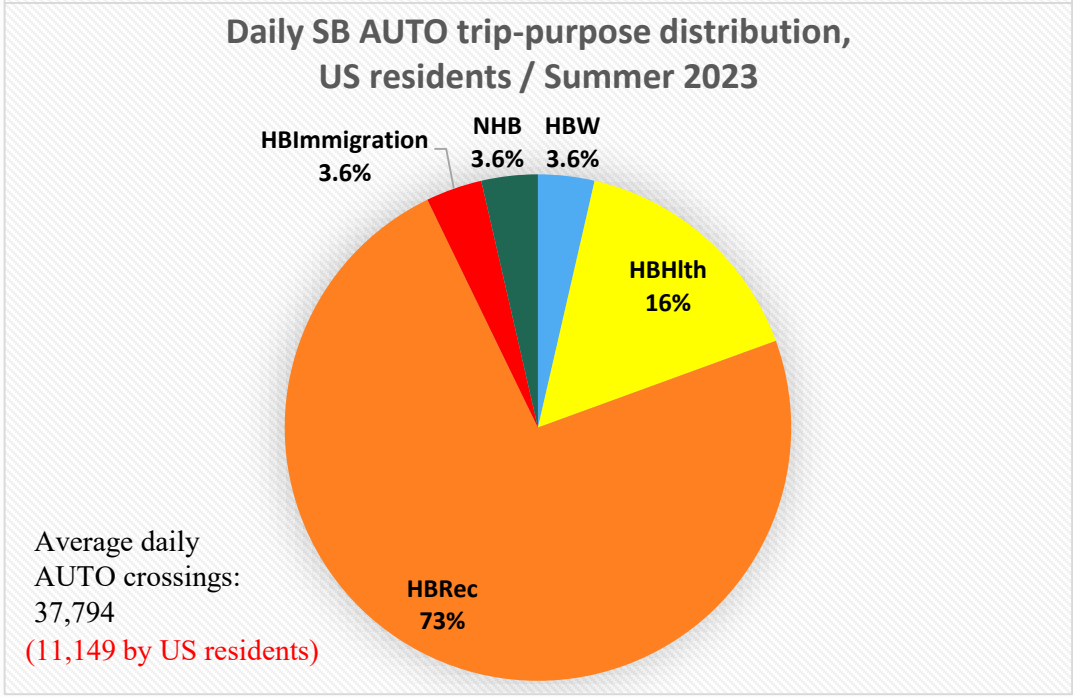


IBC Survey Results:

Daily SB AUTO trip purposes
US residents

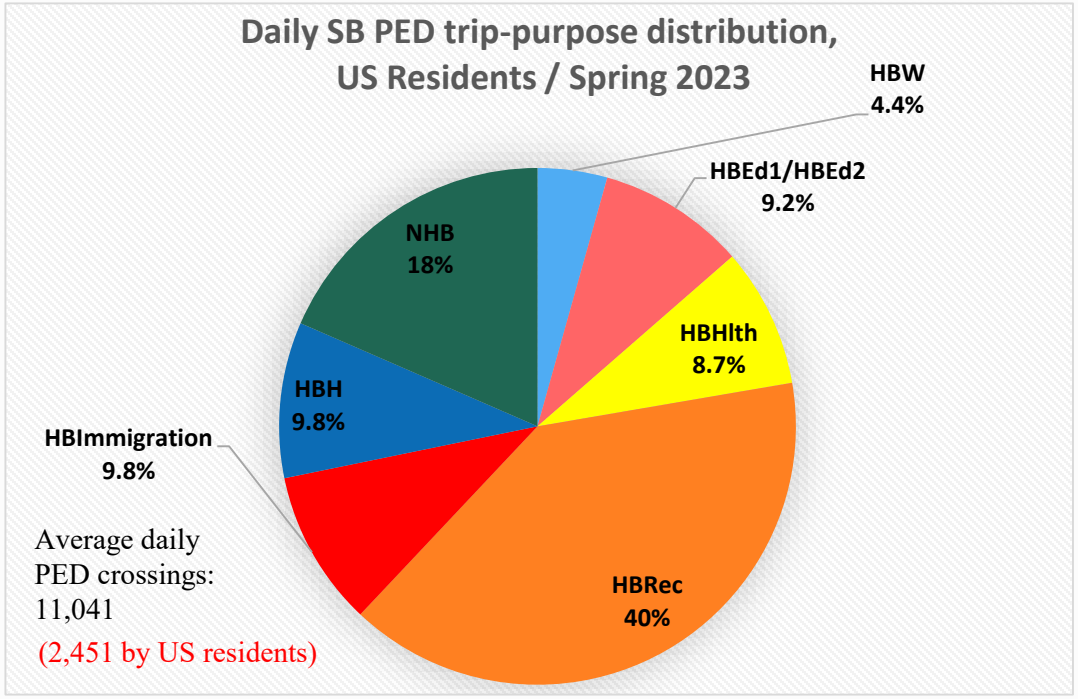


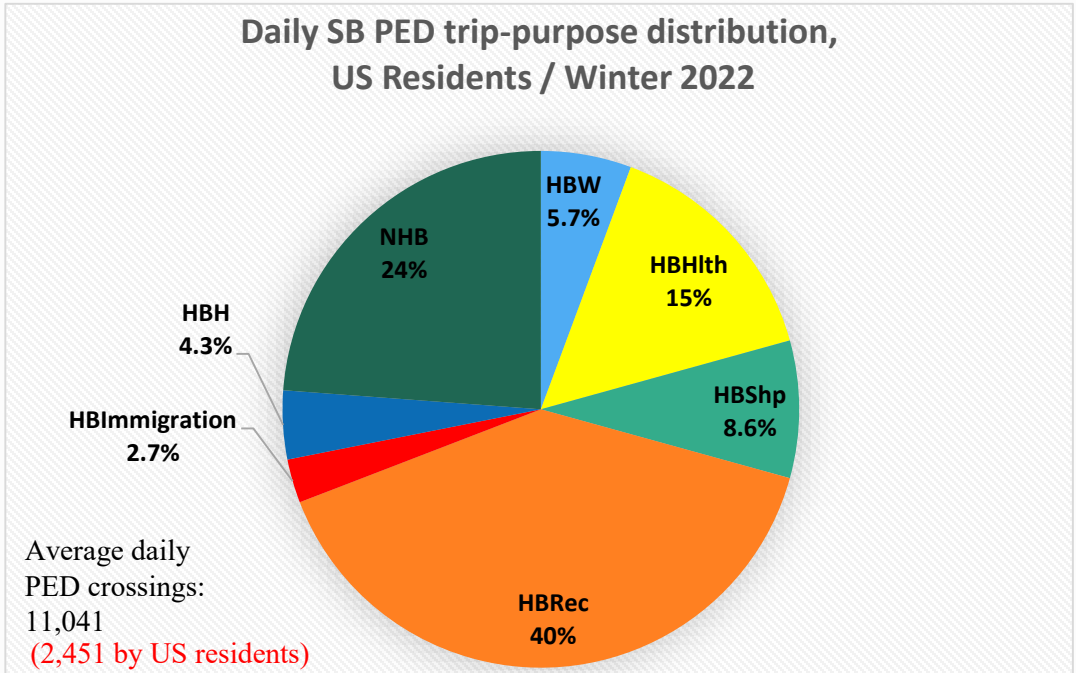


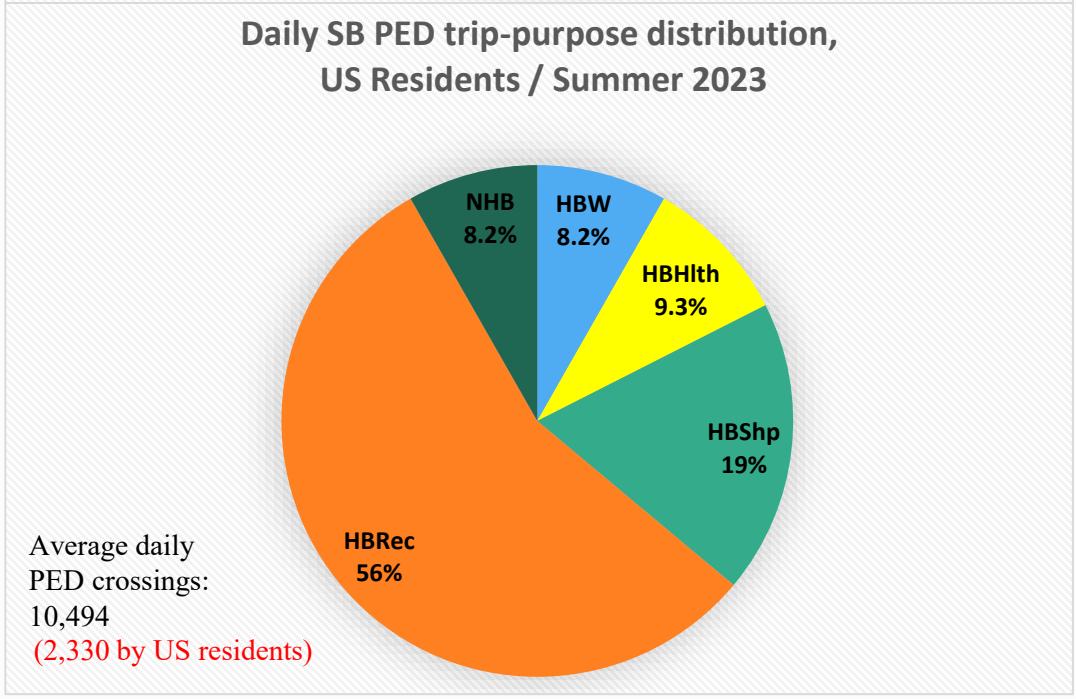


IBC Survey Results:

Daily SB PED trip purposes
US residents





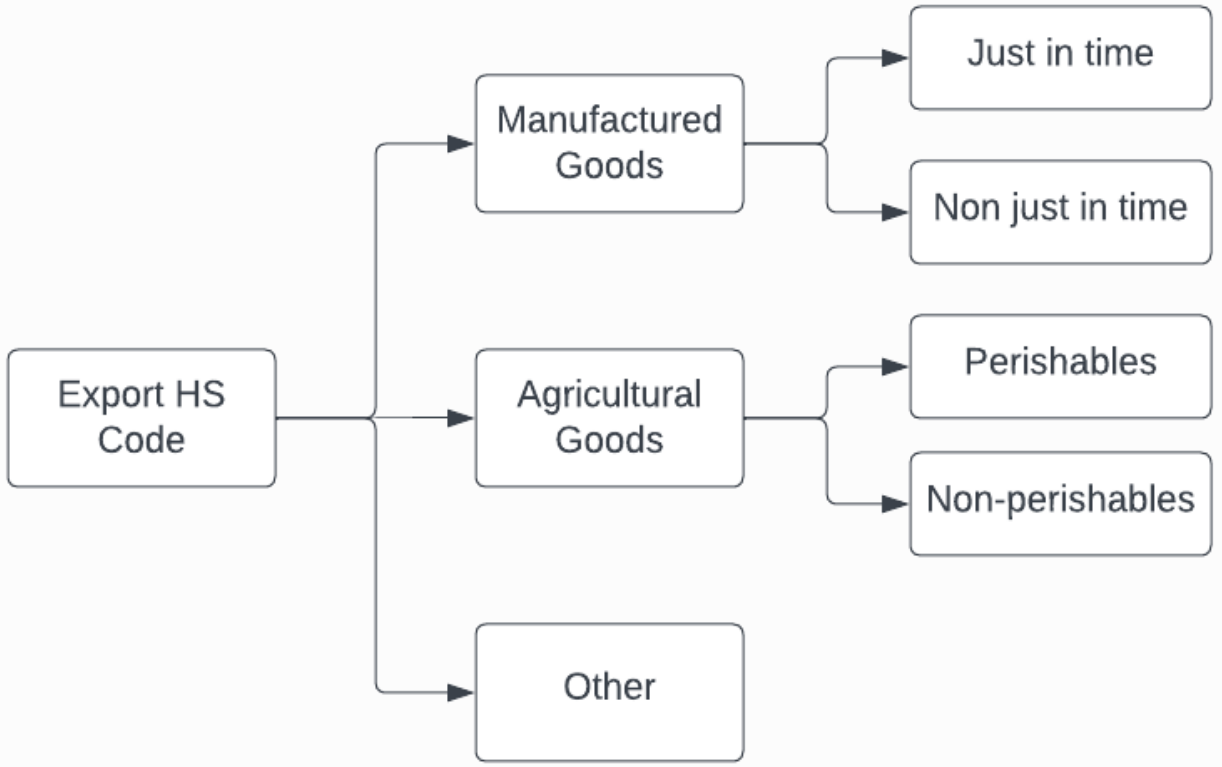


Commercial Vehicle Trip Classifications

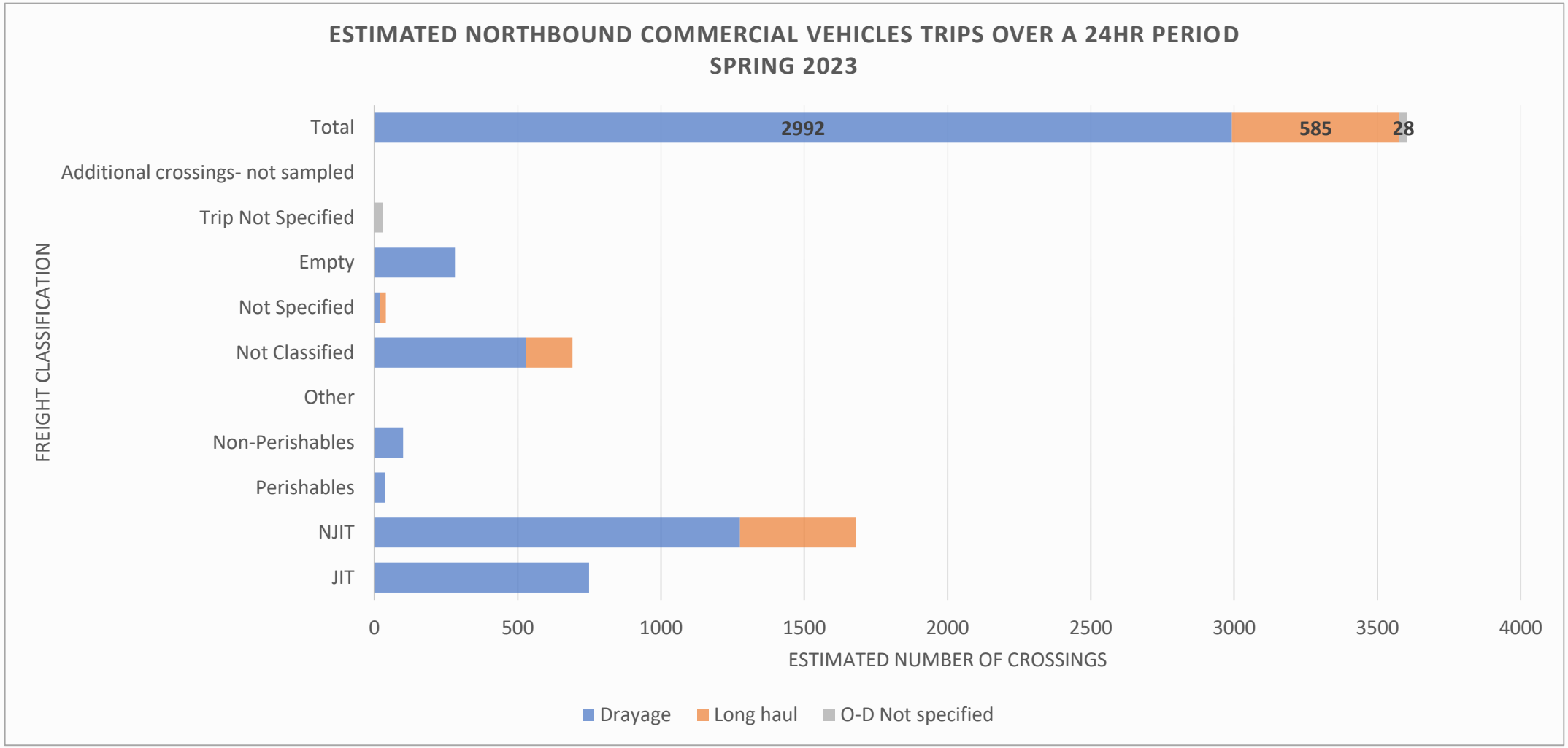
- TRUCK trip purposes were classified by distance and commodity.

- Distance
  - ✓Drayage: cross border internal-internal TRUCK trips
  - ✓Long-haul: cross border TRUCK trips with one external trip-end.

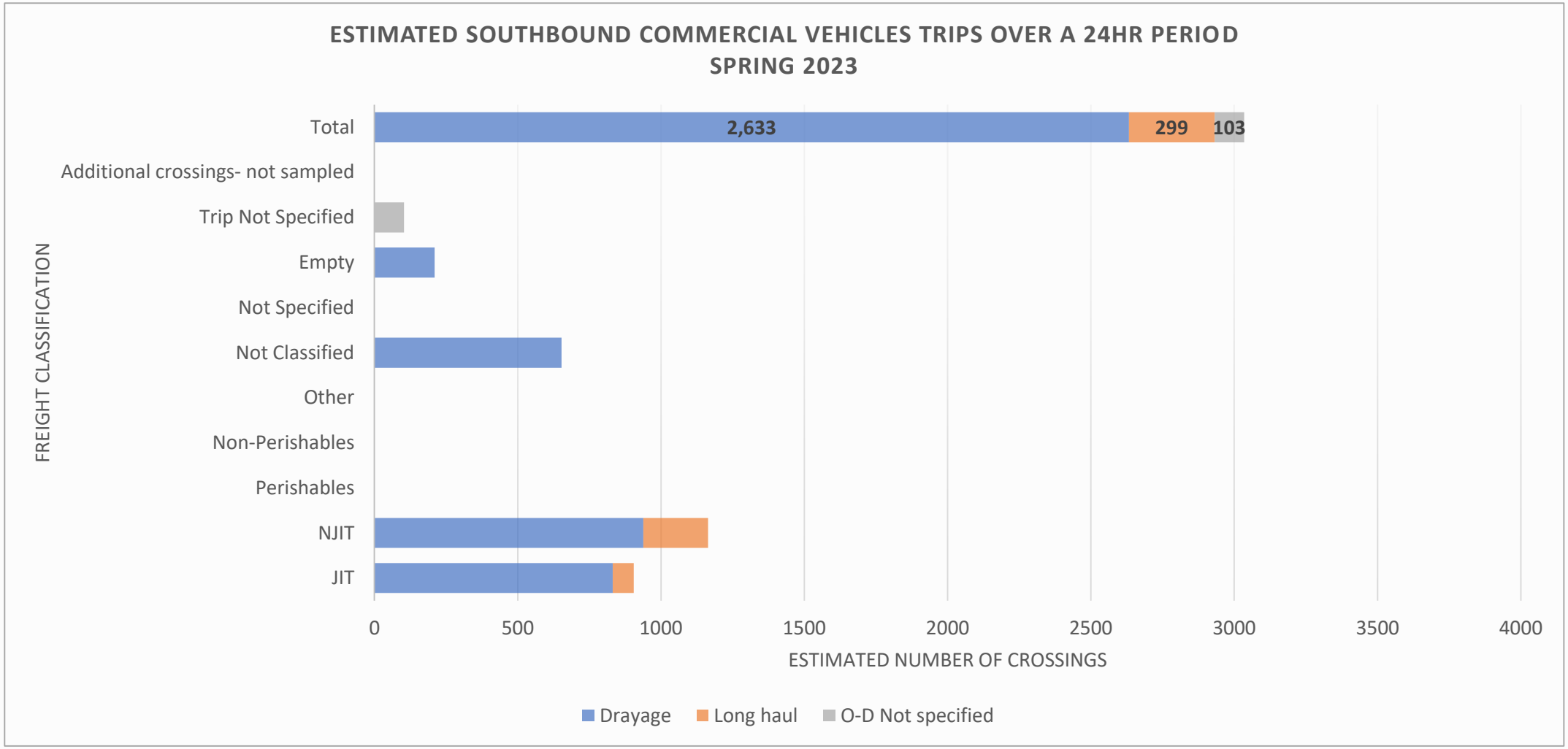
- Generic commodity groups diagram



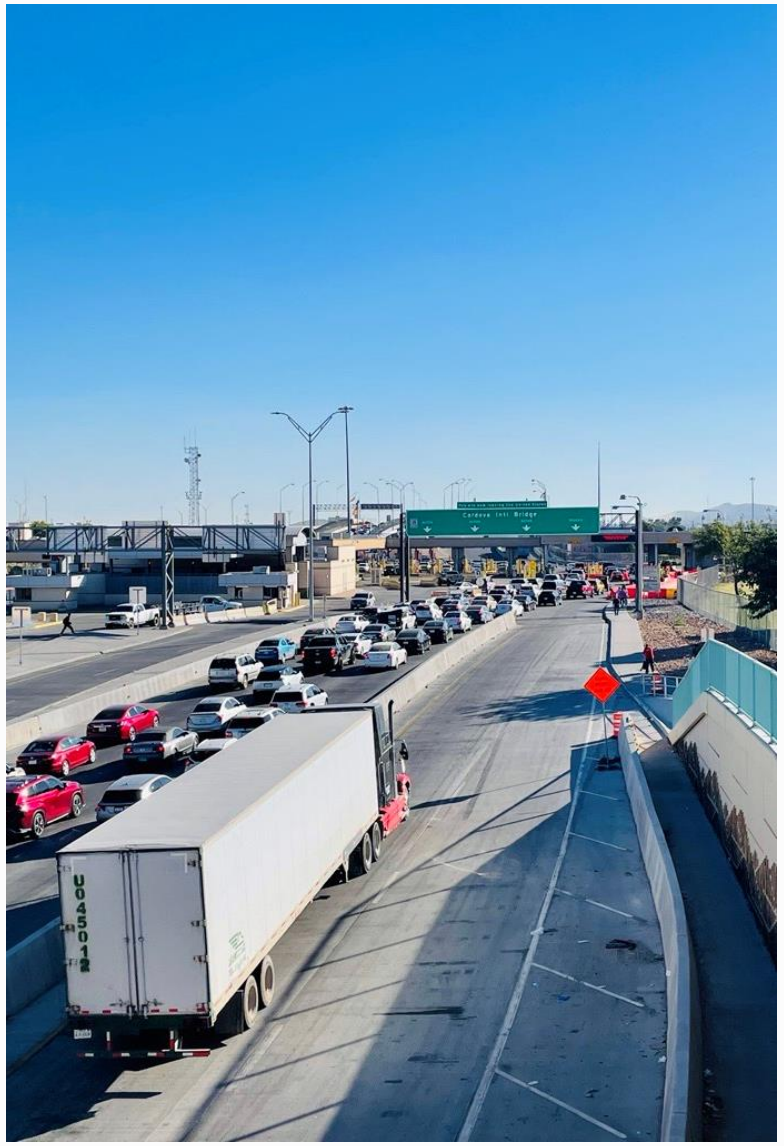
IBC Survey Results:
Daily Commercial Vehicle Trips, NB



IBC Survey Results:
Daily Commercial Vehicle Trips, SB



IBC traffic and emissions evaluation



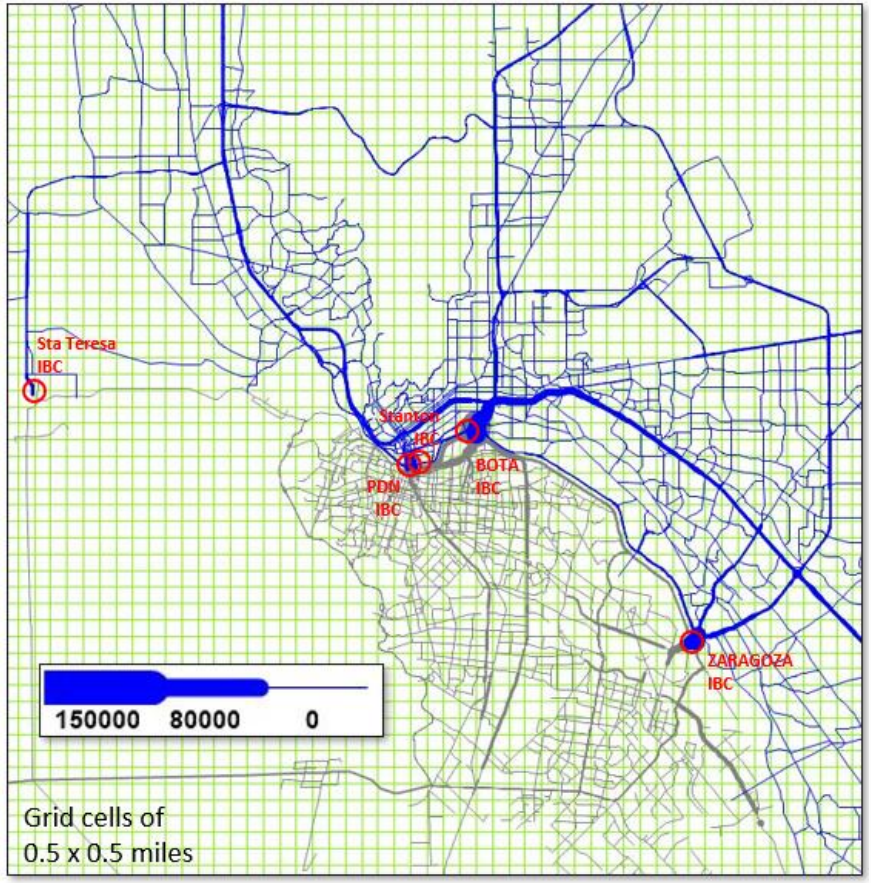
Macro Level Tools:

- ✓ International Travel Demand Model (iTDM) / 2017 validation
- ✓ Emission Sketch Tool (EST)

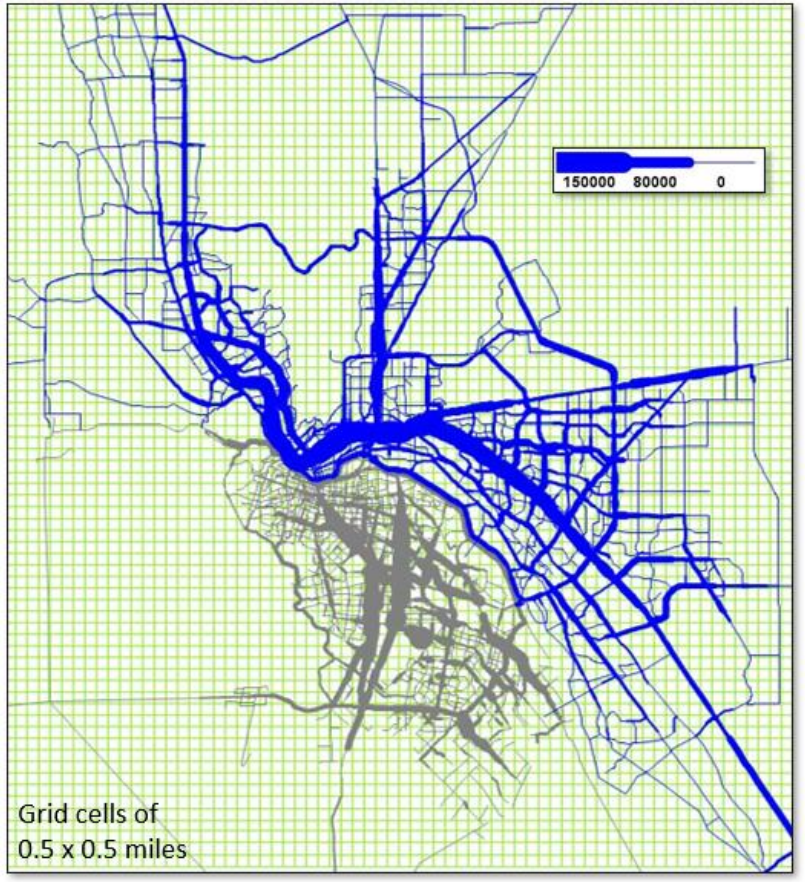
These tools allow the evaluation of the entire El Paso -Juarez Metropolitan area

El Paso - Juarez
metropolitan area

Daily traffic
Current conditions



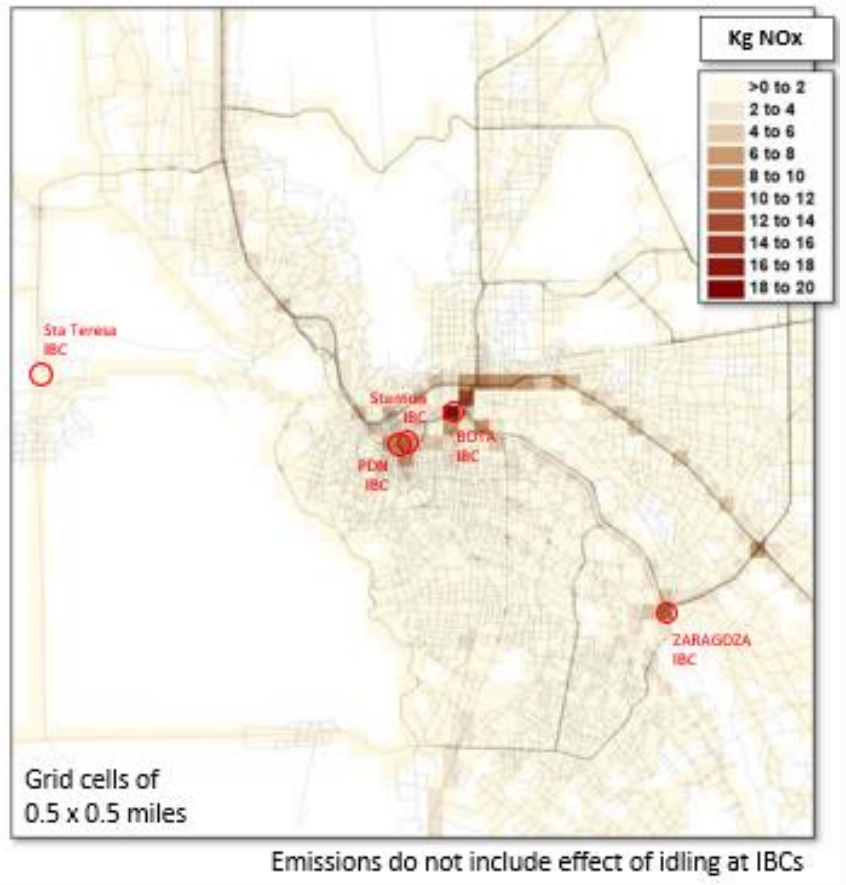
External only



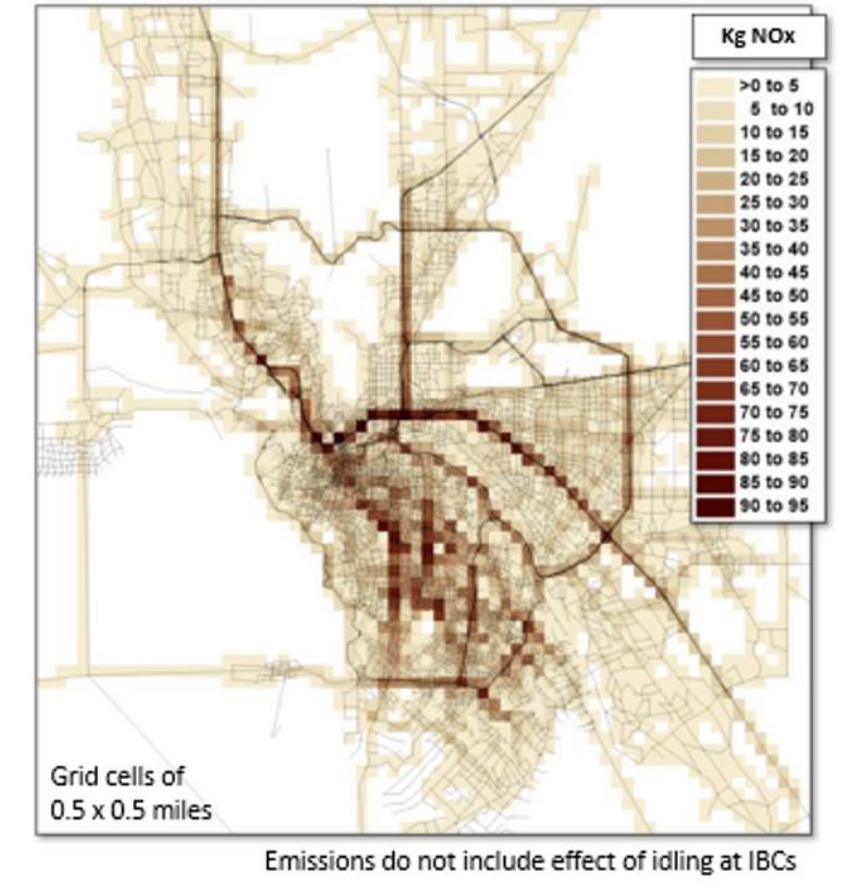
ALL (internal & external)

El Paso - Juarez
metropolitan area

Daily NOx
Current conditions



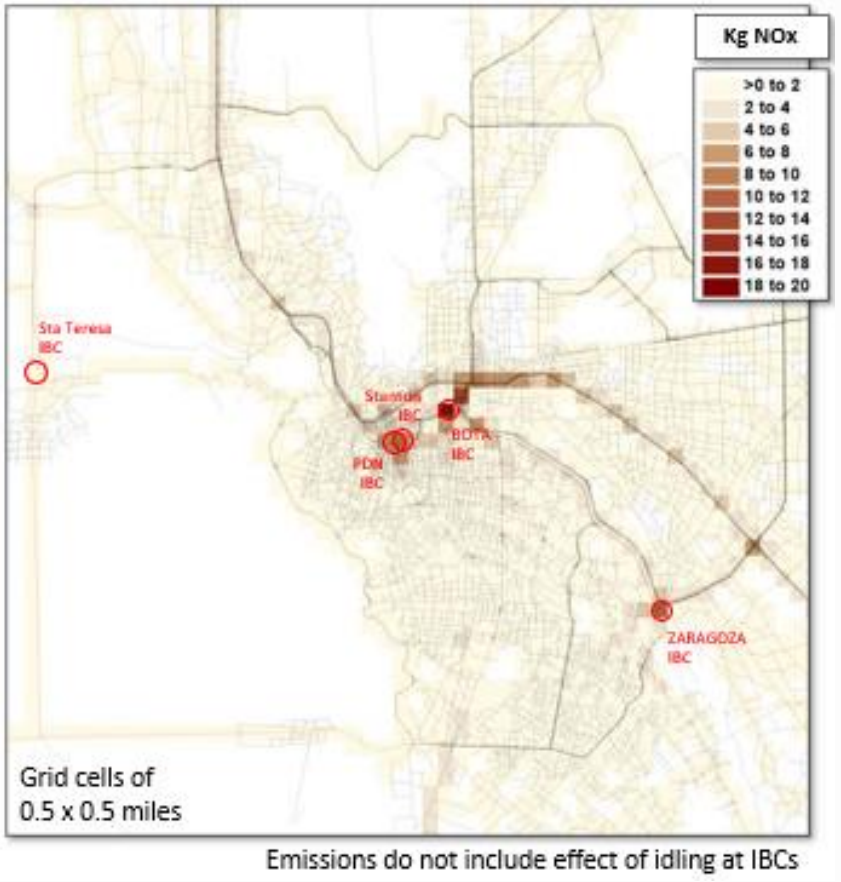
External only



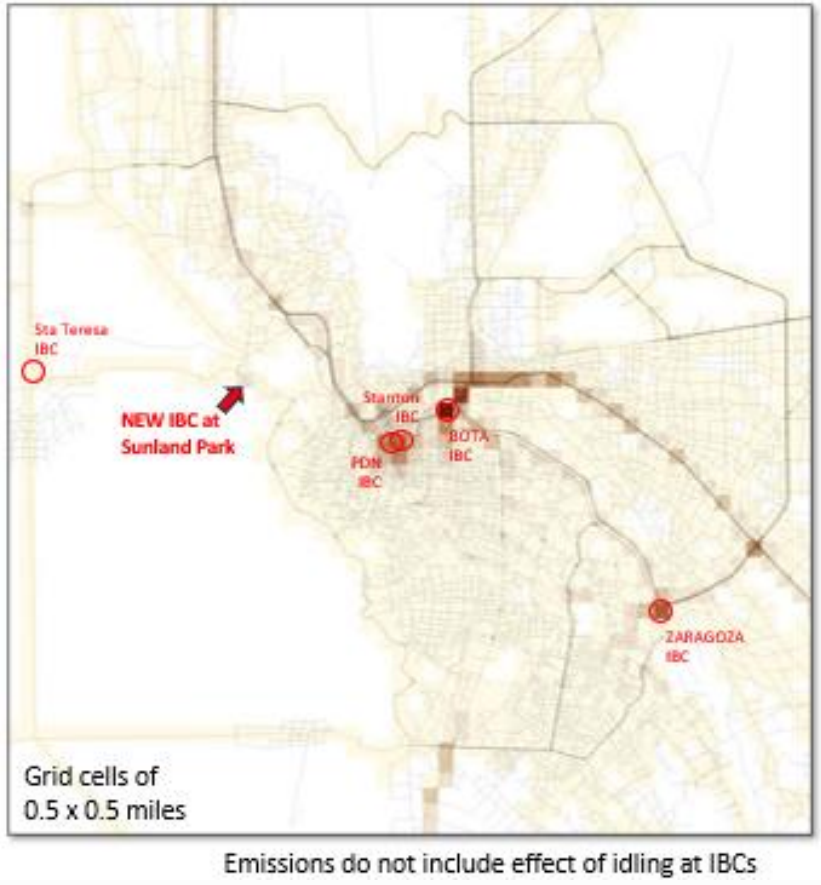
ALL (internal & external)

El Paso - Juarez
metropolitan area

Daily NOx
External only



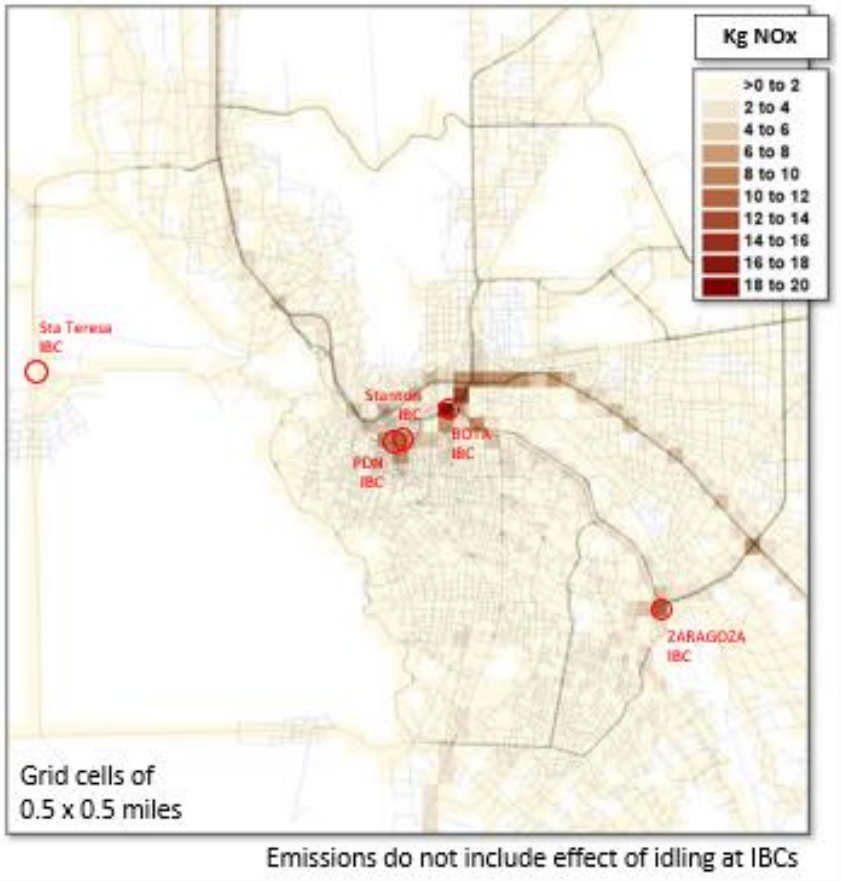
Scenario 1:
Current conditions



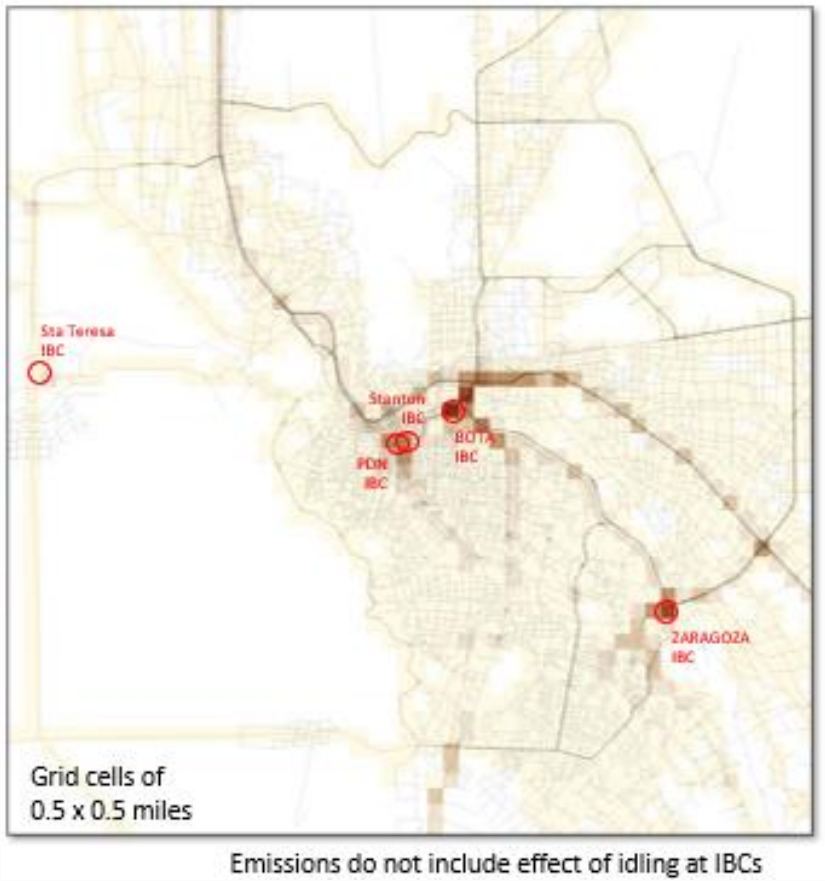
Scenario 2:
New IBC Sunland Park

El Paso - Juarez
metropolitan area

Daily NOx
External only



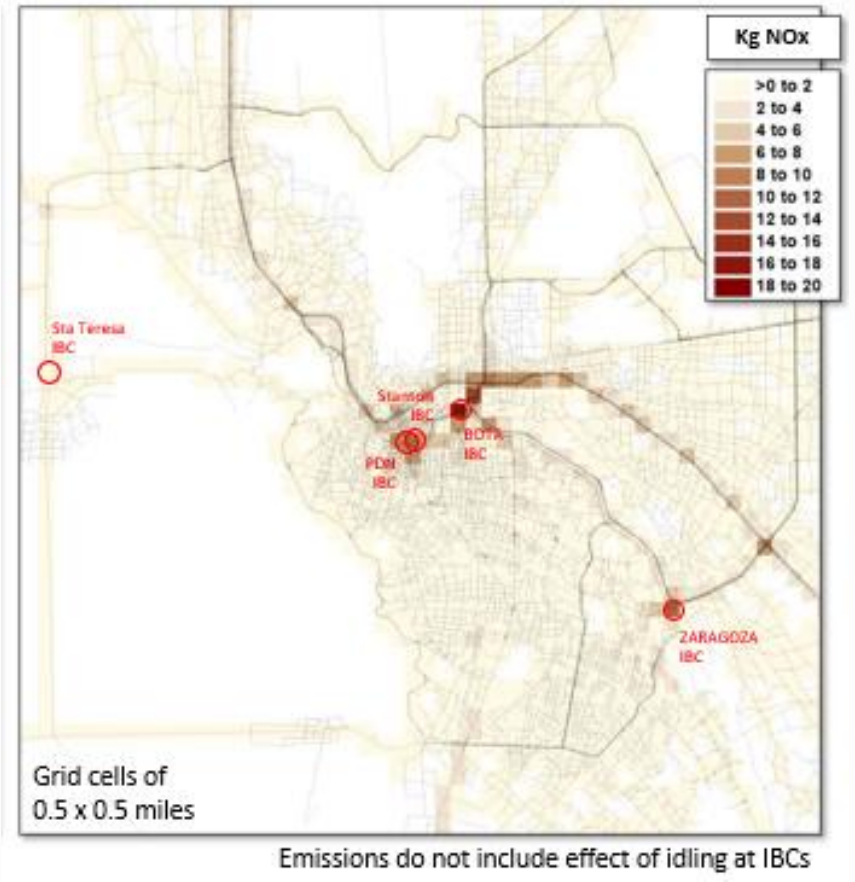
Scenario 1:
Current conditions



Scenario 3:
No trucks BOTA

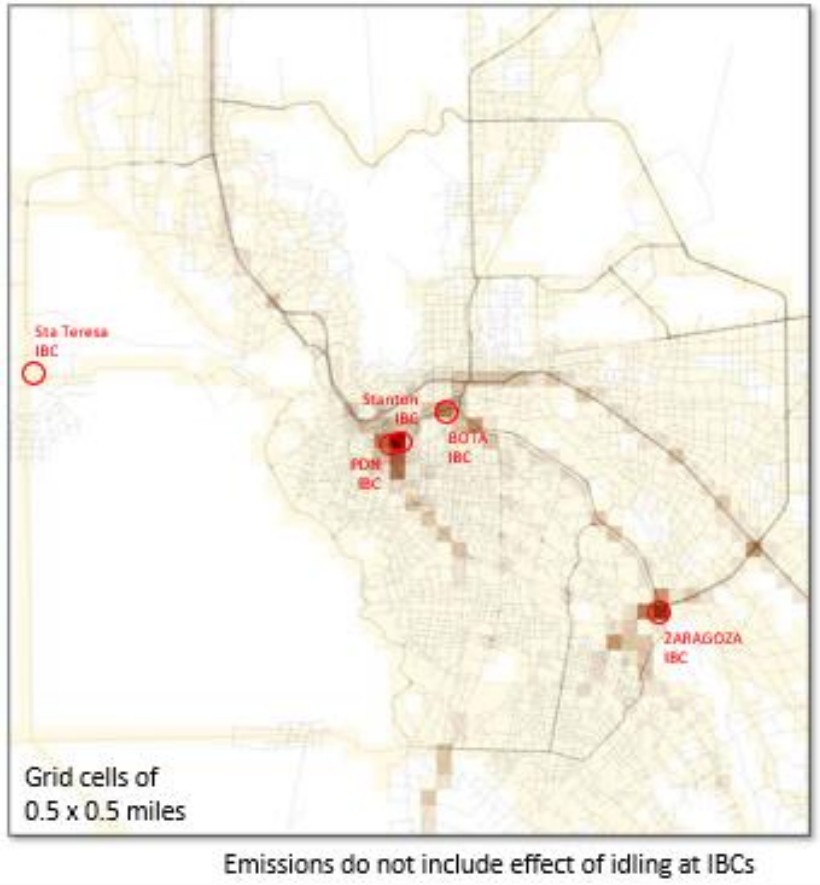
El Paso - Juarez
metropolitan area

Daily NOx
External only



Emissions do not include effect of idling at IBCs

Scenario 1:
Current conditions

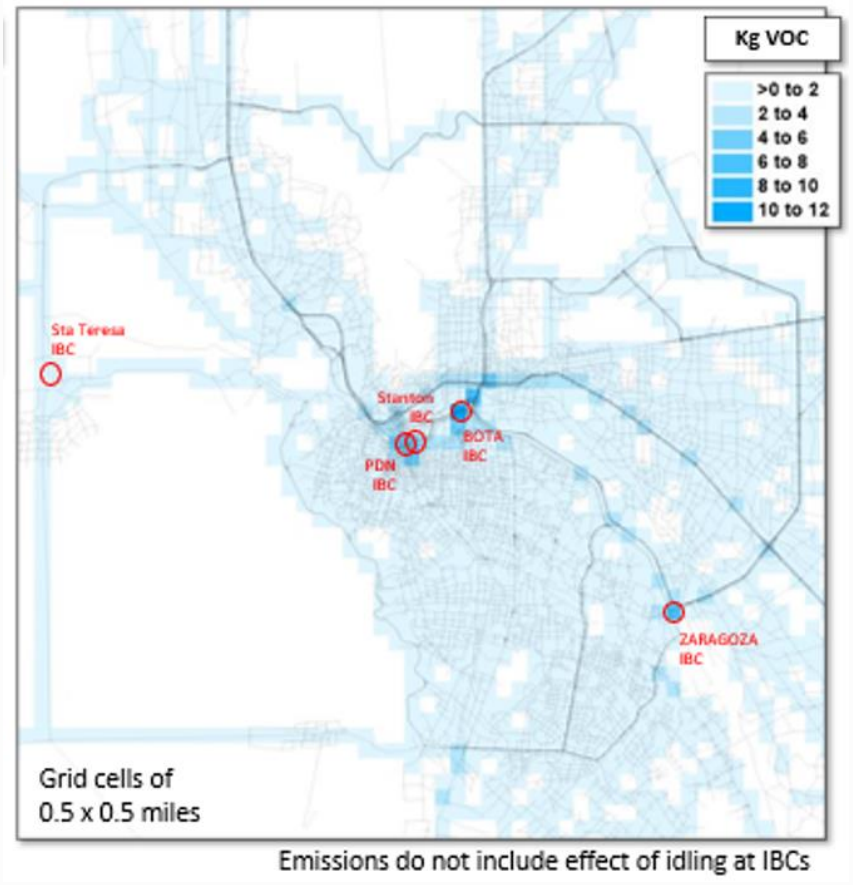


Emissions do not include effect of idling at IBCs

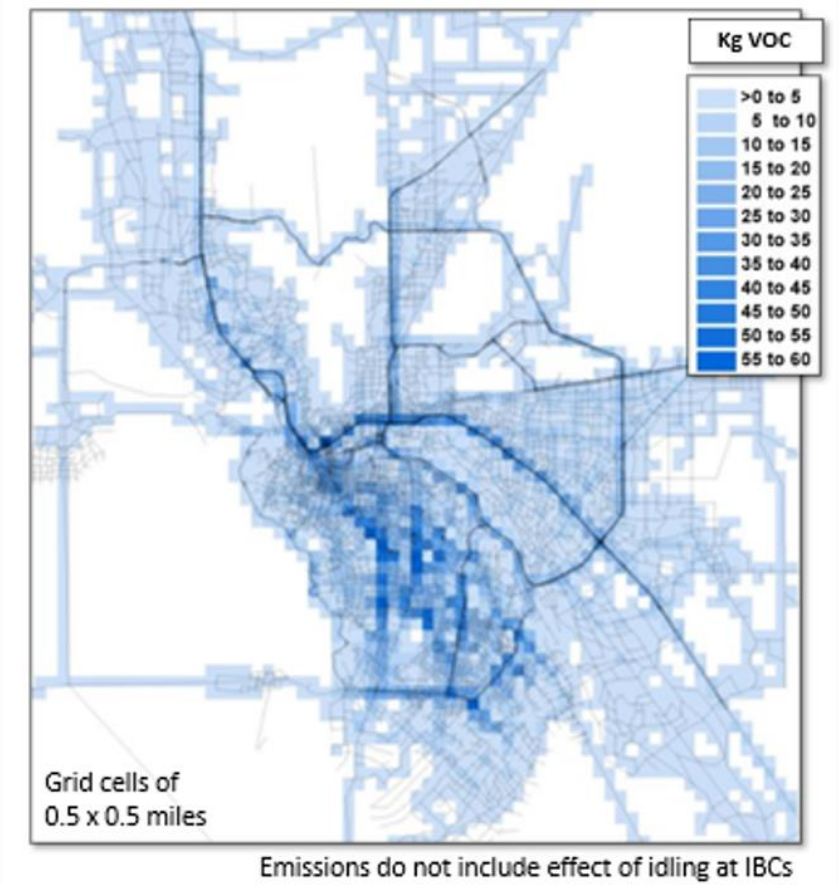
Scenario 4:
Improved Stanton & Zaragoza

El Paso - Juarez
metropolitan area

Daily VOC
Current conditions



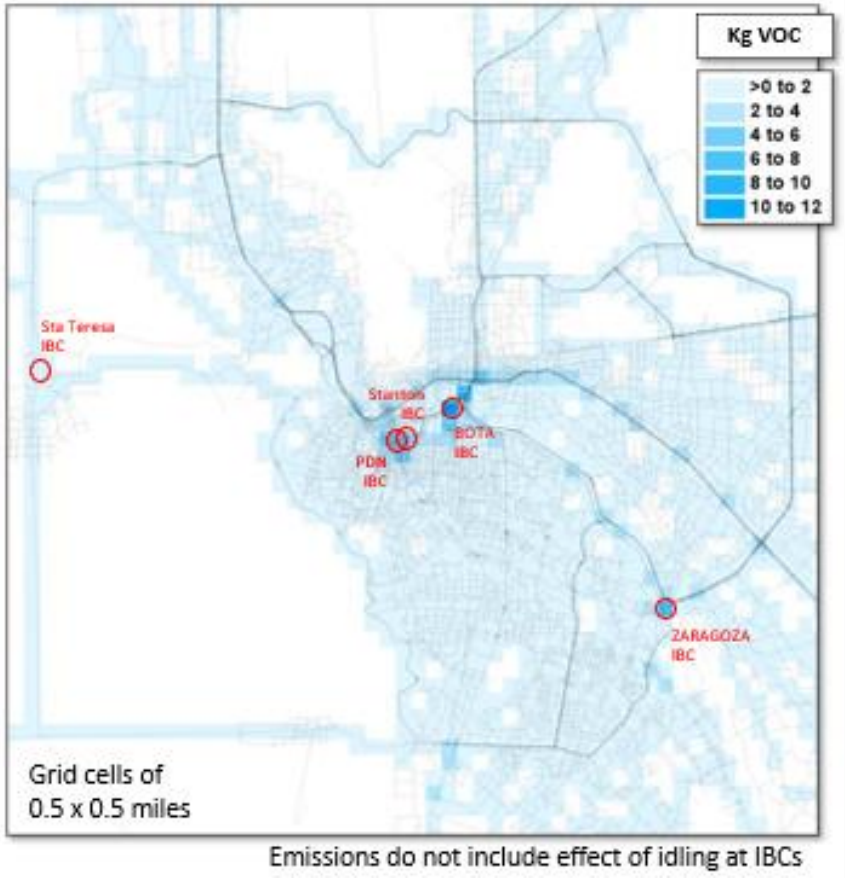
External only



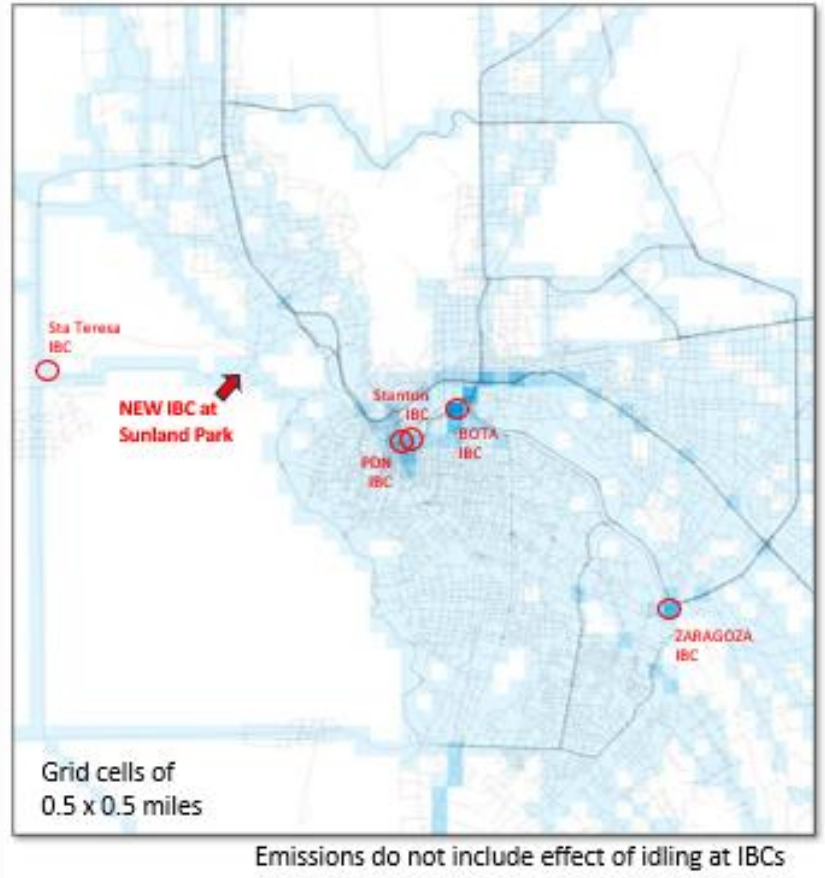
ALL (internal & external)

El Paso - Juarez
metropolitan area

Daily VOC
External only



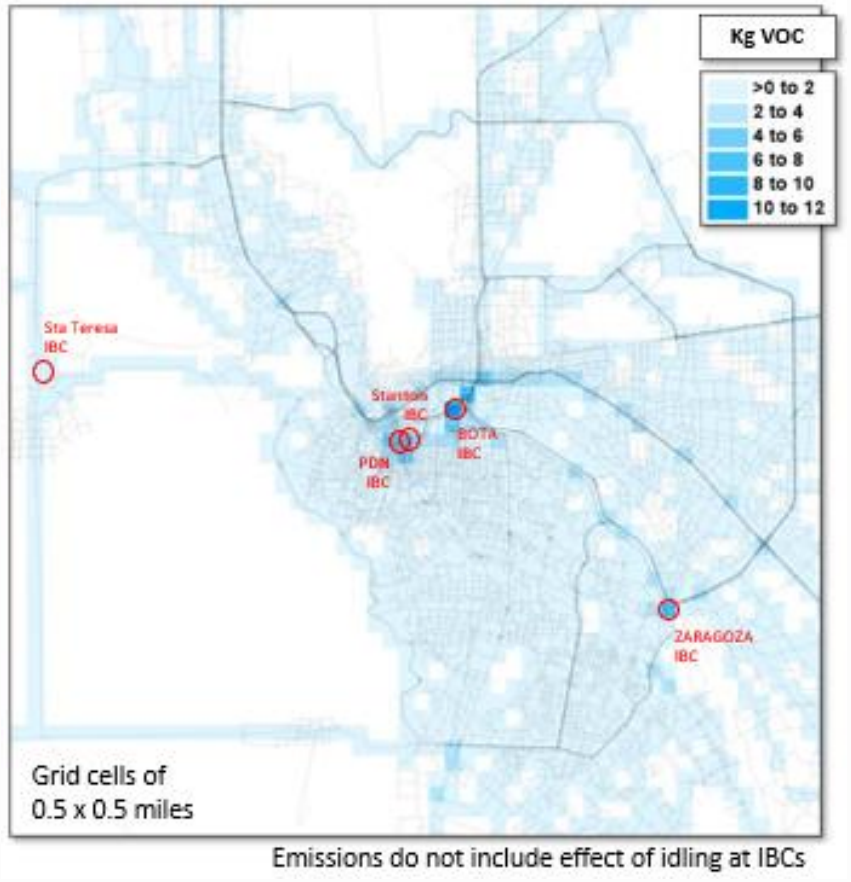
Scenario 1:
Current conditions



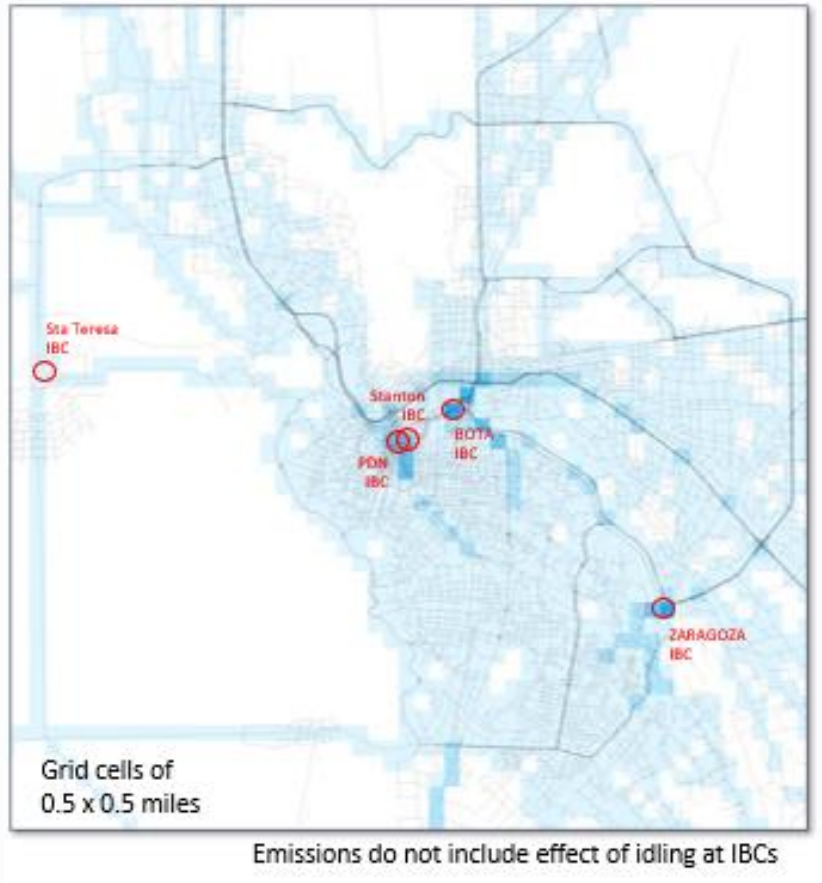
Scenario 2:
New IBC Sunland Park

El Paso - Juarez
metropolitan area

Daily VOC
External only



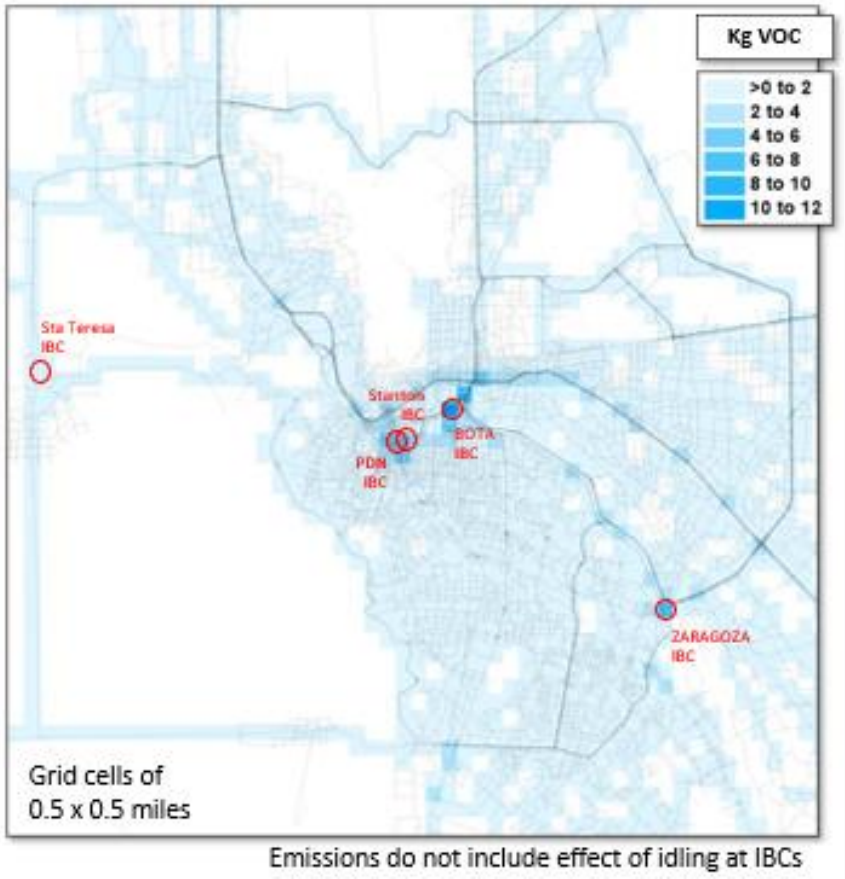
Scenario 1:
Current conditions



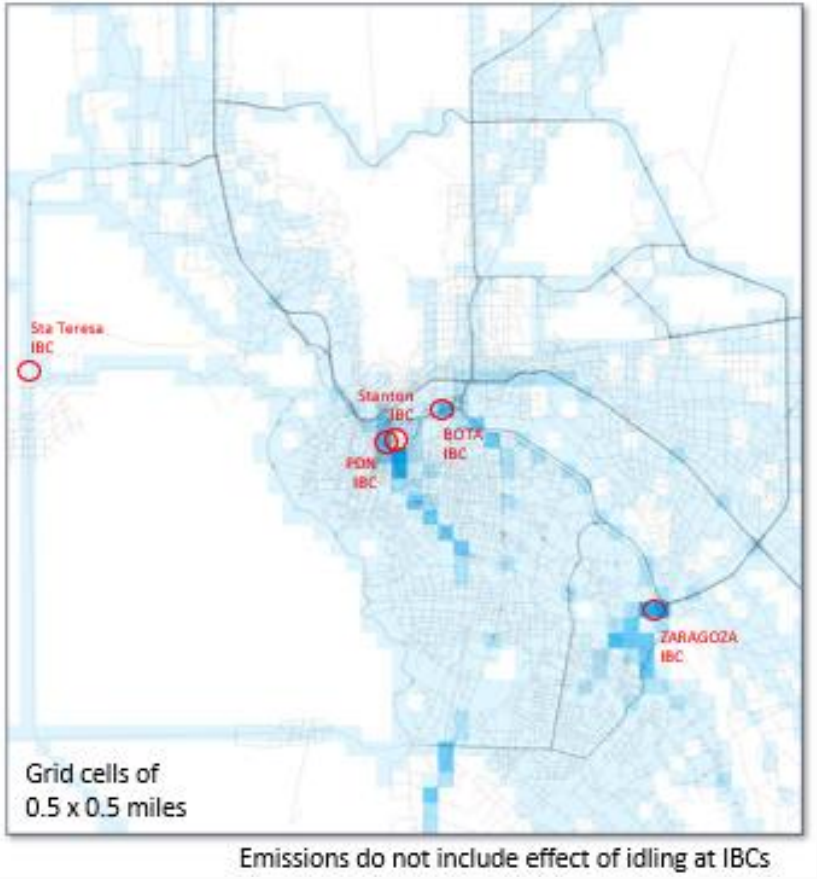
Scenario 3:
No trucks BOTA

El Paso - Juarez
metropolitan area

Daily VOC
External only



Scenario 1:
Current conditions



Scenario 4:
Improved Stanton & Zaragoza

Results of macro level tools: iTDM & EST

IBC scenario	Extension	daily VMT	daily NOx [kg]	daily VOC [kg]
1 Baseline: current conditions all traffic (internal+external)	El Paso MPO area	21,509,000	12,621	6,820
	Juarez urban area	15,876,000	10,367	7,314
	El Paso-Juarez total	**37,385,000**	**22,988**	**14,134**
1 Baseline: current conditions only external & IBC traffic	El Paso MPO area	1,642,000	954	499
	Juarez urban area	962,000	571	371
	El Paso-Juarez total	**2,604,000**	**1,525**	**870**

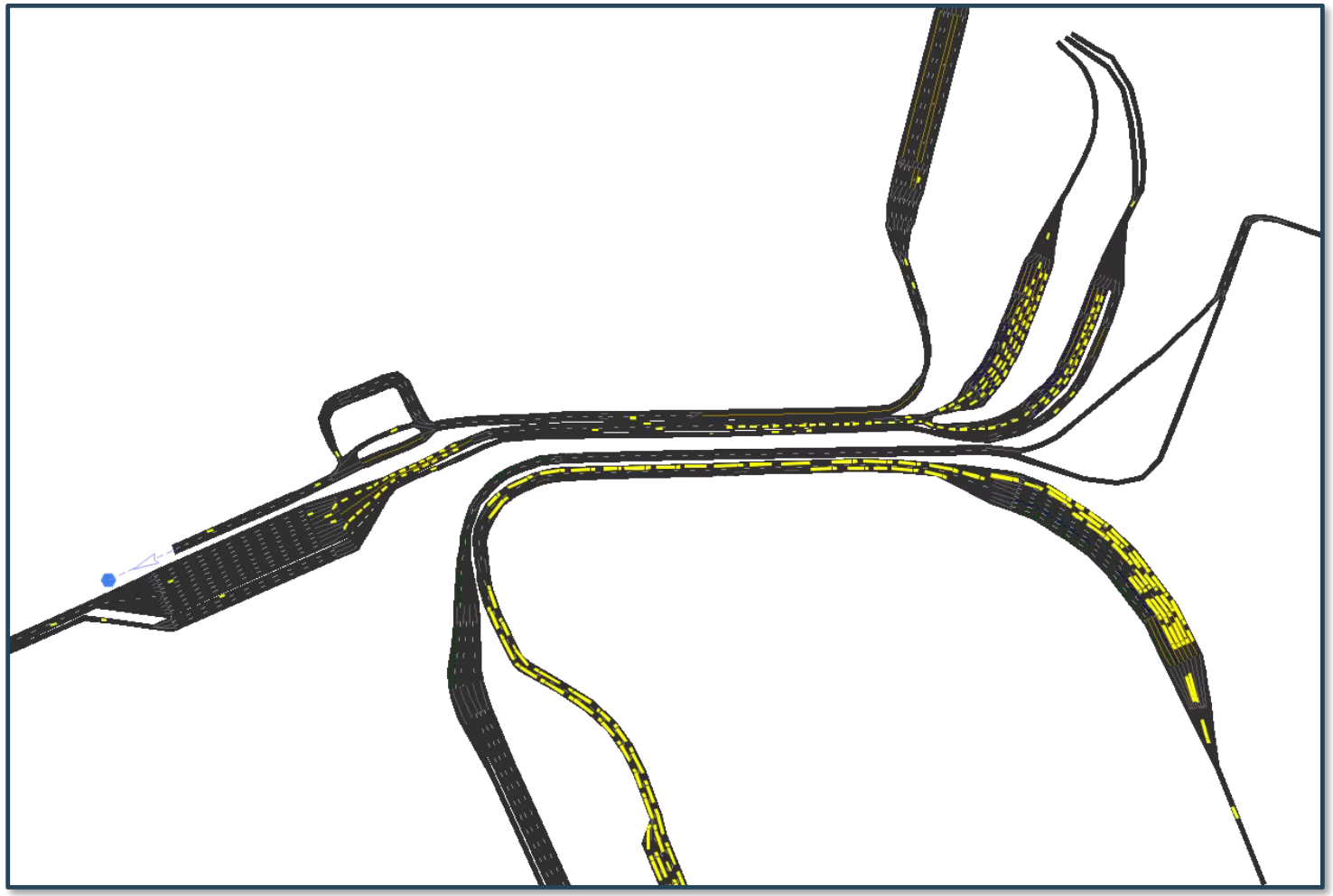
Results of macro level tools: iTDM & EST

IBC scenario	Extension	daily VMT	daily NOx [kg]	daily VOC [kg]
1 Baseline: current conditions all traffic (internal+external)	El Paso MPO area	21,509,000	12,621	6,820
	Juarez urban area	15,876,000	10,367	7,314
	El Paso-Juarez total	**37,385,000**	**22,988**	**14,134**
1 Baseline: current conditions only external & IBC traffic	El Paso MPO area	1,642,000	954	499
	Juarez urban area	962,000	571	371
	El Paso-Juarez total	**2,604,000**	**1,525**	**870**
2 New IBC Sunland Park only external & IBC traffic	El Paso MPO area	1,655,000	961	503
	Juarez urban area	1,011,000	607	398
	El Paso-Juarez total	**2,666,000**	**1,568**	**901**
3 No trucks BOTA only external & IBC traffic	El Paso MPO area	1,643,000	955	499
	Juarez urban area	1,231,000	747	492
	El Paso-Juarez total	**2,874,000**	**1,702**	**991**
4 Improved Stanton & Zaragoza only external & IBC traffic	El Paso MPO area	1,609,000	938	490
	Juarez urban area	1,192,000	729	468
	El Paso-Juarez total	**2,801,000**	**1,667**	**958**

Micro Level Tools:

- ✓ TransModeler traffic simulator
- ✓ Border Emission Estimator for Microsimulation (BEEM)

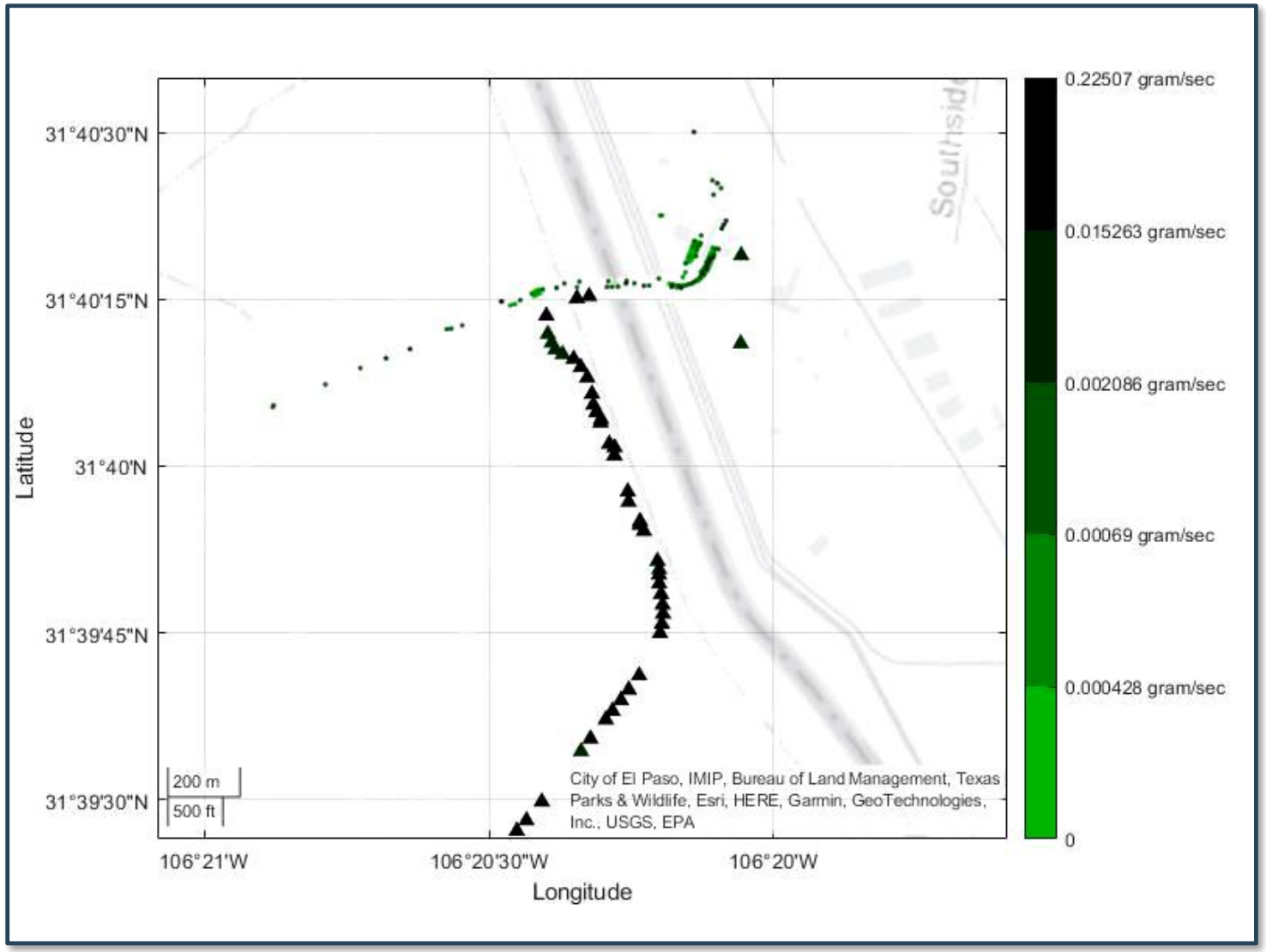
These tools allow the evaluation of individual IBCs



Traffic Simulator

- Data required
  - Traffic volume
  - Toll booth delay
  - Primary inspection booth delay
  - IBC detailed geometry
  - Available booths by hour
  - Traffic management strategies

Example of NOx emission generation



BEEM tool

- Data required
  - Trajectory tables per second from traffic simulator
  - Updated emission rates table (based on MOVES)

Results of micro level tools: BEEM

		daily NOX [kg]	All IBCs NOX [kg]	daily VOC [kg]	All IBCs VOC [kg]
Scenario 1 Baseline Current conditions	Santa Teresa IBC	8.1	487	1.3	101
	PDN IBC	22.0		7.5	
	Stanton IBC	50.6		16.7	
	BOTA IBC	163.0		44.5	
	Zaragoza IBC	237.9		30.1	
	Tornillo IBC	5.3		1.3	

Results of micro level tools: BEEM

		daily NOX [kg]	All IBCs NOX [kg]	daily VOC [kg]	All IBCs VOC [kg]
Scenario 1 Baseline Current conditions	Santa Teresa IBC	8.1	487	1.3	101
	PDN IBC	22.0		7.5	
	Stanton IBC	50.6		16.7	
	BOTA IBC	163.0		44.5	
	Zaragoza IBC	237.9		30.1	
	Tornillo IBC	5.3		1.3	
Scenario 2 New IBC Sunland Park	Santa Teresa IBC	8.1	487	1.3	101
	PDN IBC	21.9		7.5	
	Stanton IBC	50.5		16.6	
	BOTA IBC	162.5		44.4	
	Zaragoza IBC	237.2		30.0	
	Tornillo IBC	5.3		1.3	
	New SunlandPark IBC	1.6		0.3	
Scenario 3 No Trucks allowed at BOTA IBC	Santa Teresa IBC	9.0	497	1.3	101
	PDN IBC	22.0		7.5	
	Stanton IBC	50.6		16.7	
	BOTA IBC	148.3		44.5	
	Zaragoza IBC	261.7		30.1	
	Tornillo IBC	5.3		1.3	
Scenario 4 Improved Stanton and Zaragoza IBCs	Santa Teresa IBC	8.1	407	1.3	86
	PDN IBC	22.0		7.5	
	Stanton IBC	23.1		44.4	
	BOTA IBC	114.1		31.2	
	Zaragoza IBC	235.4		0.3	
	Tornillo IBC	4.0		1.0	

Macro and micro integration:

Total emissions from regional IBC flows and idling

	daily IBC travel NOX [kg]	daily IBC idling NOX [kg]	total IBC related NOX [kg]	daily IBC travel VOC [kg]	All IBCs IBC idling VOC [kg]	total IBC related VOC [kg]
Scenario 1 Baseline Current conditions	1,525	487	**2,012**	870	101	**971**

Macro and micro integration:

Total emissions from regional IBC flows and idling

	daily IBC travel NOX [kg]	daily IBC idling NOX [kg]	total IBC related NOX [kg]	daily IBC travel VOC [kg]	All IBCs IBC idling VOC [kg]	total IBC related VOC [kg]
Scenario 1 Baseline Current conditions	1,525	487	**2,012**	870	101	**971**
Scenario 2 New IBC at Sunland Park	1,568	487	**2,055**	901	101	**1,002**
Scenario 3 No Trucks allowed at BOTA IBC	1,702	497	**2,199**	991	101	**1,092**
Scenario 4 Improved Stanton and Zaragoza IBCs	1,667	407	**2,074**	958	86	**1,044**

Conclusion

- iTDM and EST (macro tools) determine emissions at regional level but do not account for idling at IBCs.

- Traffic micro simulators and BEEM provide IBC queuing and idling data, and accurate levels of emissions.

- Critical to combine macro and micro models to provide full regional picture of IBC system.

- This research has demonstrated the importance of having two levels of analysis (macro and micro) and highlights the need for interaction between both models.

Conclusion

- Idling can add up to 25% of emissions to those from traveling to/from IBCs.
- Improving more than one IBC reduces idling emissions while preventing increase in VMT and emissions from redirected flows between IBCs.
- El Paso MPO will further update tools/data and initiate Strategic Plan with robust coordination with U.S and Mexico stakeholders.

Questions