Can Light Rails Provide the Track to Cleaner Air?

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Literature Review

- Previous studies on the air pollution impact of public transit (Chen and Whalley, 2012; Gendron-Carrier et al., 2022; Xie et al., 2024) used Discontinuity-Based OLS as there was instant uptake in ridership.

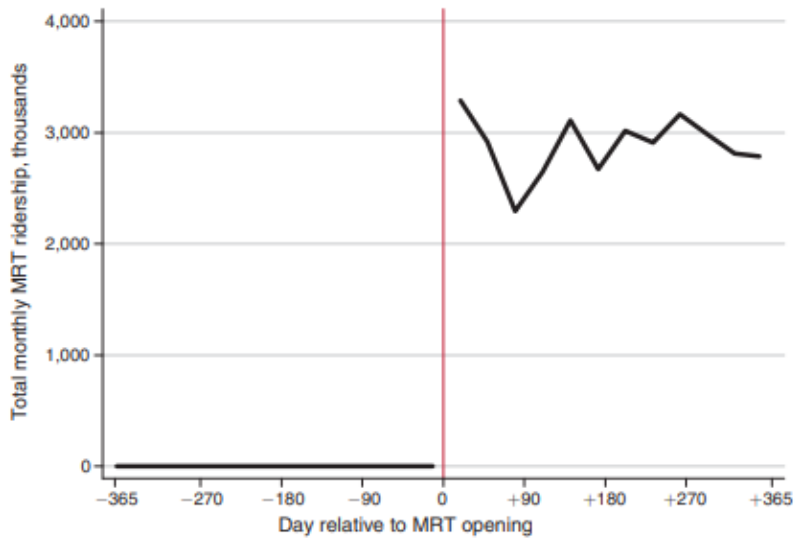


FIGURE 1. RIDERSHIP ON THE TAIPEI METRO

Figure 1: Ridership Data from Chen and Whalley (2012)

Literature Review

- *Fageda, 2021* used DiD to analyze the impact of light rail openings across 98 mid-sized European cities, and found that air pollution was reduced by 3 percent.
- The study used annual PM2.5 data, going back only up to 3 years before opening.

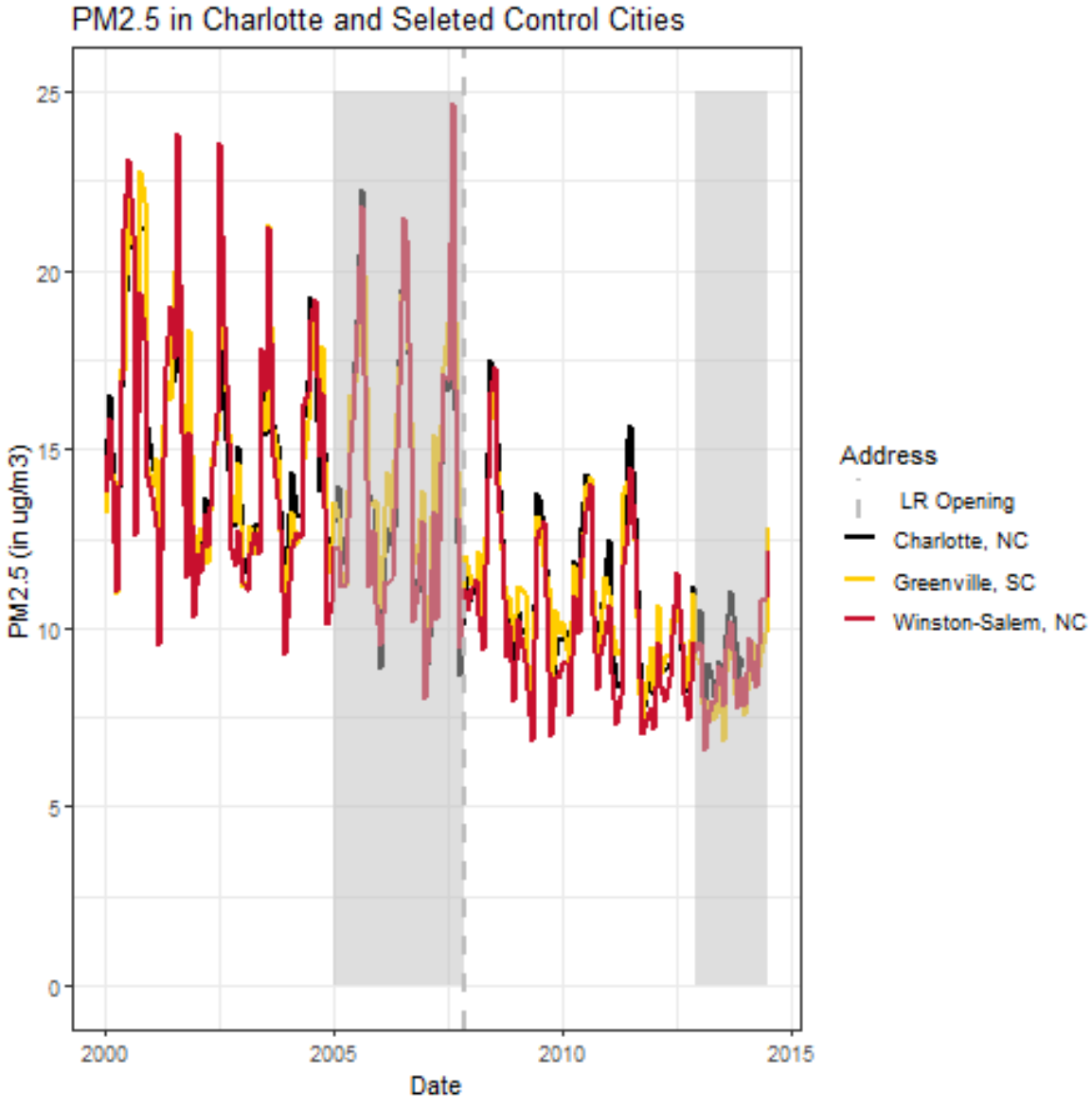
Why Light Rail?

- Light rail is a form of rail public transit with trains that combine features from buses and subways.
- Compared to buses:
  - Higher capacity, more frequent operation
  - Lower maintenance
  - More environmentally friendly (electric instead of gas!)
  - Can have exclusive right-of-way
- Compared to subways:
  - Cheaper to construct a new system (no tunnels needed!)
  - Can reach more residents and stop at more locations

Data: Light Rail Routes

- We focus on light rail systems in our study opened after the 2000s (our PM2.5 dataset has data from 2000 to 2018).
- We picked systems in cities where light rail was the primary mode of rail transit, allowing us to isolate air pollution effects resulting from the opening of a light rail.
- Cities with a population of at least 1 million residents were picked to ensure light rails were in urban cities.
- After considering these criteria, our panel of cities was narrowed down to four systems:
  Charlotte, NC's LYNX system, Houston, TX's METRORail system, Minneapolis-St. Paul, MN's METRO system, and Phoenix, AZ's Valley Metro Rail system.

PM2.5 Trends for Charlotte, NC



DiD Results

Table 1: DiD Results for Charlotte, NC

Dependent Variable:	pm25			
Model:	(1)	(2)	(3)	(4)
Variables				
operating × treatcity	-0.51	-0.54	-0.52	-0.57*
	(0.32)	(0.31)	(0.28)	(0.28)
Wind_f_tavg	-2.1***	-2.0***	-3.4***	-2.4***
	(0.54)	(0.52)	(0.53)	(0.54)
Wind_f_tavg_sq			0.42***	0.28**
			(0.11)	(0.12)
Wind_f_tavg_cu			-0.03**	-0.02
			(0.009)	(0.010)
Fixed-effects				
dow_m	Yes		Yes	
Address	Yes	Yes	Yes	Yes
dow_my		Yes		Yes
Fit statistics				
Observations	29,936	29,936	29,936	29,936
Adjusted R^2	0.32	0.42	0.33	0.43

Clustered (Address) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

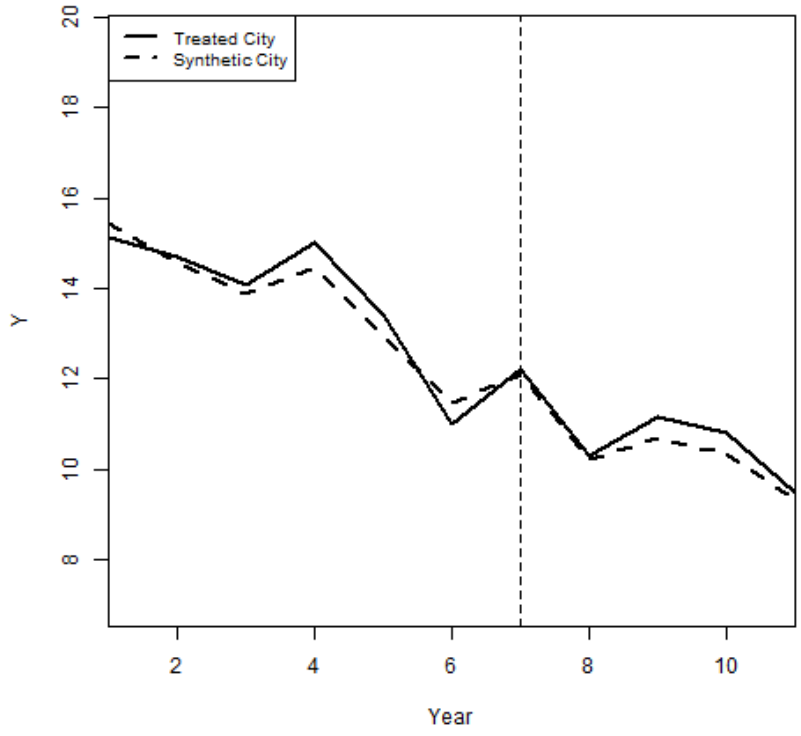
DiD Results for Each Day of the Week

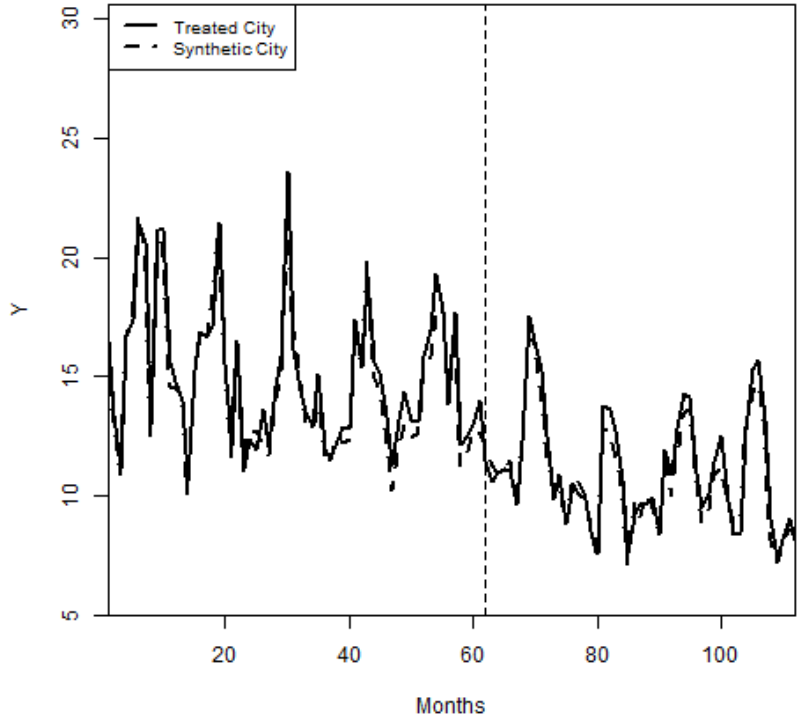
Table 2: DiD Results for Charlotte, NC

Dependent Variable:	pm25
Model:	(1)
Variables	
operating × treatcity × dowFriday	-0.48 (0.27)
operating × treatcity × dowMonday	-0.57 (0.33)
operating × treatcity × dowSaturday	-0.53 (0.35)
operating × treatcity × dowSunday	-0.50 (0.31)
operating × treatcity × dowThursday	-0.78** (0.25)
operating × treatcity × dowTuesday	-0.56* (0.25)
operating × treatcity × dowWednesday	-0.61** (0.25)
Fixed-effects	
dow_my	Yes
Address	Yes
Fit statistics	
Observations	29,936
Adjusted R^2	0.43

Clustered (Address) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

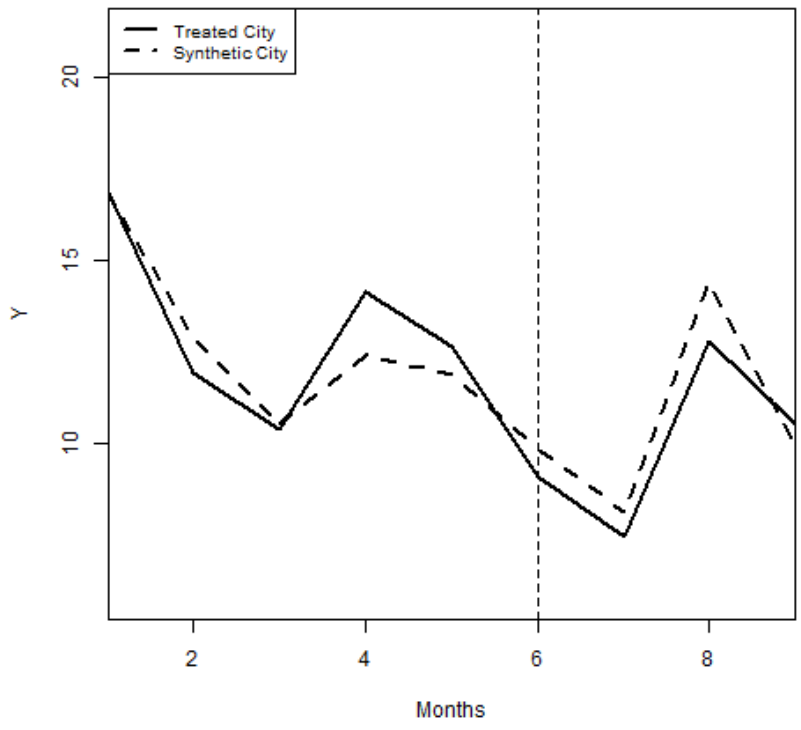
SYC Results for Charlotte, NC

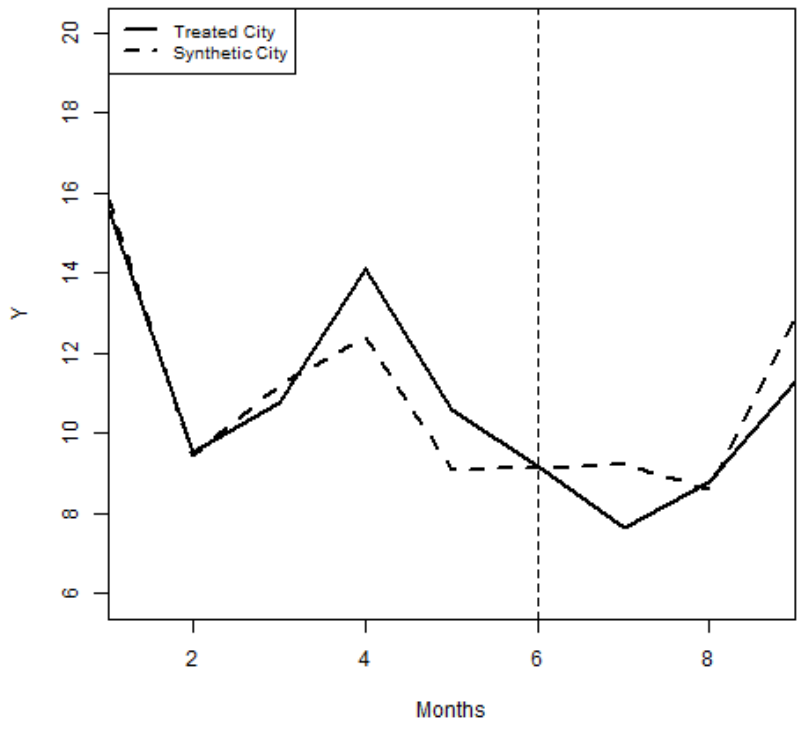




SYC Results for Charlotte, NC

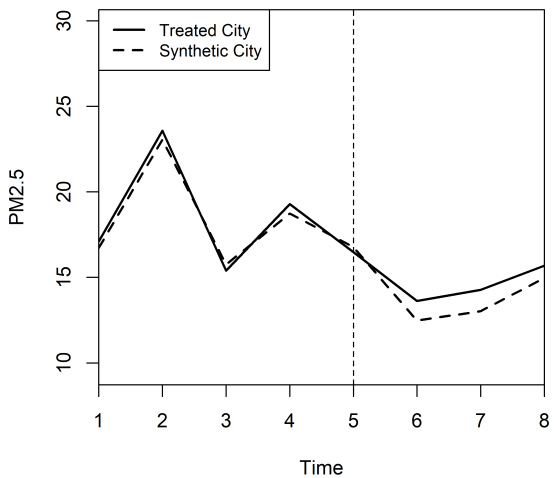
January and February averages of PM2.5 on Thursdays





SYC Results for Charlotte, NC

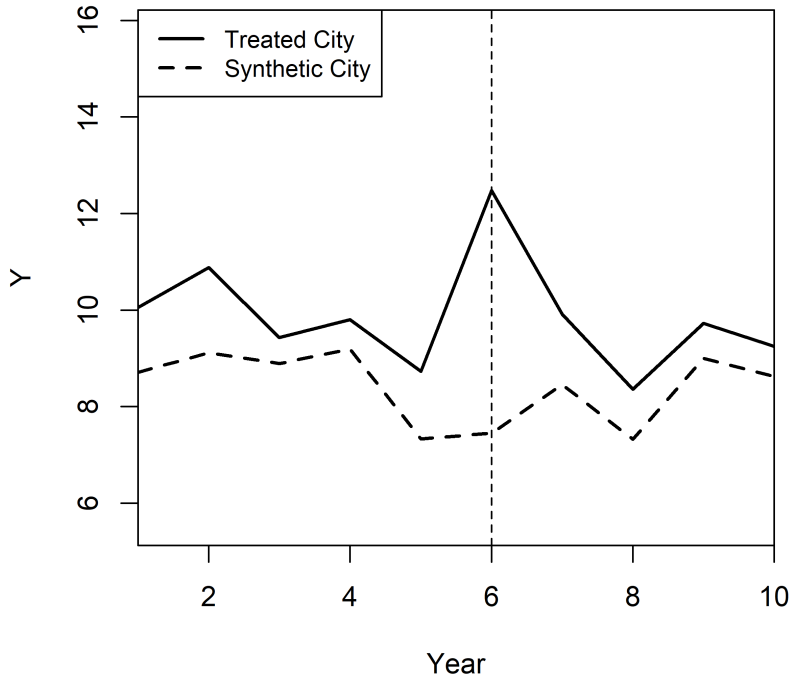
July averages of PM2.5 on Thursdays

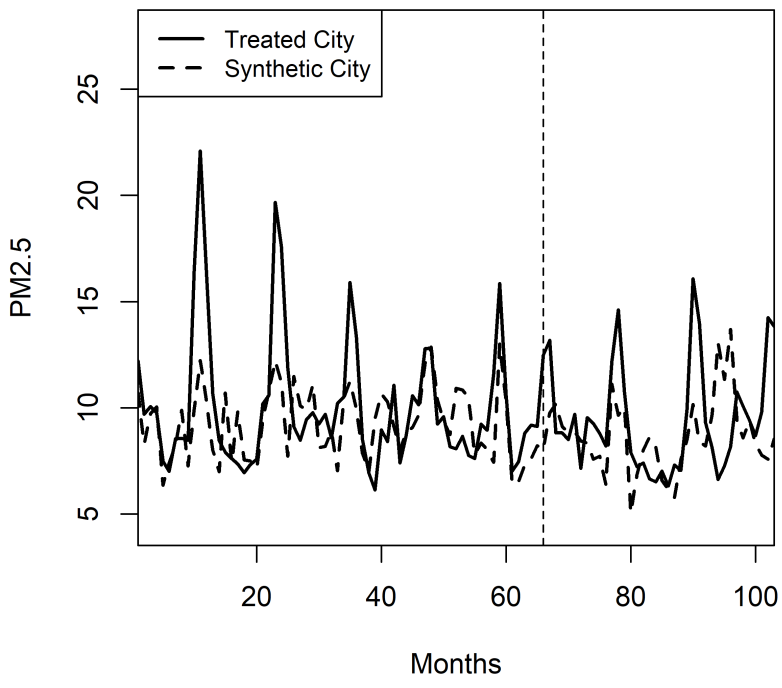


weights	unit names
0.418	Fayetteville, NC
0.582	Winston-Salem, NC

SYC Results for Phoenix-Mesa, AZ

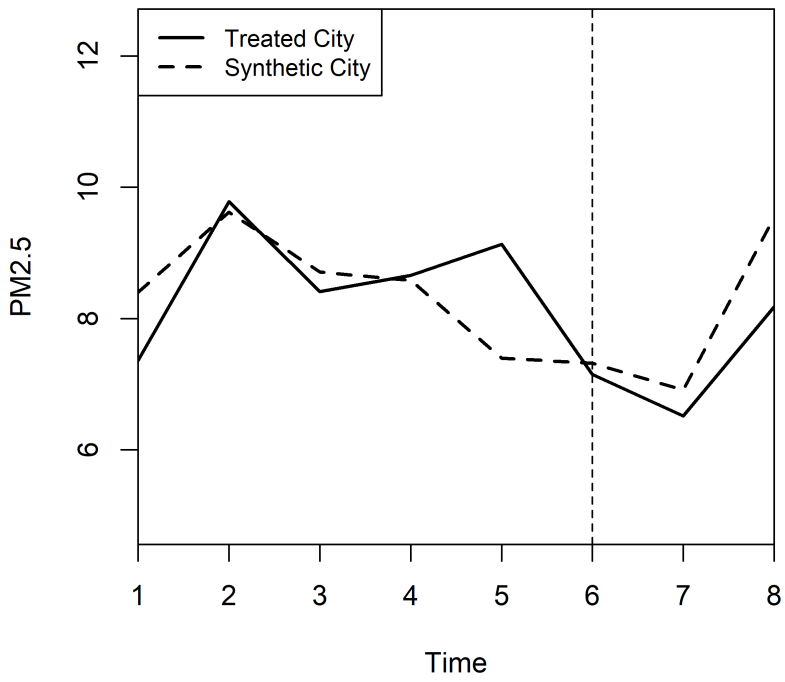
Annual and monthly averages





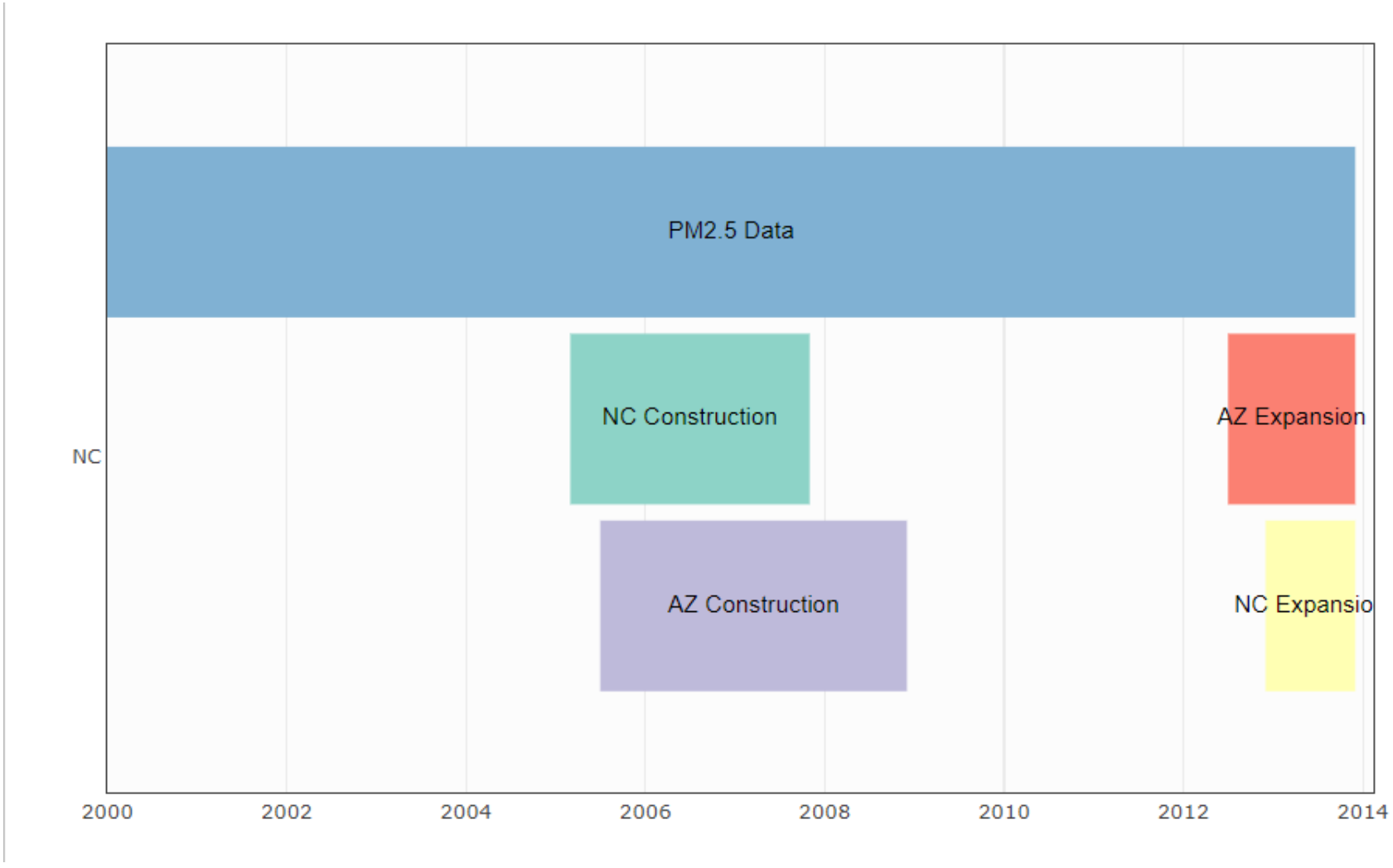
SYC Results for Phoenix-Mesa, AZ

June averages



weights	unit names
0.353	El Pason, TX-NM
0.63	Flagstaff, AZ
0.006	Las Cruces, NM
0.11	Tucson, AZ

SYC with Two Treatment Cities?



SYC with Two Treatment Cities?