Design Project – SIE 2024

Effects of the Coronavirus Public Transportation Measure “All Doors Open”

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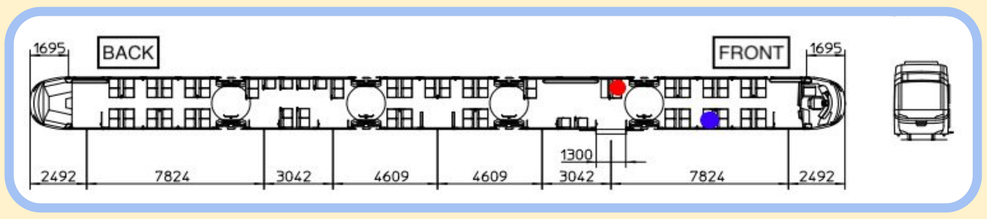
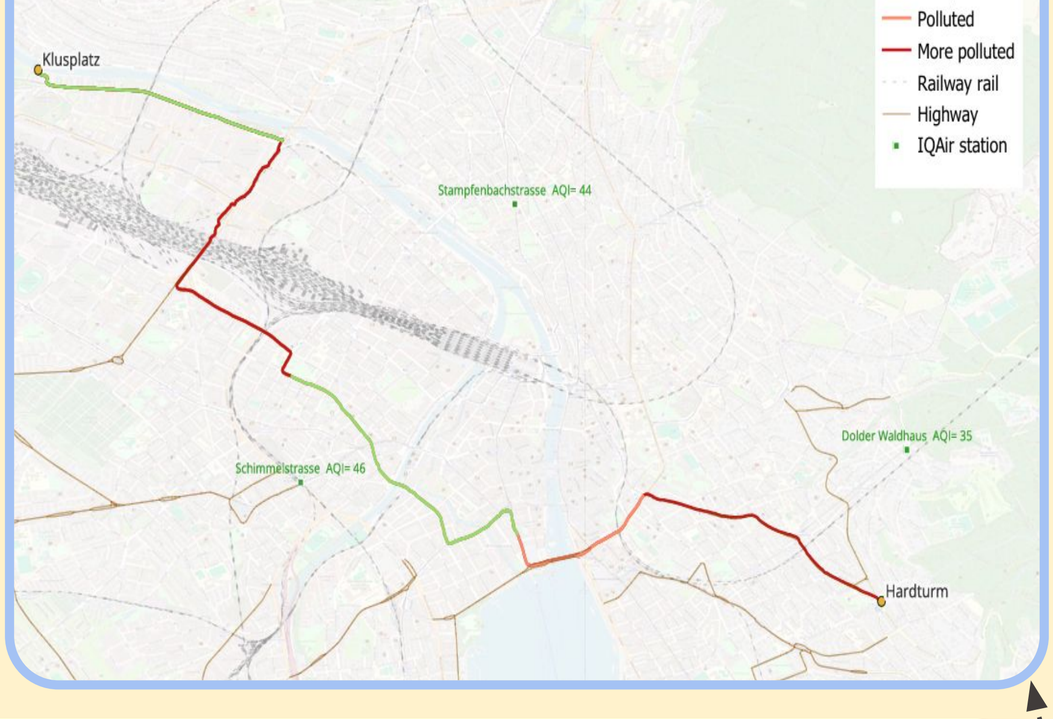
Context:
During the COVID-19 pandemic, the public transportation sector was one of the most challenging primarily because of limited air circulation, which heightened the risk of virus spread among passengers. Therefore, the “**All Doors Open**” policy was implemented by automatically opening all doors of the vehicle in order to improve air circulation and avoid physical contact for the doors stop demands. The project analysis **the efficiency** of this policy comparing it to the “**Open on demand**” policy.

Objectives:
- Does the "All Doors open" policy effectively **reduce particle & CO_2 concentrations** in tram air compared to the standard “Open on demand” policy ?
- Under **which conditions** does the "All Doors Open" policy **improve air quality** ?



Near doors

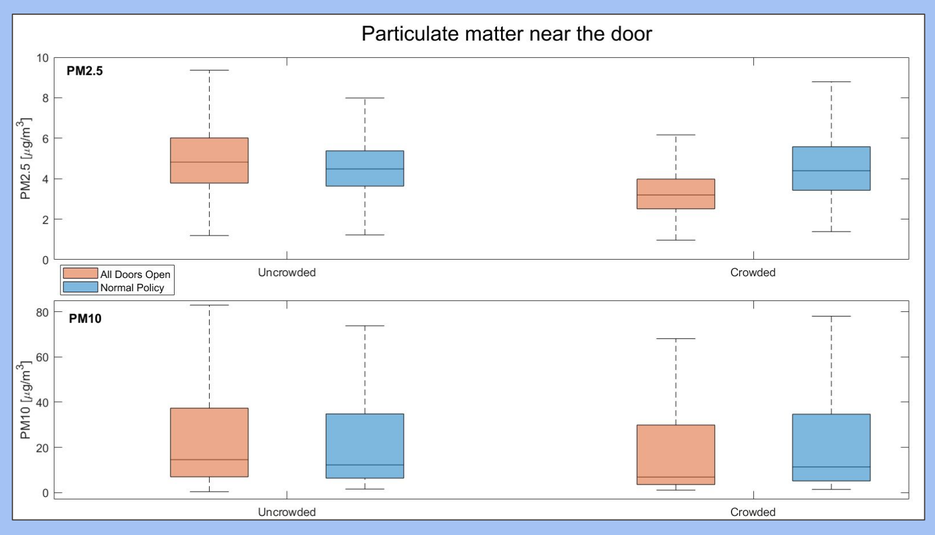
Dead zone

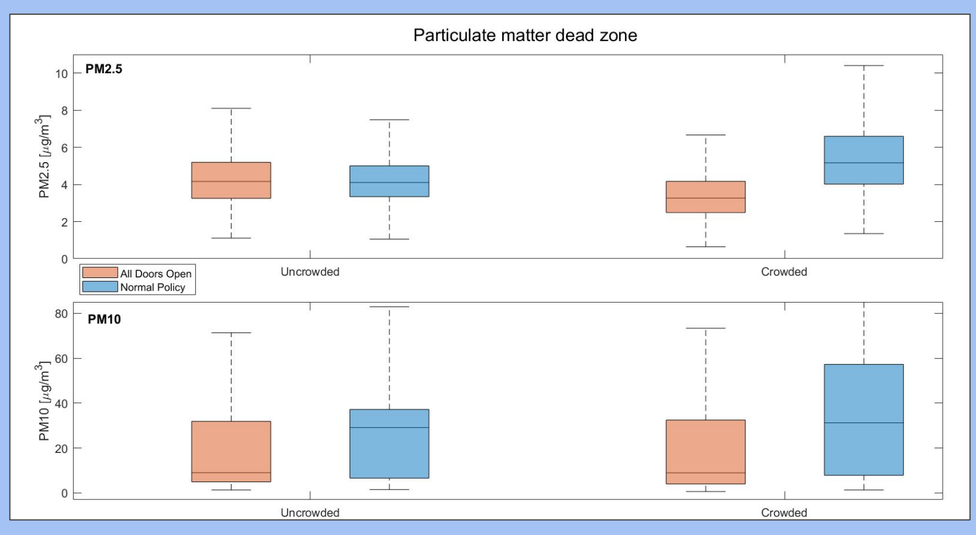


Methodology:
- **Tram Line 8,** running in the city of Zürich, from Hardturm to Klusplatz → Identify different zones of pollution (road, railways, city center, (sub)urban areas)
- Monitor **particle count and CO_2** concentration
- Measurements of the **occupancy level**
- All Doors Open vs Open on demand
- Near doors vs Dead zone
- Crowded vs Uncrowded

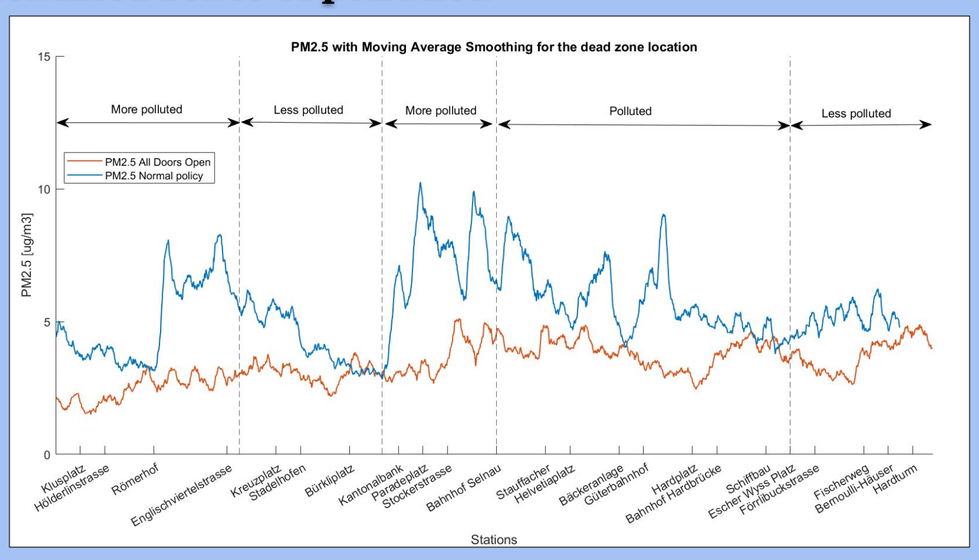
Results:

1. When **crowded**, it is helpful to **open the doors** to keep a good air quality inside the vehicle

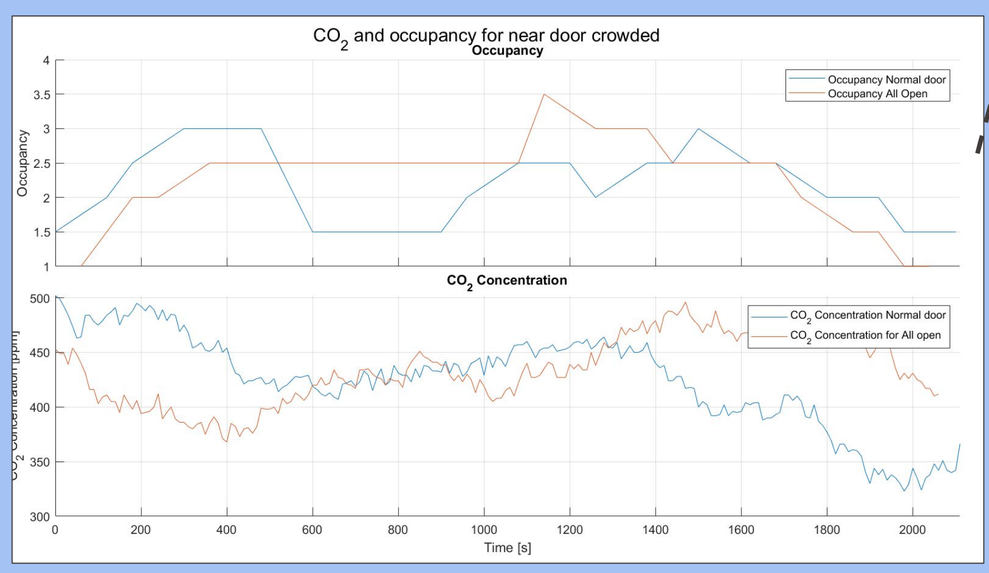




2. **Outside pollution** also affects particulate matters concentrations when **doors were opened** and coincide with **identified zones of pollution**



3. “**All Doors Open**” policy **degrades the air** quality **near doors** when talking about amount of **CO_2 inside the tram**



4. The **Air Quality Index** (AQI) for the majority of the scenarios fall within the categorization "**Good**"

AQI values	PM2.5 [ug/m3]	PM10 [ug/m3]	CO_2 [ppm]	AQI and health message
0-50	0-9	0-54	<700	Good
51-100	9.1- 35.4	55-154	701-1000	Moderate
101-150	35.5-65.4	155-254	1001-1500	Unheathy for sensitive groups
151-200	65.5- 150.4	255-354	1501-2500	Unhealthy
201-300	150.5-250.4	355-424	2501-5000	Very unhealthy
>300	>250.5	>425	>5000	Hazardous

			PM2.5 [ug/m3]	PM10 [ug/m3]	CO_2 [ppm]
Crowded	Near door	Normal	7.937	51.642	487.8
		Door Open	5.6061	33.1394	479
	Dead zone	Normal	9.3503	68.0689	551
		Door Open	5.636	38.4826	518
Uncrowded	Near Door	Normal	7.1217	43.9175	493.9
		Door Open	8.9342	57.3176	497.4
	Dead Zone	Normal	6.5127	58.9217	529
		Door Open	6.8048	36.8041	461.3

Conclusion:
Door openings system has to be chosen **carefully**, based on **the occupancy level**. The **more crowded** the tram is, the better it is to **open more regularly** the doors, since **air circulation is more complicated** in these cases. But it is also more likely that someone wants to stop at a given station when there is more people in the tram.

- Sciences et ingénierie de l’environnement