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Assessing Sustainable Mobility Scenarios and their Influence on Street Level Air Pollution: A Comparative Analysis in Kesselsdorfer Street in Dresden, Germany.

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This work addresses the following topic(s) from the Call for Contributions:
(Please check at least one box)

☐ Placemaking to integrate urban spaces and mobility
☐ Promoting sustainable mobility choices in metropolitan regions
☒ Governing responsible mobility innovations
☒ Shaping the transition towards mobility justice
☒ System analysis, design, and evaluation
☐ other: ________________________

Extended Abstract

From here 700-1000 words, grouped by the following sections:

Problem statement

Considering that transportation highly contributes to air pollution, sustainable mobility strategies are presented as a solution not only for reducing air pollution but also for promoting a better quality of life (Brůhová et al., 2020). However, urban plans are designed to operate at city level, and the translation of sustainability targets, particularly those aimed at reducing pollution, remains unclear for street-level interventions. The scale of this project allows greater community ownership of the decision-making process (Ramos, 2022). So, it is necessary to involve people's perspectives to go beyond the phrasing of emissions within the goals and objectives of urban plans, integrating complementary measures that allow not only improve air quality but also well-being (Szopinshka et al., 2022; Sanchez et al., 2021). This, along with the fact that pollution has a negative impact on health and that individuals' views are rarely included in pollution assessments, raises the need for a comprehensive methodology that will allow a holistic assessment of air pollution for street-level projects.

Research objectives

This research assessed street air pollution in Kesselsdorfer Street (Dresden) through the application of a hybrid methodology within different street scenarios based on sustainable mobility strategies. To achieve this aim, it was necessary to build and assess different street scenarios towards the reduction of car-related emissions using ADMS-Roads simulations and people experience data. Finally, this research provided insights and outlined a framework for air pollution assessments that can be replicated in other contexts.

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Methodological approach

This research combined ADMS-Roads dispersion model with people experience data (Gehl, 2021). The first step involved the baseline, with the street profile and urban analysis of Kesselsdorfer Street, a GIS canyon analysis, and the current situation model in ADMS-Roads. Then, different scenarios were created and prioritized based on selection matrices between stakeholders' inputs, city goals in urban plans, future projects for the area, and case studies. From this, the hybrid methodology was introduced, with two paths, one related to the modeling and simulation of the scenarios using ADMS-Roads; and the second one, a qualitative approach by using online surveys to collect perspectives of the current situation and the scenarios. To conclude, the results were compared between scenarios from the dispersion model and the survey, which allowed the development of an air pollution assessment framework.

ADMS-Roads specifications:

The inputs for ADMS-Roads included meteorological data for 2022, traffic flows, canyon specifications, and emissions data from Dresden. Five receptor points were identified in each intersection, these were assessed at a height of 1.65 meters. The software was instructed to simulate NO_2, PM_{10}, and $PM_{2.5}$ levels for each scenario. The outputs were point-specific hourly values and pollution maps using ADMS-Roads' Mapper function.

Surveys:

A 17-question online form was developed to understand the perceptions of pollution, traffic, and noise in each developed scenario. The survey used a five-point Likert scale and was conducted in English to residents and people who work and circulate in the area. Furthermore, this survey was complemented with interviews with local mobility officers.

Scenario development:

Four scenarios were developed for Kesselsdofer Streer, considering its high commercial activity, peak hour traffic flow of 805 vehicles (Dresden, 2023), and deep canyons street structure. The **current scenario (CS)** represents the status quo and three explorations (Figure 1). The **optimistic scenario (OPT)** with an 11.8% increase in traffic; a **radical scenario (RAD)** with a redesign of one section of the street in favor of only public transport circulation (and a lane for residents and emergencies), with 11.8% (3x) decrease in traffic plus a 3.5% increase for public transport. Finally, a **setback scenario (SB)** with more car-centered policies that includes two more lanes for cars, sidewalk reduction, and an 11.8% (3x) increase in traffic circulation.

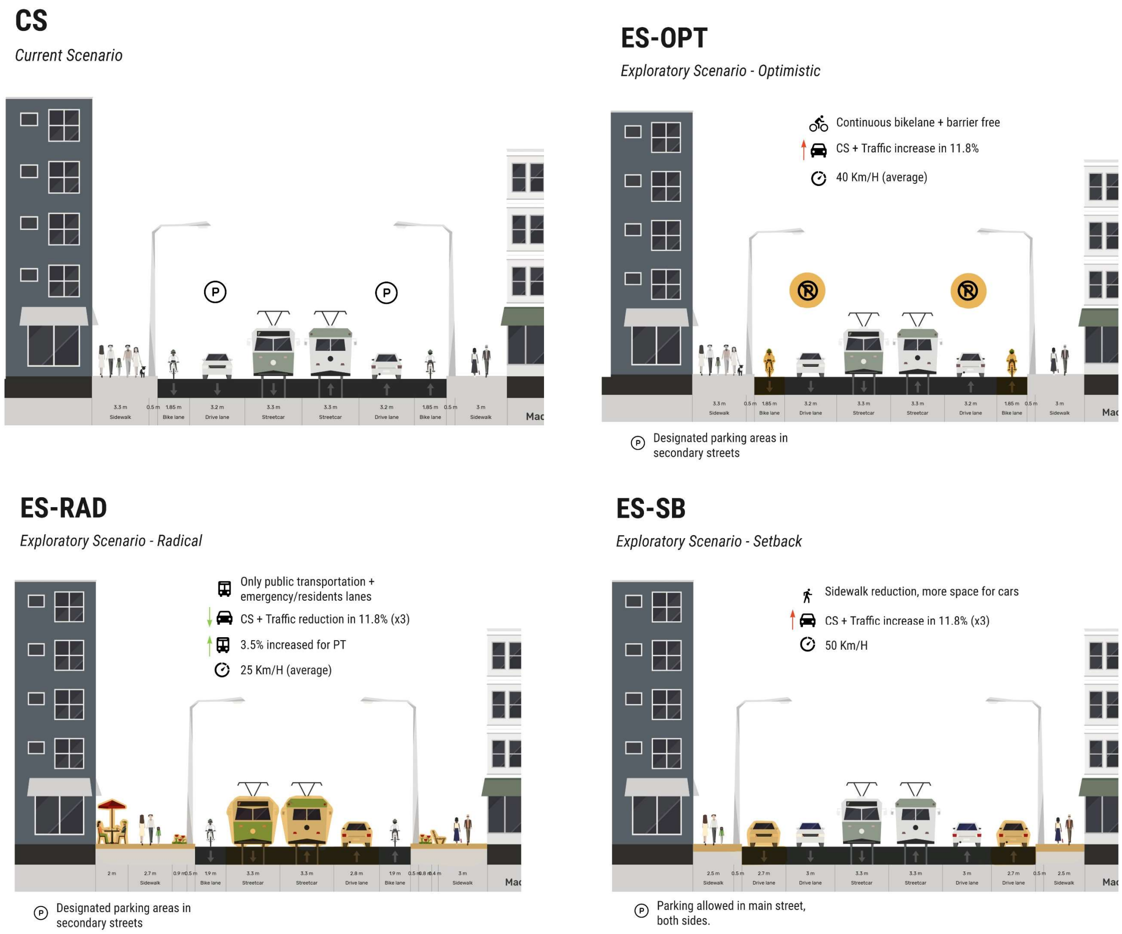

Figure 1: Scenarios' sections with descriptions

(Expected) results

This study provided a detailed assessment of the exploratory scenarios that aim to reduce air pollution. It shows that shifting towards more sustainable transportation methods contributes to further emissions reductions. A radical scenario has the potential to cut NO_2, PM_{10}, and $PM_{2.5}$ emissions by 91.6%, 66.26%, and 67.61%, respectively, compared to the current scenario (Table 1). The maximum average values for NO_2 and $PM_{2.5}$ concentrations do not exceed the European Union (2008) and WHO (2021) regulated hourly maximum value of 200 µg/m^3 and 15 µg/m^3, respectively; contrarily, PM_{10} values surpass the daily threshold (50 µg/m^3) by 19% in all the scenarios.

Table 1: Variation percentages for all the scenarios at peak hours

Variation percentages reached in the scenarios

	Scenario	NO2	PM10	PM2.5
Day 45	OPT	↑11.66%	↑11.79%	↑11.55%
P.H.: 20 h.	RAD	↓91.60%	↓66.26%	↓67.61%
	SB	↑35.16%	↑35.37%	↑38.03%
Day 56	OPT	↑12.00%	↑5.12%	↑8.10%
P.H.: 9 h.	RAD	↓70.00%	↓22.54%	↓56.68%
	SB	↑35.00%	↑14.96%	↑32.39%

All the assessed scenarios presented two constant hotspots located in street sections 2 and 4 (Figure 2) that correspond to deep street canyons (with aspect ratios near 1.5). Thus, it is corroborated that the planning of deep canyons in cities prevents the dispersion of particles and concentrates pollutants. The hotspots' locations coincide with street areas of high commercial activity, thus justifying specific interventions for reducing pollution levels and protecting users.

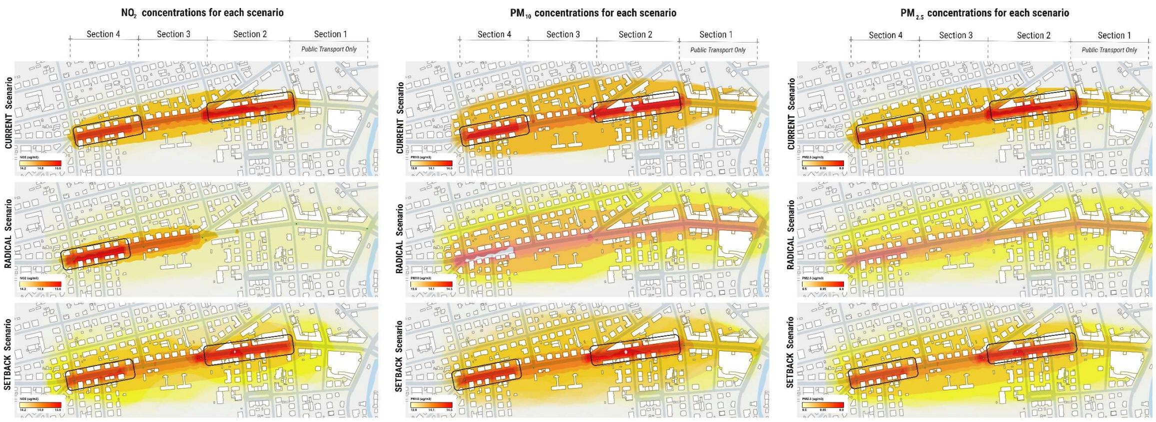

Figure 2: Pollution maps and hotspots for all the scenarios for NO_2, PM_{10}, and $PM_{2.5}$

This research implemented a dual approach that revealed that dispersion models and people's perceptions go hand in hand, meaning that while pollution and traffic increase in the simulations, so does citizens' perception of high levels of pollution (Figure 3). According to the survey, around 80% of respondents preferred fewer cars (RAD scenario) and more urban greenery, thus, even radical mobility improvements need to be accompanied by complementing strategies in the streetscape.

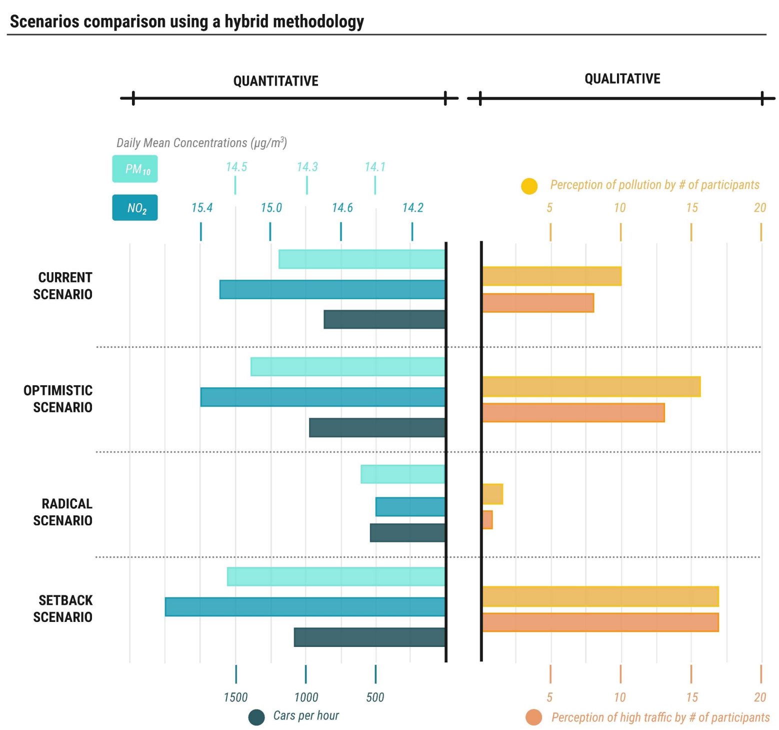

Figure 3: Comparative assessment of the quantitative and qualitative data per scenario

Finally, a framework for assessing air pollution is presented in Figure 4, summarizing the main stages of this research methodology. The outcome is designed to be utilized at street level as an alternative approach to strategic transport planning. This study suggests that tackling car-related emissions does not require going as far as to implement a completely radical mobility scenario (that could be hindered by social or economic factors), but aiming in that direction can contribute to a significant change in pollution levels. Air pollution must be assessed in a holistic way, including local communities' perspectives, for more informed decisions and better local and beyond regulations.

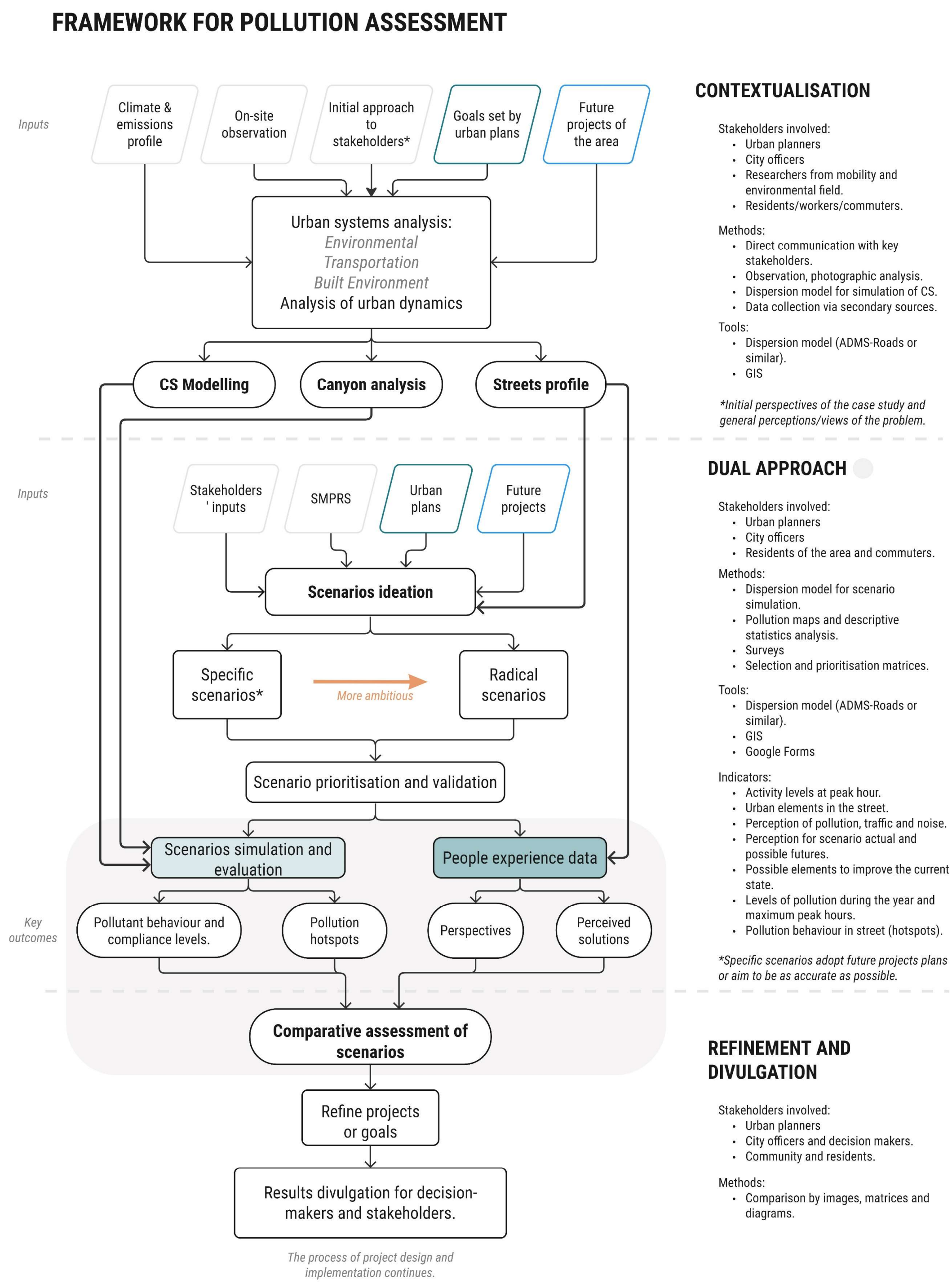

Figure 4: Framework for air pollution assessment

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