



20th Annual Community Modeling and Analysis System (CMAS) Conference

Review of PM_{2.5} source apportioning studies in Tehran megacity

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November 2021



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Introduction

- Tehran:
 - Population: 13,260,000 (2017)
 - Metropolitan area: 2,235 km²
 - Urban area: 1,200 km²





Introduction

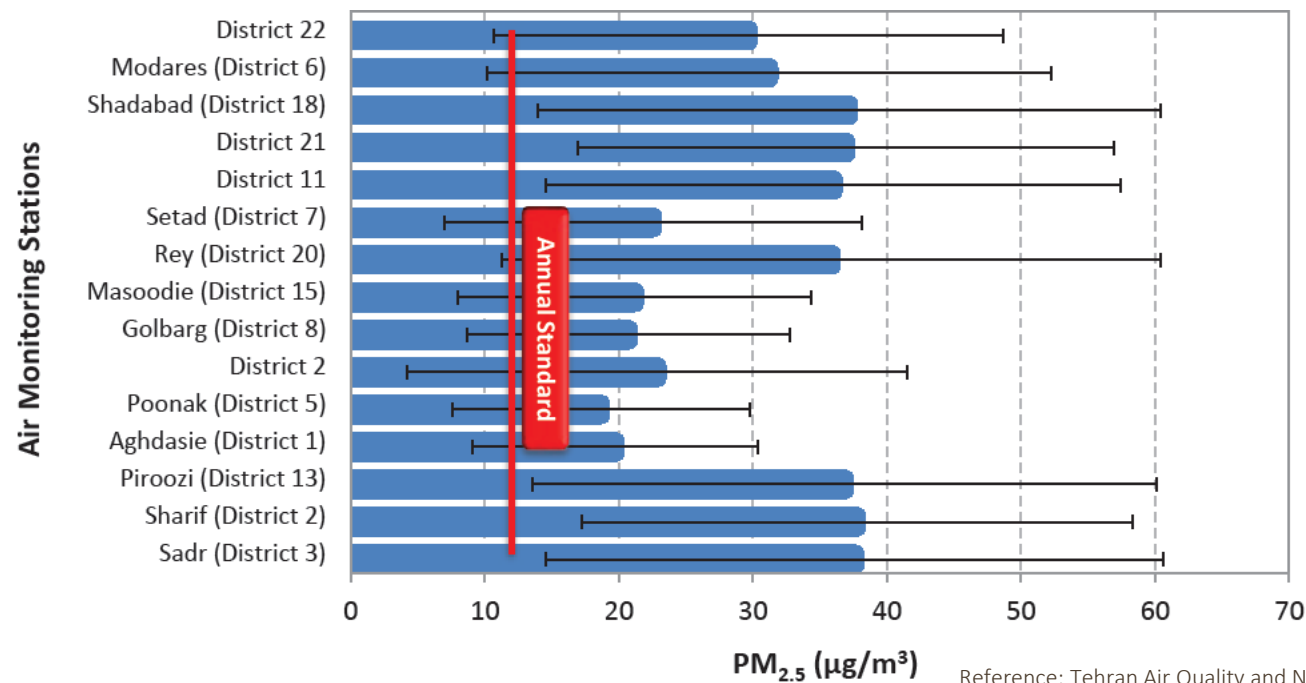
- Tehran:
 - Environmental health costs from air pollution in Tehran
~ b2.6\$ in 2016 (ref. WB)



Introduction



PM_{2.5}: the criteria pollutant in Tehran



Reference: Tehran Air Quality and Noise Report, Period of March 2019-March 2020, QM99/03/01(U)/1



Introduction

- Three main methods for assessing the share of different emission sources:
 - 1) Emission inventory approach for direct evaluation of the primary emission rates from each source
 - 2) Source apportionment of a sample at receptors and,
 - 3) The sensitivity of the concentration to the emission from an emission source.



Reviewing Methodology

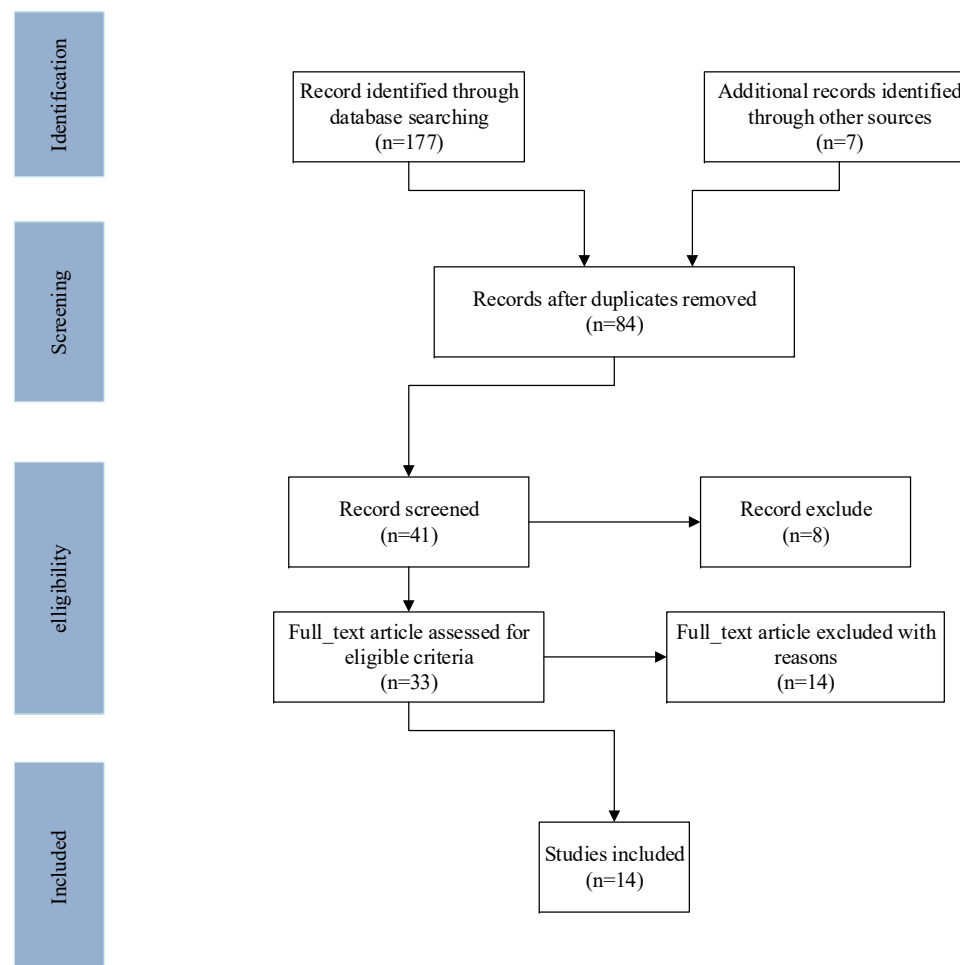
- 3 main electronic databases : Scopus, Web of sciences, PubMed
- Time set: from January 1, 2005, until July 20, 2021
- Key words: “air pollution”, “air quality”, “atmospheric pollution”, “air pollutants”, “particulate matter”, “PM_{2.5}”, “fine PM”, “fine particulate matter”, “source apportionment”, “emission inventory”, “Tehran”. Operators such as “OR” and “AND”
- Final evaluation : 1) published on a peer-reviewed journal in English, 2) master and Ph.D. thesis related to this subject, 3) letters, non-English language papers, conference abstracts, short communications, news articles, and posters.



Results

The initial searches:

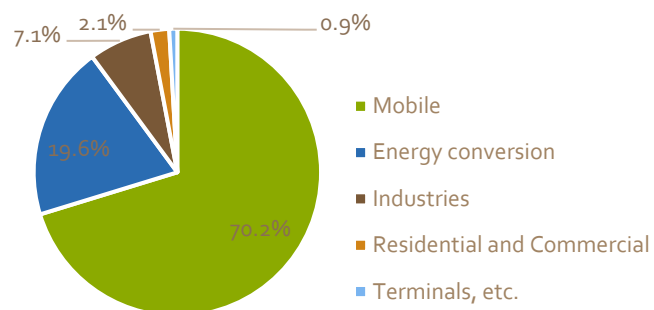
- 171 records.
- 110 unrelated articles
- 67 studies were reviewed for eligibility evaluation,
- 26 full-text articles met the inclusion criteria
- 12 full texts were finally investigated in which original source apportioning results were reported.



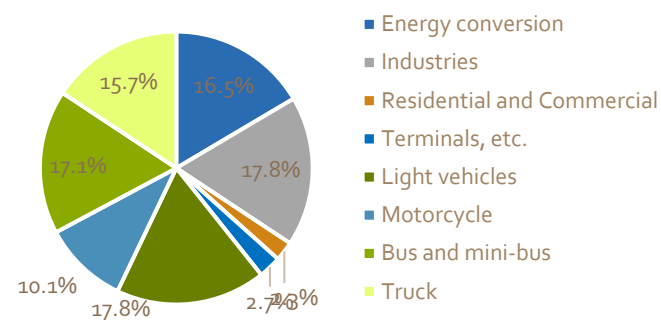
Results

- Emission inventory (EI) literature

1- A GIS-based PM_{2.5} emission inventory development for Tehran. In the Urban Climate



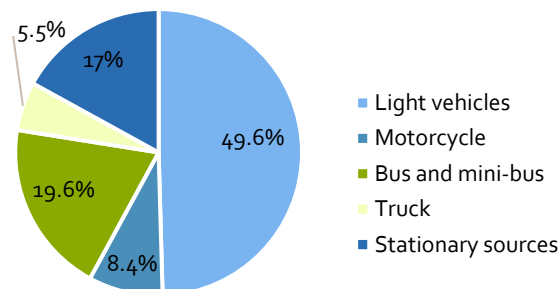
2- Tehran PM_{2.5} emission inventory in 2017



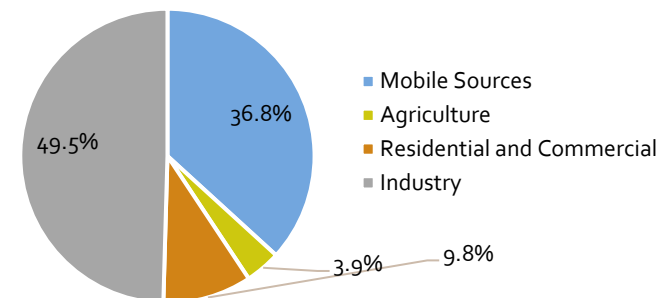
Results

Emission inventory (EI) literature

3- Source apportionment of Tehran's air pollution by emission inventory. in the International emission inventory conference of EPA

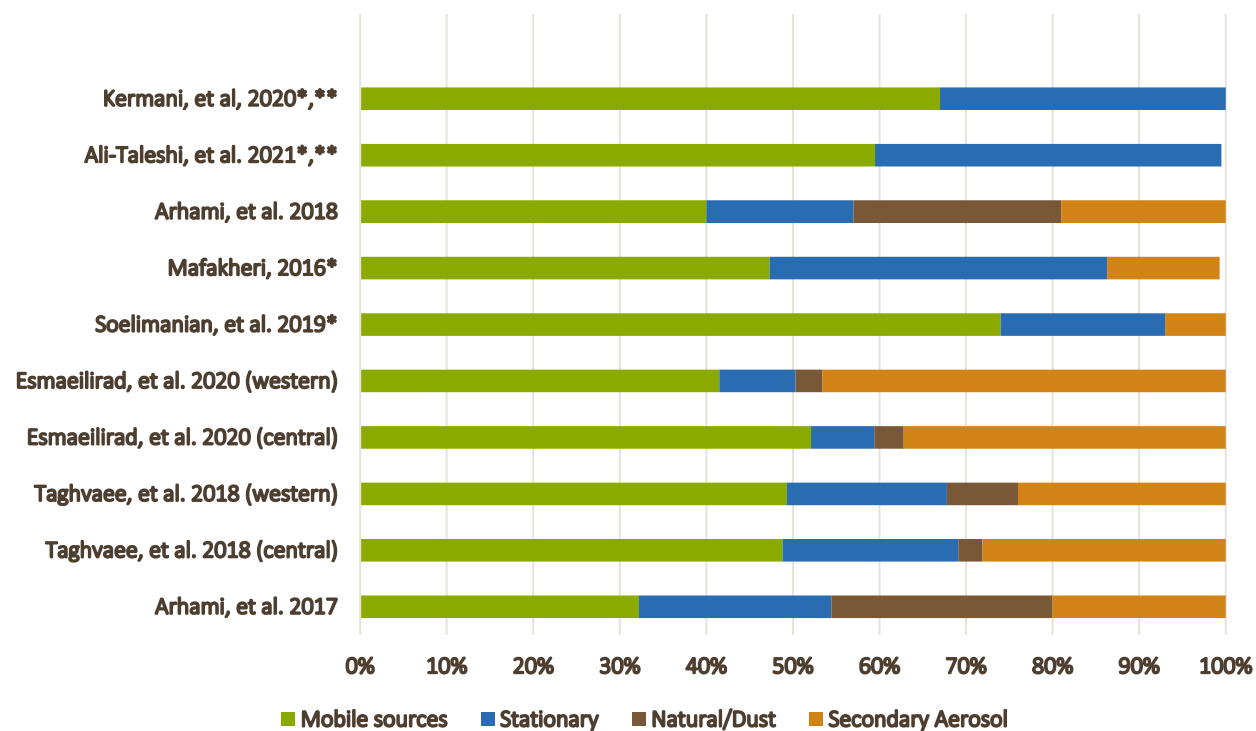


4- On the environmental effectiveness analysis of energy policies: A case study of air pollution in the megacity of Tehran. In the Science of The Total Environment



Result :

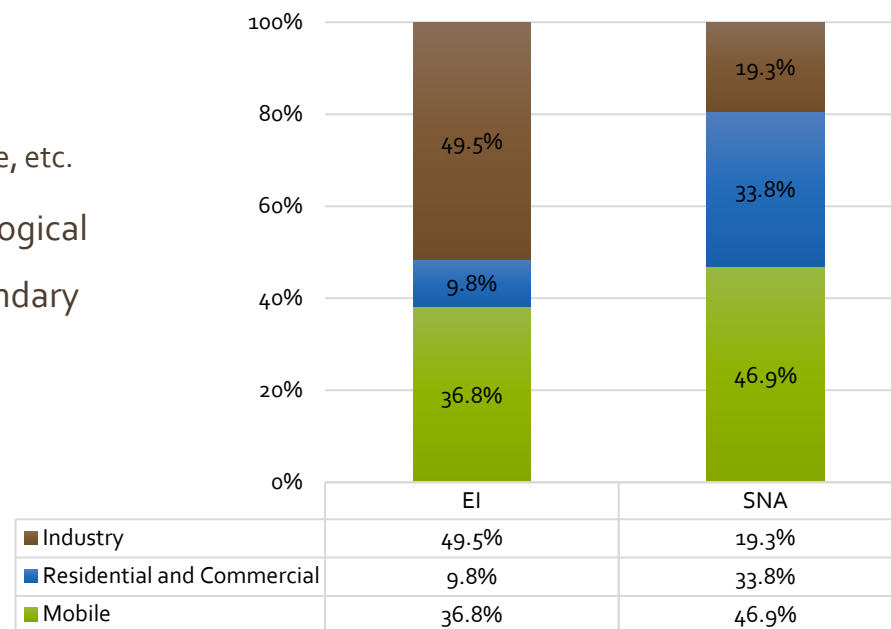
- Source apportionment (SA) literature



Result :

- **Sensitivity analysis (SNA) literature**

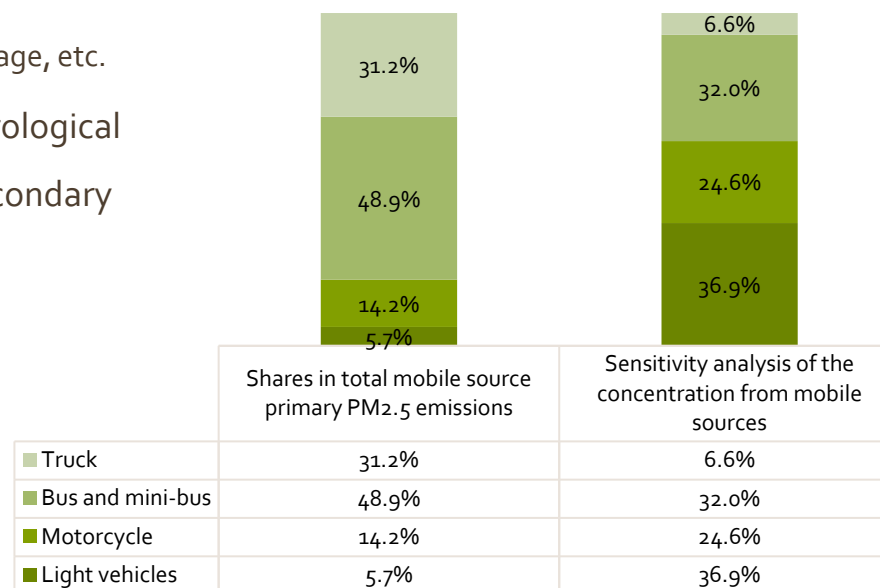
- Inconsistency of the assumptions.
 - Emission factors, geographical coverage, etc.
- Effect of geographical and meteorological situation on the dispersion and secondary formation of the pollutants.



Result :

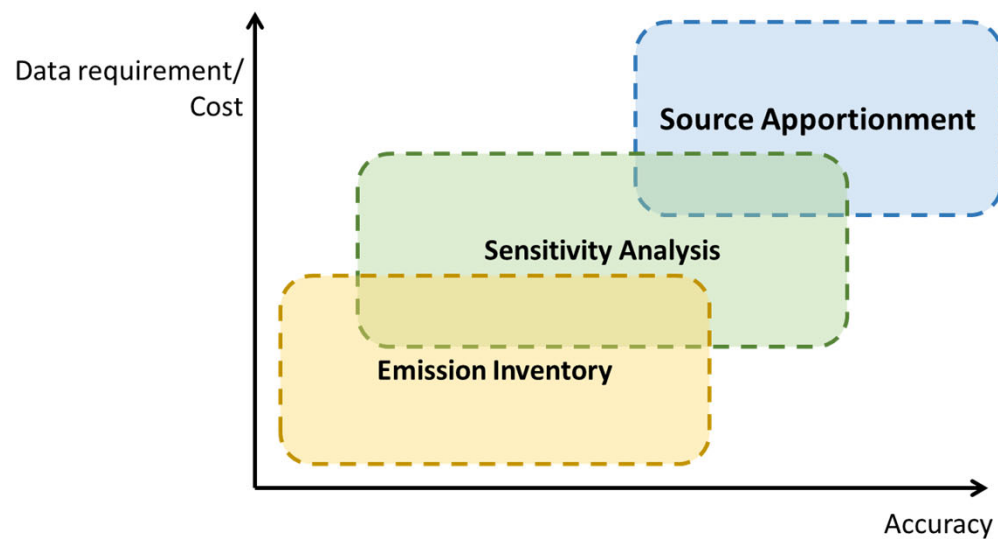
- **Sensitivity analysis (SNA) literature**

- Inconsistency of the assumptions.
 - Emission factors, geographical coverage, etc.
- Effect of geographical and meteorological situation on the dispersion and secondary formation of the pollutants.



Discussion:

Data requirement and accuracy in each method is different



Discussion:

Methods	Advantages	Limitations
Emission Inventory (EI)	<ul style="list-style-type: none"> - Averaged values over an area and time-period - Easy to conduct at low cost - Possibility of detailed source apportioning of the emission among different sources 	<ul style="list-style-type: none"> - Low accuracy - Data-intensive - Inconsistency in emission factors - Not considering the secondary production of pollutants - Emission rates not representative of effects - Not considering the natural concentrations
Source Apportionment (SA)	<ul style="list-style-type: none"> - High accuracy in decomposing the sampled PM. - Suitable for accounting the contribution of sources in a local pollution - Consideration of natural concentrations and secondary PM formation - Consideration of the effect of emission sources, meteorology and geography of the city. 	<ul style="list-style-type: none"> - Inaccuracy in linking the chemical decomposition result with the emission source - Point specific values not averaged over area and period - Costly sampling and analyzing process.
Sensitivity Analysis (SNA) of the simulated concentration	<ul style="list-style-type: none"> - Potential for consideration of secondary pollutant formation - Possibility of long-term and short-term estimates - Easy to conduct - Possibility of assessing the effects of different emission sources, meteorology and geography of the city. - Proper for evaluation of mitigation scenarios 	<ul style="list-style-type: none"> - Dependent on emission inventory input to the dispersion model - Dependent on the assumptions in concentration distribution modeling (boundary and background concentrations, emission sources, and mass fluxes, ...) - Inaccuracy in the validation of the simulation results - Costly access to compatible dispersion simulation models and gathering model inputs



Recommendation:

- The SA results are more consistent and reliable for the identification of the shares of the emission sources in pollution. On the other hand, the EI results are more deviated from each other.
- Among the methods, SNA is especially appropriate for evaluation of the effectiveness of sector-specific environmental management plans.
- EFs and the spatial coverage of the study area, as well as the state of consideration of non-exhaust industrial and agricultural emissions, are very effective in the emission inventory results.
- Each one of the source apportioning approaches benefits from particular relative advantages and, therefore, may be the most appropriate approach in specific situations. On the other hand, each of the methods suffers from shortcomings.
- Further analysis of the available literature on source apportioning of other criteria pollutants in Tehran (e.g., PM_{10} , Ozone, and SO_2) is suggested for future studies.



Thank you for your attention!

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