Best Practices towards Clean Air

A Catalogue of Urban Transportation Policies to Reduce Traffic-Related Emissions and Air Pollution

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Motivation

• Urban areas and cities are undertaking several "policies", "actions", "measures", "strategies" and "practices" ("policy interventions") to reduce emissions, air pollution, exposure, and negative health impacts

• Number of available options increasing + technologies emerging → **Evidence base is large**

Urban policy interventions to reduce traffic emissions and traffic-related air pollution: Protocol for a systematic evidence map

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ABSTRACT

Introduction: Cities are the world's engines of economic growth, innovation, and social change, but they are also hot spots for human exposure to air pollution, mainly originating from road traffic. As the urban population continues to grow, a greater quantity of people risk exposure to traffic-related air pollution (TRAP), and therefore also risk adverse health effects. In many cities, there is scope for further improvement in air quality through targeted urban policy interventions. The objective of this protocol is to detail the methods that will be used for a systematic evidence map (SEM) which will identify and characterize the evidence on policy interventions that can be implemented at the urban-level to reduce traffic emissions and/or TRAP from on-road mobile sources, thus reducing human exposures and adverse health impacts.
Methods: Articles will be searched for and selected based on a predetermined search strategy and eligibility criteria. A variety of databases will be searched for relevant articles published in English between January 1, 2000 and June 1, 2020 to encompass the interdisciplinary nature of this SEM, and articles will be stored and screened using Rayyan QCRI. Predetermined study characteristics will be extracted and coded from included studies in a Microsoft Excel sheet, which will serve as an open access, interactive database, and two authors will review the coded data for consistency. The database will be queryable, and various interactive charts, graphs, and maps will be created using Tableau Public for data visualization. The results of the evidence mapping will be detailed via narrative summary.
Conclusion: This protocol serves to increase transparency of the SEM methods and provides an example for researchers pursuing future SEMs.

Systematic Evidence Map

Urban policy interventions to reduce traffic-related emissions and air pollution: A systematic evidence map

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ABSTRACT

Background: Urban areas are hot spots for human exposure to air pollution, which originates in large part from traffic. As the urban population continues to grow, a greater number of people risk exposure to traffic-related air pollution (TRAP) and its adverse, costly health effects. In many cities, there is a need and scope for air quality improvements through targeted policy interventions, which continue to grow including rapidly changing technologies.
Objective: This systematic evidence map (SEM) examines and characterizes peer-reviewed evidence on urban-level policy interventions aimed at reducing traffic emissions and/or TRAP from on-road mobile sources, thus potentially reducing human exposures and adverse health effects and producing various co-benefits.
Methods: This SEM follows a previously peer-reviewed and published protocol with minor deviations, explicitly outlined here. Articles indexed in Public Affairs Index, TRID, Medline and Embase were searched, limited to English, published between January 1, 2000, and June 1, 2020. Covidence was used to screen articles based on previously developed eligibility criteria. Data for included articles was extracted and manually documented into an Excel database. Data visualizations were created in Tableau.
Results: We identified 7528 unique articles from database searches and included 376 unique articles in the final SEM. There were 58 unique policy interventions, and a total of 1,139 unique policy scenarios, comprising these

Research aims

- Identify and summarize global evidence on urban policy interventions to reduce <u>traffic emissions</u> and/or <u>TRAP</u>
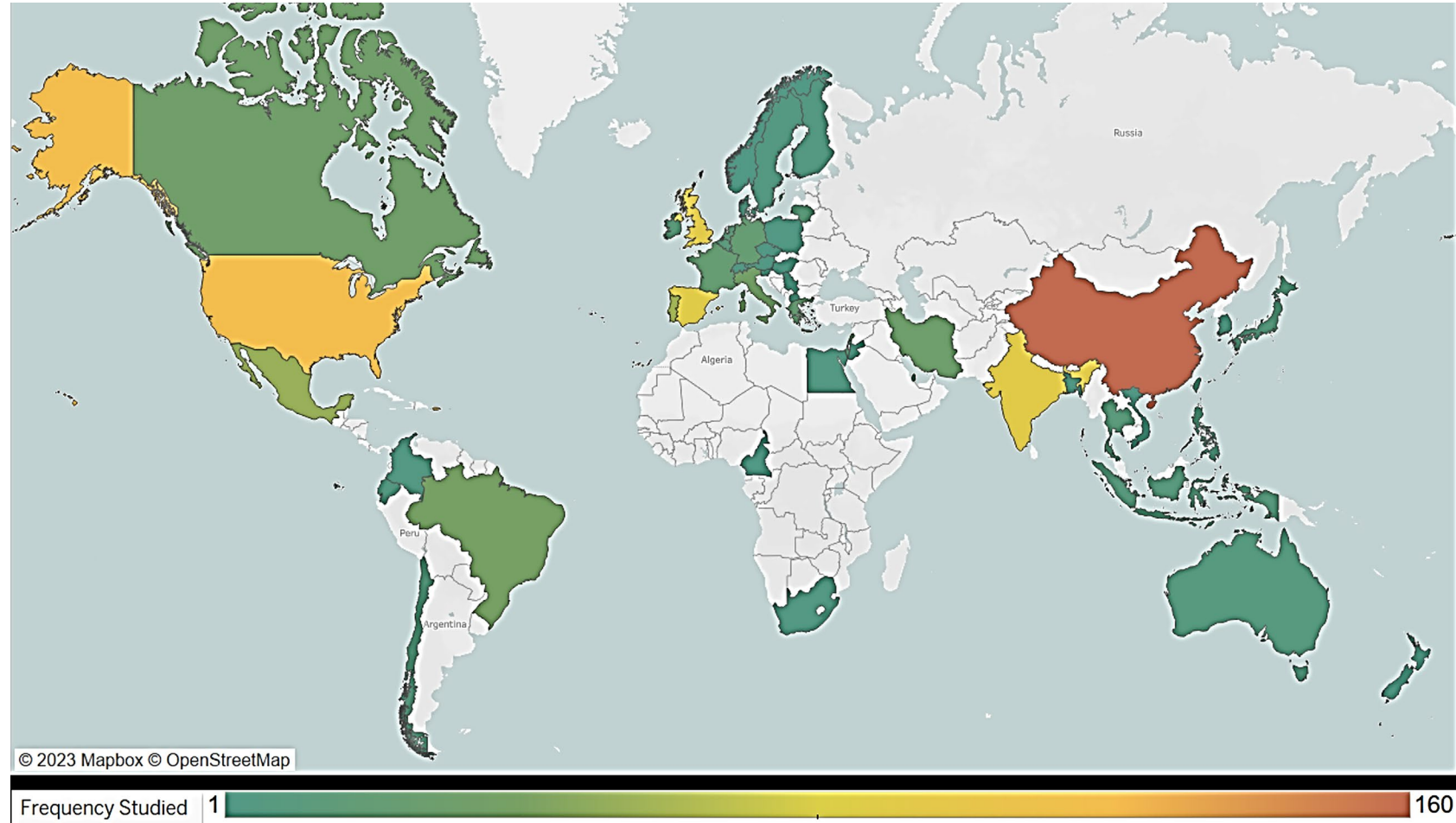
- Recorded direction of impact reported (Increase, Reduction, No Change, Mixed Effect)

- Secondary outcomes
  - Human exposure, Health effect or impact, Co-benefits, Barriers and enablers to implementation

Results

January 1, 2000, and June 1, 2020

- 1,139 unique policy intervention scenarios

- From 376 peer-reviewed articles

- 307 unique urban/urbanized locations

- Most policies studied in Europe (463), Asia (355), North America (206)

- Least in South America (57), Africa (10), Australia (7)

Management, standards, and services – 807

- Vehicle emission regulation
- Vehicle retirement or replacement
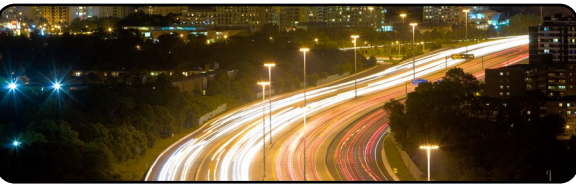- Vehicle use restriction
- Low emission zones

Technology – 406

- Alternative fuel technology
- Vehicle retrofitting
- Alternative vehicle technology

Pricing – 216 studied times

- Parking charges
- Road pricing
- Congestion charges

Infrastructure – 210

- Bus rapid transit infrastructure
- Public and active transportation infrastructure
- Roadway development and intersection alterations

Behavioural – 116

- Public transport mode shift and promotion
- Active transportation mode shift and promotion
- Flexible working arrangements and ride sharing

Land-use – 77

- Development density and mix
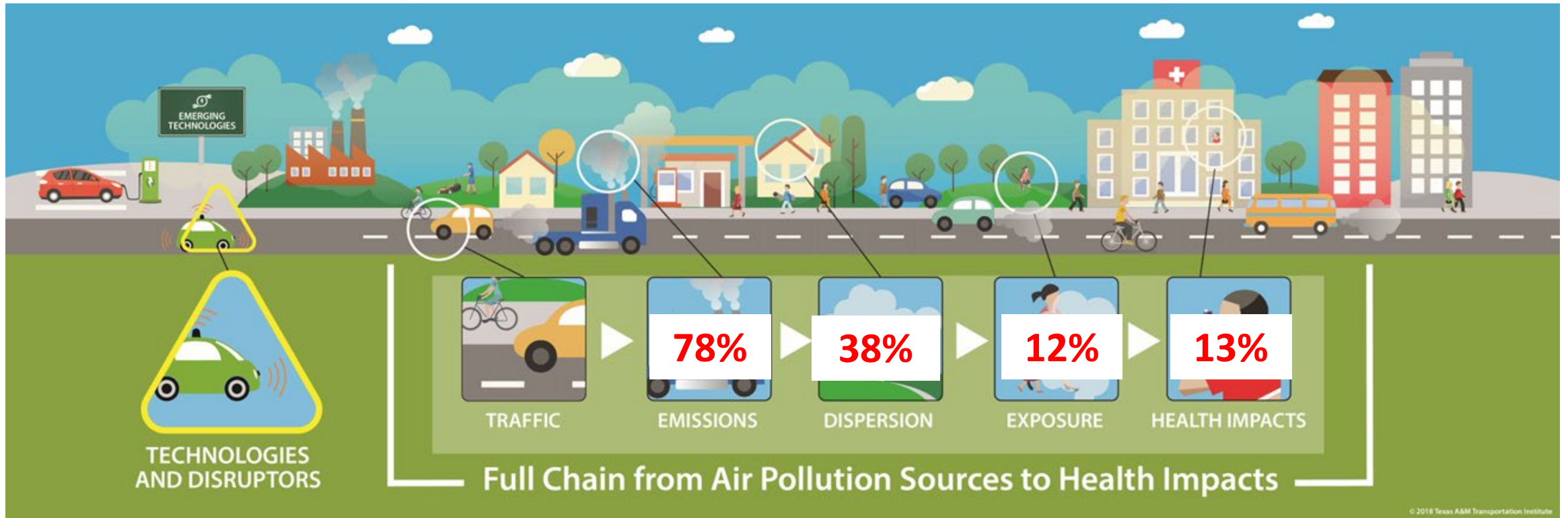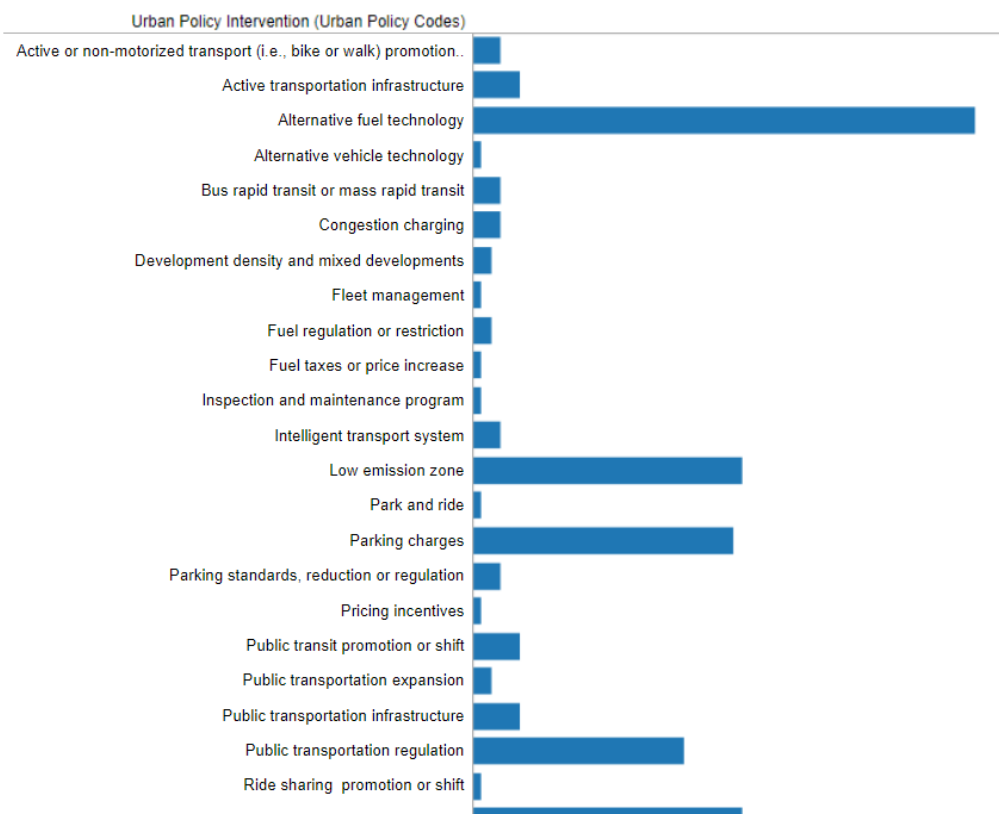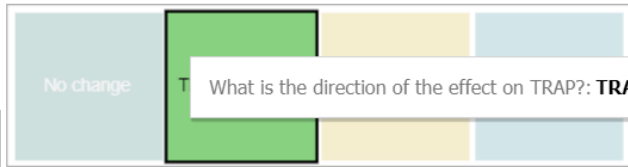- Transit oriented development
- Parking expansion

58 types of unique policies

Results

Image from carteeh.org

Workbook: SEM Data Visualizatio ✕   +

tableau.tamu.edu/t/TTI/views/SEMDataVisualizationV2/SEMVisualizationDashboard?%3Adisplay_count=n&%3Aembed=y&%3AisGuestRedirectFromVizportal=y&%3Aorigin=viz_share_link&...

5. Policy Barriers: Frequency of policy scenarios that document each policy barrier.

6. Co-benefits: Frequency of policy scenarios that document each co-benefit.

7. Analysis Start and End Years: Frequency of policy scenarios that document each start and end analysis year.
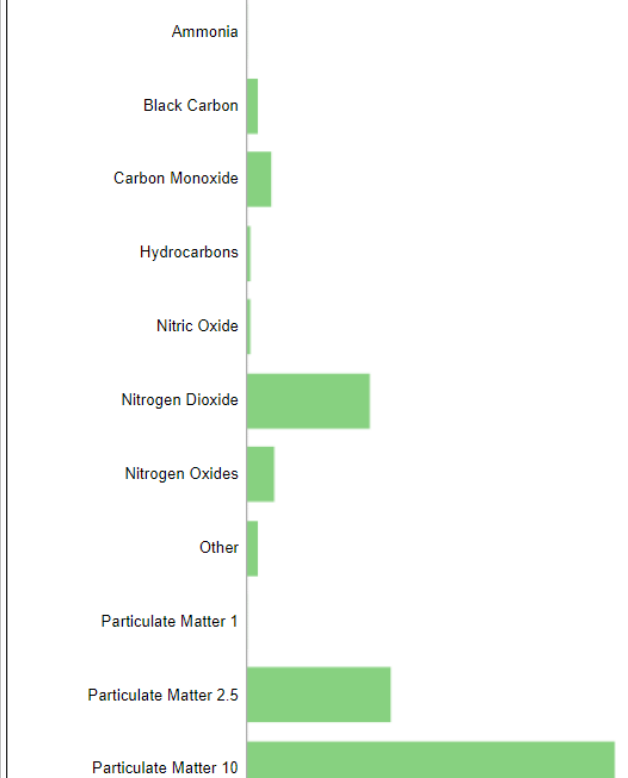
Visual to display

Policy Interventions ▾

Urban Policy Intervention (Urban Policy Codes)

- Active or non-motorized transport (i.e., bike or walk) promotion..
- Active transportation infrastructure
- Alternative fuel technology
- Alternative vehicle technology
- Bus rapid transit or mass rapid transit
- Congestion charging
- Development density and mixed developments
- Fleet management
- Fuel regulation or restriction
- Fuel taxes or price increase
- Inspection and maintenance program
- Intelligent transport system
- Low emission zone
- Park and ride
- Parking charges
- Parking standards, reduction or regulation
- Pricing incentives
- Public transit promotion or shift
- Public transportation expansion
- Public transportation infrastructure
- Public transportation regulation
- Ride sharing promotion or shift

What is the direction of the effect on TRAP?

No change | T | Emission reduction | Mixed effect | Emission

What is the direction of the effect on TRAP?: **TRAP reduction**

What is the direction of the effect on Traffic Emissions?

Emission reduction | Mixed effect | Emission

TRAP Pollutant

- Ammonia
- Black Carbon
- Carbon Monoxide
- Hydrocarbons
- Nitric Oxide
- Nitrogen Dioxide
- Nitrogen Oxides
- Other
- Particulate Matter 1
- Particulate Matter 2.5
- Particulate Matter 10

Pollutant

- Ammonia
- Black Carbon
- Carbon Monoxide
- Hydrocarbons
- Nitrogen Dioxide
- Nitrogen Oxides
- Other
- Particulate Matter 2.5
- Particulate Matter 10
- Particulate Matter X
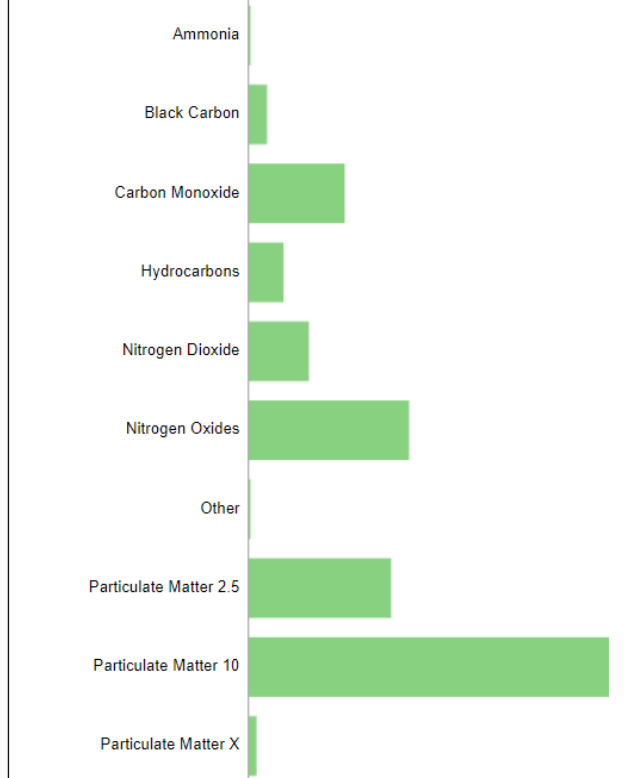
Most studied policies with recorded emissions and air pollution reductions

- Alternative fuels technologies (n=52)
  - Bioethanol mixtures, natural gas, liquefied petroleum gas, petrol versus diesel, hydrogen
- Vehicle retrofitting (n=29)
  - Particles filters, exhaust catalysts: three-way catalytic converters, continuously regenerating trap (CRT), exhaust gas recirculation (EGR), selective catalytic reduction (SCR)
- Road pricing (n=28)
  - Cordon toll, road user charging
- Low emission zones (n=28)
  - In isolation and as part of SUMPs
- Parking charges (27)
  - Doubling parking charge

Most studied policies with recorded emissions and air pollution reductions

- Vehicle emissions regulations (n=25)

- Public transportation regulation (n=22)
  - Improvement of bus speed + reduction of travel time

- Vehicle retirement and replacement (n=12)

- Public transportation mode shift and expansion (n=12)

- Vehicle use restrictions (n=10)
  - Odd/even day traffic restriction schemes, car free areas or days, HGV ban or recirculation incl. in rush hour, restriction on construction activities and vehicles , restriction on access to city centres

Little published evidence on alternative vehicle technologies (n=4)

Packages of policies may work best

- 380 policy scenarios (33.4%)

- Development of packages of policy measures, in which each measure can be expected to support the others by making it more effective or easier to implement (May et al., 2018)

Packages of policies may work best

- "Central and inner London inbound <u>road user charging</u>, all day £2 across central London, and peak charge of £2 across Inner London, Workplace <u>parking levy</u> throughout London of £1500 per annum, Central and inner London <u>public parking charges doubled</u>, 20% <u>reduction in travel times for radial PT</u> movements to/from central London, 50% of buses, 25% HGVs and 5% of CLVs <u>converted to LPG</u>, 100% of <u>buses fitted with particle traps</u>, Central and Inner London <u>LEZ</u>, allowing EURO3+cars and EURO3+CV"

Packages of policies may work best
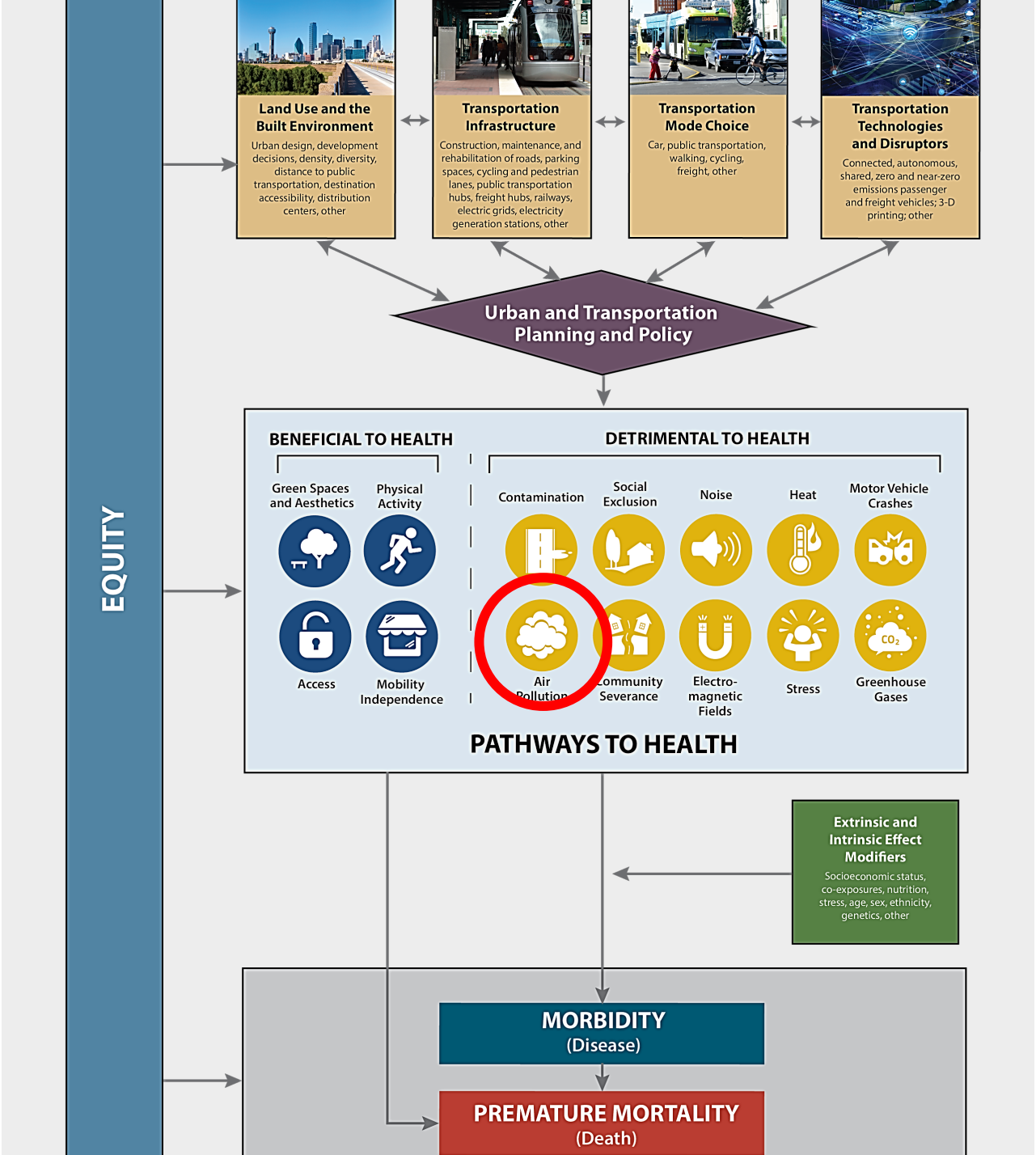
Glazener et al., 2021

Multiple policies improve multiple pathways

→ land-use and behavioural policies are very promising!

- Effects of other pathways, comparable to – or with larger impact than - air pollution e.g. physical inactivity, motor vehicle crashes (Mueller et al., 2015)

Example

- 50-70% statistically significant reduction in injuries in London Low Traffic Neighbourhoods (LTN) (Laverty et al, 2021; Goodman et al., 2021)
- Physical activity from walking + cycling increased by 2 hours/week in LTN residents after 2 years (Aldred and Goodman, 2021)
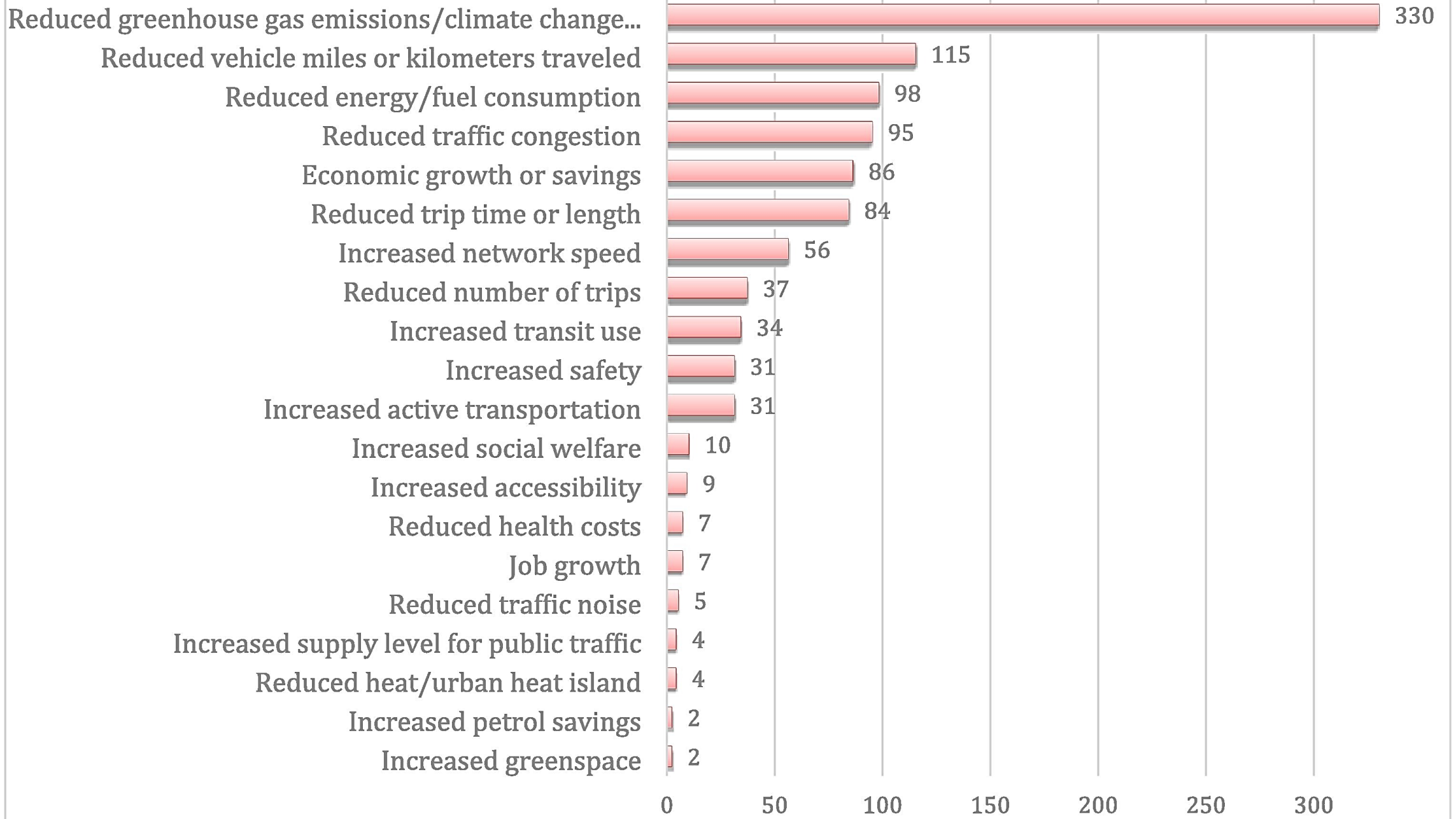- 5.7-8.9% ambient NO_2 reduction effect (Yang et al., 2022)

Land-use – 77

Behavioural – 116

| Co-benefit	Count
Reduced greenhouse gas emissions/climate change...	330
Reduced vehicle miles or kilometers traveled	115
Reduced energy/fuel consumption	98
Reduced traffic congestion	95
Economic growth or savings	86
Reduced trip time or length	84
Increased network speed	56
Reduced number of trips	37
Increased transit use	34
Increased safety	31
Increased active transportation	31
Increased social welfare	10
Increased accessibility	9
Reduced health costs	7
Job growth	7
Reduced traffic noise	5
Increased supply level for public traffic	4
Reduced heat/urban heat island	4
Increased petrol savings	2
Increased greenspace	2

Co-benefits Recorded (raw data included in the database): reported a total of 1,047 times in 204 unique articles
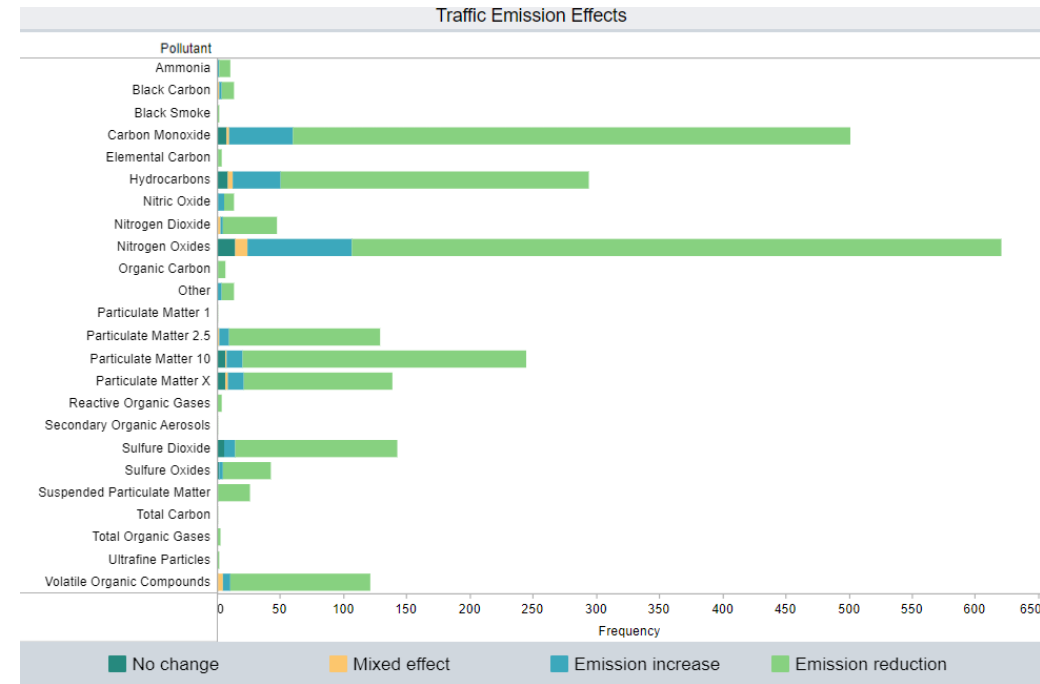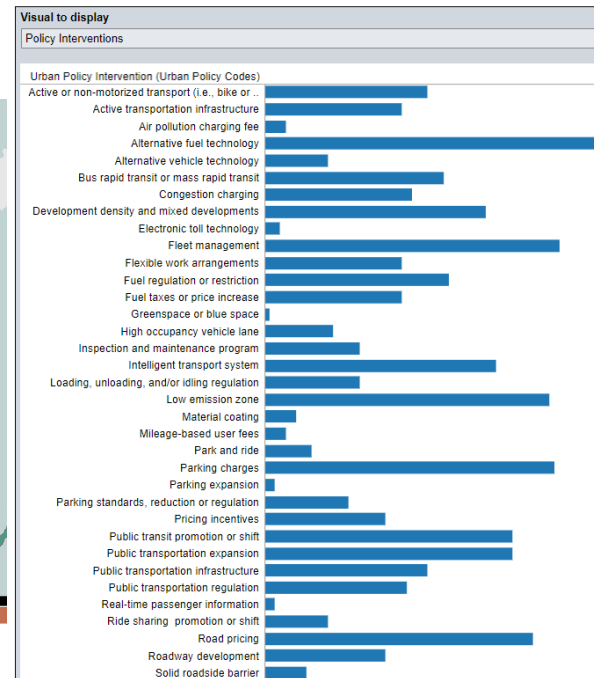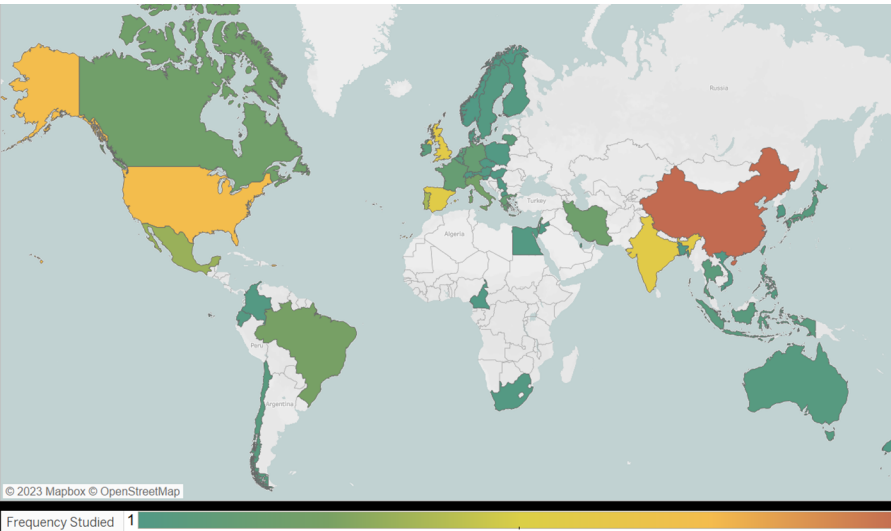
Interactive visualization tool ([online](#)) and [database](#) for decision-support

New evidence map and tools launched to support policies to redu... traffic-related air pollution

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Thank you!

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