Senatsverwaltung
für Umwelt, Verkehr
und Klimaschutz

BERLIN

CT 1 – SOURCE APPORTIONMENT IN SUPPORT OF AIR QUALITY MANAGEMENT SOURCE APPORTIONMENT OF NO_2

IMMIS-LUFT: BERLIN STREET LEVEL

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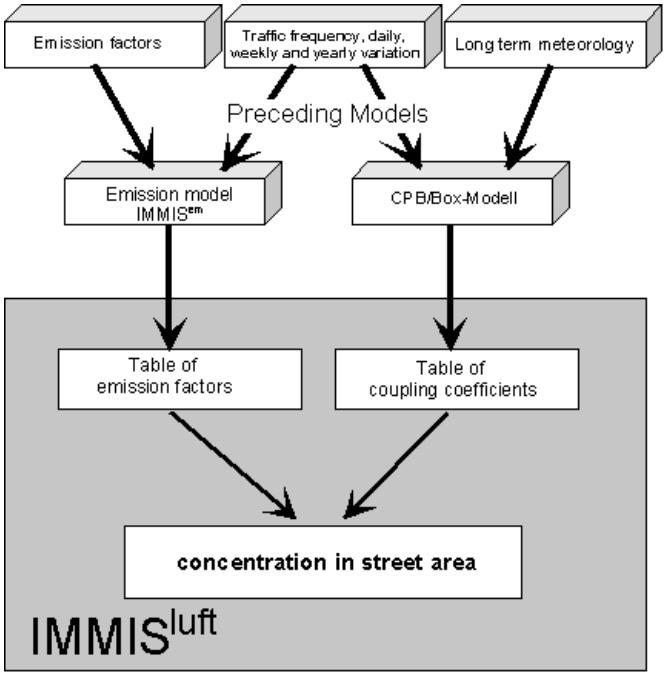
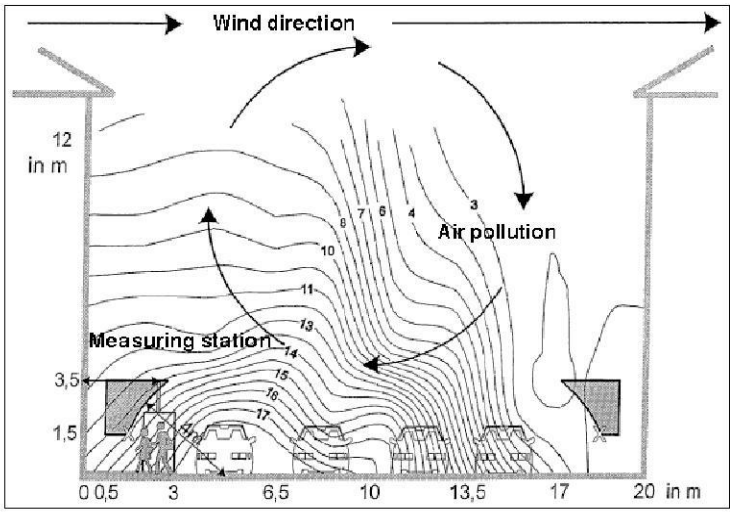
Air Quality Planning
Berlin

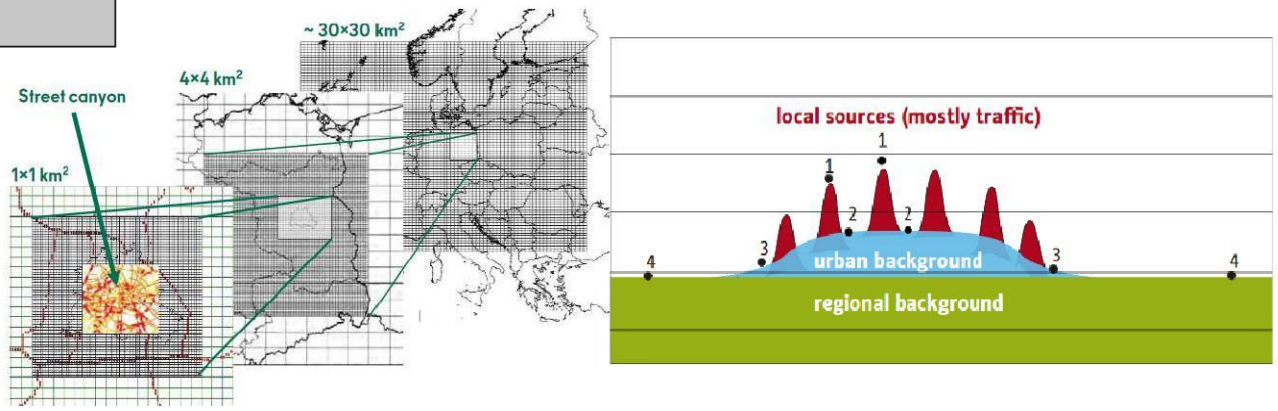
Modelling the urban street level NO_2 concentrations



Source: IVU Umwelt GmbH



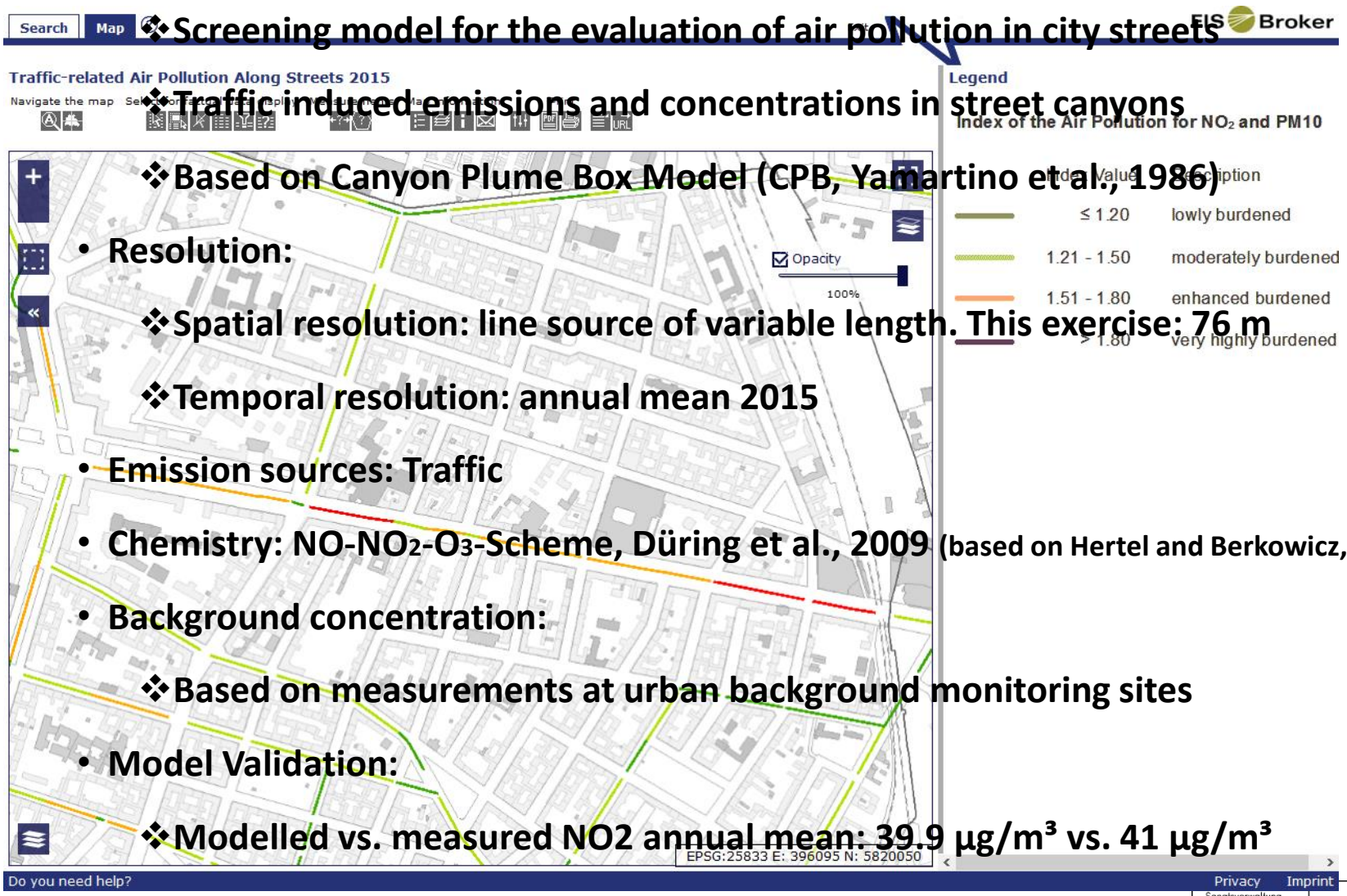
Source: based on Berkowicz et al, 2000



Source: SenUVK 2019

Modelling the urban street level NO_2 concentrations

- **IMMIS-Luft**:
  - ❖Screening model for the evaluation of air pollution in city streets
  - ❖Traffic induced emissions and concentrations in street canyons
  - ❖Based on Canyon Plume Box Model (CPB, Yamartino et al., 1986)
- Resolution:
  - ❖Spatial resolution: line source of variable length. This exercise: 76 m
  - ❖Temporal resolution: annual mean 2015
- Emission sources: Traffic
- Chemistry: NO-NO_2-O_3-Scheme, Düring et al., 2009 (based on Hertel and Berkowicz, 1989)
- Background concentration:
  - ❖Based on measurements at urban background monitoring sites
- Model Validation:
  - ❖Modelled vs. measured NO2 annual mean: 39.9 µg/m³ vs. 41 µg/m³



Modelling the urban street level NO_2 concentrations
Key questions

Are your Source Apportionment results for NO_2 consistent?

- In other words, if your Source Apportionment result are based on "**brute force**" impacts, are these behaving linearly over the whole range of emission reductions (0-100%)?
- If not, to what extent can it be considered consistent?

Are your Source Apportionment results additive?
In other words, is the sum of the impacts/contributions of two sources equal to the impact/contribution of the combined sources. I.e. for two sources A and B: CAB=CA+CB?
Is this property influenced by the emission reduction strength?

Are your results influenced by the chemical profile of the considered sources?
In other words, do you obtain different results if you reduce, for a specific source, only NOX emissions instead of all emitted chemical compounds (e.g. VOC, SO2,...)

How sensitive are your results to the regional background?

Can you identify any relationship between NO2 and NOX concentrations in your modelling results?
In other words, can you perform your SA analysis in terms of NOX and then "convert" them to NO2?

Are "tagging contributions" comparable to "impacts" for NO2?
If yes, under which conditions? (i.e. emission reduction strength, chemical regime, boundary conditions...)

Source apportionment NO_2 with IMMIS-Luft

Scenarios:

Cities = BERLIN (FA01)

Sectors =
A = Berlin Fleet
B = Berlin Fleet no LDV
C = Berlin Fleet no HDV
D = Berlin Fleet no Diesel PC
E = Berlin Fleet only Diesel no Gas PC

•Methods = Brute Force

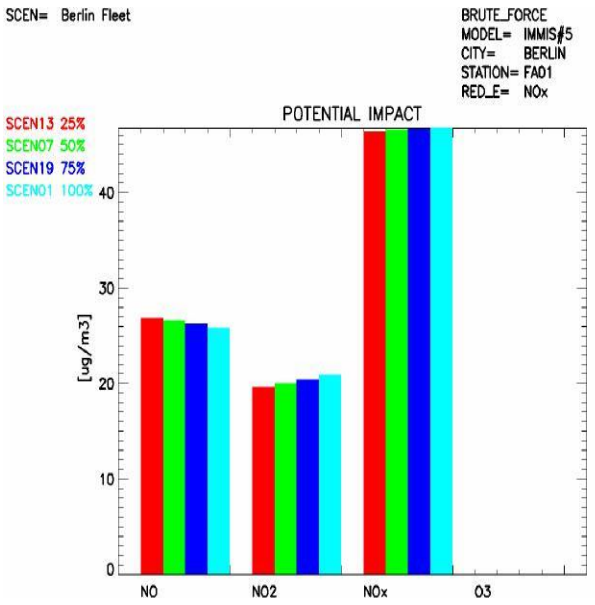
Emissions = NOX

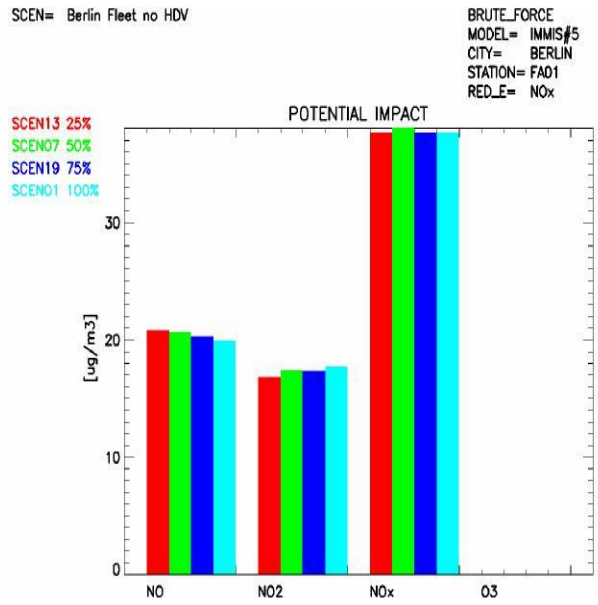
Period = 2015

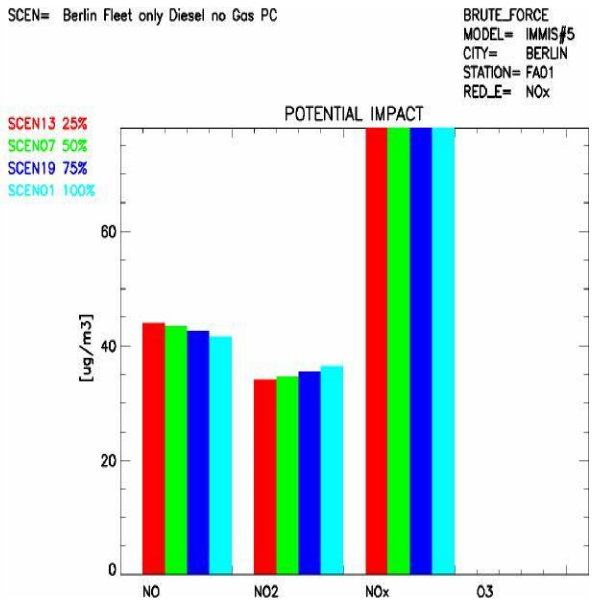
	sector red/tag	Emission red/tag	Red/tag strength
SCEN01	A,B,C,D,E	NOX	100
SCEN02			
SCEN03			
SCEN04			
SCEN05			
SCEN06			
SCEN07	A,B,C,D,E	NOX	75
SCEN08			
SCEN09			
SCEN10			
SCEN11			
SCEN12			
SCEN13	A,B,C,D,E	NOX	50
SCEN14			
SCEN15			
SCEN16			
SCEN17			
SCEN18			
SCEN19	A,B,C,D,E	NOX	25
SCEN20			
SCEN21			
SCEN22			
SCEN23			
SCEN24			

Sensitivity runs:
F = background variations of NOx, NO_2 and O_3 (-25%, -50%, -75%):
NO-NO_2-O_3 photochemistry schemes vs. statistical approach NO_2 = f(NOx)
G = Meteorology: Wind-speed (-25%, -50%, -75%)

Consistency – NOX reduction







Results are substantially consistent for all reduction strengths, with a minor increase from 25 to 100%

(minor) inconsistency is related to NO_2 term from photochemistry

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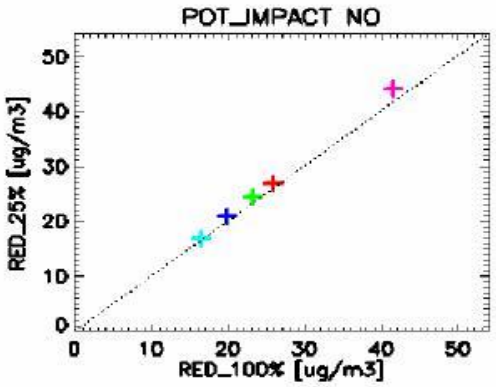
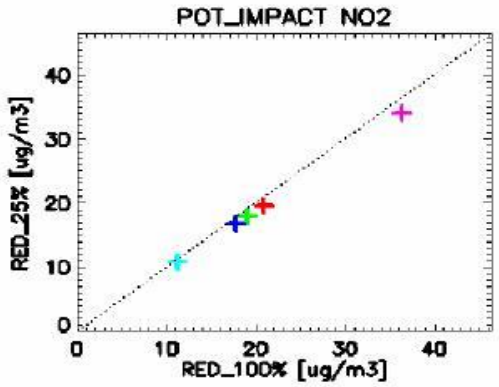
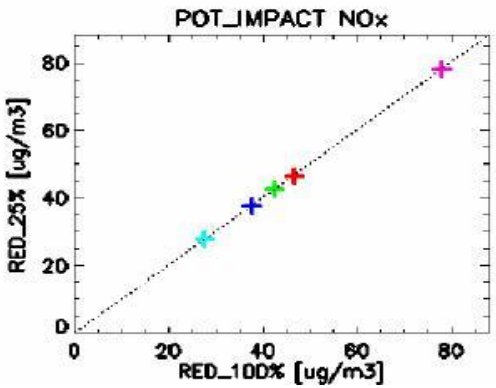
Consistency – NOX reduction

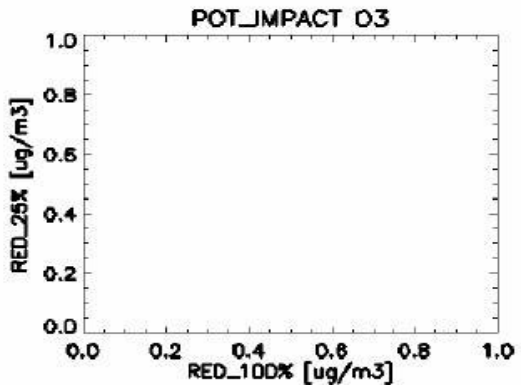
SCEN= Berlin Fleet
SCEN= Berlin Fleet no LDV
SCEN= Berlin Fleet no HDV
SCEN= Berlin Fleet no Diesel PC
SCEN= Berlin Fleet only Diesel no Gas PC

BRUTE_FORCE
MODEL= IMMIS#5
CITY= BERLIN
STATION= FA01
RED_E= NOx









Results are substantially consistent for all scenarios

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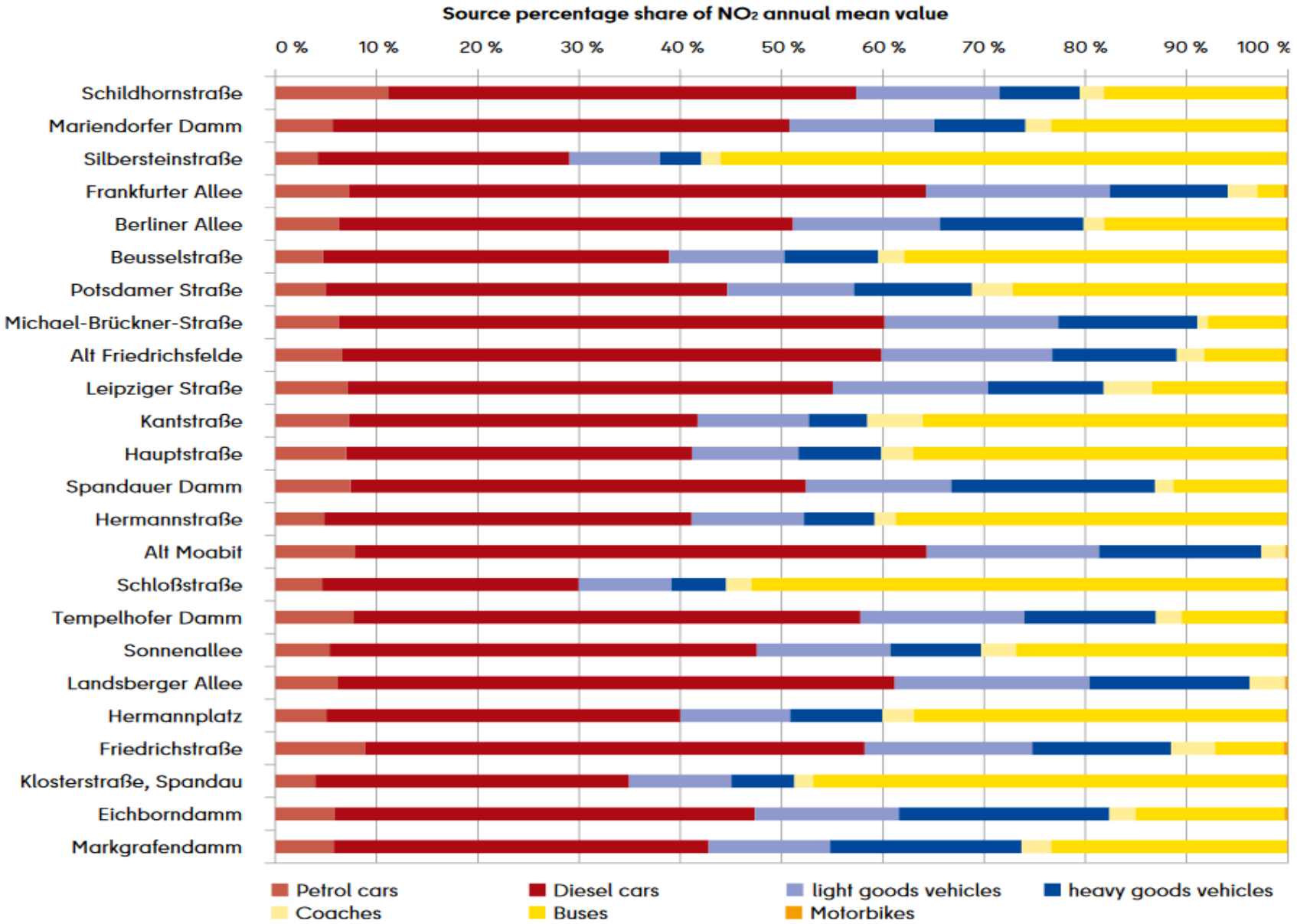
Source Apportionment NO_2 street level: Summary: IMMIS-Luft for Berlin

- **Results are substantially consistent for all reduction strengths, with a minor increase from 25 % to 100 % due to NO_2-photochemistry**

- **Available simulations do not allow to check additivity properties of source apportionment results**

- **Sensitivity runs are interesting, but could not be used in this exercise**
  - **will be repeated**
  - **runs for additivity exercise will be performed**

Source Apportionment NO_2 street level: What do cities need:



Thank you for your attention!

Air Quality Plan for Berlin

https://www.berlin.de/sen/uvk/en/environment/air/

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Source Apportionment NO_2 street level: What do cities need: