Für Mensch & Umwelt

Umwelt Bundesamt

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Simplified national approach for assessing potential AQD compliance in 2030 and beyond

Andreas Eisold
Section II 4.1 – General Aspects of Air Quality Management
German Environment Agency (UBA-DE)

with support from Johanna Appelhans, Tobias Bachmann, Stefan Feigenspan, Stephan Nordmann, Susan Kessinger, Andrea Minkos and many others

Outline

- questions at national level

- simplified national approach* to project potential compliance with AQ standards
  - scheme
  - data requirements
  - results
    - background concentrations and average exposure indicator (AEI)
    - hot-spot concentrations (without / with less local knowledge)
  - discussion

*Note: The approach was not considered as best practice in a JRC document from 2022.

Questions at national level

EU air quality standards – 'long-term' averages (Annex I)

Pollutant	Period	Until 2030	As of 2030	WHO 'Guideline'
$PM_{2.5}$	(calendar year)	25 µg/m³	**10 µg/m³**	5 µg/m³
PM_{10}	(calendar year)	40 µg/m³	**20 µg/m³**	15 µg/m³
NO_2	(calendar year)	40 µg/m³	**20 µg/m³**	10 µg/m³

EU air quality standards – 'short-term' averages (Annex I)

Pollutant	Period	Until 2030	As of 2030	WHO 'Guideline'
$PM_{2.5}$	(1 day)	-	**25 µg/m³** (-18d)	15 µg/m³ (-3d)
PM_{10}	(1 day)	50 µg/m³ (-35d)	**45 µg/m³** (-18d)	45 µg/m³ (-3d)
NO_2	(1 day)	-	**50 µg/m³** (-18d)	50 µg/m³ (-3d)
NO_2	(1 hour)	200 µg/m³ (-18h)	**200 µg/m³** (-3h)	200 µg/m³ (-1h)

Questions at national level

Average exposure reduction obligations

Pollutant	Period	As of 2030
$PM_{2.5}$	(10 year)	**-10 to -25%** per 10 year
Applies if average exposure concentration is > **5 µg/m³**		
NO_2	(10 year)	-15 to -25% per 10 year
Applies if average exposure concentration is > **10 µg/m³**		

*To be based on **Average Exposure Indicator,** expressed as µg/m³ (AEI) shall be based upon measurements in **urban background** locations in average exposure territorial units (AETU);*

*The AEI shall be assessed as a **3-calendar-year** running annual mean averaged over all urban background sampling points in the AETU.*

AETU = NUTS1 or NUTS2 or combination thereof if smaller than entire territory of the Member State and < 85 000 km²

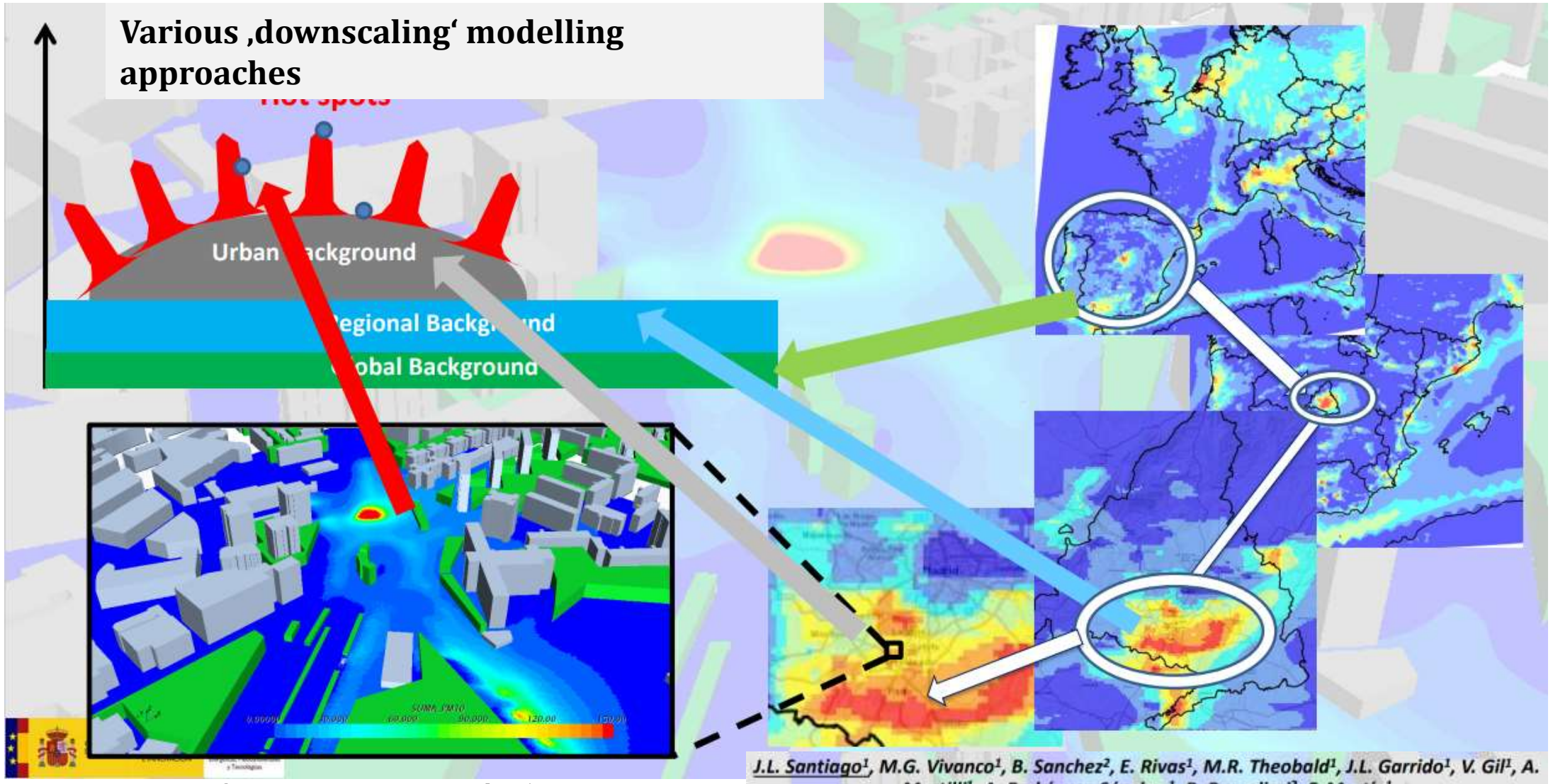
Questions at national level

- Projected compliance to
  - limit values at specific measurement sites (measured values not modelled values!)
  - average exposure reduction obligation (AERO) at all urban background measurement sites (and not modelled urban background concentrations) in a defined territorial unit (3-year annual mean)

➢ For assessment of potential compliance in the future at a certain site (air quality planning) usually modelling applications* are used.

* AQD-definition: ‘modelling application’ means application of a modelling system, understood as a chain of models and submodels, including all necessary input data, and any post-processing;
AND
In order to ensure uniform conditions for the implementation of this Directive, implementing powers should be conferred on the Commission as regards further technical details for modelling applications […]
THEREFORE
a guidance document “Technical support document on the use of modelling for various application domains under the Ambient Air Quality Directive” is drafted, that will probably lead to an implementing act on the use of modelling in the AQD context.

Modelling application



from a presentation at the 51st TFIAM in 2022:

Simplified national approach to project potential compliance with AQ standards

Step 1 – Urban Background Concentrations

Calculating the concentration in a projection year at each measurement site (rural and urban background) by multiplying the measured concentration in the base year by the modelled relative concentration change (base year to projection year) in the respective grid cell.

Step 2 – Hot-Spot Concentrations

Calculating the concentration in a projection year at each measurement site (hot-spot) by multiplying the calculated additional load (from measured hot-spot minus measured background concentration)in the base year by relative emission change (base year to projection year) in the respective grid cell (assuming correlation of local additional load and local emissions).

Quelle: Lohmeyer GmbH, eigene Darstellung
Kartengrundlage: OpenStreetMap contributors, CC-BY-SA

Optional, if step 2 is not performed for all hot-spot sites

Step 3 – Deriving threshold concentration (national average) for base year at which compliance in the projection year is more likely than non-compliance

Simplified national approach to project potential compliance with AQ standards

Step 1 – Urban Background Concentrations

Calculating the concentration in a projection year at each measurement site (rural and urban background) by multiplying the measured concentration in the base year by the modelled relative concentration change (base year to projection year) in the respective grid cell.

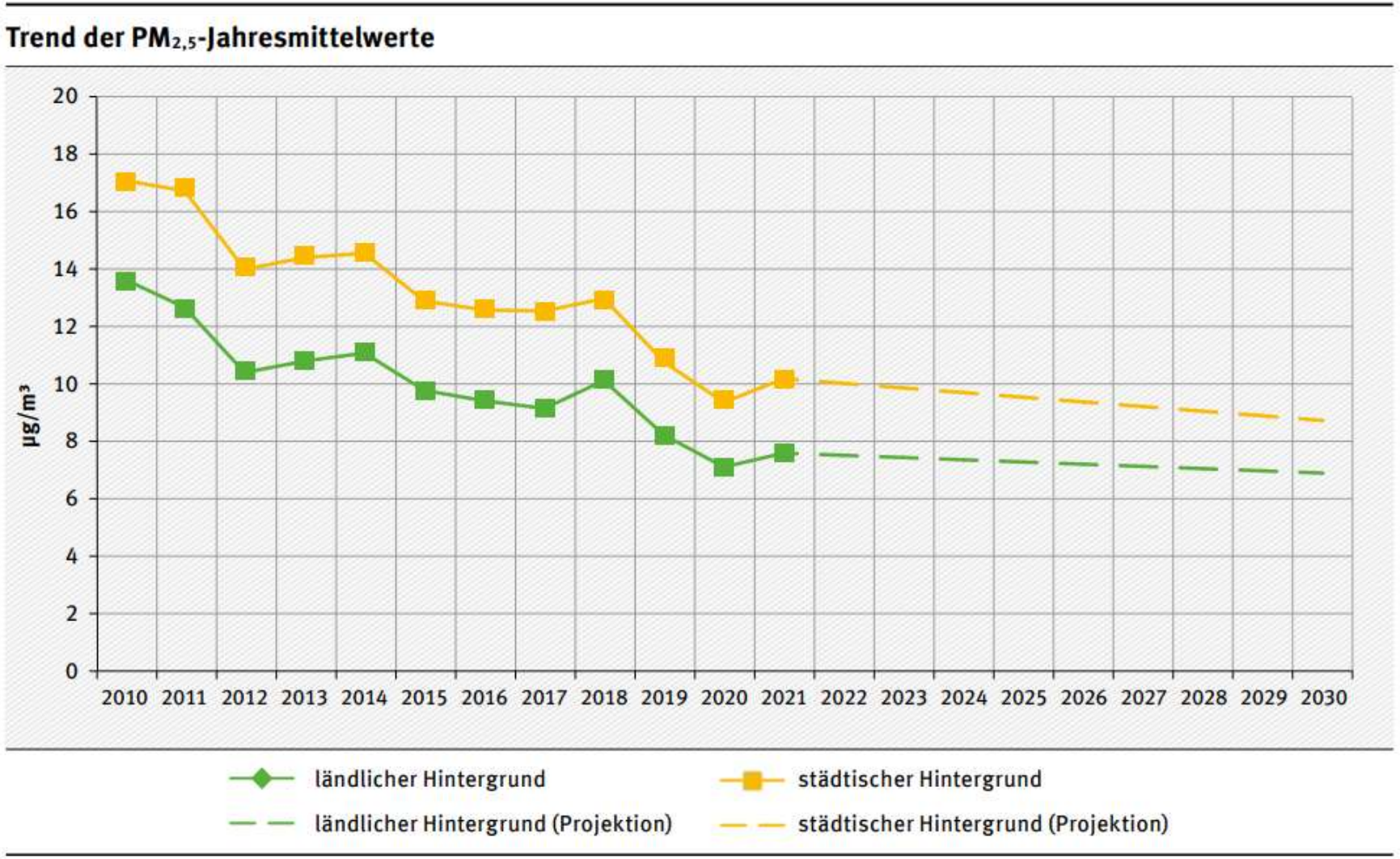
- Options:
  - given concentration map for base and projection year
  - concentrations outside the national modelling grid / domain as boundary conditions for own national modelling (using national emission dataset)
  - nested modelling approach by using supranational emission dataset (e. g. CAMS-REG, GAINS) and national emission dataset for base and projection year

Step 2 – Hot-Spot Concentrations

Calculating the concentration in a projection year at each measurement site (hot-spot) by multiplying the calculated additional load (from measured hot-spot minus measured background concentration)in the base year by relative emission change (base year to projection year) in the respective grid cell (assuming correlation of local additional load and local emissions) + addition of step 1 and step 2

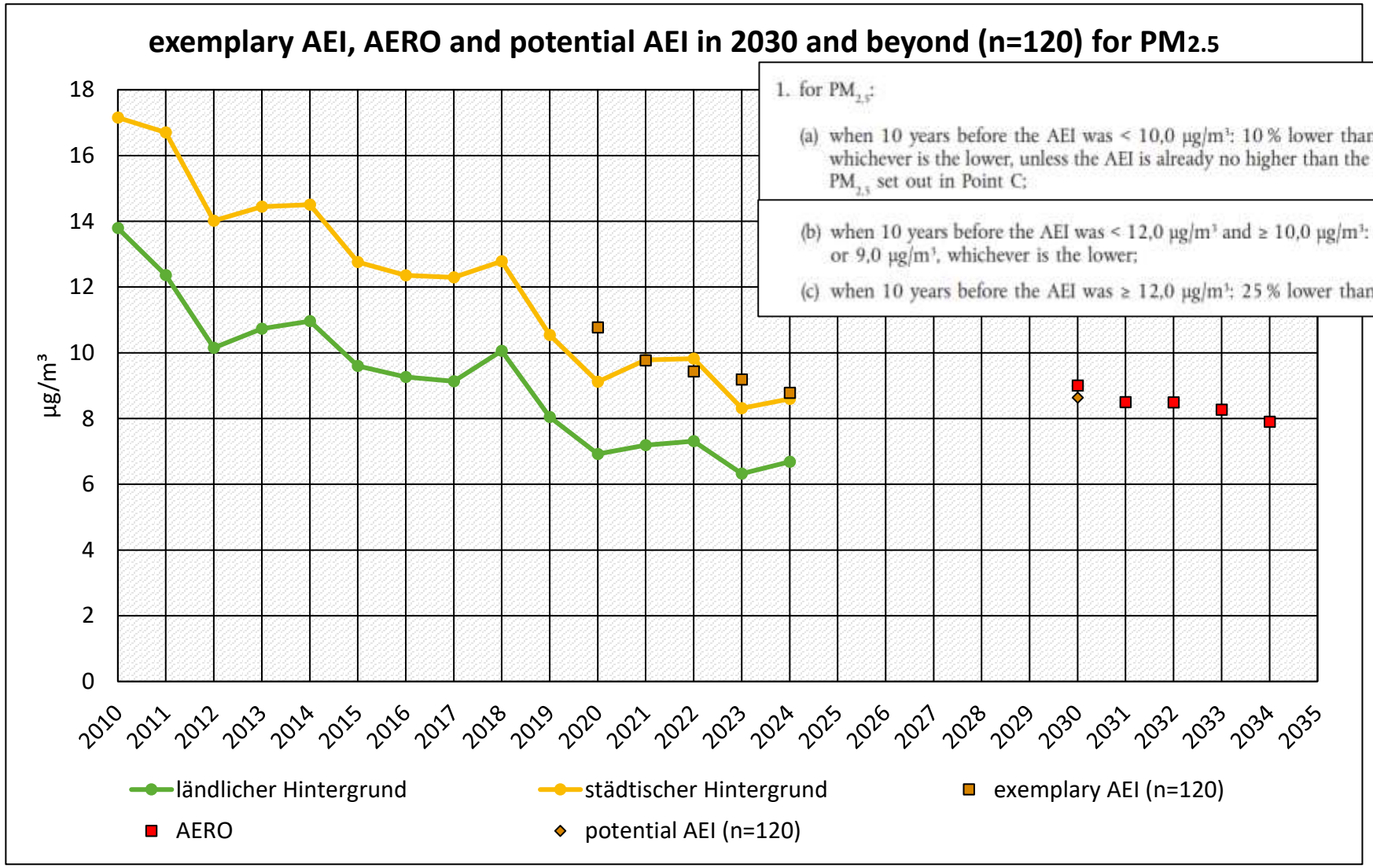
- Options:
  - relative emission change per grid cell from top-down (gridded) emission dataset or bottom-up local emission data

STEP 1 – projected average annual mean over all German background measurement sites



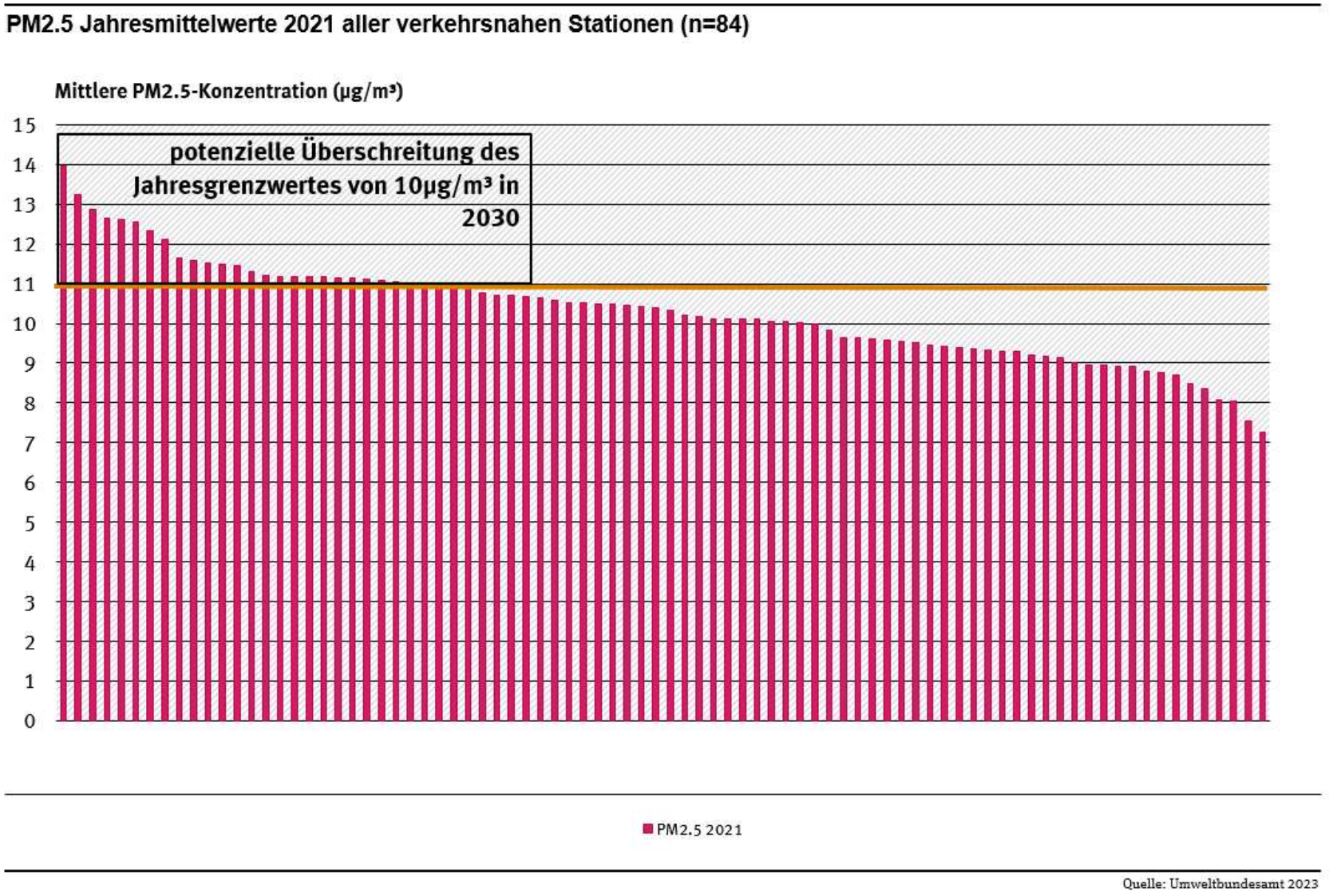
Quelle: Umweltbundesamt 2025

Projected compliance with average exposure reduction obligation (AERO) for PM2.5



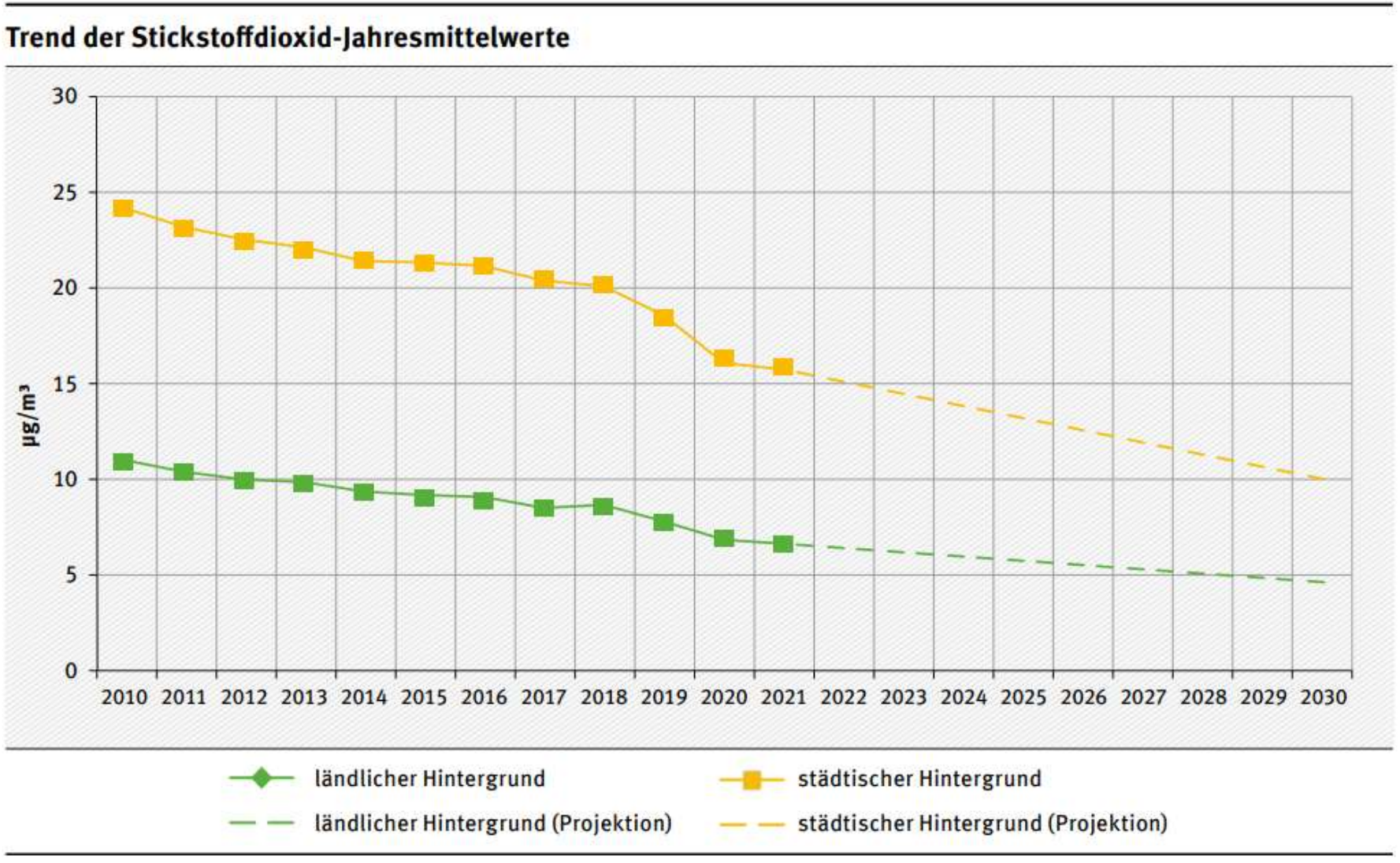
- compliance with PM2.5-AERO is projected, but risk of non-compliance will rise, as levels get closer to 5 µg/m³
- average exposure territorial units are not yet defined for Germany, but must be at NUTS 1 or NUTS 2 level or a combination of
- How to deal with contributions from natural sources?
- Meteorological fluctuations make a continuous reduction, especially of PM2.5, difficult.

STEP 3 – Calculating a threshold concentration for traffic-related measurement sites (if measured concentration in 2021 was below, limit value compliance in 2030 is considered likely)



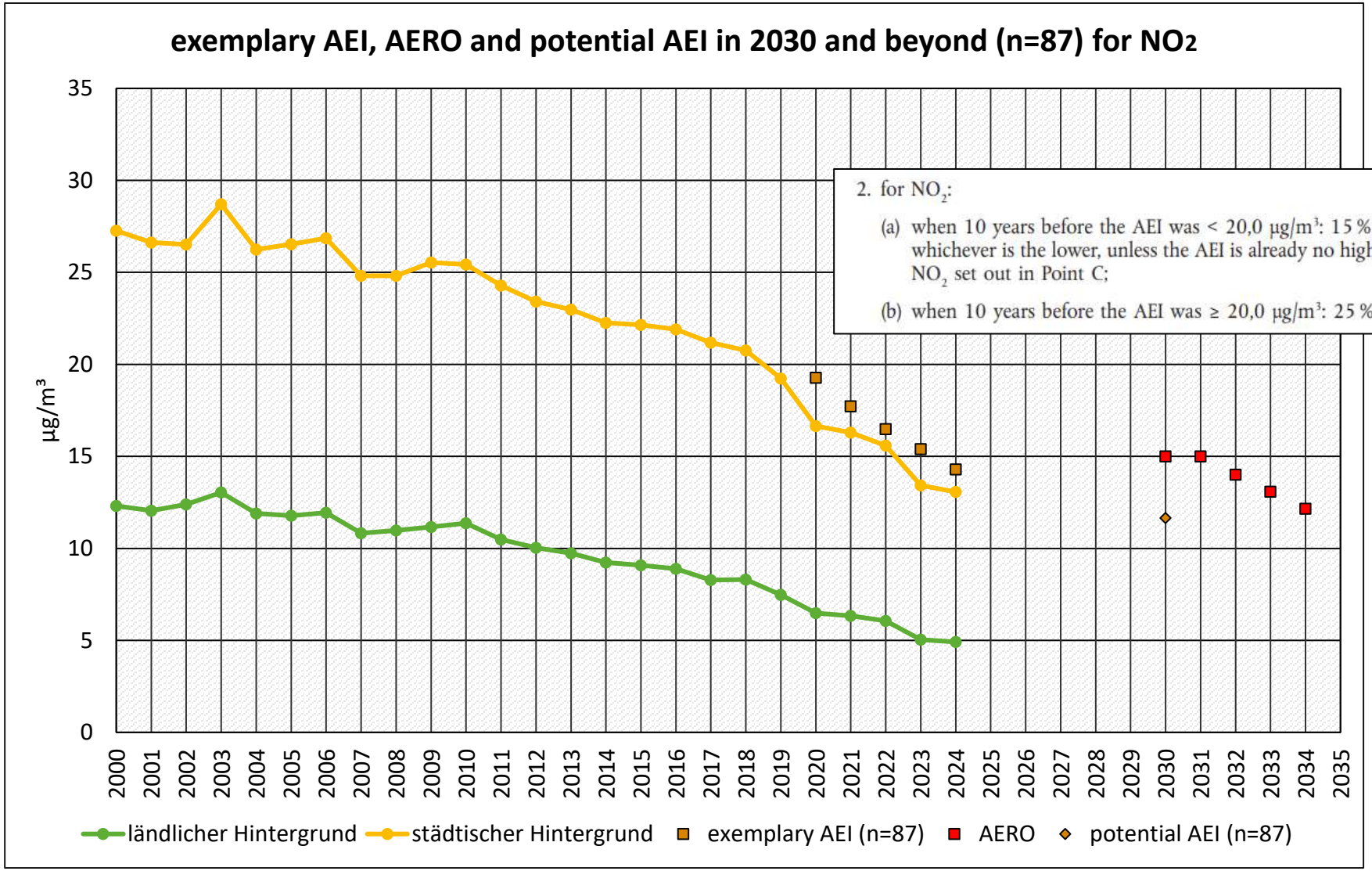
- for 2/3 of the current measurement sites, compliance is considered likely
- high meteorologically-induced uncertainty
- maybe additional PM2.5 measurement sites will appear up to 2030 (at sites where currently only PM10 has been measured)

STEP 1 – projected average annual mean over all German background measurement sites



Quelle: Umweltbundesamt 2025

Projected compliance with average exposure reduction obligation (AERO) for NO_2



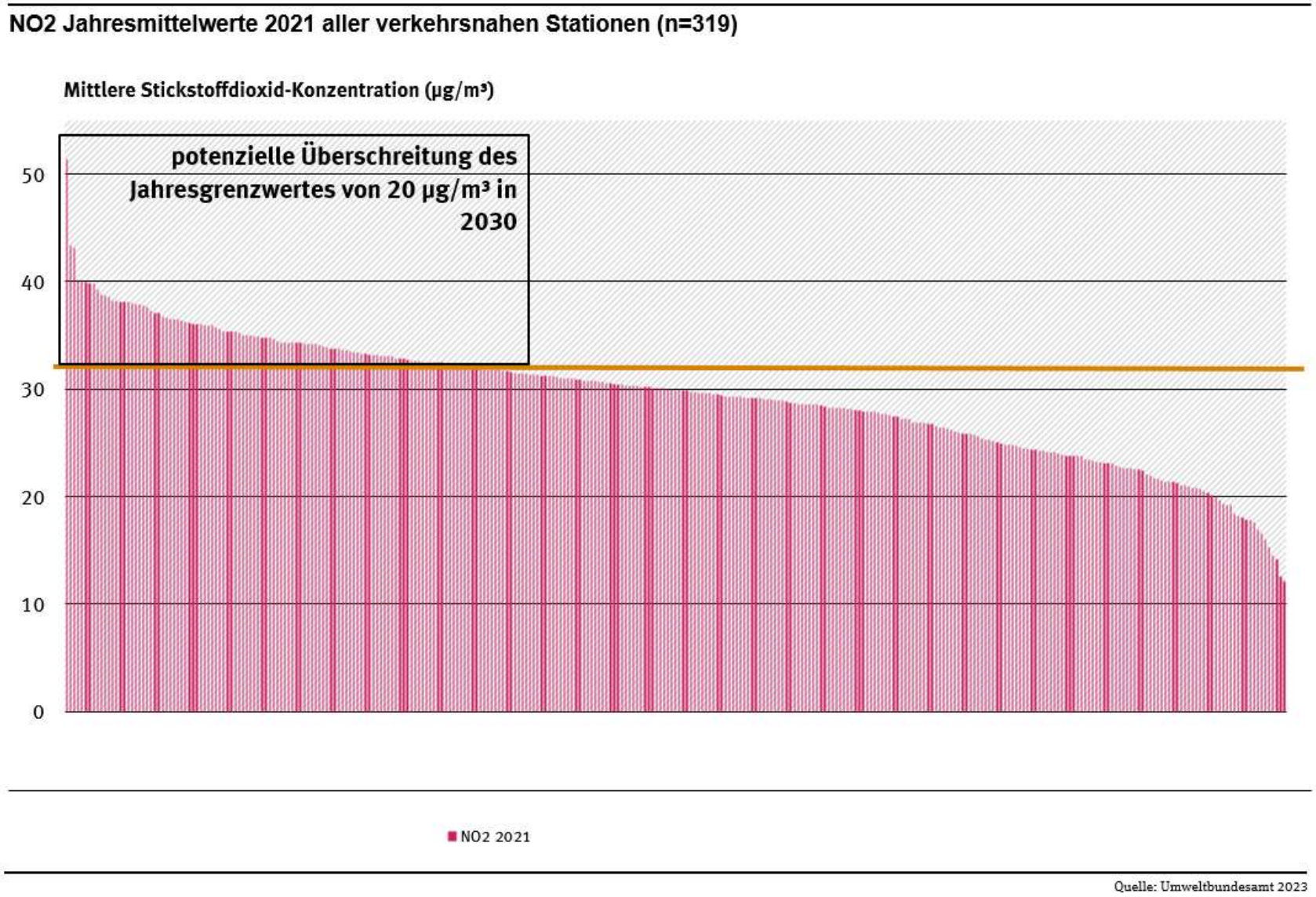
2. for NO_2:

(a) when 10 years before the AEI was < 20,0 µg/m³: 15 % lower than the AEI was 10 years before or 15,0 µg/m³, whichever is the lower, unless the AEI is already no higher than the average exposure concentration objective for NO_2 set out in Point C;

(b) when 10 years before the AEI was ≥ 20,0 µg/m³: 25 % lower than the AEI was 10 years before.

- compliance with NO_2-AERO is projected
- projection is sensitive for political framework (e.g. no new registrations of fossil fuel vehicles from 2035 onwards)
- average exposure territorial units are not yet defined for Germany, but must be at NUTS 1 or NUTS 2 level or a combination of

STEP 2 – Calculating a threshold concentration for traffic-related measurement sites (if measured concentration in 2021 was below, limit value compliance in 2030 is considered likely)



- for 2/3 up to 4/5 of the current measurement sites, compliance is considered likely (largely depending on the share of BEVs in the German fleet in 2030)
- high uncertainty of the national approach regarding the individual conditions and developments at each measurement site

Discussion

- Simplified approach was tested against micro-scale modelling with high quality bottom-up emission data at a few sites
  - results did not differ significantly
  - the better the top-down emission data for regional modelling (up to urban background concentrations) and in each grid cell (spatial gridding of the national top-down emission data or local bottom-up emission data) the better the results
  - perform the approach more than one time with various meteorological years will give you a better picture

- However, an approximate direction can also be derived from coarser data.

- The approach already approved to be very helpful for policy advice at the national level regarding potential air quality improvements at the local scale through EU and national legislation as well as a starting point for local air quality planning.

Thank you very much.

Andreas Eisold
andreas.eisold@uba.de
+49 (0)340 2103-2683

https://www.umweltbundesamt.de/en/topics/air