An Alternative 'Measurements + Modelling' Approach to Compliance Under the Current AAQD

A Concawe 'Proof of Concept' Project

FAIRMODE Technical Meeting October 7-9, 2019, Madrid

Thanasis Megaritis, Concawe

Les White, AERIS Europe Ltd

Road Map

01 Introduction

- Compliance: In Practice
- Compliance: The Importance of Annex III of the AAQD
- Compliance: The Economics of Monitoring
- Compliance: An Alternative ‘Measurements + Modelling Approach

02 The Concawe ‘Proof of Concept’ Project

- NO_2 Concentration Gradient Methodology
- Application to NO_2 Compliance Assessment in France, Germany, Italy, Poland, Spain and the UK

03 Conclusions

01 Introduction

Compliance: in Practice

- **Non-compliance with AQLVs has been a major concern throughout the EU since the AAQD entered into force.**

- **Commission's interpretation of compliance: wherever you measure a given pollutant concentration, it must be compliant with the corresponding AQLV of Annex XI.**

- **Initially, the opening clause of Article 13 of the directive would seem to suggest this:**

  - *"Member States shall ensure that, throughout their zones and agglomerations, levels of sulphur dioxide, PM_{10}, lead and carbon monoxide in ambient air do not exceed the limit values laid down in Annex XI. In respect of nitrogen dioxide and benzene, the limit values specified in Annex XI may not be exceeded by the dates specified therein."*

- **However, the clause in Article 13 that immediately follows provides an important further clarification:**

  - *"Compliance with these requirements shall be assessed in accordance with Annex III".*

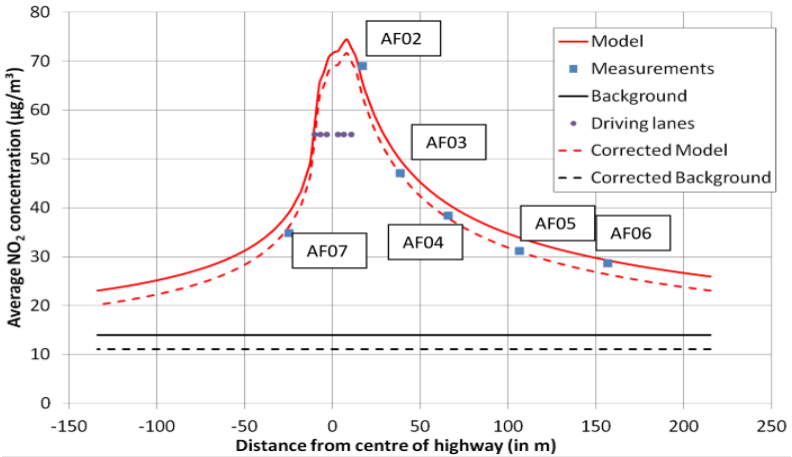
- **Annex III, is therefore a key element in the assessment of whether an area in a given Zone *or Agglomeration* is in compliance with the limit values.**

Compliance: The Importance of Annex III of the AAQD

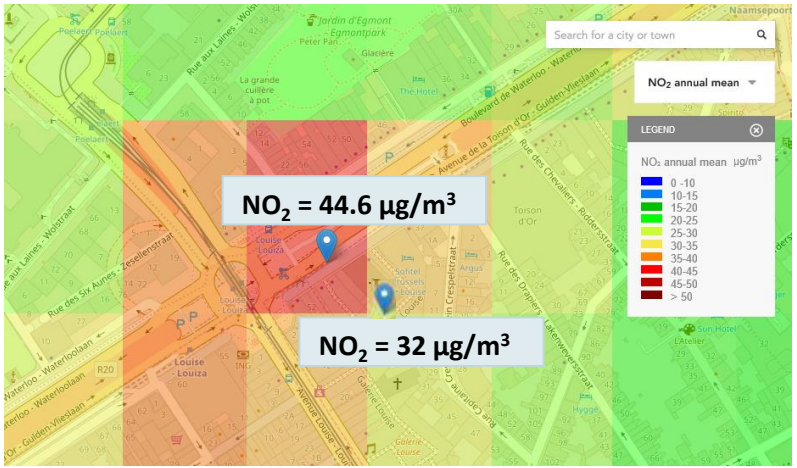
- **There are very significant clauses to be found in Annex III:**
  - The siting of sampling points in locations that ensure that measurements represent the maximum concentration that the population is likely to be exposed to for a period which is significant compared to the averaging time of the limit value(s).
  - In the case of hourly limit values, which clearly warrant near road locations, the setting of a maximum distance of 10m from the kerb indicates a need to ensure air is sampled in such a way as to be representative of at least 100m of that particular street segment.

Compliance: The Importance of Annex III of the AAQD

- **The significance of this may be seen by the published data on gradients in NO_2 concentrations in several studies.**



Source: Lefebvre and Vranckx, VITO ATMOSYS Report (2013)



Source: Concawe NO_2/NOx source apportionment tool.

- **Given the above, why are the majority of measurement stations used to assess compliance with the annual mean NO_2 AQLV located at the roadside?**

Compliance: The Economics of Monitoring

- **Implementing the monitoring requirements of the AAQD needs to take account of the costs associated with a given measuring station.**
  - Annex III would indicate a station for monitoring compliance with the annual mean AQLV would generally be located in an urban background location.
  - Whereas Annex III would indicate the station used for assessing compliance with the 1-hour limit value would need to be in a road side location not more than 10m from the kerbside, particularly where high pedestrian activity occurs in that area at certain times of the day.
- **Installing separate stations for monitoring compliance with long and short average time AQLVs for NO_2 has very significant cost implications (costs are essentially doubled).**
- **As a consequence, this has resulted in Member states, on cost efficiency grounds, combining the measurements of several pollutants into a single station.**
- **The location of such measuring stations are therefore determined by the pollutant that has a limit value with the shortest averaging time e.g. NO_2 1-hour**

Compliance: Is there a better way?

- **While significantly reducing monitoring costs, this will tend to overestimate non-compliance, particularly in the case of annual mean NO_2, compared to a compliance assessment consistent with Annex III.**

- **So is there a better way to assess compliance (fully in-line with Annex III) which can accommodate the need to have cost-efficient monitoring without compromising the goal of protecting human health in-line with the prescribed AQLVs of Annex XI?**

An Alternative ‘Measurements + Modelling’ Approach

- **Robust air quality models which have been widely used in supporting air quality assessments and the development of air quality management plans, can offer a means of robustly assessing compliance in-line with the requirements of Annex III and without the need to invest in a much more extensive/expensive monitoring network.**

- **This could be achieved without losing the importance of compliance assessments being primarily based on measured air quality.**

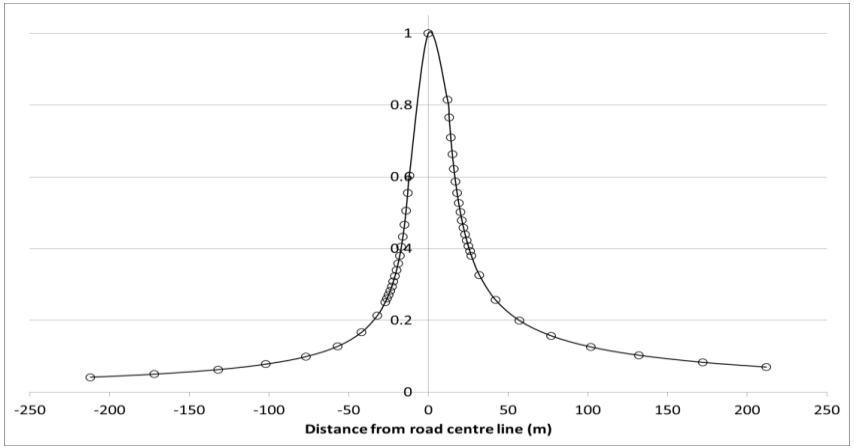
- **The key role for modelling would be to generate the concentration gradients from roadside locations to the urban background as a fraction of the roadside level.**

- **Already published data indicates that robust concentration changes with distance could be generated for each pollutant. These could be used to develop adjustment factors to kerbside measurement of annual mean NO_2 to determine the equivalent urban background level.**

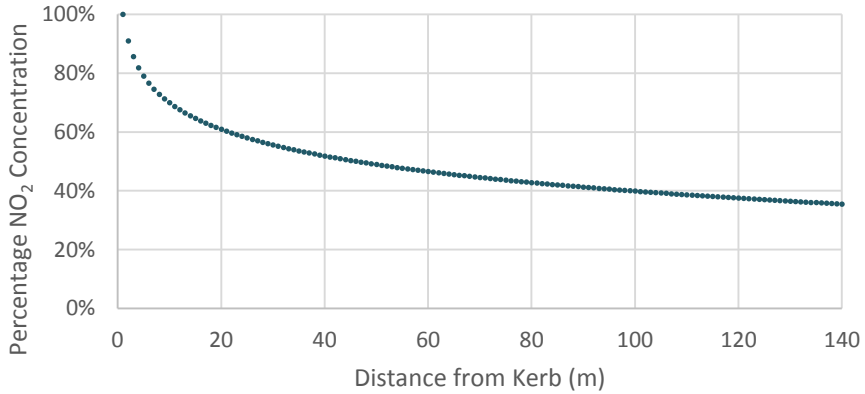
- **As a ‘demonstration of concept’, Concawe have undertaken a study focussing on NO_2 compliance based on the published NO_2 gradients of DEFRA and detailed data (2015 measurement and monitoring station location data) available from the EEA.**

02 The Concawe ‘Proof of Concept’ Project

NO_2 Concentration Gradient Methodology



- This figure shows an example normalised concentration profile for NO_2 with distance from the road centreline.
- This illustrates the steep reduction over the first few metres from the emission source.



- This figure shows a normalised concentration profile for NO_2 with distance from the kerb.
- A 30% reduction is observed at 10m from the kerb.
- Roadside monitoring stations can be located anywhere within 10m of the kerb

Source: DEFRA Technical Report, December 2015, Annex B, Figure B.2 – Example normalised concentration profile

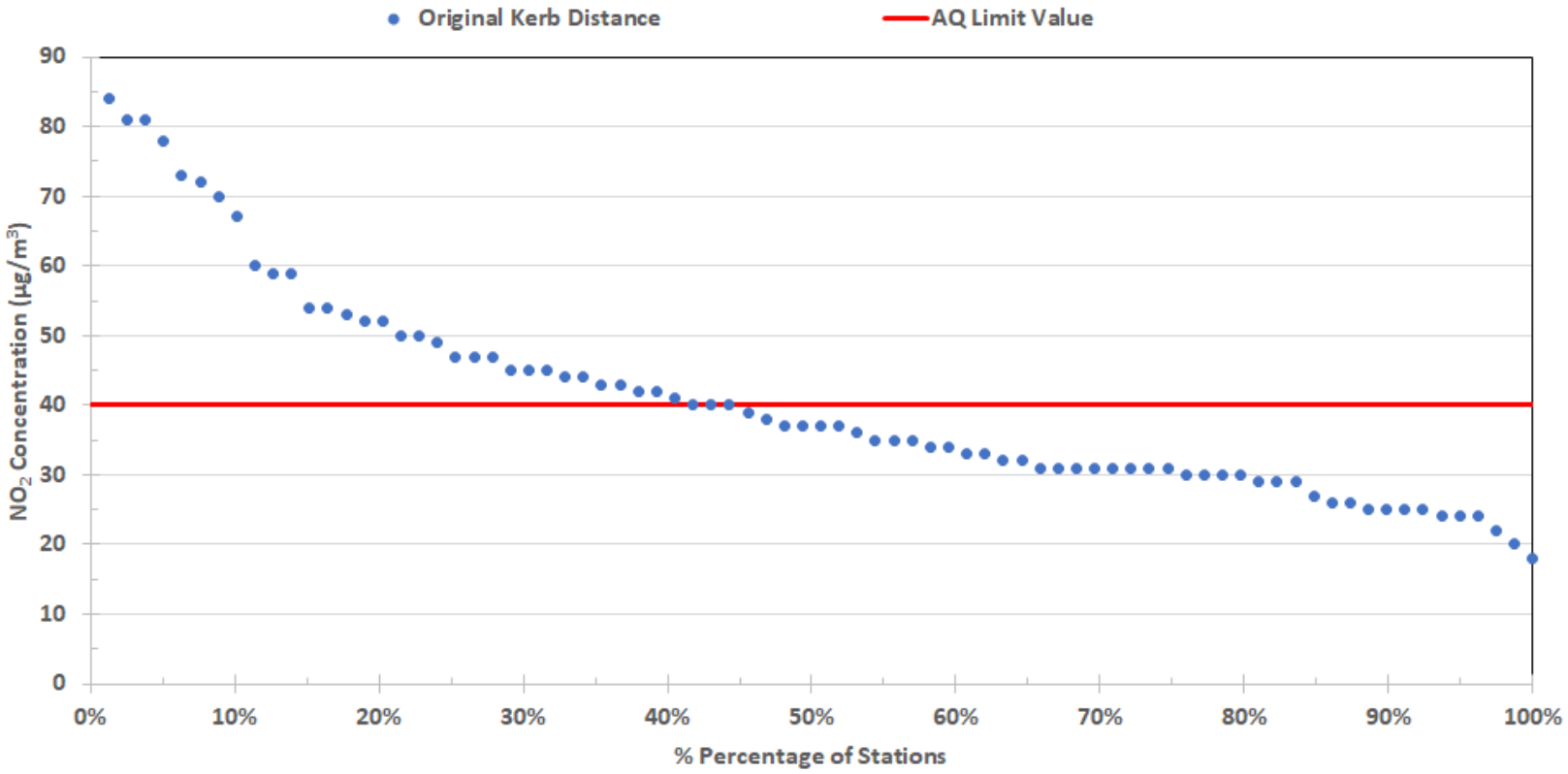
02b

NO_2 Compliance Assessment using the Concentration Gradient Methodology

Application to France, Germany, Italy, Poland, Spain and the UK

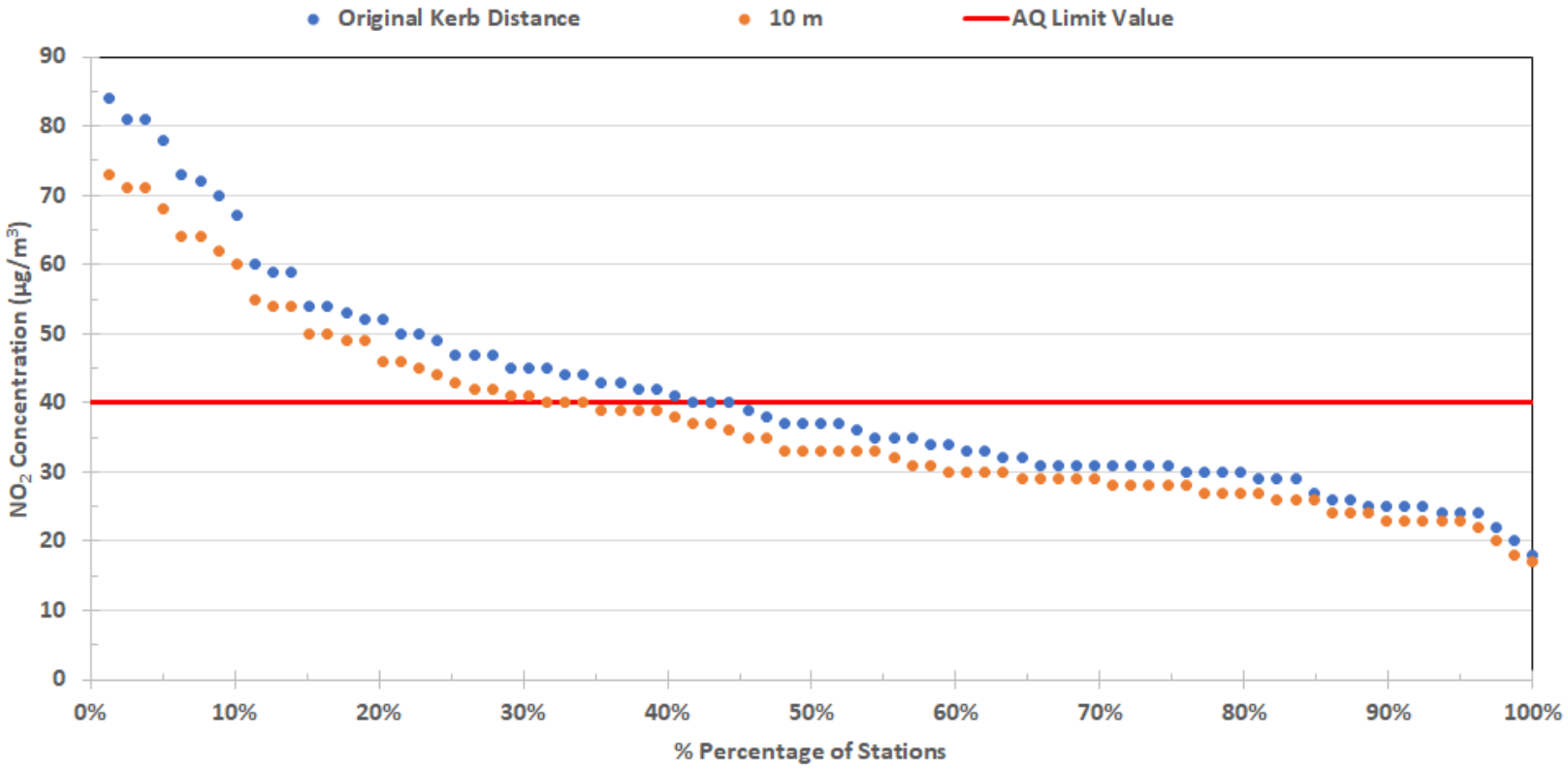
Concawe

France - NO_2 concentration profile at original kerb distance



Data: EEA Data for Traffic Stations in 2015.

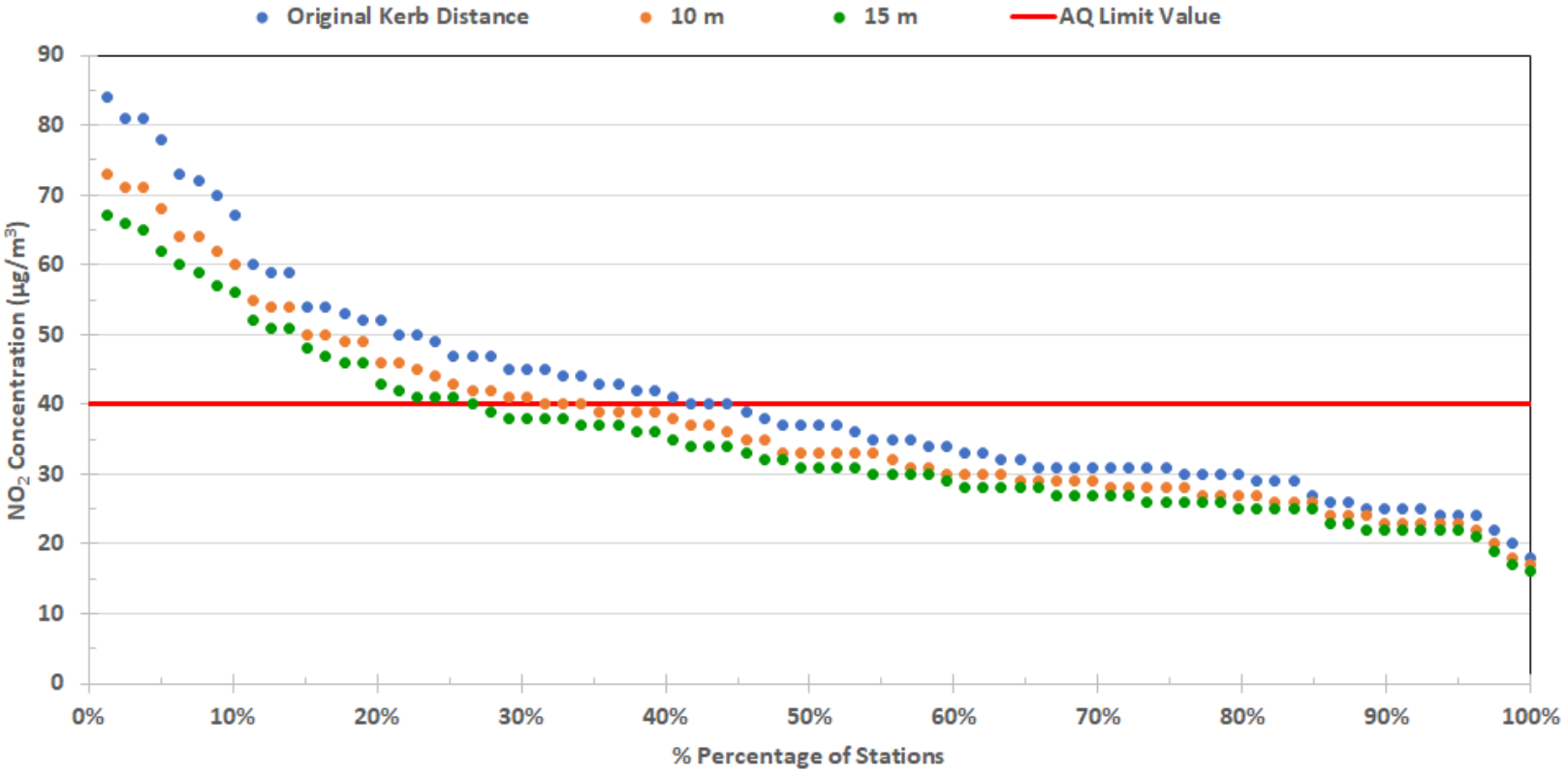
France - NO_2 concentration profile at 10m distance from the kerb



Data: EEA Data for Traffic Stations in 2015.

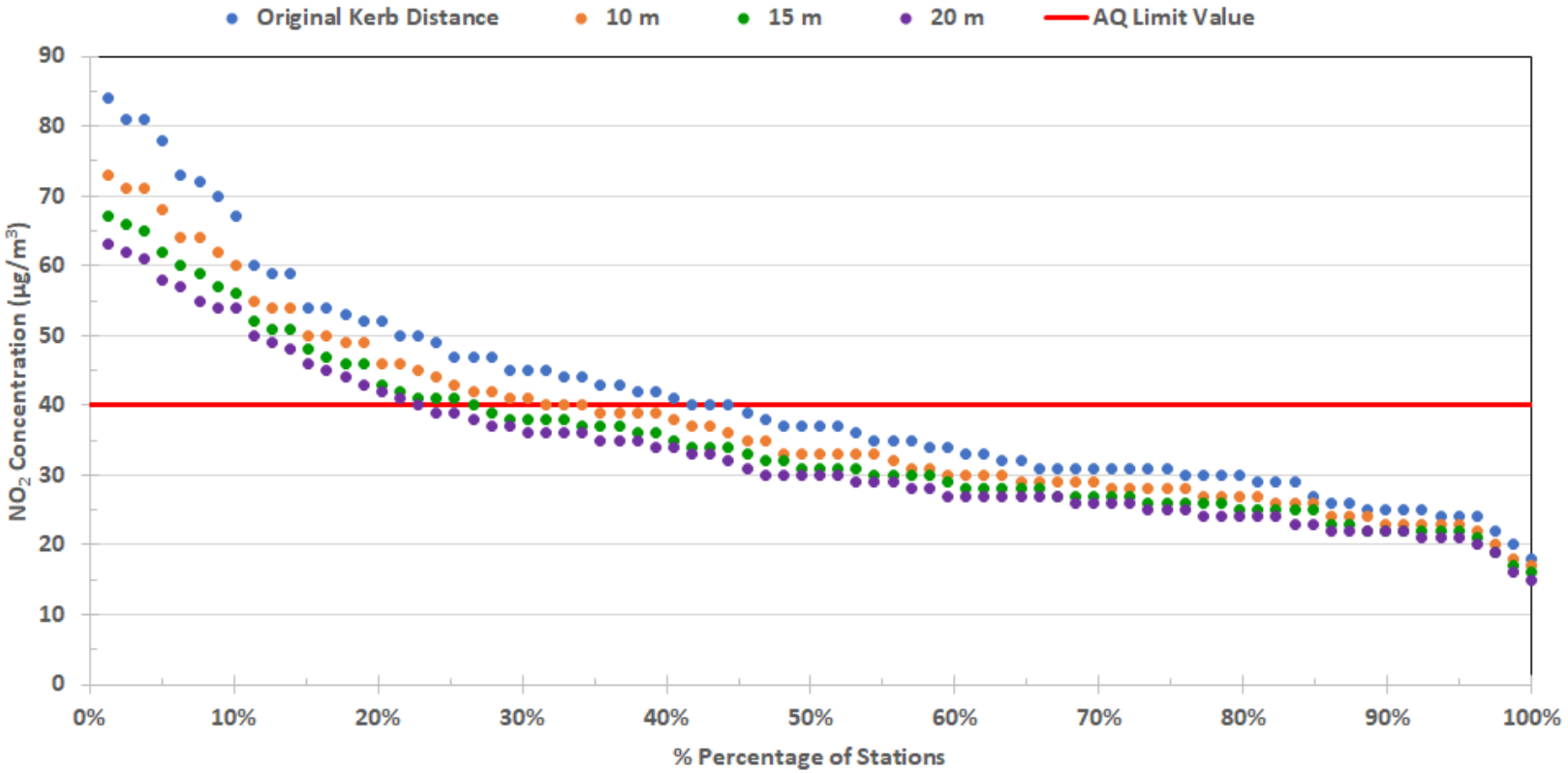
Concawe

France - NO_2 concentration profile at 15m distance from the kerb



Data: EEA Data for Traffic Stations in 2015.

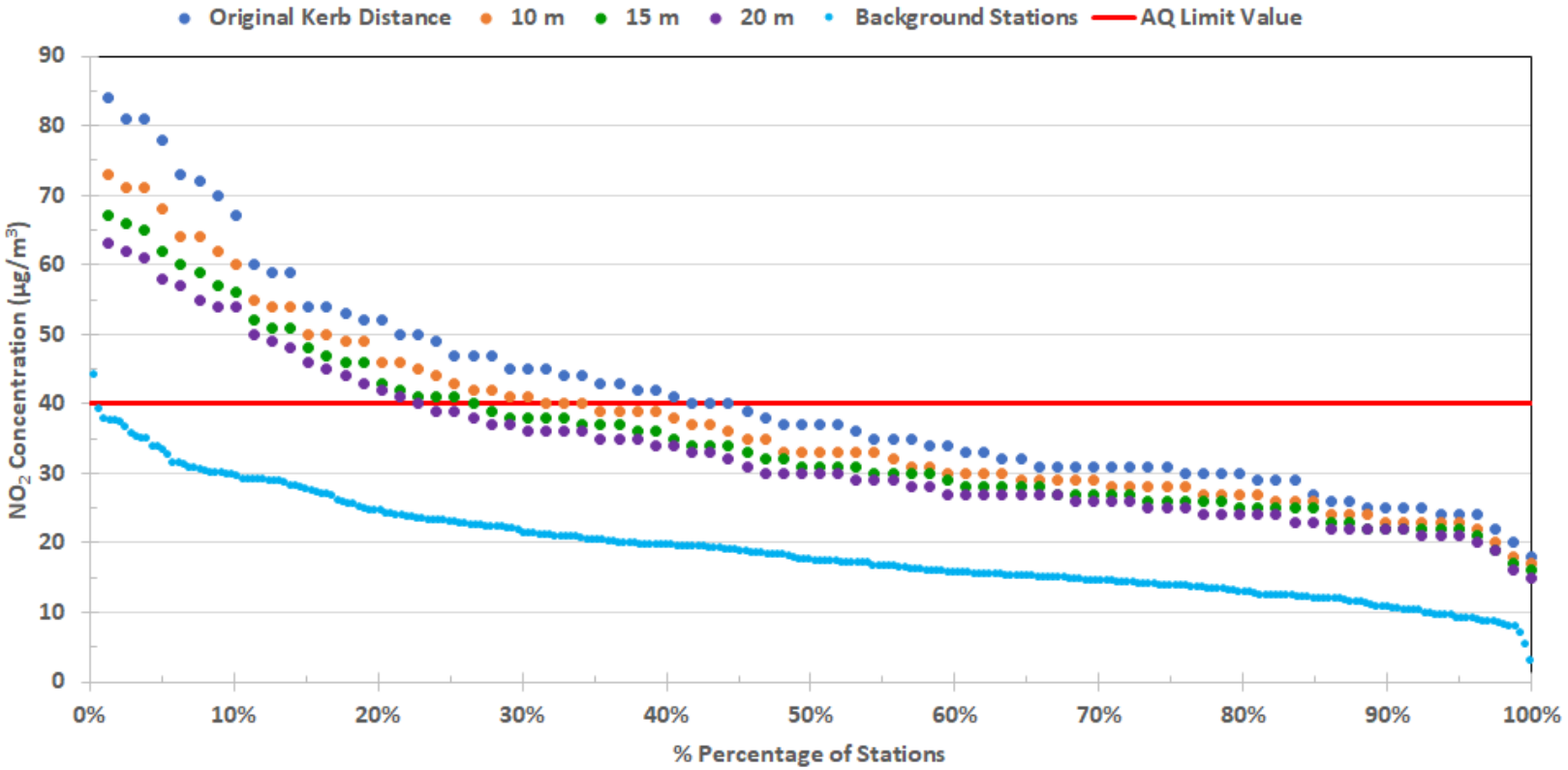
France - NO_2 concentration profile at 20m distance from the kerb



Data: EEA Data for Traffic Stations in 2015.

Concawe

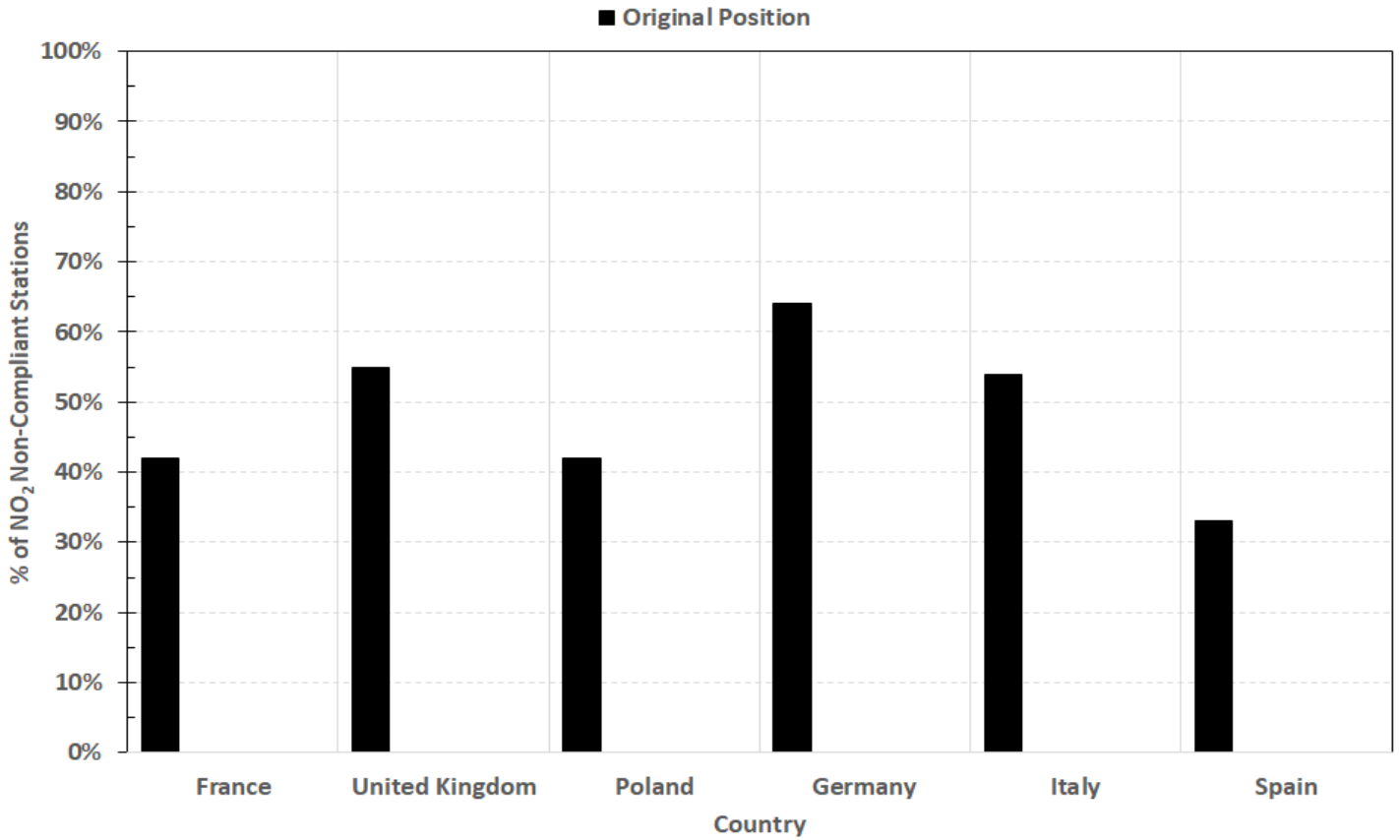
France - NO_2 concentration profile at 10, 15, and 20m distance from the kerb



Data: EEA Data for Traffic Stations in 2015.

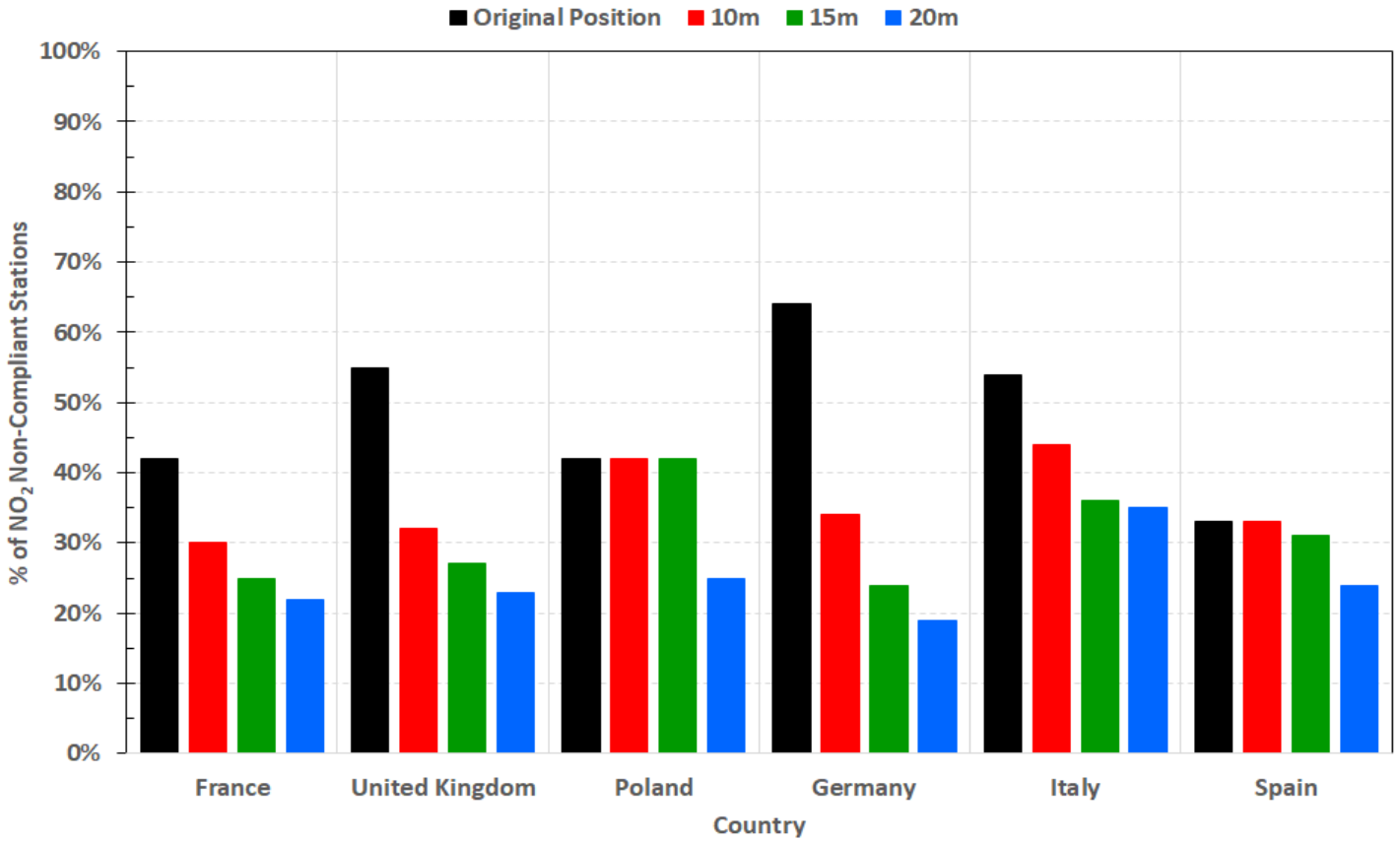
Concawe

% of NO_2 non-compliance at different distances from the kerb



Concawe

% of NO_2 non-compliance at different distances from the kerb



Concawe

03 Conclusions

Conclusions

- **Based on the analysis, a "measurements + modelling" approach for assessing compliance with the AQLVs is possible, being fully in-line with Annex III and remaining faithful to the goal of protecting human health.**

- **Modelling can be used to generate the NO_2 concentration gradients from roadside locations as a fraction of the roadside level and using individual roadside NO_2 measurements.**

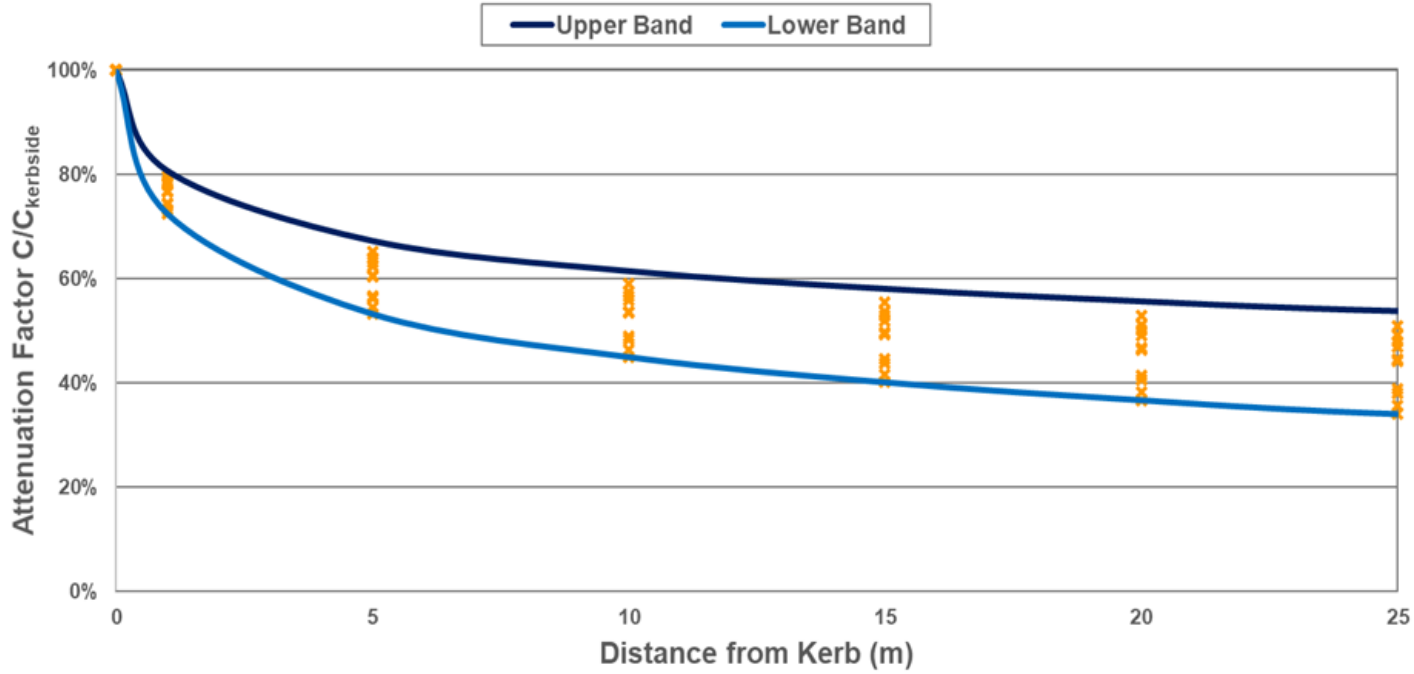
- **Preliminary results have shown that this new approach could <u>significantly change the compliance picture in Europe.</u>**

  ➢ In 2015, this reduces the NO_2 non-compliant stations by 10-30%.

Thoughts for the Audience

- **Taking this 'proof on concept' forward will require significant further work, work which the FAIRMODE modelling community is ideally positioned to undertake.**

- **Would there be an interest in further developing this concept within FAIRMODE?**



Concawe

Concawe

Environmental Science
for European Refining

www.concawe.eu

Thank you for your attention

Thanasis Megaritis
athanasios.megaritis@concawe.eu

Les White
les.white@aeriseurope.com