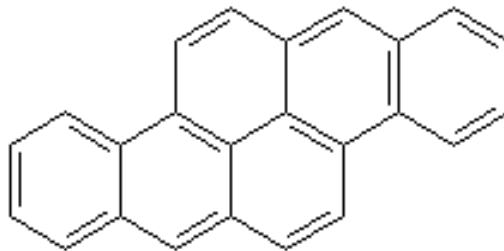
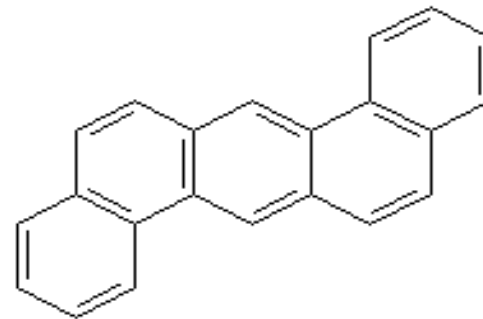
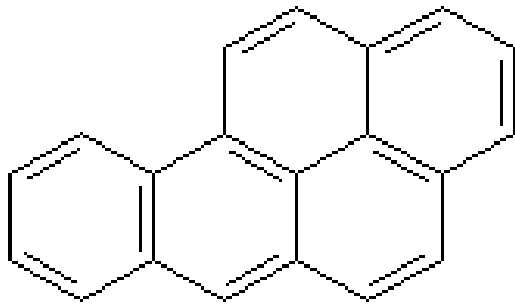


PAH - Sources and Measurement

Mike Woodfield - AEAT



The Background (1)

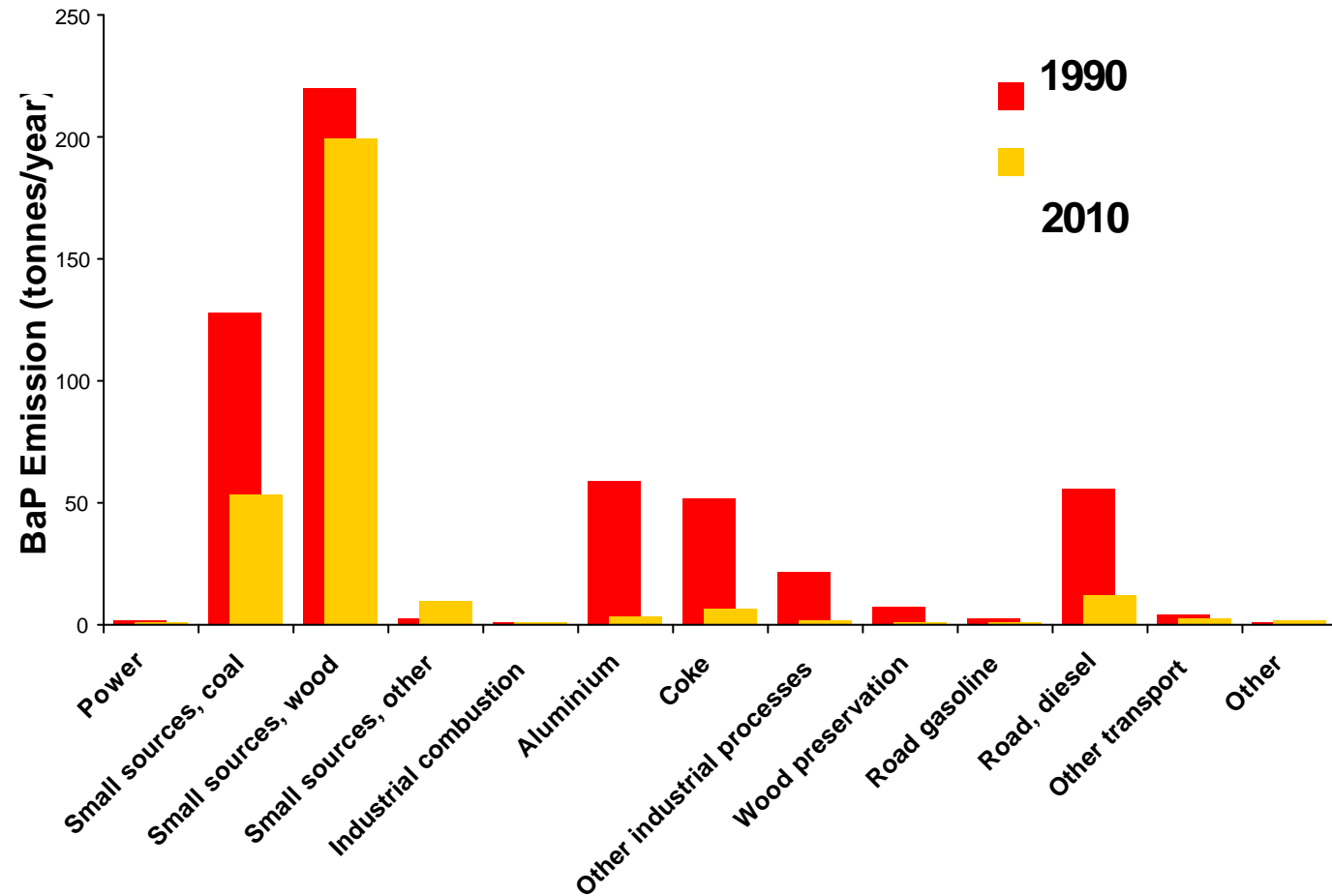
- PAH in Ambient include substances known to produce cancer;
- World Health Organisation considers the risk to human health from ambient PAH levels warrants its management;
- 8 EU member states have guidance and recommendations;
 - *UK EPAQS based recommendation to be incorporated into the AQS but not into regulation for the purposes of LAQM*
- PAH are subject to long range transport and are included in the UN ECE POPs Protocol;
- There are no controls directly on PAH emissions at EU level;
- On the basis of precedent and practicality B[a]P has frequently used as a indicator of PAH activity for practical and technical reasons.

The Background (2)

- Emission inventories for PAH have a high uncertainty
 - *inventory uncertainty >50%*
- Different procedures are used throughout the EU to collect and analyse ambient air samples for PAH and inter-comparability is poor;
- Dispersion modelling of PAH is limited due to the limitations of emissions data;
- There appears to be a downward trend in concentration as a result of regulatory measures already implemented.
- Concentrations can be high close to large industrial sites, busy roads, and communities burning coal and wood domestically.

Toxicology

- Occupational studies exist for estimating the risk to human health posed by ambient PAH; (*mainly lung cancer related*)
- B[a]P is a useful indicator of the carcinogenic risk of ambient mixtures of PAH compounds;
- There are insufficient data to assess the risk posed by PAH in vehicle exhausts;
- future changes in the profile (and hence the carcinogenic impact) may occur;
- The unit risk (lifetime exposure to a mixture represented by 1 ng.m⁻³ B[a]P), based on a number of occupational studies, is in the range 80 – 100 x 10⁻⁶ .
- Working on the WHO estimate of a unit risk of 87 x 10⁻⁶ the risk associated with AQM standards of 0.01, 0.1 and 1.0 ng/m³ would be 1 x 10⁻⁶, 1 x10⁻⁵ and 1 x 10⁻⁴ respectively



Current and projected BaP emissions for the EU 15 + 6 accession states
 (Source TNO 2001)

Sources (1)

- There are four major emission source components: Mobile, Domestic, Industrial, Agricultural/Natural.
- **Domestic sources** numerous, widespread, small, poorly understood;
 - can lead to widespread population exposure sometimes at elevated levels.
 - Emission data is poor and the sources are not well characterised.
 - There is no uniform European regulation and the net size of the source is likely to remain relatively constant over the period to 2010.
- **Industrial Sources:** understood and regulated at European level (by IPPC).
 - Total PAH emissions are decreasing but particulate PAH is largely associated with particles $<2.5\mu\text{m}$.
 - Some industrial sources have a local impact.

Sources (2)

- **Mobile Sources** regulated but not specifically for PAH.
 - The emission is a function of engine type, load, age, fuel and driving mode.
 - Emission of particulate PAH is associated with particles <2.5um.
 - Emissions are at ground level, widespread and concentrated in urban environments with potential to create elevated levels in urban and city environments.
 - **Agricultural** burning can be a source of PAH and while often regulated at a local level is not uniformly controlled at a European level.
- **Natural sources** are stochastic: fires, volcanoes etc.

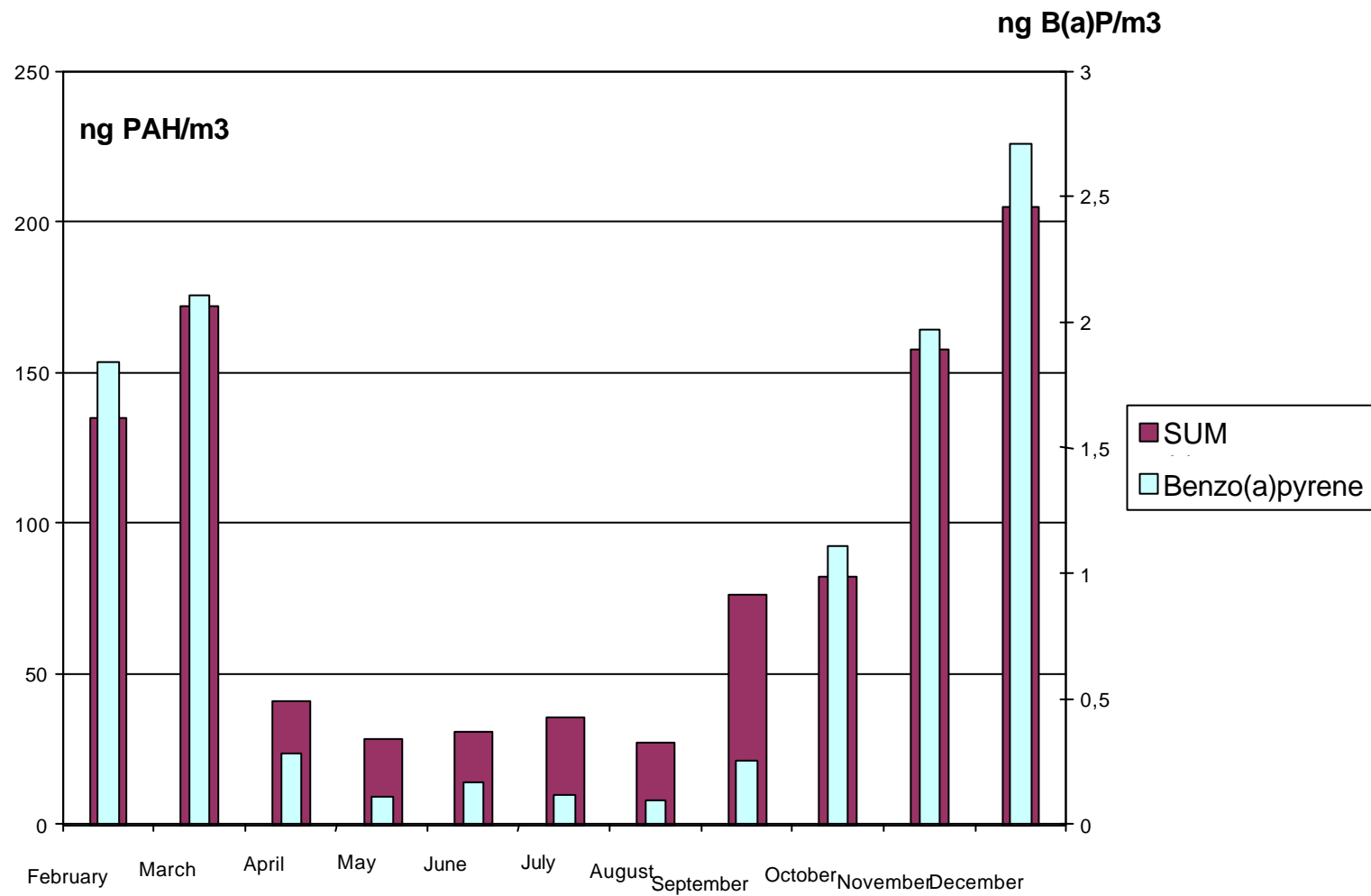
Breakdown of BaP emissions from area sources

Area source sector	1999 Emission (kg)
Roads ¹	840
Light industrial activity ²	98
Domestic	4047
Area other ³	2916
Total	7900

Notes:

1. Emission from roads include petrol, diesel and tyre wear
2. A further breakdown of 'light industrial activity' is given in Table 2.3 below
3. A further breakdown of the 'area other' category is given in Table 2.4 below

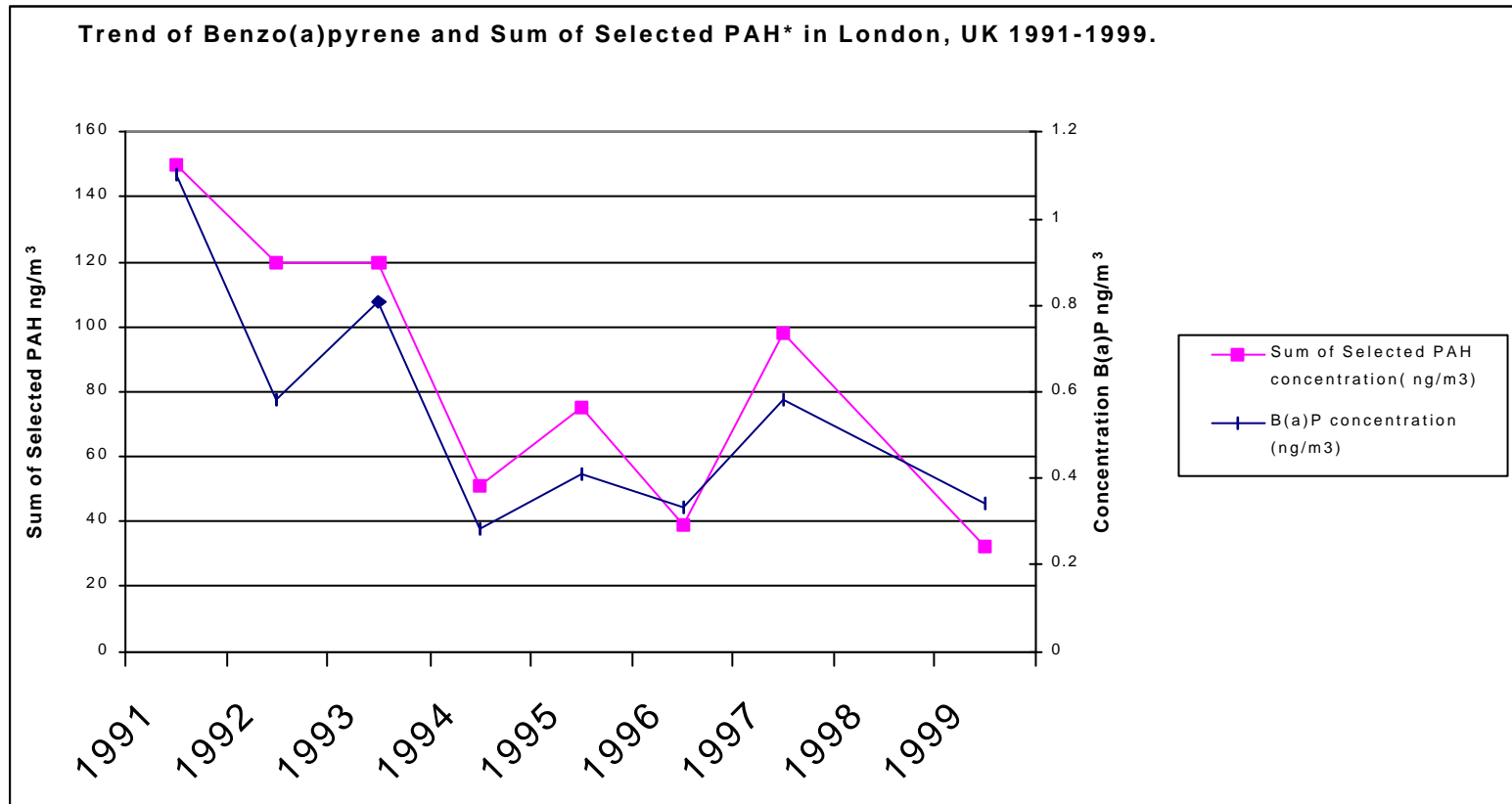
Inter-seasonal variation of PAH in Vienna, Austria



Ambient concentrations

- sampling is costly and technically challenging;
- PAH concentration data is sparse, there is no Community wide, consistent, set of data available;
- monitoring networks in a limited number of member states;
 - *(there are 15 measurement sites in the UK with 10 more to be added)*
- PAH monitoring concentrates on a limited number of species;
- most of monitoring is directed to particle-bound PAH;
- data suggests a reducing trend of both total PAH and B[a]P;
- strong intra annual variation with particulate PAH concentrations, including B[a]P, being an order of magnitude higher in winter than in summer.
 - *(in 2000 the annual average in the UK ranged from 0.04-1.17ng/M³ BaP)*

Trend of sum of selected PAH and Benzo[a]pyrene in London, UK



Measurement Issues

- Different procedures are used in the EU to collect and analyse ambient PAH;
- There is no EN standardisation for the quantification of PAH;
- Typical measurement uncertainty is +/- 50% at the 95% confidence level but many measurements will have considerably worse precision;
- detection limit 0.02 to 0.05 ng/m³ .

Monitoring/Measurement (1)

- Base information is poor and the PAH 'mix' varies, further information is needed:
 - seasonally and geographically
 - from emission sources as a result of regulatory and economic changes.
- based on their potency for carcinogenicity and their occurrence in the atmosphere monitoring is needed for:
 - BaP, BaA, BbFA, BjFA, BkFA, IP, DBahA.
- BUT '**monitoring**' stations need be relatively small in number, are not required to achieve the high levels of data capture and need not have the same high level of measurement uncertainty as that required for compliance measurements.

Monitoring/Measurement (2)

- B[a]P can be a 'marker' for PAH management purposes:
 - widely used
 - occupational studies assume the risk is characterised by B[a]P
 - particulate bound PAH,
 - relatively stable,
- A method is needed for '**measurement**' of compliance with an AQS;
- Siting of measurement stations depends on population exposure;
 - The cost of sampling and analysis is a function of the number of monitoring stations, the sampling method used, the frequency and analytical methodology adopted.
 - Opportunities exist to optimise measurement cost effectiveness for predominantly particulate bound PAH by using sites or equipment measuring other particulate pollutants such as metals

Justification for an AQS

- There is a need to collect a consistent body of information on a ranges of PAH to:
 - better assess emissions and trends,
 - population exposure,
 - track changes to concentration and composition of the mix.
- There is justification, on a precautionary basis, for setting a PAH AQS for guidance purposes which;
 - reflects the uncertainty of current knowledge;
 - can be used to manage annual average exposure;
 - has a ‘moderate’ temporal resolution;
 - is particle related (PM10);
 - includes B[a]P.
- Measurement site criteria should reflect population exposure

Air Quality Strategy for PAH

- Objective provisional for the present
- Targets set should be for the longer term
- DEFRA have proposed a UK wide objective of achieving $0.25\text{ng}/\text{m}^3$ BaP as an annual average by the end of 2010.
- This will not be a national standard
- Neither will it be set in regulations for the purposes of LAQM