Indoor modelling of SVOCs

Distribution, fate and transport pathways

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From outdoor to indoor models

What is ”the indoor environment”?

Households

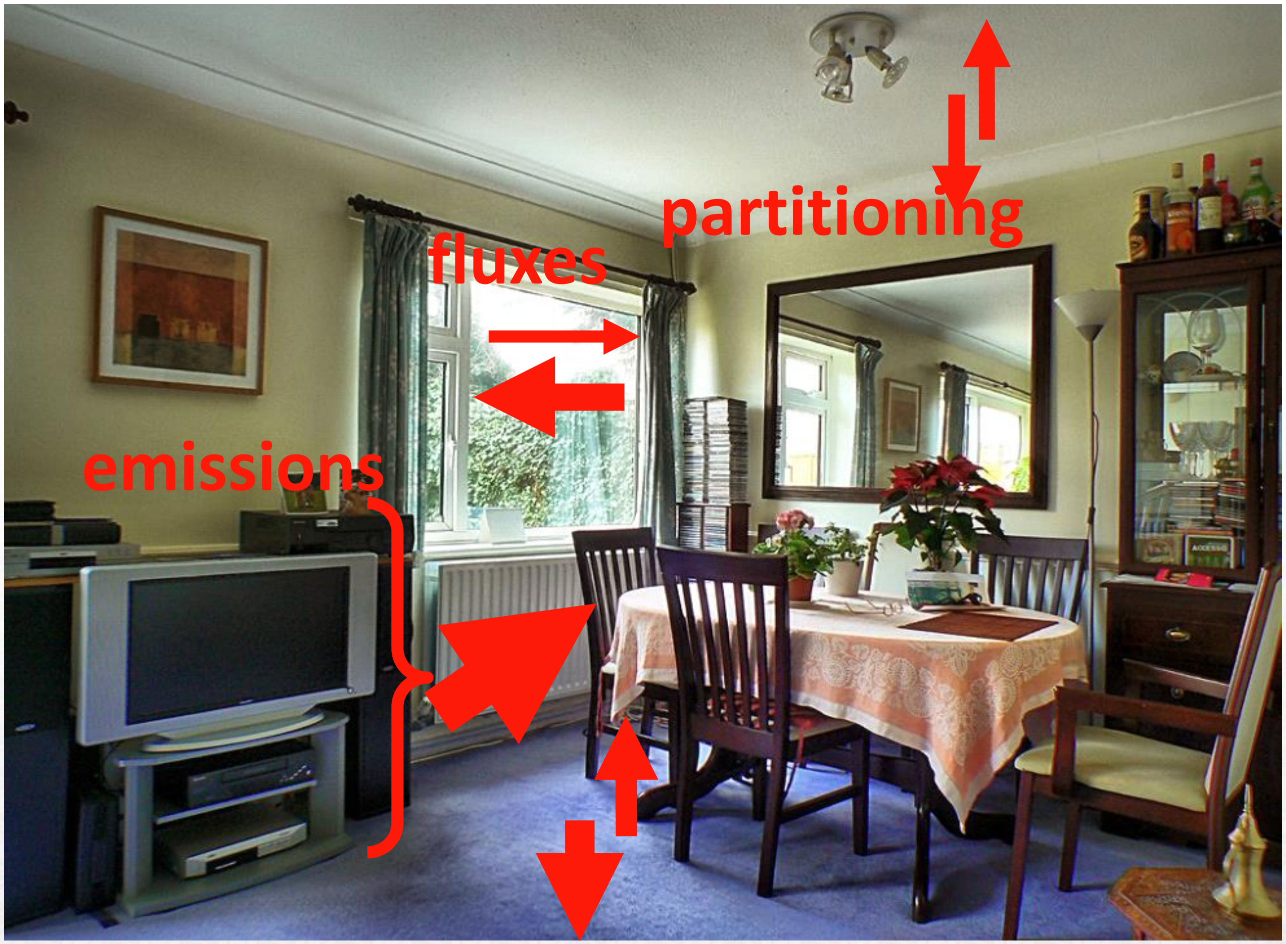
Offices

Schools/day care centres

Varying characteristics

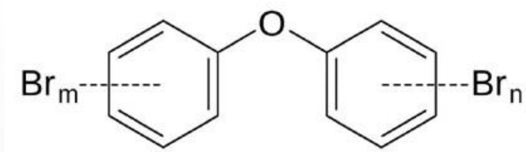
- Dimensions
  - Small
- ”Compartments”
- Ventilation rates
- Sources

What is needed to model indoor fate and transport?

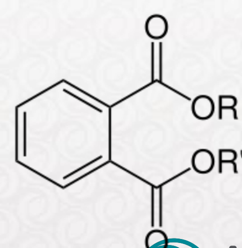


Chemicals

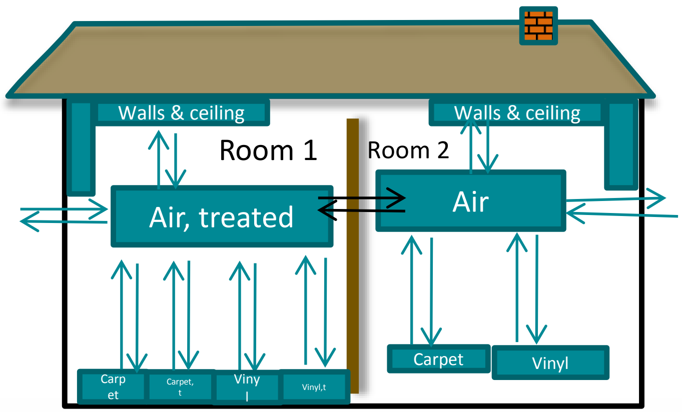
- Flame retardants (e.g. PBDE)



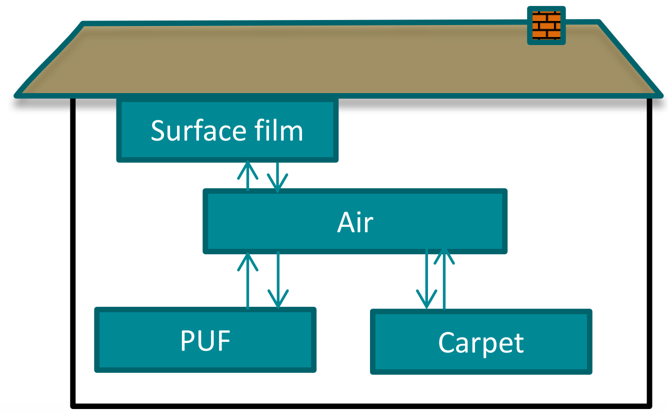
- Plasticizers (e.g. phtalates)



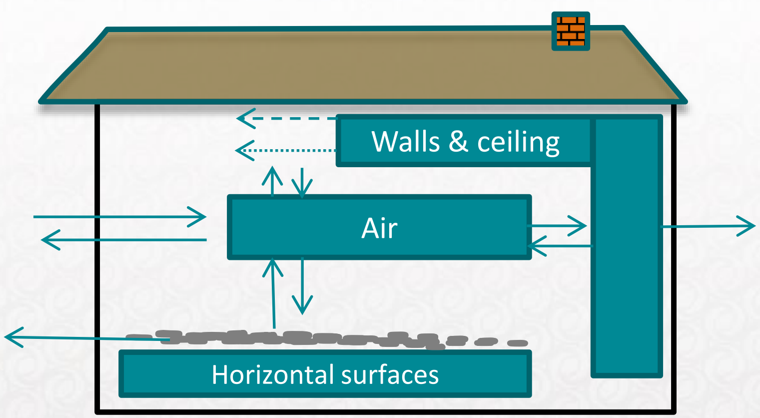
Indoor models



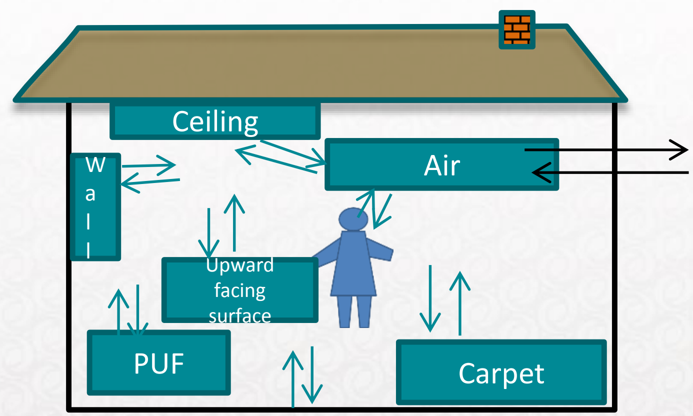
Bennett & Furtaw. 2004. Environ. Sci. Technol. 38, 2142-2152



Zhang et al. 2009. Environ. Sci. Technol, 43, 2845-2850



Cousins et al. 2012. Environ. Sci. Technol, 43, 2845-2850

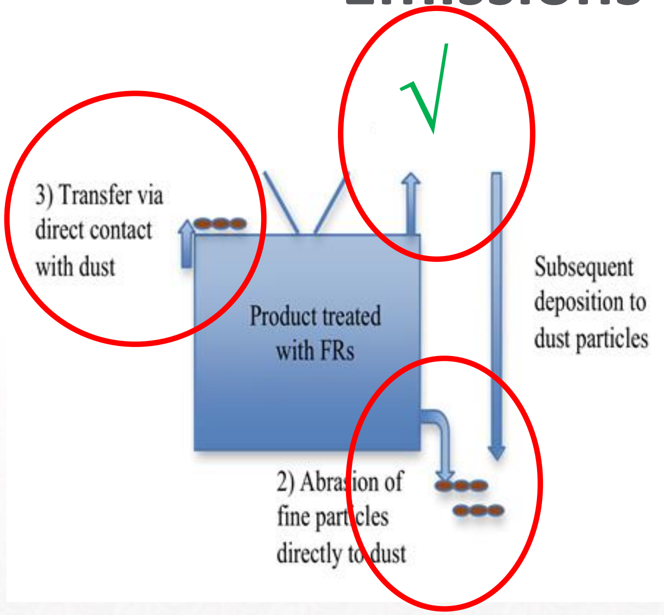


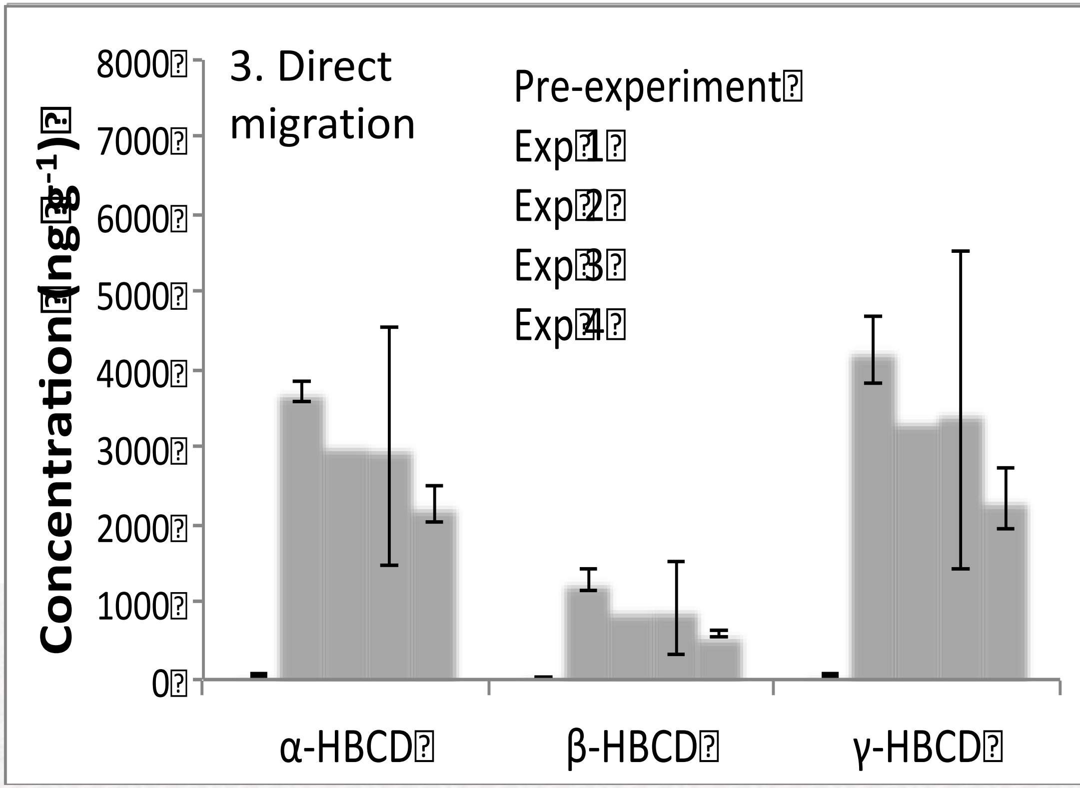
Zhang et al. 2014. Environ. Sci. Technol., 48 (20), 12312–12319

Chemicals

- ”Consumer chemicals”
  - Flame retardants
  - Plasticisers
  - Surfactants (Fluorinated substances)
  - Alkylphenols
  - Others…?

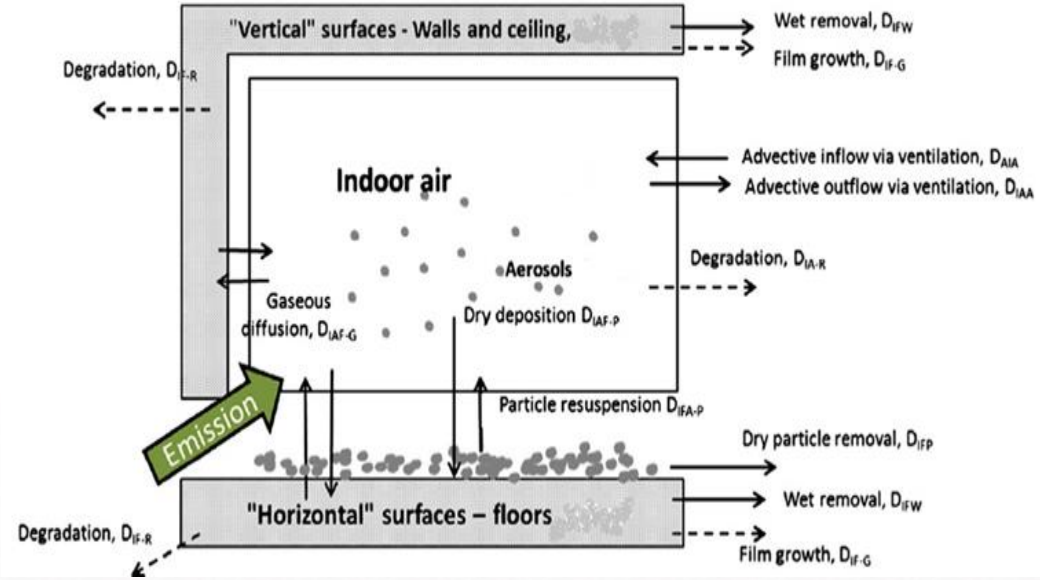
Emissions





Rauert et al. 2014. Sci.Tot. Environ.,493, 639–648 (Abrasion)
Rauert et al. 2014. Indoor air doi:10.1111/ina.12151 (volatilisation)
Rauert. 2014. Ph D thesis Birmingham University, ch 6.5 (direct migration)

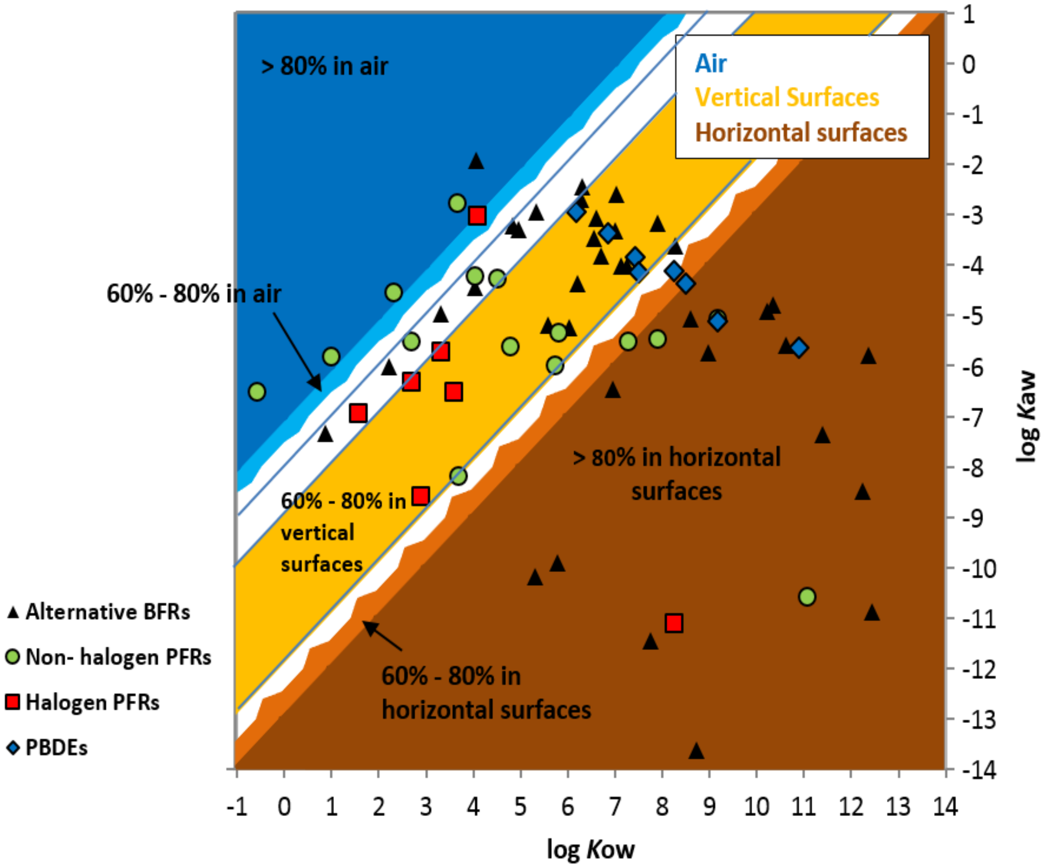
Partitioning mechanisms and fluxes



'*SMURF*' model (Cousins 2012)

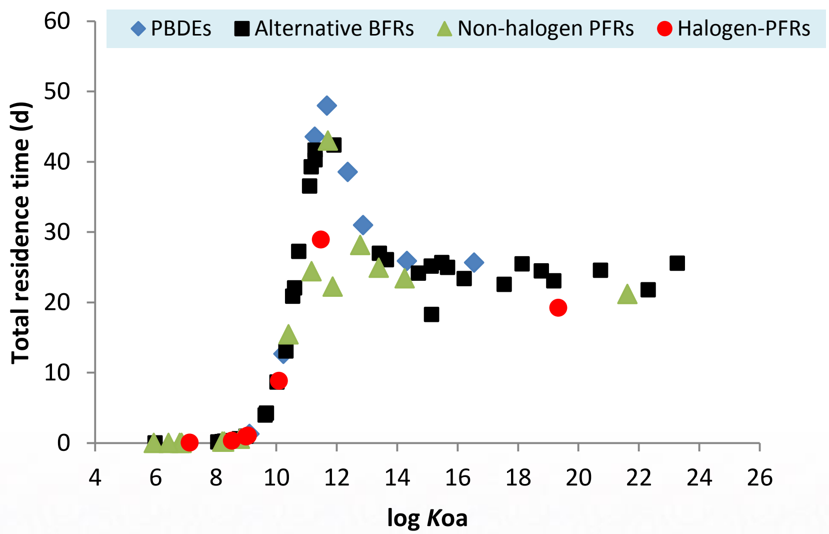
- Few (if any) empirical ”material-air” partition cofficients
- Koa often used surrogate
- Nature of surfaces poorly characterised
- Dust removal – based on mass balance approaches

Indoor fate: mass distribution – example of BFRs (Liagkouridis et al., 2014)



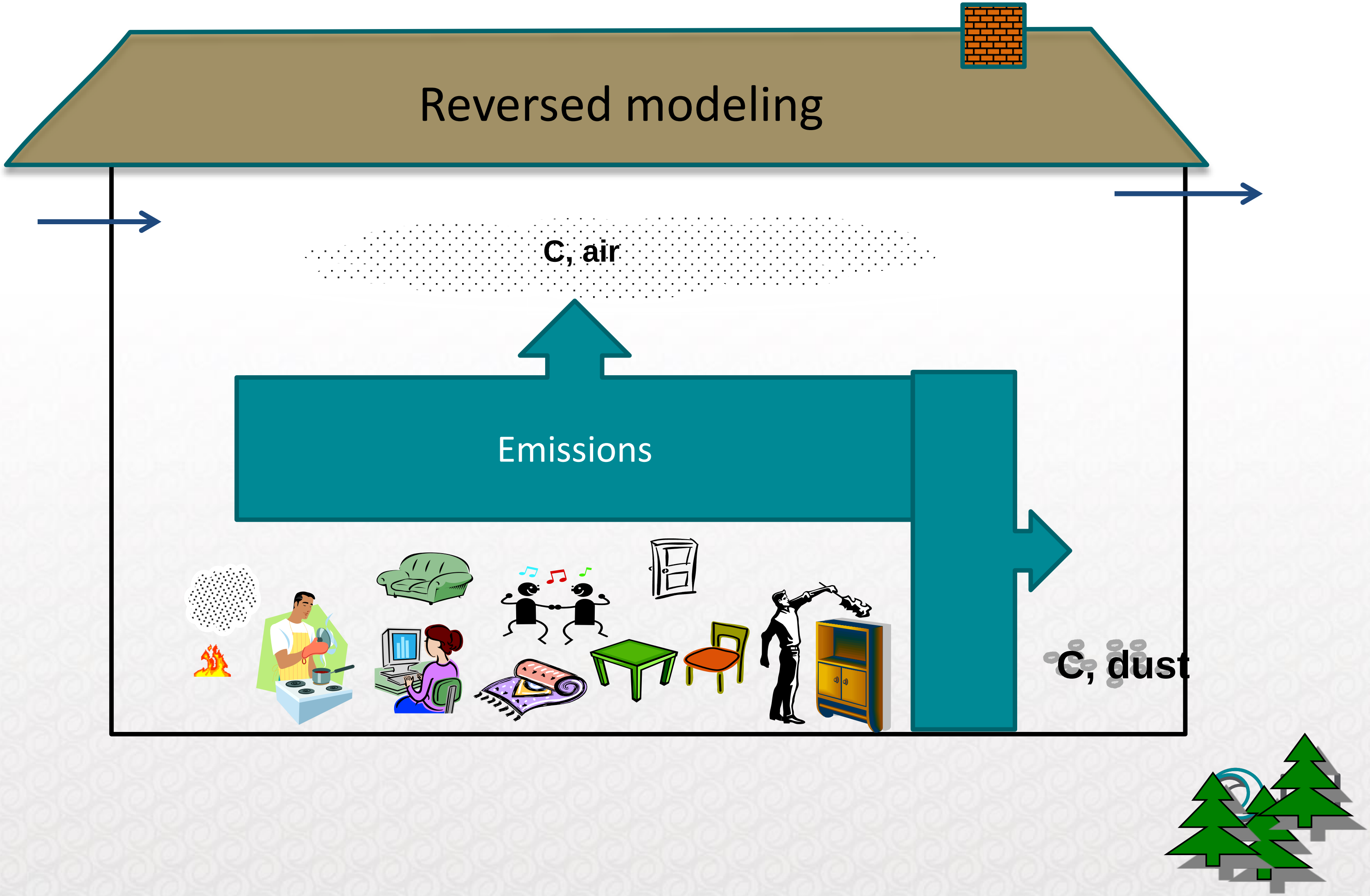
- Most alternative BFRs similar to PBDEs; strong affinity for organic phase on surfaces and particles
- 4 out of the 7 HPFRs partition like lighter PBDEs (***BDE-28, -47 & -99***)
- Lighter NHPFRs (***TMP,TEP, TiBP, TBP, TPP, DOPO***) present in air, whereas the others have PBDE-like partitioning behaviour

Indoor fate: Total residence time



K_{oa} dependence of total residence time

- Total residence time governed by *advection loss* **>>** *degradation loss*
- *NHOPFRs, HOPFRs* and many alternative BFRs less persistent indoors than *PBDEs*
- More volatile compounds (**logK_{oa} < 8**) removed fast by ventilation
- FRs on vertical surfaces (**11 < log K_{oa} < 13**) removed slower than FRs on horizontal surfaces


Reversed modeling
C, air
Emissions
C, dust

Indoor fate: key points

- Fate of most SVOCs influenced by particle movement
- Indoor surfaces significant sinks;
  - might act as re-emitting (secondary) sources prolonging residence time
- Ventilation is critical for removal – source to outdoors (Björklund et al., 2012; Newton, 2015)
- Dust removal crucial for removing low-volatility compounds

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Future challenges

- Standardisation/characterisation of matrices (e.g. dust, film)
- Large heterogeneity – difficult to generalise
- Particle dynamics/mass-balance
  - How to conduct systematic studies?
- Human exposure in focus

Thank you for the attention!

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