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Indoor air background levels of volatile organic compounds in California residences

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2024 Chlorinated Conference
Denver, Colorado

Topics for this presentation

1. Why another indoor air background study
2. Review of previous studies and guidance in California
3. Study results
4. Next steps

Why care about indoor air background concentrations?

With current vapor intrusion (VI) guidance, there is high likelihood of buildings “screening in” for indoor air sampling

Understanding of typical indoor air (background) concentrations becoming more critical for risk communication and data evaluation

Obvious potential for overlap of site contaminants from subsurface sources and personal, indoor, and ambient sources to residential and nonresidential indoor air

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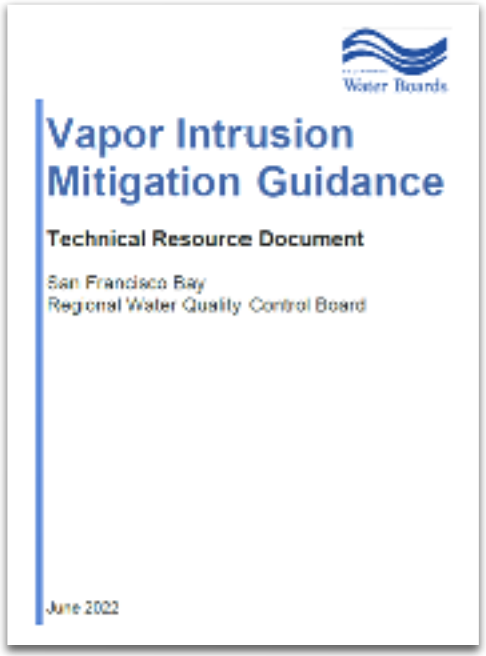
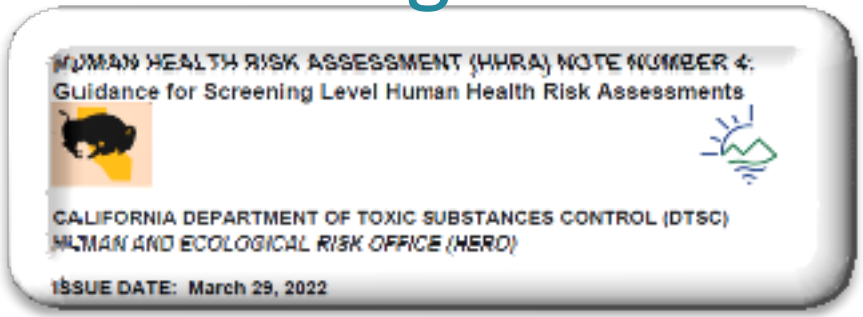
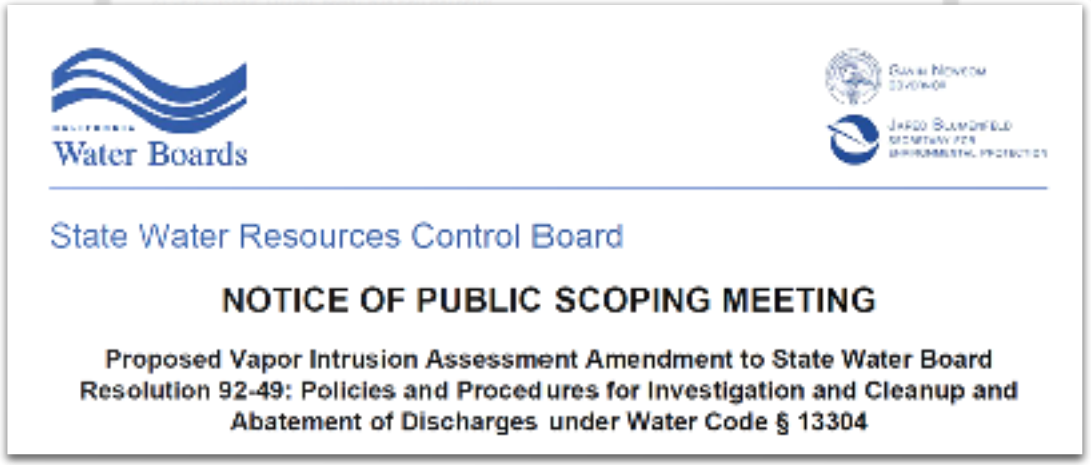
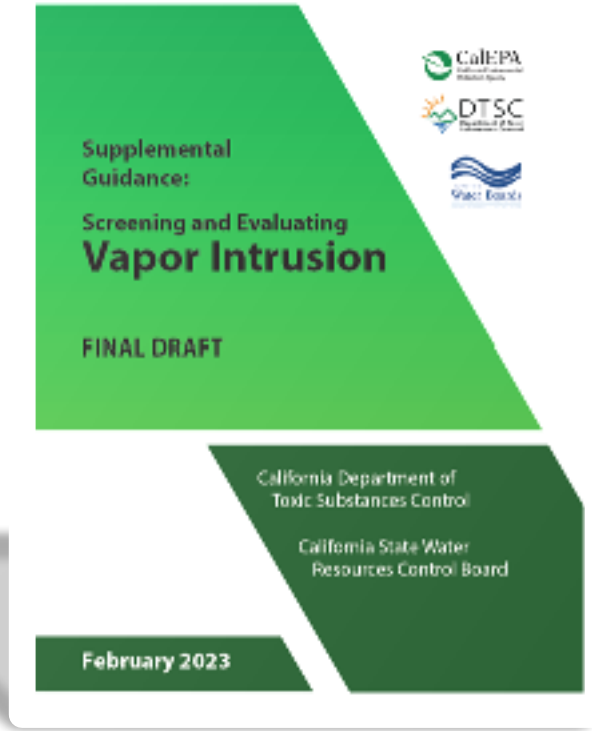
Recent VI-related studies and guidance in California









Understanding indoor air background

Volatile organic compounds (VOCs) are very common in indoor air (*Gordon et al., 1999; Clayton et al., 1999; Sexton et al., 2004; Bradley et al., 2004; RIOPA, 2005; Rago et al., 2007 and 2021; EPRI, 2007; MT DEQ, 2012*)

Outdoor ambient air, household activities (even outside the home), consumer products, building materials, and furnishings all contribute to indoor air concentrations

Removing a product before you sample only removes the container of that product and may be misleading; it was very likely (or is still being) used on surfaces in that building and residual impacts may remain

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Common sources of VOCs used in residences

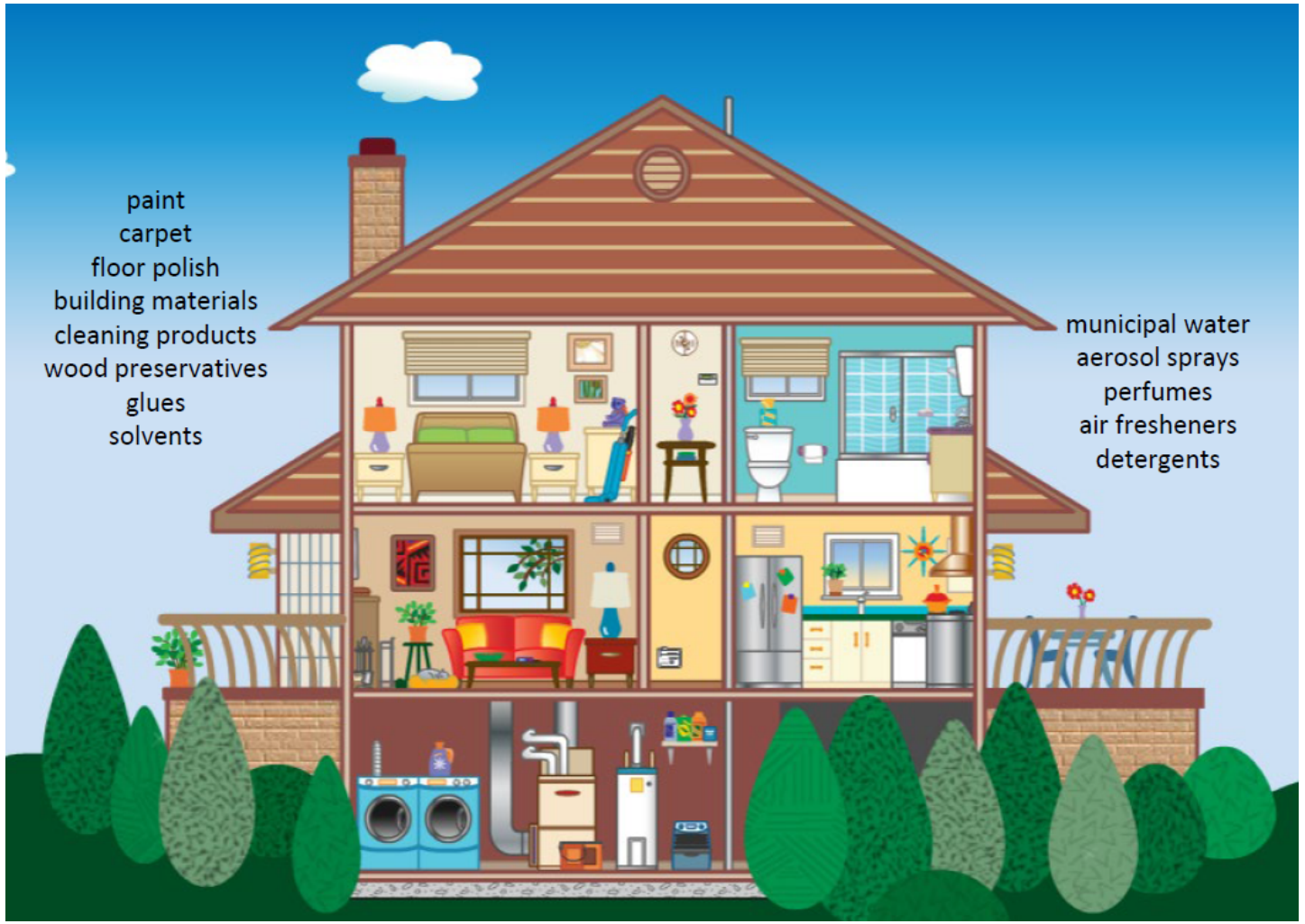
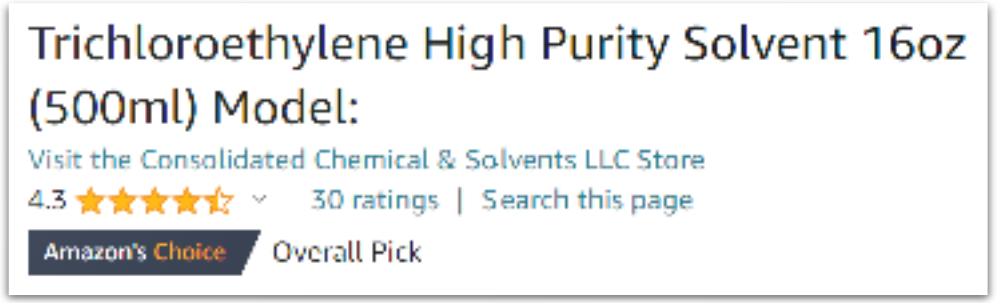


Image source: https://www.epa.gov/indoor-air-quality-iaq/interactive-tour-indoor-air-quality-demo-house

Existing residential background data

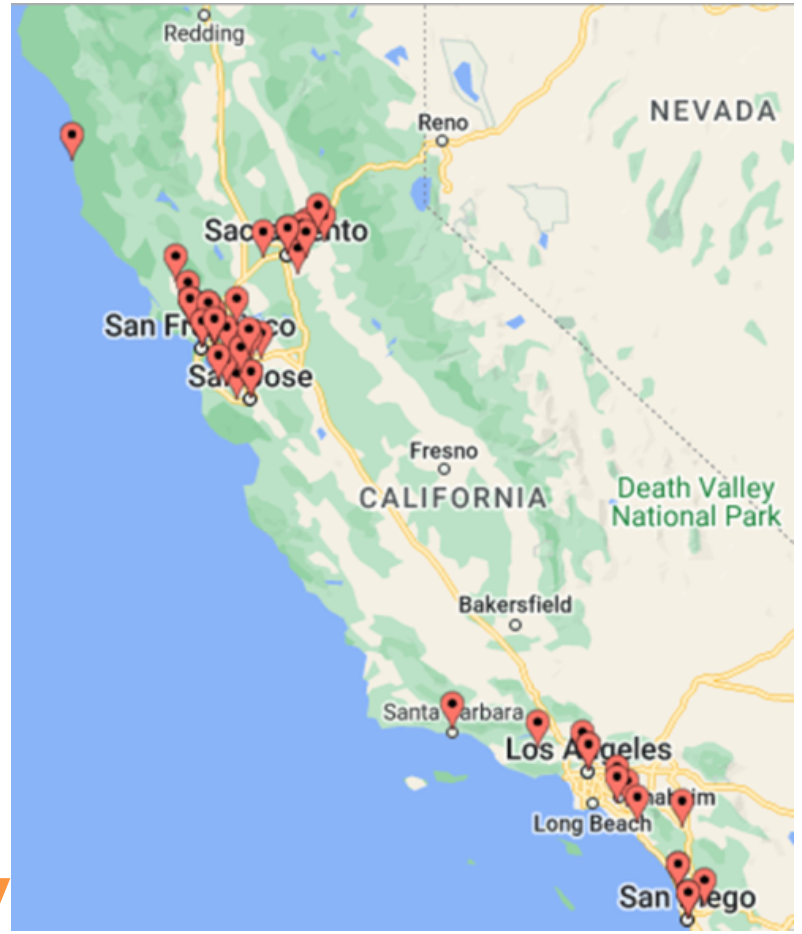
- Mainly from older data sets (1990-2005)
- Inconsistent sampling and analytical methods with higher detection limits
- Varying objectives, methodologies, geographies, statistics
- Consumer products and ambient air quality have changed over time, and different chemicals are being detected in indoor air (*e.g., 1,2-dichloroethane*)

➢ *Order pure trichloroethylene products for home delivery (6/3/2024)*



Focus of this new study

- Completed sampling at 57 residences in rural, suburban, and urban areas in California
  - No known vapor intrusion
  - Target sample location was frequently an occupied room (e.g., living/family room)
- Sampling completed between February 2023 and February 2024



Our volunteers were environmental consultants, lawyers, laboratory scientists, and regulators, are familiar with indoor sources and this may have led to lower observed concentrations

Sample analysis

- Eurofins Air Toxics provided equipment and analysis of samples
- Sampling conducted using fused silica-lined canisters fitted with 24-hour flow controllers
- U.S. Environmental Protection Agency Air Method, Toxic Organics - 15 (TO-15) in synchronous SIM/Scan system (TO-15 Hi/Lo)
  - Scan mode: 62 target VOCs
  - SIM mode: 43 target VOCs

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Summary of home types

- Majority were single-family homes, no basements
  - 12% were condo or townhome
- Construction style varied
  - Slab-on-grade, dirt crawl space, both
  - Timber piles
- Attached garage, no garage

Select frequently detected compounds (µg/m^3)

Analyte	Frequency of Detection	Range of Detected Concentrations	RWQCB Residential IA ESL July 2019	EPA Residential IA RSL* May 2024
Ethanol	100%	42 - 14000	NA	NA
Acetone	98%	18 - 330	32000	NA
Dichlorodifluoromethane (CFC-12)	98%	2.1 - 3.2	NA	10
Toluene	96%	0.36 - 9.6	310	520
Carbon tetrachloride	95%	0.39 - 0.96	0.47	0.47
Trichlorofluoromethane (CFC-11)	95%	1 - 51	NA	NA
Chloroform (Trichloromethane)	93%	0.17 - 7.1	0.12	0.12
m,p-xylenes	93%	0.32 - 9.8	NA	NA
Benzene	86%	0.23 - 1.8	0.097	0.36
Ethylbenzene	86%	0.13 - 4.2	1.1	1.1
Isobutane	81%	1.6 - 310	NA	NA
Butane	79%	1.6 - 1900	NA	NA
Acrolein	75%	1.7 - 8.4	NA	0.0021
Isopropyl alcohol (2-propanol)	70%	7 - 1800	NA	21
Naphthalene	68%	0.07 - 1.9	0.083	0.083
1,2-Dichloroethane	67%	0.12 - 6.9	0.11	0.11

When detected, > ESL

*USEPA RSL TR=10^{-6}, HI=0.1

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Select petroleum hydrocarbons (µg/m^3)

Analyte	Frequency of Detection	Range of Detected Concentrations	KM Mean	25th Percentile	50th Percentile	75th Percentile	Median (detect)	RWQCB Residential IA ESL July 2019	EPA Residential IA RSL* May 2024
Benzene	86%	0.23 - 1.8	0.634	0.41	0.6	0.8	0.62	0.097	0.36
Toluene	96%	0.36 - 9.6	1.964	1	1.5	2.6	1.5	310	520
Ethylbenzene	86%	0.13 - 4.2	0.46	0.22	0.3	0.52	0.32	1.1	1.1
m,p-xylenes	93%	0.32 - 9.8	1.205	0.55	0.69	1.2	0.68	NA	NA
o-xylene	89%	0.14 - 3.5	0.495	0.22	0.34	0.51	0.34	NA	10
Naphthalene	68%	0.07 - 1.9	0.167	0.076	0.12	0.18	0.14	0.083	0.083

*USEPA RSL TR=10^{-6}, HI=0.1

When detected, > ESL

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Select chlorinated solvents (µg/m^3)

Analyte	Frequency of Detection	Range of Detected Concentrations	KM Mean	25th Percentile	50th Percentile	75th Percentile	Median (detect)	RWQCB Residential IA ESL July 2019	EPA Residential IA RSL* May 2024
Tetrachloroethene	19%	0.19 - 1.6	0.248	0.19	0.2	0.29	0.46	0.46	11
Trichloroethene	2%	0.22 - 0.22	0.132	0.15	0.16	0.17	0.22	0.48	0.48

*USEPA RSL TR=10^{-6}, HI=0.1

Next steps

- Examine relationships between:
  - Geographies
  - Structure characteristics
  - Other studies

- Publish!

Closing thoughts

- Many VOCs commonly identified in indoor air background, with some at levels that *exceed regulatory screening levels*
- Indoor air background is building-specific, but it may be appropriate to *consider ranges of concentrations* as a line of evidence in VI evaluations
- Understanding background data can be of strategic importance in VI data review, focusing investigations, mitigation decision making, and risk communication

Acknowledgments and thanks

- Our volunteers!
- Haley & Aldrich
- Eurofins Air Toxics: Heidi Hayes and Monica Tran
- California Environmental Protection Agency

Thank you!

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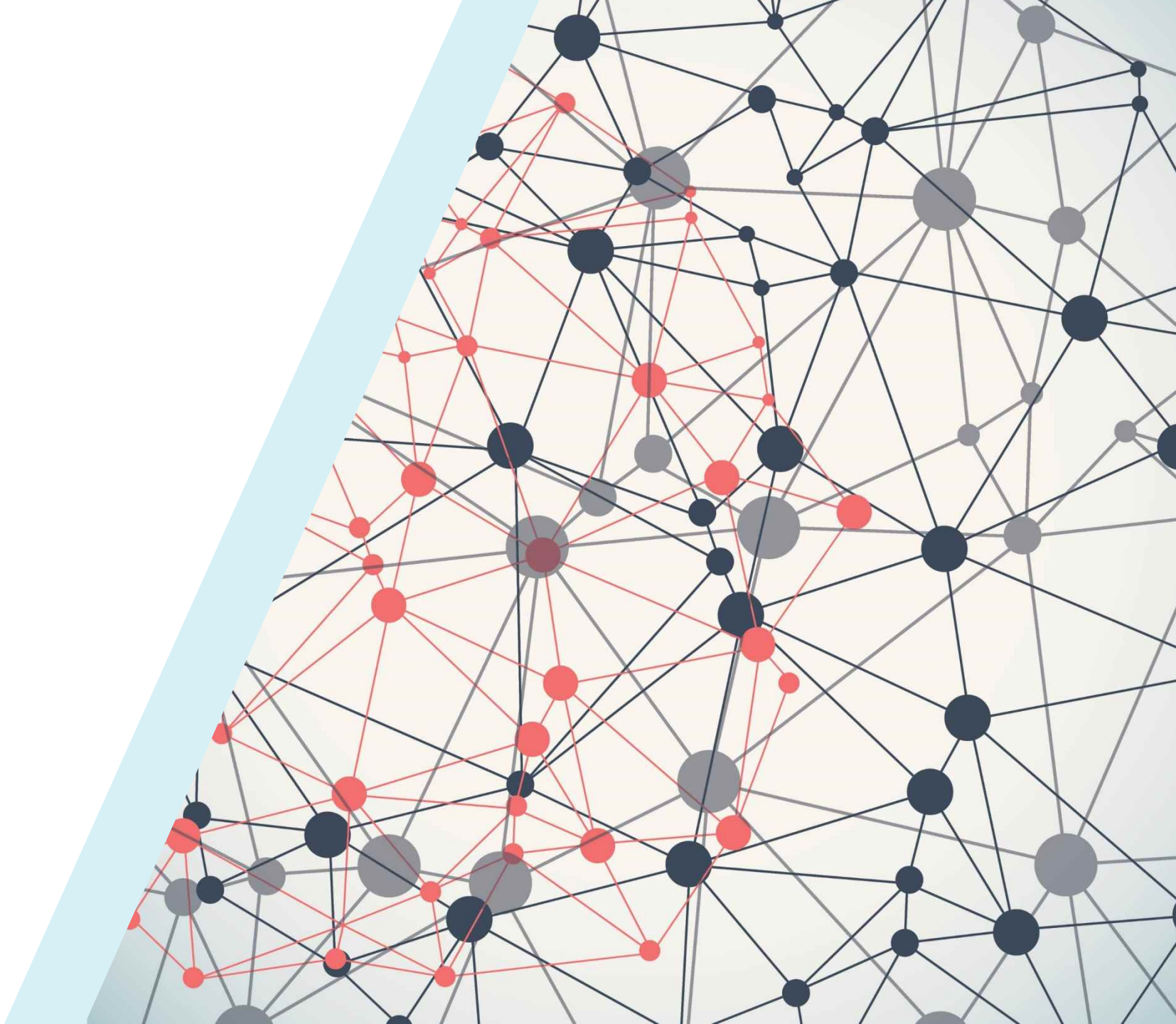

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