

Supporting Information

Air Pollution in Europe

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Emission Trends of SO_x and NMVOCs in the period 2004-2014

The decline in SO_x emission follows the implementation of the EU AQDs. Due to large damages to ecosystems and agricultural lands because of acid rain in the nineties, SO_x emitting sectors were subjected to heavy legislation in the 2004 directive and control was further tightened in 2008.^{[1],[2]} The largest contribution to the decline can be ascribed to improved hydrodesulphurization processes implemented by refineries.

The level assessment of the disaggregated emission output of SO_x in 2014 identified one major contributor, namely the ‘Public electricity and heat production’ sector that had a share of 47% to the total output (Fig. 5). After the second greatest polluter, the ‘Residential: Household and gardening (mobile)’ sector, the contribution flattened out considerably.

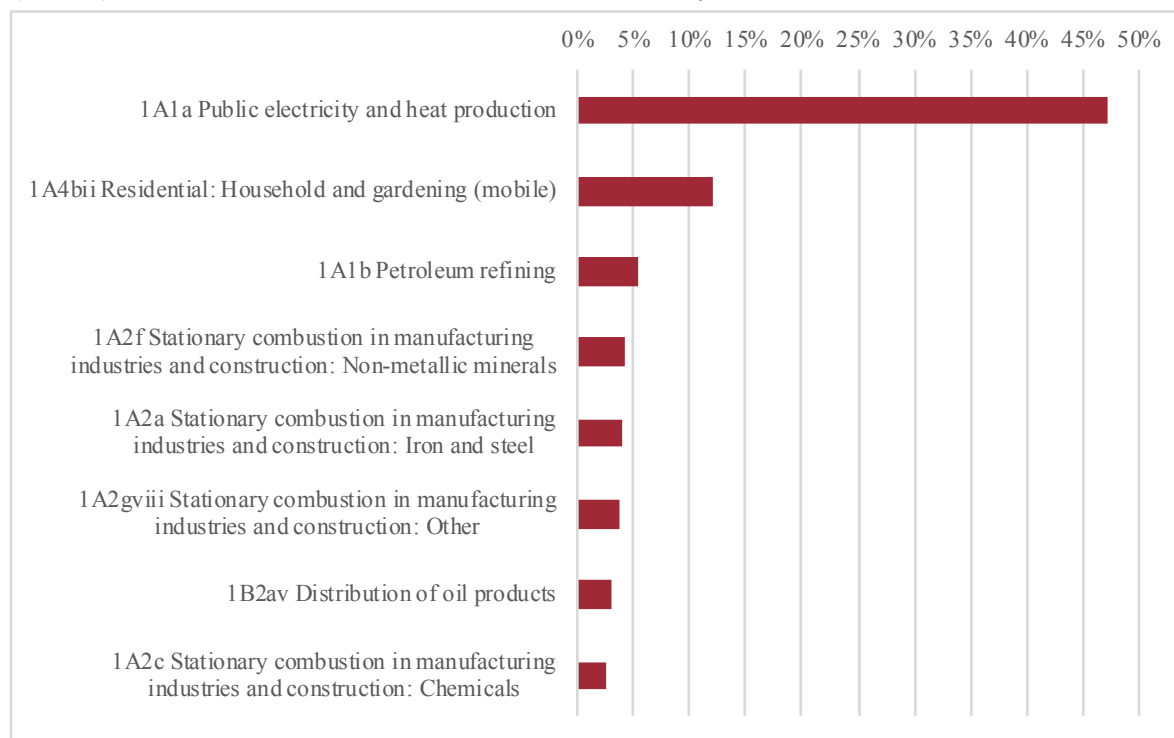


Figure S1. *Level assessment* of the SO_x sector output in 2014. The sum of the contributions adds up to 80% of the total output.

NMVOC emissions were cut by 39% (Fig. 4 in main text). This is attributed to the industrial sector, which reduced the use of NMVOCs as solvents in the paint and coating industry (Fig. S2). The key categories obtained via *level assessment* of the sector-specific emission data in 2014 were: ‘Coating applications’ (14%), ‘Residential: stationary’ (12%), and ‘Domestic solvent use including fungicides’ (11%). The only sector in the top three that was also indicated as key in the trend assessment was the residential combustion sector which saw an increase in contribution compared to 2000 levels of 8%. This suggests that tighter control on residential emissions could benefit ambient air quality, although impact by volume would be small.

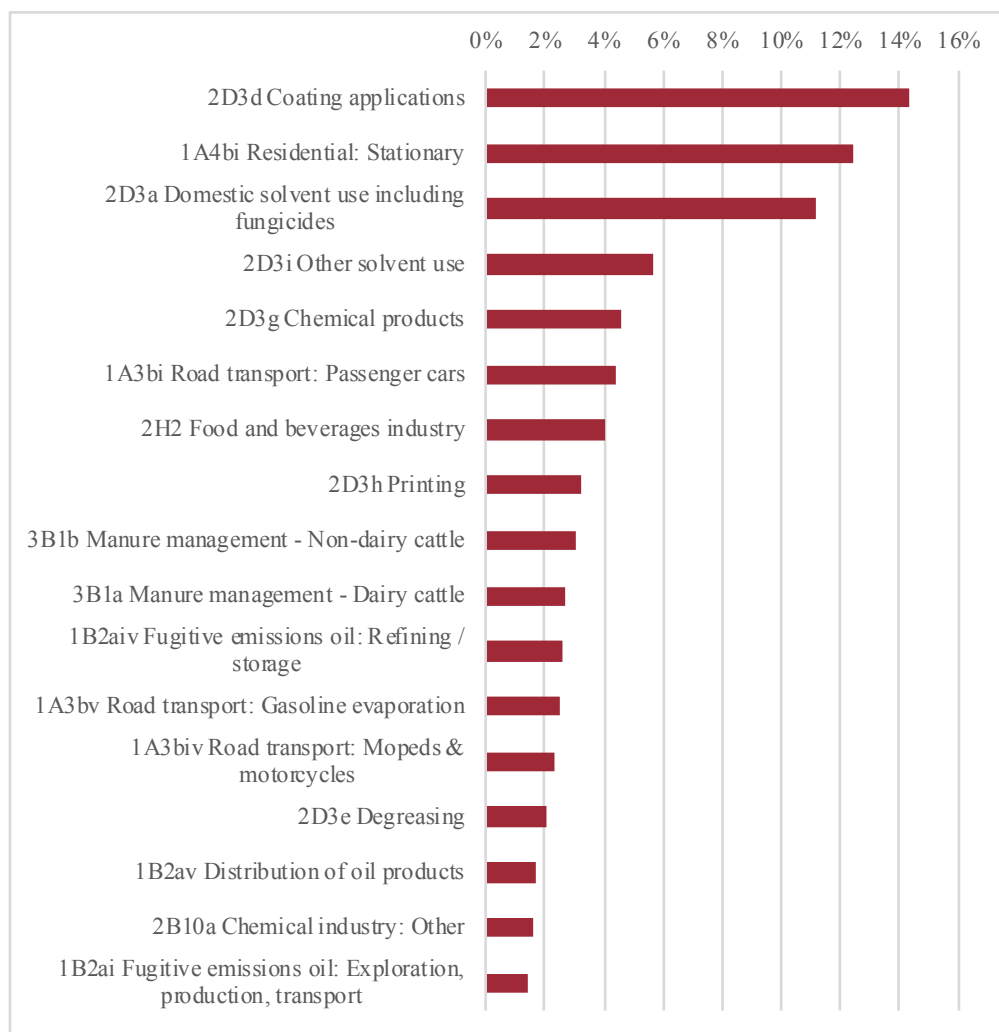


Figure S2. *Level assessment* of the relative sector output of NMVOCs in 2014. The sum of the contributions adds up to 80% of the total output.

References

- [1] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 Relating to Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air, 2005.
- [2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe, 2008.
- [3] G. Wang, R. Zhang, M. E. Gomez, L. Yang, M. Levy Zamora, M. Hu, Y. Lin, C. Cheng, T. Hu, Y. Ren, Y. Wang, J. Gao, J. Cao, Z. An, W. Zhou, G. Li, J. Wang, P. Tian, W. Marrero-Ortiz, J. Secrest, Z. Du, J. Zheng, D. Shang, L. Shao, W. Wang, Y. Huang, Y. Zhu, Y. Li, J. Hu, B. Pan, L. Cai, Y. Cheng, Y. Ji, F. Zhang, D. Rosenfeld, P. S. Liss, R. A. Duce, C. E. Kolb, J.M. Molina, *Proc. Natl. Acad. Sci. USA* **2016**, 113, 13630–13635.
- [4] R. Hampel, A. Peters, R. Beelen, B. Brunekreef, J. Cyrus, U. de Faire, K. Fuks, B. Hoffmann, A. Hüls, M. Imboden, A. Jedynska, I. Kooter, W. Koenig, N. Künzli, K. Leander, P. Magnusson, S. Männistö, J. Penell, G. Pershagen, H. Phuleria, N. Probst-Hensch, N. Pundt, E. Schaffner, T. Schikowski, D. Sugiri, P. Tiittanen, M-Y. Tsai, M. Wang, K. Wolf, T. Lanki, *Environ. Int.* **2015**, 82, 76–84.
- [5] D. Q. Rich, H. M. Kipen, W. Huang, G. Wang, Y. Wang, P. Zhu, P. Ohman-Strickland, M. Hu, C. Philipp, S. R. Diehl, S-E. Lu, J. Tong, J. Gong, D. Thomas, T. Zhu, J. Zhang, *JAMA* **2012**, 307, 2068–2078.
- [6] H. Harmens, G. Mills, F. Hayes, K. Sharps, M. Frontasyeva, P. Lazo, F. Qarri, G. Soja, H. Zechmeister, M. Mehrabova, Y. Aleksiyaynak, G. M. Gecheva, S. Miranova, N. P. Gribacheva, G. Zeiko, I. Milanovic, I. Suchara, J. Sucharova, A. Ene, *Air Pollution and Vegetation; ICP Vegetation Annual Report 2015/2016*, 2016.