

The Swiss approach **to clean air policy**

Insights Paper



Key achievements

Air pollution comes with human, economic, and environmental costs, threatens development gains, and has important impacts on the climate. Over the last three decades, emissions of most pollutants in Switzerland have declined markedly, thanks to effective policies and targeted abatement measures. Consequently, harmful effects on human health and other impacts – crop losses or damage to buildings and cultural monuments – and the resulting economic costs, have gradually declined. The number of annual premature deaths attributable to air pollution, for example, dropped from around 3,700 in 2000 to about 2,300 in 2018.¹

The main sources of air pollution are motorised traffic from on-road and non-road vehicles and machinery (NO_x, PM₁₀), wood burning (PM_{2.5} and black smoke or soot), agriculture (NH₃, PM₁₀) and industry (VOCs, NO_x, PM₁₀).

Since 1998, **particulate matter** concentration levels have decreased by 51 per cent for PM₁₀ and 48 per cent for PM_{2.5} (see Figure 1) as a result of the reduction in primary particle emissions attributable to technological improvements in wood combustion installations, abatement of exhaust emissions from road vehicles, particle filters for new

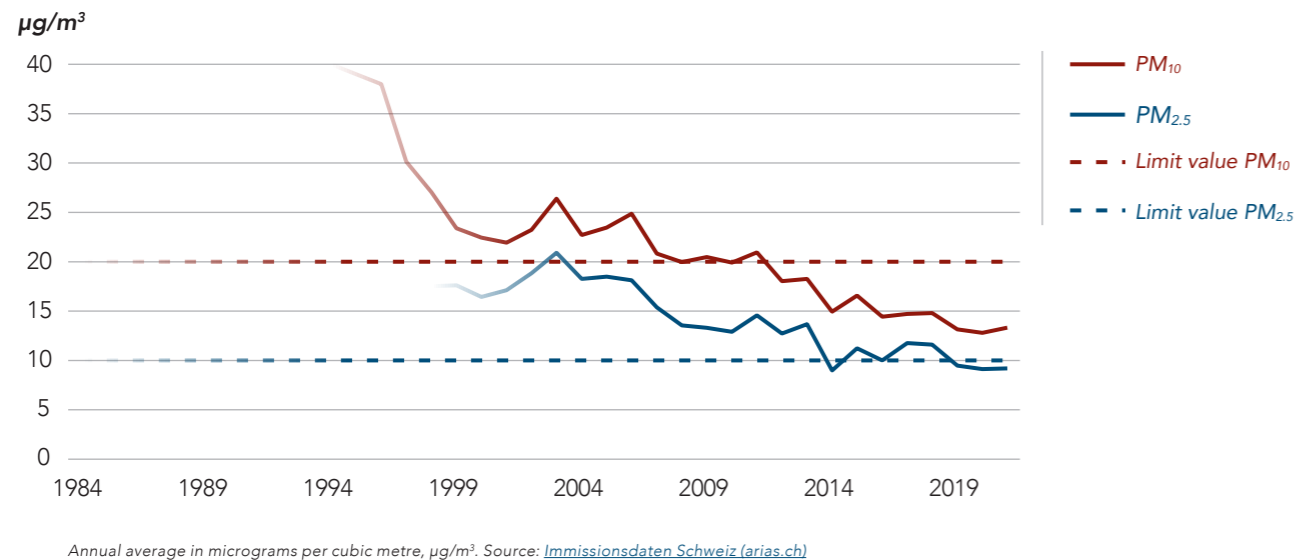
construction machinery with diesel engines, and the reduction of secondary particles, especially sulphate and nitrate (FOEN 2022a).

At all monitoring sites, the concentrations of **nitrogen dioxide (NO₂)** have decreased in recent decades (see Figure 2). Chief among the factors accounting for the declines are emission standards for road vehicles; industrial plants switching from residual fuel oil, coal and gas oil to natural gas; a reduction in total fuel use resulting from the introduction of the incentive tax on combustible fossil fuels; and technical improvements such as flue gas denitrification (FOEN 2022a).

The maximum **sulphur dioxide (SO₂)** concentration level was reached around 1985 (see Figure 2) and has decreased substantially since then, mainly due to the reduction of the sulphur content in fuels and combustibles and to exhaust aftertreatment systems.

The concentrations of **non-methane volatile organic compounds** declined as a result of the economic incentive tax on VOCs (see Figure 3).

Figure 1: Particulate matter (PM₁₀ and PM_{2.5}) concentrations and limit values



¹ <https://www.bafu.admin.ch/bafu/en/home/themen/thema-luft/luft-daten--indikatoren-und-karten/luft-indikatoren/indikator-luft.pt.html/aHR0cHM6Ly93d3cuaW5kaWthdG9y-ZW4uYWRTaW4uY2g0UHViG/jl0FibURldGFpbD9pbmQ9TFUwMjMmbG5nPWVwJlN1Ymo9Tg%3d%3d.html>

Figure 2: Nitrogen dioxide (NO₂) and sulphur dioxide (SO₂) concentrations and limit values

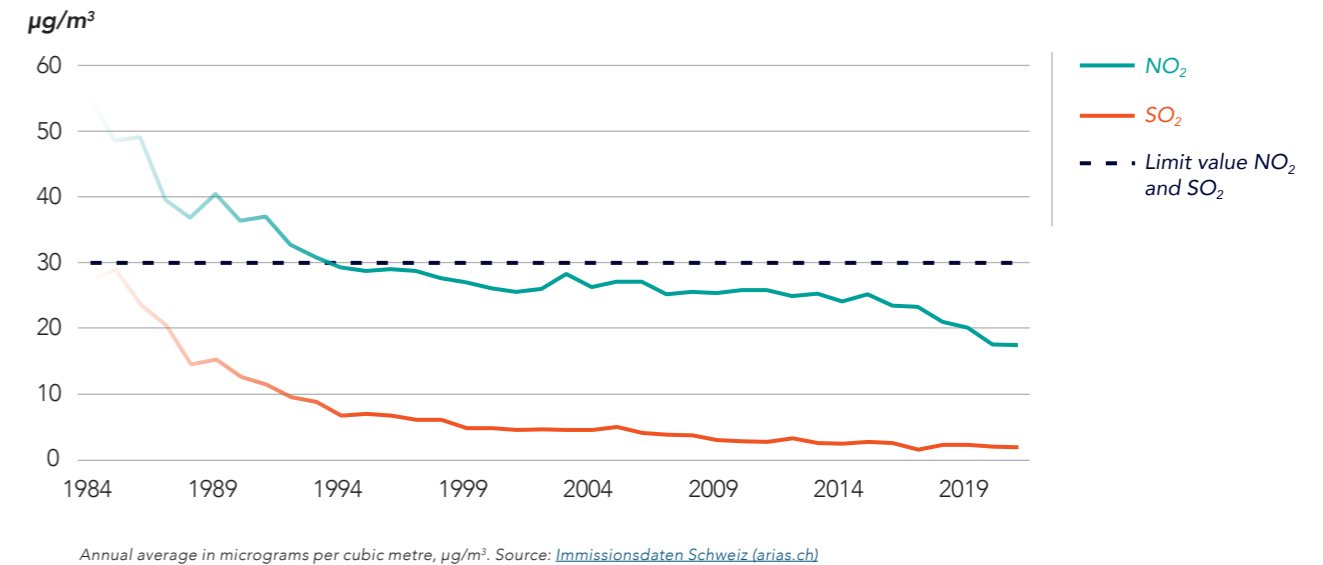
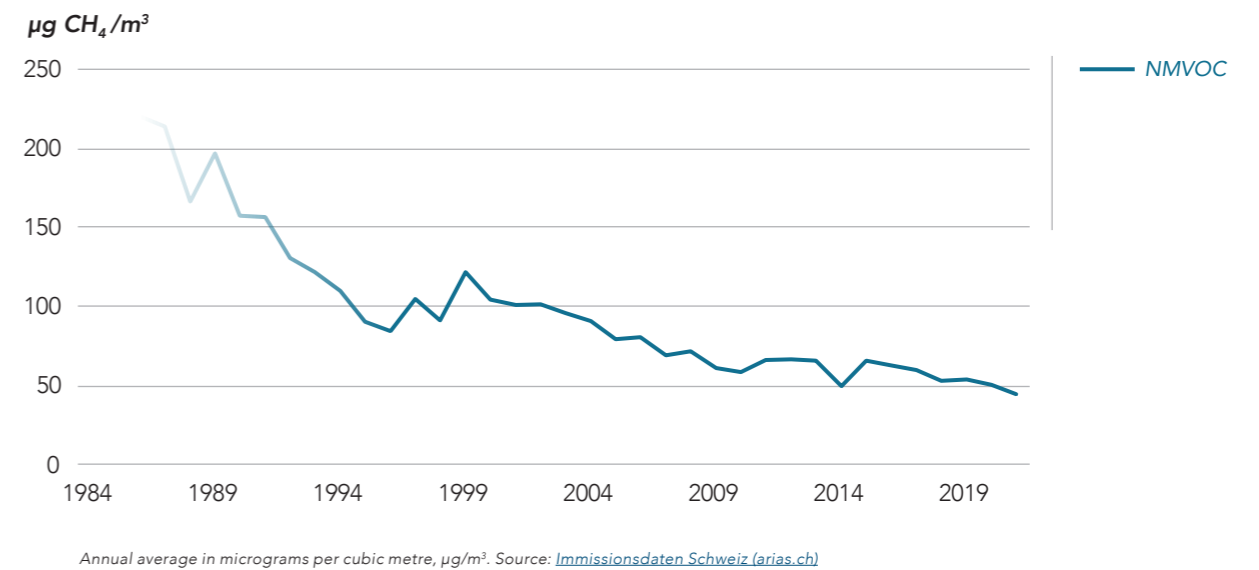


Figure 3: Non-methane volatile organic compound (NMVOC) concentrations



Despite the considerable successes of Swiss air pollution control policy, challenges remain:

- Measured concentrations of ozone (O₃) often exceed the ambient limit value over a large area in summer
- Concentrations of PM_{2.5} exceed the 2021 WHO air quality guidelines in several locations
- Exceedances of NO₂ concentrations are still observed at locations with heavy traffic
- In large parts of Switzerland nitrogen in the environment exceeds critical loads for nitrogen deposition and critical levels for ammonia concentration (FOEN 2022b).

That more needs to be done is evident from the following figures: In 2018, air pollution in Switzerland led to about 2,300 premature deaths² and is responsible for more than 1,800 hospital admissions every year. The total annual health costs are estimated to be over CHF 6 billion corresponding to 0.8 per cent of Swiss GDP (FOEN 2022b). A global analysis demonstrates that costs of action are far lower than the costs of inaction, with regional and global evidence showing that improving air quality is extremely cost-effective, with benefits exceeding costs in some cases by a factor of 30 (UNEP 2021).

² Population in Switzerland: 8.6 m

Swiss air pollution legislation

The Federal Environmental Protection Act (EPA) and the Ordinance for Air Pollution Control (OAPC), which entered into force in 1985 and 1986, respectively, express the Swiss clean air policy. The main goal of the EPA is to protect people against harmful effects or nuisances, and to preserve the natural foundations of life sustainably (Swiss Confederation, EPA article 1.1). The EPA contains the fundamental principles and the OAPC specifies the detailed prescriptions on air pollution control – emission limit values, ambient air quality standards and others. The EPA provides for a two-stage procedure:

1. The precautionary principle requires that air pollution be reduced as far as possible in accordance with the state of the art and economic viability. Measures must be taken at the source (emission limitation).
2. If the precautionary principle is not sufficient to comply with the limit values of the OAPC, stricter emission limitations must be ordered.

The OAPC is revised every 2-6 years. Generally, revisions and amendments are driven by scientific findings, exceedances of air quality limit values, advancements in technologies and changes in the costs of abatement technologies.

Swiss federalism

Switzerland is a federal state. This means that state powers are divided between the Confederation, the 26 cantons and the communes (around 2,300). The competences are divided among these entities according to the principle of subsidiarity. The Confederation assumes only those tasks that exceed the power of the cantons or require uniform regulation by the Confederation.

The OAPC requires the cantons to monitor the level and evolution of air pollution in their territories³ (Swiss Confederation, OAPC, Art. 27). If the ambient air quality does not meet the federal quality requirements, the cantons are obliged to develop and implement Clean Air Action Plans.

The mix of measures

To the complex task of improving air quality, Switzerland applies a mix of regulations and financial incentives in combination with the development of action plans and international cooperation.

Regulations

At the federal level, the OAPC regulates pollutant emissions from heating systems, industrial plants (see Annex 1, OAPC), motor vehicles, machinery and equipment, ships and rail vehicles, and regulates the quality of fuels and heating materials (see Annex 5, OAPC). In addition, the state of the art is to be applied to vehicles, industrial and agricultural plants, and heat generators. The ramifications include exhaust regulations for motor vehicles, harmonisation with EU regulations, particle filters for non-road vehicles and machinery and quality regulations for fuels and combustibles.

Taxes and incentives

The Confederation sets financial incentives such as emissions-based landing fees or taxes. Based on the EPA, the Ordinance on the Incentive Tax on Volatile Organic Compounds (VOCs) has been in force since 1998, and an incentive tax on VOCs has been levied since 2000.⁴

In addition, a CO₂ levy⁵ on combustible fossil fuels, such as heating oil and natural gas, provides an incentive to use fossil fuels more economically and to switch to renewable energy sources, and thereby reduce air pollutant emissions associated with fossil fuel combustion.

Action plans

Action plans exist at both the federal and cantonal levels. The national Action Plan on Particulate Matter⁶ defines several measures for reducing particulate emissions from road transport and wood furnaces.

Cantons are obliged to develop Clean Air Action Plans if the ambient air quality does not correspond to the federal requirements. Cantons select measures based on their effectiveness, efficiency and feasibility, and coordinate the development of measures with each other and with the private sector in a consultative process with public authorities and interest groups affected by the measures.

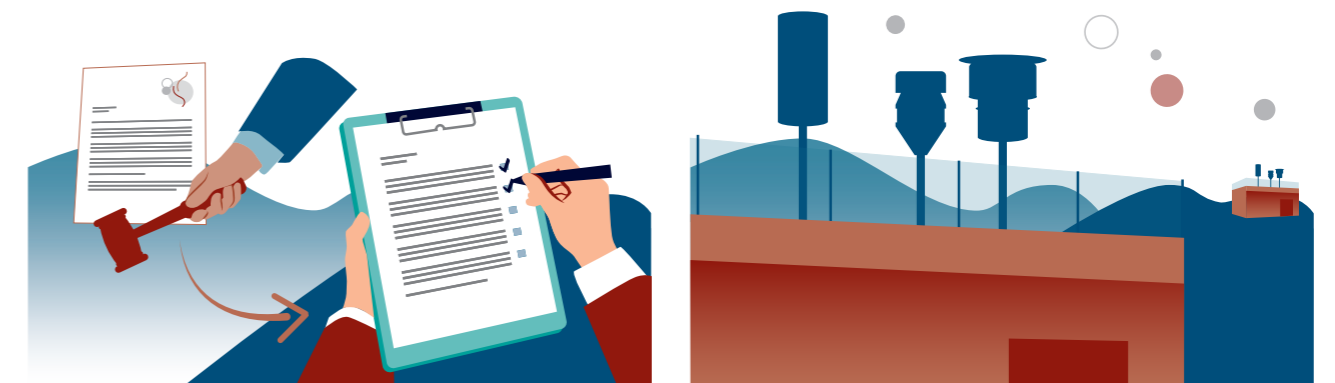
International cooperation

Given that air pollution does not stay within national borders, international efforts to reduce emissions are key. Switzerland participates in international cooperation, such as the United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (CLRTAP) and its seven protocols.

Switzerland also supports partners from low- and middle-income countries in tackling air pollution.⁷ The cooperation focuses primarily on providing technical support to countries in updating and improving their air quality standards and legislation, and in identifying and implementing effective measures to reduce pollutant emissions.

Air quality management and enforcement

Swiss air quality management and enforcement embraces a range of proven techniques and approaches across a spectrum of related issues in accordance with Swiss governance.



Shared responsibilities

In Switzerland, legislation takes place at the national level; enforcement, at the cantonal level. Cantons are responsible for monitoring air quality, measuring emissions of industrial installations, maintaining emission inventories, and for the development and enforcement of clean air action plans.

Measurement networks

The National Air Pollution Monitoring Network (NABEL)⁸ measures indicator pollutants of national importance, such as nitrogen dioxide, ozone and fine particles, at 16 locations in Switzerland. It is an important instrument for enforcing the OAPC, especially insofar as it serves to monitor the success of air pollution control measures. Air quality is also measured at the cantonal level.

³ These cantonal measurement networks complement the measurement network at the national level.

⁴ Since 2003, the levy rate has been CHF 3 per kg of VOC (equals around 3 dollars).

⁵ CO₂ act, chapter 5: <https://www.fedlex.admin.ch/eli/cc/2012/855/en>

⁶ National Action Plan on Particulate Matter: <https://www.news.admin.ch/news/message/attachments/1641.pdf> (available only in German)

⁷ See: <https://www.eda.admin.ch/content/dam/deza/en/documents/publikationen/Diverses/SDC-Clean-Air-FINAL-WEB2.pdf>

⁸ <https://www.bafu.admin.ch/bafu/en/home/topics/air/state/data/national-air-pollution-monitoring-network-nabel.html>



Emission inventories

National and cantonal emission inventories enable the identification of the sources of air pollutant emissions and are therefore an important instrument in the development of mitigation measures. The national emissions of the various sources of air pollutants, including greenhouse gases, are collected by or on behalf of the FOEN and processed for the attention of the international conventions^{9,10} and for national needs.



Emission limit updates

The emission limits are adjusted regularly mainly on the basis of new scientific findings or the further development of technologies. The authorities are required by the OAPC to ensure that existing stationary installations that do not comply with the requirements of this Ordinance are remediated. If necessary, the authorities impose operating restrictions or decommission the installation for the duration of the remediation.



Stakeholder engagement

Federal and cantonal authorities provide public information on air pollution and the harmful effects of elevated air pollutant concentrations to increase public awareness and acceptance of the measures being taken. The Swiss Society of Air Protection Officers – Cercl’Air – brings together representatives from Swiss public authorities and universities working in air pollution control, and promotes the exchange of experience and knowledge and the transfer of knowledge between science and practice in Switzerland. The activities of Cercl’Air include:

- The development of recommendations for standardisation and coordination
- The participation in consultations on federal laws, regulations and related directives
- The organisation of conferences, excursions, lectures and continuing education courses
- The establishment and maintenance of relationships with experts, organisations and institutions active in air pollution control



Air pollutant modelling

The [PolluMap](#)¹¹ uses emission data, air pollutant concentration measurements and models of pollutant dispersion in the atmosphere to calculate air pollutant concentrations throughout Switzerland in real time. This tool can identify areas with exceedances of limit values, and is an important source of information for policymakers.

Science and policy

New scientific findings and novel approaches routinely inform Swiss clean air policy. The Paul Scherrer Institute (PSI), with financial support from the Federal Office for the Environment and the cantons, for example, has investigated the effects of wood combustion on particulate pollution and has provided a scientific basis for developing and implementing targeted measures.¹²

PSI also investigates source apportionment based on the chemical composition of particulate matter.¹³ These results strongly influenced the legislation on wood firing systems, as they showed that wood burning contributes substantially to air pollution in several parts of Switzerland.

In addition, PSI researchers have measured the composition of fine dust at 22 locations in Europe.¹⁴ The result is a European map of the most important aerosol sources. Epidemiologists use this information to determine the aerosol sources that are most detrimental to human health, and policymakers in turn use these findings to propose targeted measures to reduce the most dangerous aerosols.

Conclusion

The Swiss experience in air quality management shows that air pollution can be greatly reduced when strong regulation is combined with fiscal and financial instruments, concrete action plans and continuous and comprehensive monitoring. The further reduction of premature deaths from air pollution, however, requires continuous development of the regulatory instruments such as regular updates of emission and concentration limits.

⁹ <https://www.ceip.at/status-of-reporting-and-review-results/2022-submission>

¹⁰ <https://unfccc.int/ghg-inventories-annex-i-parties/2022>

¹¹ PolluMap Model: <https://www.bafu.admin.ch/bafu/en/home/topics/air/state/data/luftbelastung--modelle-und-szenarien.html>

¹² See PSI news on the study: <https://www.psi.ch/en/media/our-research/during-winter-smog-fire-places-put-cars-in-the-shade>

¹³ <https://www.bafu.admin.ch/dam/bafu/de/dokumente/luft/externe-studien-berichte/chemical-characterisation-and-source-identification-of-pm-in-switzerland.pdf.download.pdf/Characterisation-source-identification-PM.pdf>

¹⁴ See PSI news on the study: <https://www.psi.ch/en/media/our-research/european-map-of-aerosol-pollution>

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<https://www.shareweb.ch/site/disasterriskreduction/Pages/Climate-DRR-and-Environment-Home.aspx>

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