How have NMVOC emissions changed based on the legislature in the EU?

Introduction

Non-methane volatile organic compounds are a common term used for a set of photochemically reactive compounds in the atmosphere, excluding methane. Examples of the compounds are benzene, ethanol, formaldehyde, cyclohexane and more. The methane is excluded due to its high ambient concentration compared to the other gases. The reason why these gases are grouped together as an emission, is because their collective properties are a lot easier to study than the individual gases.

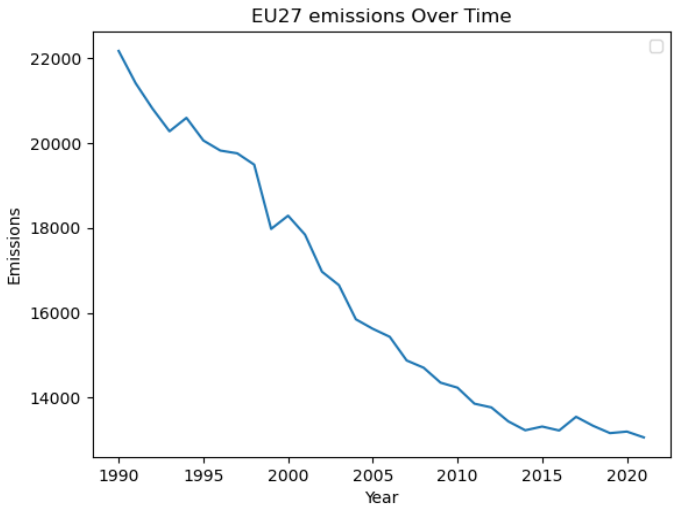
As NMVOCs cover a range of different compounds, they also arise from a diverse set of industries/sectors. The most prominent categories of NMVOC emissions are from industrial processes and product use, agriculture, extraction and distribution of fossil fuels, transport and stationary combustion plants. This varies between different countries. In India, about 60% of the NMVOC emissions were due to solid-fuel combustion in 2010 (Stewart *et al.*, 2021), and in Sweden refineries, pulp and paper plants are the largest emission contributors (Naturvårdsverket, 2023) .

NMVOCs are an essential part of the process which produces Ozone on a ground level. Large amounts of ozone on the ground level can damage crops as well as cause irritation in the respiratory tract for humans. Some of the NMVOCs also have direct effects on human health, like Benzene which may cause leukemia, or formaldehyde, acrolein and furan which have a toxic impact . A 2014 study found that the toxic impact comes primarily from transportation sectors and residential sources and that there is no clear correlation between total NMVOC emissions and these health impacts (Laurent and Hauschild, 2014).

In 2001, the national emissions ceilings directive was introduced in the EU. This law required EU member states to create national emission limits for different air pollutants, including NMVOCs. These goals were to be reached from 2010-2019 and then further emission reduction commitments would be made for 2020-2029 (European Environment Agency, 2022).
In addition, the European green deal is expected to reduce emissions of air pollutants significantly, even though the climate law is mainly aimed at greenhouse gases.

Results

This plot shows the EU27 emissions of NMVOC in kiloton (KT) through time (years) from 1990 to 2021. We can see the amount of NMVOC emissions decrease over time to reach approximately 13 065 KT of emissions.
Based on the policies mentioned in the introduction, it would make sense for there to be a sharp drop in emissions from around the year 2001. This can be seen in the graph, but there also seems to be a similarly sharp decrease before this point, when there was no clear legislation in place. This can be explained through the fact that a lot of the early NMVOC emissions were produced in industrial processes and that these processes have incorporated catalysts and other technologies to improve health impact in the working environment (NAEI, 2022). This also applied to passenger cars, where newly produced cars had to have catalysts.



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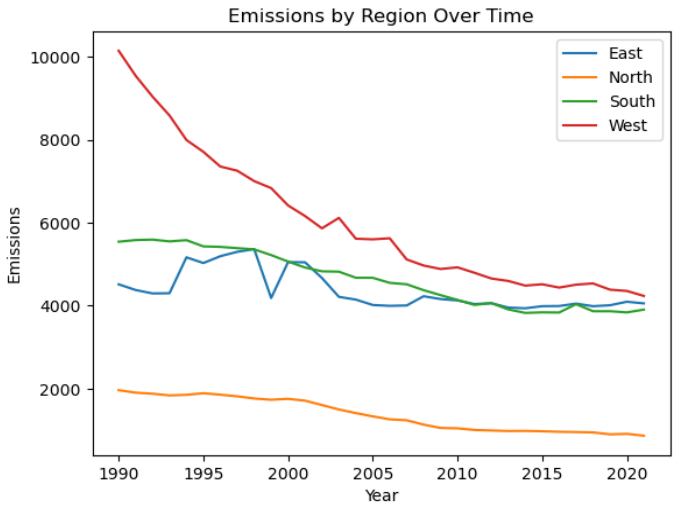
Since Europe as a region can be quite large and we want a more detailed picture of where the emissions are coming from, we divide Europe into four different regions. The regions are North, South, East and West.

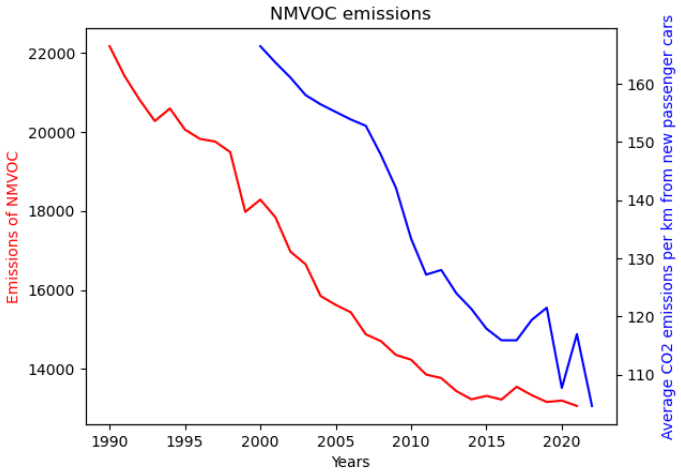


We can see North, West and South Europe decreased their NMVOC emissions over time.
In 1990, Western Europe was the most polluting European region by producing more than 10 000 KT of NMVOC emissions. In 2021, it almost reached the level of the South and the East region.

However, Eastern Europe didn't really do the job : if you compare

the 1990's level to the 2021's, the amount of emissions is pretty the same. Besides, from 1994 to early 2000's, emissions increased to reach almost 6000 KT. After that, the level has stayed quite constant with a slight increase since mid 2010's.
This can be explained by the fact Eastern Europe includes the two most polluting EU27 countries : Poland and Turkey.

In our data analysis we found that one of the most emitting sectors was the personal transport sector. This led us to find a dataset over emissions from new passenger cars.



The graph above shows a comparison between the emissions of NMVOCs and average CO2 per km from new passenger cars. This graph has a clear correlation and supports our findings in which passenger car technology has been an important factor in the reduction of NMVOC technology.

Conclusion

It seems 2001's policy decreased globally the NMVOC emissions through the EU27 even if there was a decreasing effect before due to the industrial processes catalysts. The general reduction trend has been fairly steady in Europe and seems to reach a more stabilizing rate around the year 2014. This might be due to technological limitations where it is a lot harder to cut the remaining emissions in cars and industrial processes than what it used to be.

We also see the difference between European regions remains. Eastern Europe didn't manage its emissions reduction well, by staying roughly constant, while the North, West and South all reduced their emissions consistently.

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