



OPPORTUNITY #28

What if we could absorb greenhouse gas emissions and particulate matter on demand anywhere in the world?

'MOBILE' SUPER SCRUBBERS

Enabled by materials science, automation and advanced machine intelligence, emissions and particulate matter are absorbed on an as-needed basis, anywhere in the world, independent of technological capabilities available on hand.

MEGATREND
Saving Ecosystems

TRENDS
Air Pollution
Nanotechnology
New Materials

SECTORS AFFECTED
Materials & Biotechnology
Chemicals & Petrochemicals
Data Science, AI & Machine Learning
Energy, Oil & Gas & Renewables

On average, those living in the largest urban cities in the MENA region breathe in **10 times** the **level of pollutants** in the air that the World Health Organization considers safe



WHY IT MATTERS TODAY

Air pollution, including both particulate matter (PM) and gas emissions,⁵⁰⁷ is responsible for 19% of all cardiovascular deaths and 21% of all stroke deaths globally.⁵⁰⁸ It is estimated that the direct costs to health due to climate change will have risen to between \$2 billion and \$4 billion per year by 2030.⁵⁰⁹

Carbon dioxide stays in the atmosphere for thousands of years.⁵¹⁰ While other greenhouse gases do not stay around for as long, they become more potent and damaging than carbon dioxide over time.⁵¹¹ For example, methane stays in the atmosphere for about 12 years,⁵¹² accounts for about 25% of all greenhouse gas emissions and is more than 25 times more potent than carbon dioxide.⁵¹³ Nitrous oxide stays in the atmosphere for about 114 years; it makes up only a small share of global greenhouse gas emissions but 1 kg of nitrous oxide is 300 times more potent than 1 kg of carbon dioxide.⁵¹⁴

PM is a term for small particles, measuring less than 10 µm (micro-metres) across, that are found in the air and that have serious health impacts on humans, animals and aquatic life.⁵¹⁵ Particles measuring less than 2.5 µm, or aerosols, are a severe health hazard with long-term exposure.⁵¹⁶ While 90% of aerosols come from gases that are emitted by natural sources (such as volcanoes, sandstorms, plants and algae in oceans) and that react with the atmosphere to create aerosols, 10% are linked to industrial or transportation emissions.⁵¹⁷ Around 99% of the global population breathes air that exceeds the World Health Organization's (WHO) air quality limits,⁵¹⁸ and, even though PM concentrations decreased on average by 30% to 40% during the COVID-19 lockdowns in 2020 compared to levels in the same period in the years 2015 to 2019, some areas saw increases or spikes for other reasons, such as dust or secondary PM formation from other gas emissions.⁵¹⁹

Even with national efforts to move away from hydrocarbon dependence in the Middle East and North Africa (MENA), climate change will have significant implications including drought, rising sea levels and extreme heat.⁵²⁰ On average, those living in the largest urban cities in the MENA region breathe in 10 times the level of pollutants in the air that the World Health Organization considers safe.⁵²¹ Air pollution causes around 270,000 deaths per year and costs the region \$141 billion per year, or 2% of regional GDP.⁵²²



THE OPPORTUNITY

Clean air will one day be a critical need if climate change persists. Materials science, automation and advanced machine intelligence could contribute to the invention of a mobile emissions and particulate matter (PM) scrubber that could absorb carbon dioxide, other greenhouse gases and PM anywhere in the world. If this idea were scaled, scrubbers could be positioned at sea as offshore platforms to absorb emissions and PM.

Mobile emissions and PM scrubbers could be standalone solutions powered by renewable sources of energy. Using advanced materials, they could efficiently absorb greenhouse gases and PM and either store them for later use or convert them into fuel⁵²³ and other non-harmful, possibly useful chemicals.⁵²⁴

BENEFITS

Improved health with reduced air pollution in both local and wider regions. Reduced costs for lower-income countries in mitigating the effects of climate change.

RISKS

Increased dependence on technology. Difficulties using advanced machine intelligence to ensure that technologies (especially mobile or offshore ones) are autonomous yet sufficiently efficient. Misuse of platforms.



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