Impacts of materials and their supply chains

Part 2 – use phase

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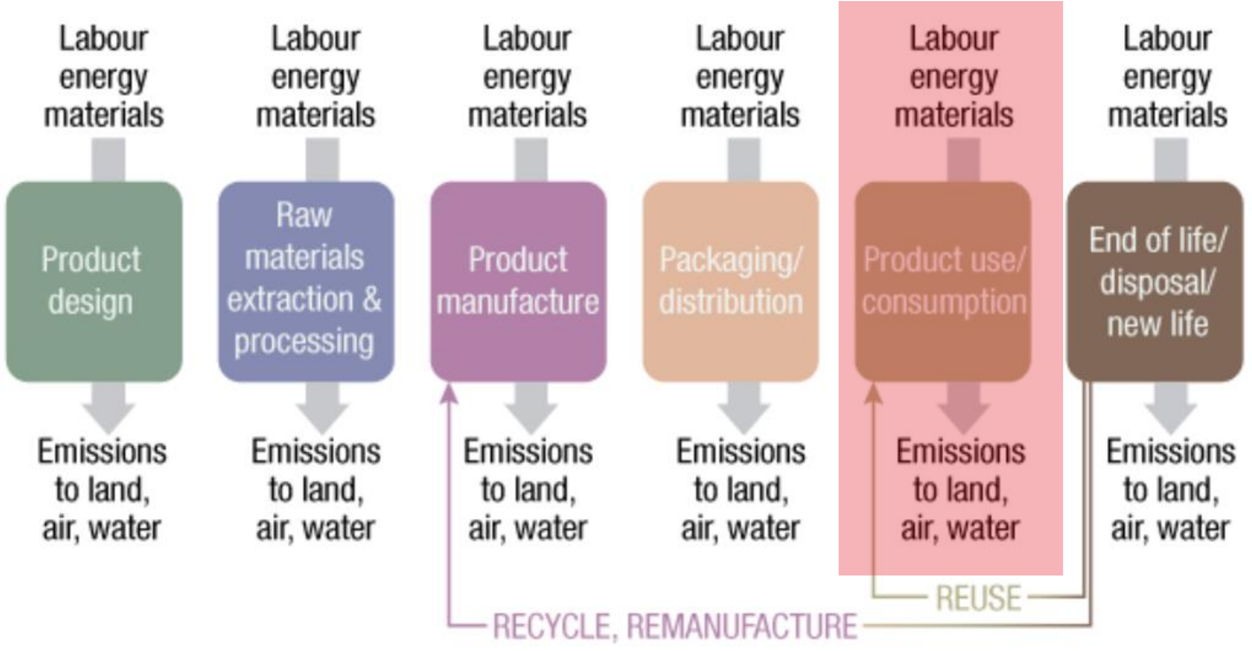
Overview

- The value of nature
- Raw material extraction & transformation
- Use phase
- End of life
- 2020 Petro-chemical economy vs. 2050 NetZero

Use phase

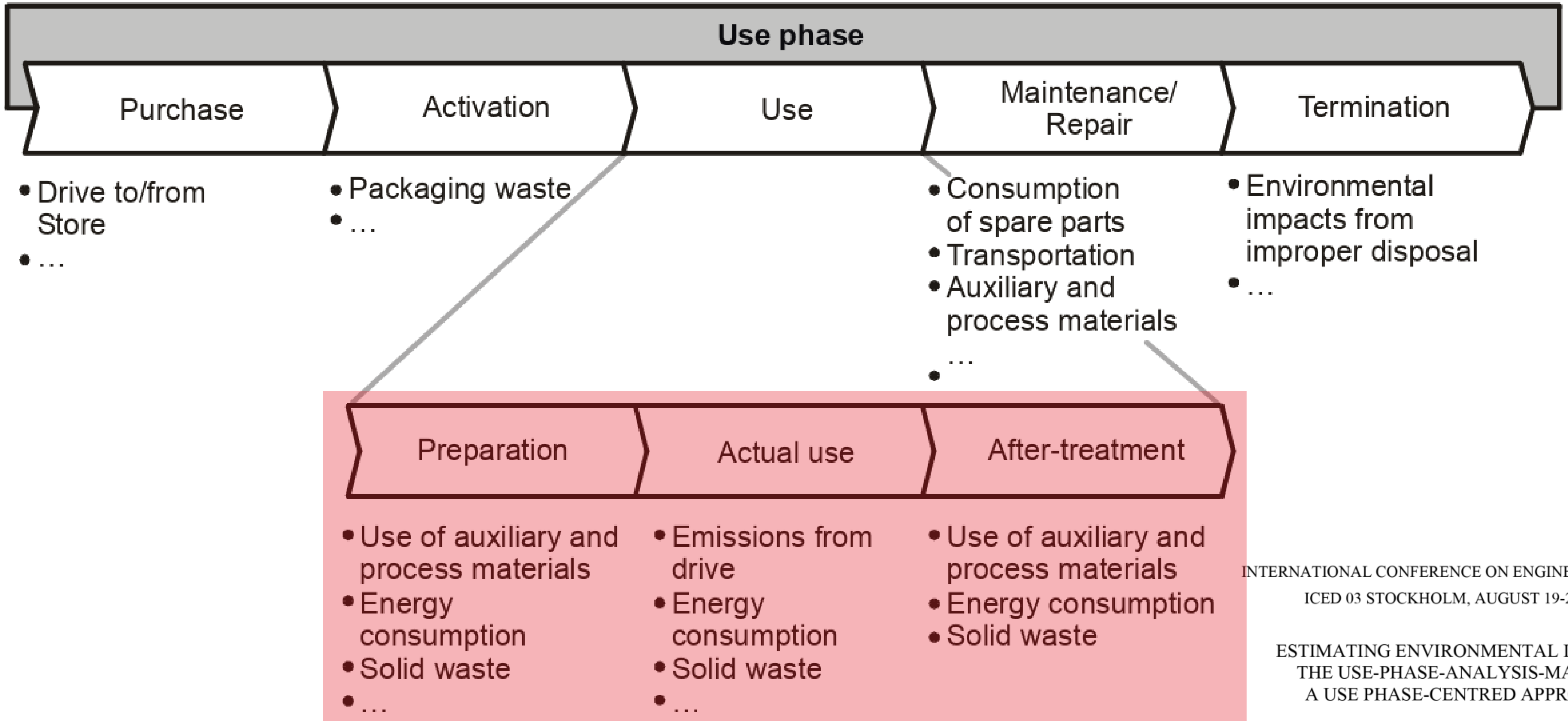
Figure 1: Phases in the life cycle of a product. Life Cycle Assessment (LCA) is a quantitative tool that facilitates the systematic quantitative assessment of products, in terms of environmental, human health, and resource consumption considerations. The methodology is internationally standardised by ISO 14040.



Source: Modified from UNEP Life Cycle Initiative.

RMIS - Environmental impacts along the supply chain

Use phase



INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN
ICED 03 STOCKHOLM, AUGUST 19-21, 2003

ESTIMATING ENVIRONMENTAL IMPACTS:
THE USE-PHASE-ANALYSIS-MATRIX -
A USE PHASE-CENTRED APPROACH

Christof Oberender and Herbert Birkhofer

Figure 1. Structuring the use phase in sub-phases and related environmental impacts [2]

Impact of use phase of engineered products (when a product is used)

- Product efficiency, durability, and repairability can influence the environmental impact.
- The environmental footprint during use includes energy consumption and emissions (electricity & fossil fuels).
- Products can impact human health, especially through chemicals or waste generation.
- Product availability and affordability affecting different socio-economic groups.
- Consumer habits and cultural attitudes toward product longevity and disposal.

- Degradation of materials leading to microplastic and other pollutants.
- Exposure to harmful chemicals, like phthalates in plastics and flame retardants in electronics.
- Respiratory issues from emissions related to product use (e.g., vehicles).
- Skin conditions or allergies due to exposure to synthetic materials.
- Long-term health effects from the continued exposure to low-level toxins.

Environmental impacts of engineered products and materials

1. **Energy Consumption**: Many products, especially electronic devices and appliances, consume a substantial amount of energy during their use phase. This can lead to increased greenhouse gas emissions if the energy is sourced from fossil fuels.
2. **Resource Depletion**: Continuous use of products often requires resources such as water, cleaning agents, and other consumables, which can contribute to resource depletion
3. **Emissions and Pollution**: Products like vehicles and industrial machinery can emit pollutants during their use phase, contributing to air and water pollution
4. **Waste Generation**: The use phase can generate waste, such as packaging materials, disposable components, and maintenance-related waste

Environmental footprint of your product's use phase

Examples of products, impacts, benefits

1. Automobiles

- **Environmental Impacts**: Cars emit greenhouse gases and pollutants like CO2, NOx, and particulate matter, contributing to air pollution and climate change. They also consume significant amounts of fossil fuels
- **Societal Impacts**: Automobiles provide mobility and convenience but can lead to traffic congestion, accidents, and health issues related to air pollution

2. Refrigerators

- **Environmental Impacts**: Refrigerators consume electricity, which can lead to higher greenhouse gas emissions if the electricity is generated from fossil fuels. Older models may also use refrigerants that are harmful to the ozone layer
- **Societal Impacts**: They improve food preservation and safety, reducing food waste and supporting better nutrition

3. Smartphones

- **Environmental Impacts**: Smartphones require energy for charging and can contribute to electronic waste. The production and disposal of smartphones involve hazardous materials
- **Societal Impacts**: They revolutionize communication, access to information, and social connectivity but can also lead to issues like digital addiction and privacy concerns / mental health issues

4. Industrial Machinery

- **Environmental Impacts**: Industrial machinery often consumes large amounts of energy and water, and can emit pollutants during operation. This contributes to resource depletion and environmental degradation.
- **Societal Impacts**: These machines increase productivity and economic growth but can pose health and safety risks to workers if not properly managed.

5. Household Appliances (e.g., Washing Machines)

- **Environmental Impacts**: Washing machines use water and electricity, contributing to resource consumption and energy-related emissions. Detergents used can also impact water quality.
- **Societal Impacts**: They save time and labor, improving quality of life, but can lead to increased household energy and water bills.

Anthropogenic Emissions and Human Mortality due to Ambient Air Pollution

- Globally
  - Anthropogenic ozone
    - 493,000 deaths/year
    - Land transportation greatest impact (80,900 deaths/year, 16% global burden),
  - Anthropogenic PM 2.5
    - 2.2 million deaths/year
    - Inhalable particles with diameters generally 2.5 micrometers and smaller
    - Residential and Commercial sector contributed the most to PM 2.5 related premature mortality 675,000 deaths/year, 30%).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Research | 13 May 2016

The Impact of Individual Anthropogenic Emissions Sectors on the Global Burden of Human Mortality due to Ambient Air Pollution

Authors: Raquel A. Silva, Zachariah Adelman, Meridith M. Fry, and J. Jason West | AUTHORS INFO & AFFILIATIONS

Publication: Environmental Health Perspectives • Volume 124, Issue 11 • Pages 1776 - 1784 • https://doi.org/10.1289/EHP177

5,225 Altmetric 11 PDF

Abstract

Background:

Exposure to ozone and fine particulate matter (PM2.5) can cause adverse health effects, including premature mortality due to cardiopulmonary diseases and lung cancer. Recent studies quantify global air pollution mortality but not the contribution of different emissions sectors, or they focus on a specific sector.

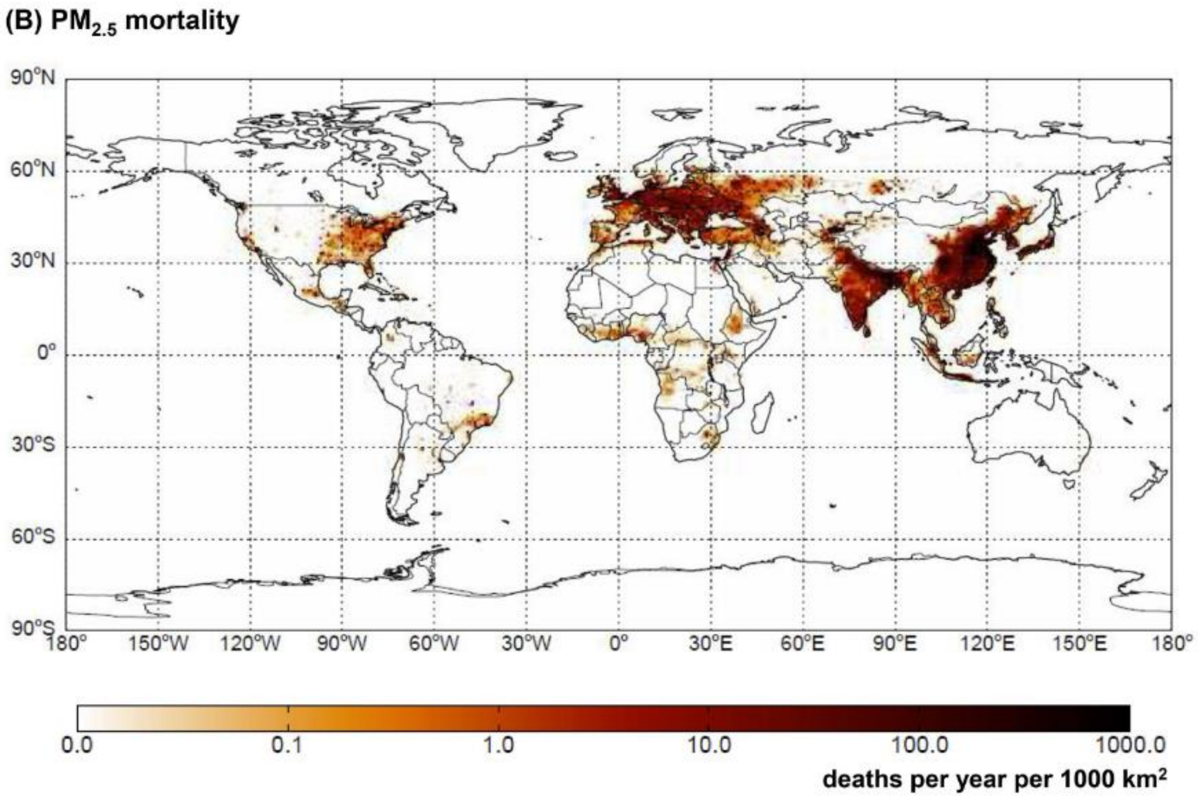
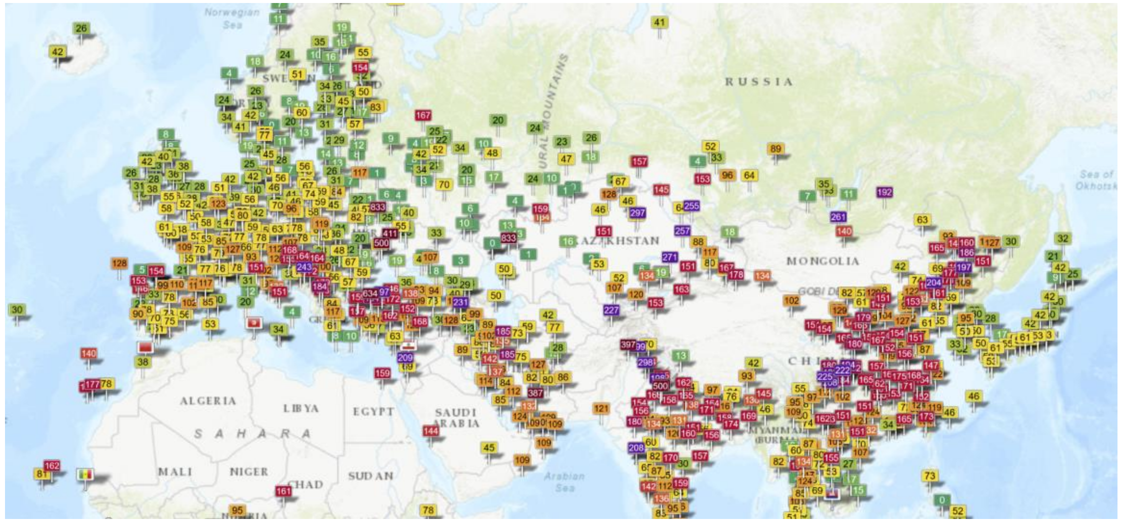


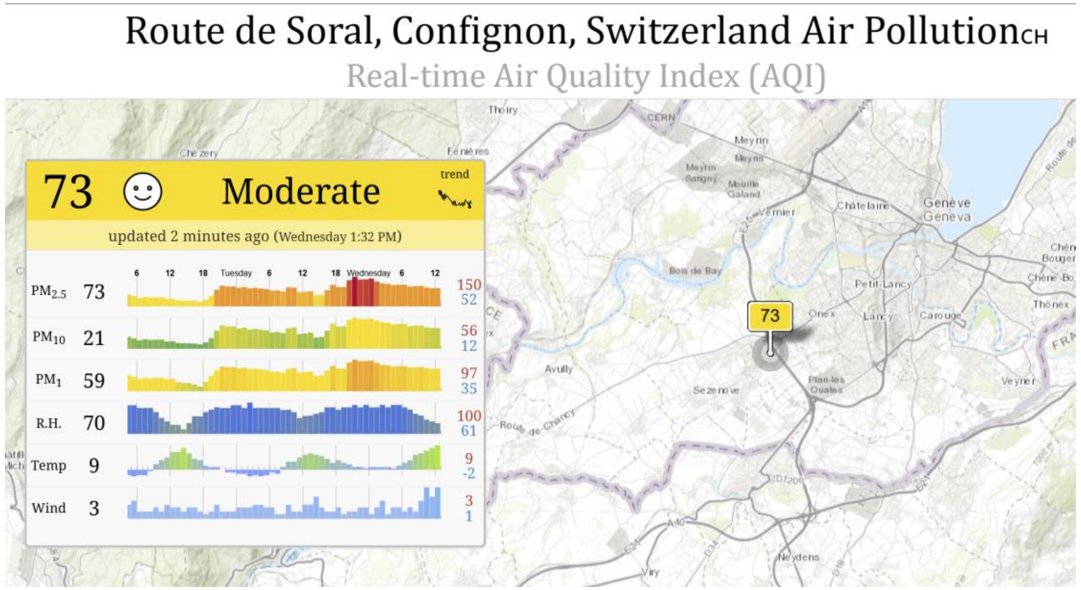
Figure 1. Premature ozone-related respiratory mortality (*A*) and $PM_{2.5}$-related mortality [ischemic heart disease (IHD) + stroke + chronic obstructive pulmonary disease (COPD) + lung cancer (LC)] (*B*) in 2005 (deaths per year per 1,000 km^2), shown as the mean of 1,000 Monte Carlo simulations.

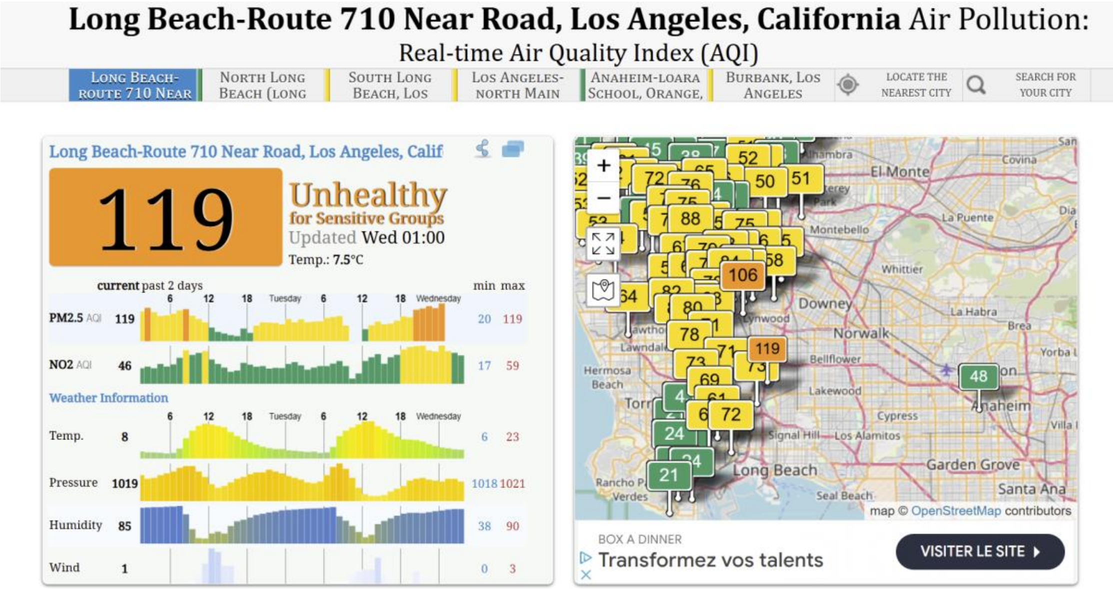
Environmental Health Perspectives • VOLUME 124 | NUMBER 11 | November 2016 1779

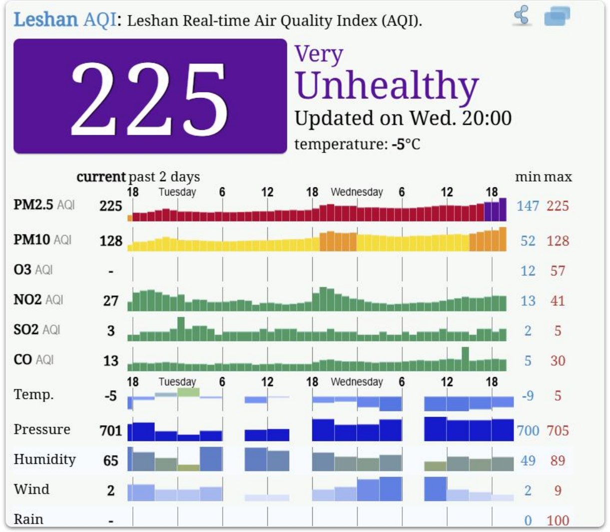
The Impact of Individual Anthropogenic Emissions Sectors on the Global Burden of Human Mortality due to Ambient Air Pollution

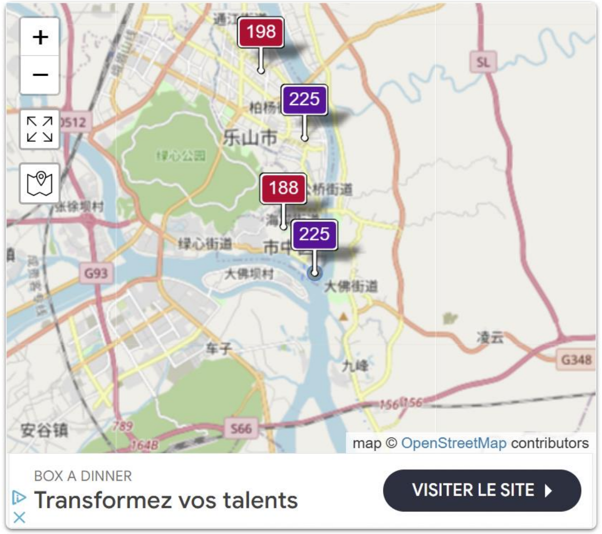
18th Dec 2024 snapshots







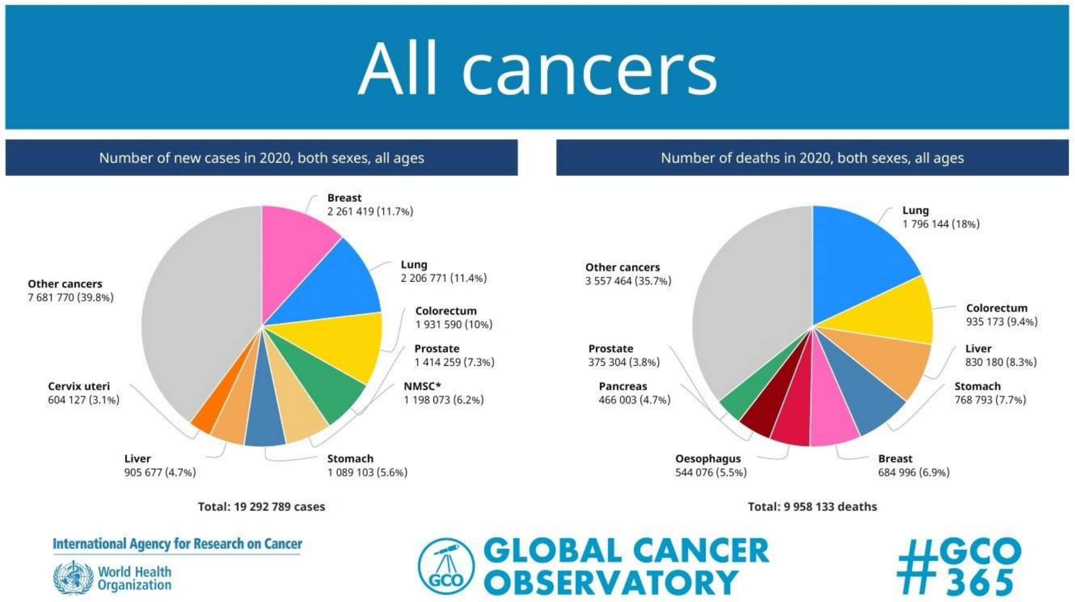


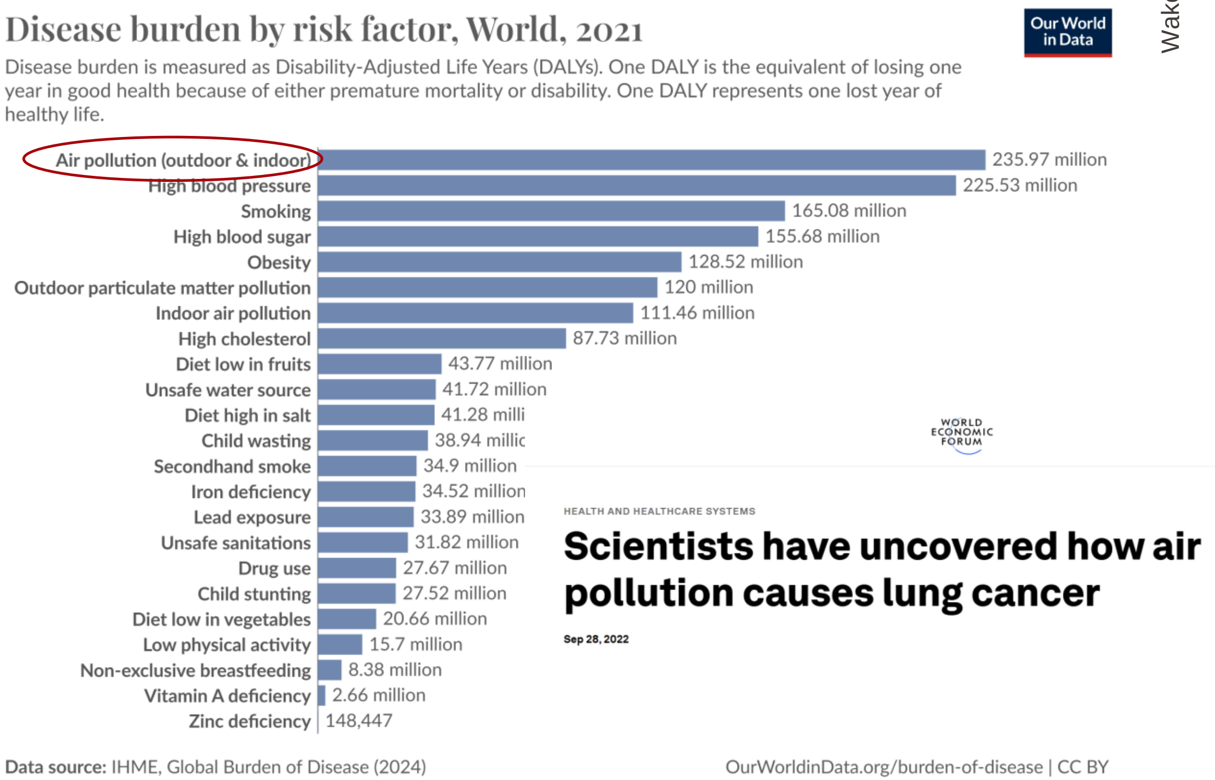


[World's Air Pollution: Real-time Air Quality Index]

Our Petro-chemical economy is not good for us

- Cancer is one of the leading causes of death globally, accounting for almost 60% of deaths, according to the WHO. Lung cancer was the most lethal form of cancer in 2020, linked to 1.8 million deaths. It's also the second most common cancer after breast cancer.





They have also discovered a molecule which helps prevent cells in the lung from becoming cancerous, which could accelerate the development of new cancer medicines.

[Scientists establish link between air pollution and lung cancer | World Economic Forum](#)

[Deaths by risk factor, World, 2021](#)

[Data review: how many people die from air pollution? - Our World in Data](#)

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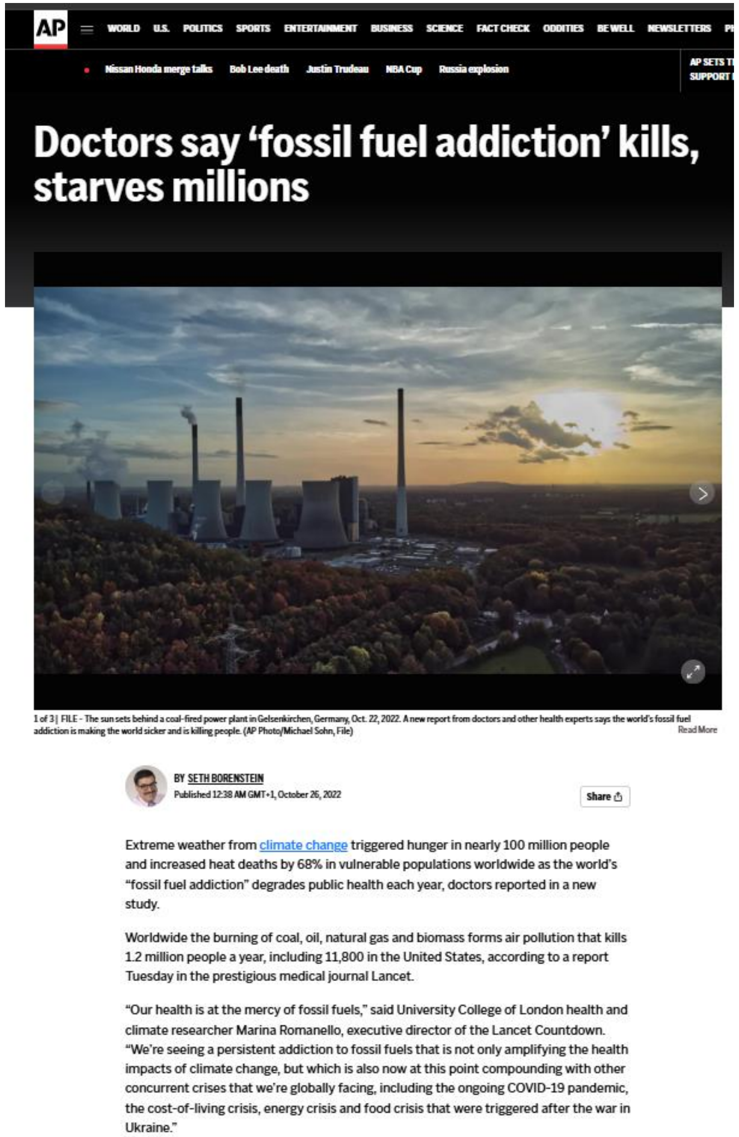
Anthropogenic Air Pollution cost to economy

- World bank
  - Leading environmental risk to health, causing 7 million premature deaths each year.
  - This is equivalent to the number of people that have died from COVID-19 since March 2020.
  - Globally costs an estimated $8.1 trillion in 2019, 6.1% global GDP.
  - In individual countries, the economic burden of pollution associated with premature mortality and morbidity is also significant, equivalent to 5 to 14% of countries' GDPs.



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Nissan Honda merge talks Bob Lee death Justin Trudeau NBA Cup Russia explosion

Doctors say 'fossil fuel addiction' kills, starves millions

1 of 3 | FILE - The sun sets behind a coal-fired power plant in Gelsenkirchen, Germany, Oct. 22, 2022. A new report from doctors and other health experts says the world's fossil fuel addiction is making the world sicker and is killing people. (AP Photo/Michael Sohn, File) Read More

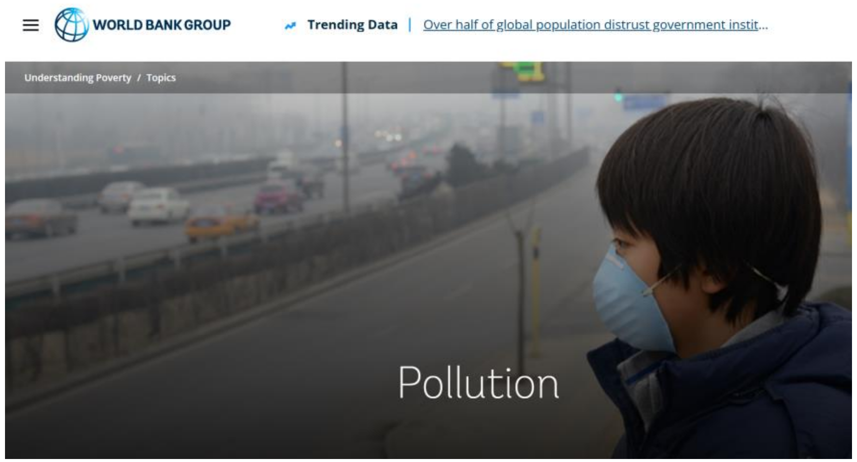
BY SETH BORENSTEIN
Published 12:38 AM GMT+1, October 26, 2022

Share

Extreme weather from climate change triggered hunger in nearly 100 million people and increased heat deaths by 68% in vulnerable populations worldwide as the world's "fossil fuel addiction" degrades public health each year, doctors reported in a new study.

Worldwide the burning of coal, oil, natural gas and biomass forms air pollution that kills 1.2 million people a year, including 11,800 in the United States, according to a report Tuesday in the prestigious medical journal Lancet.

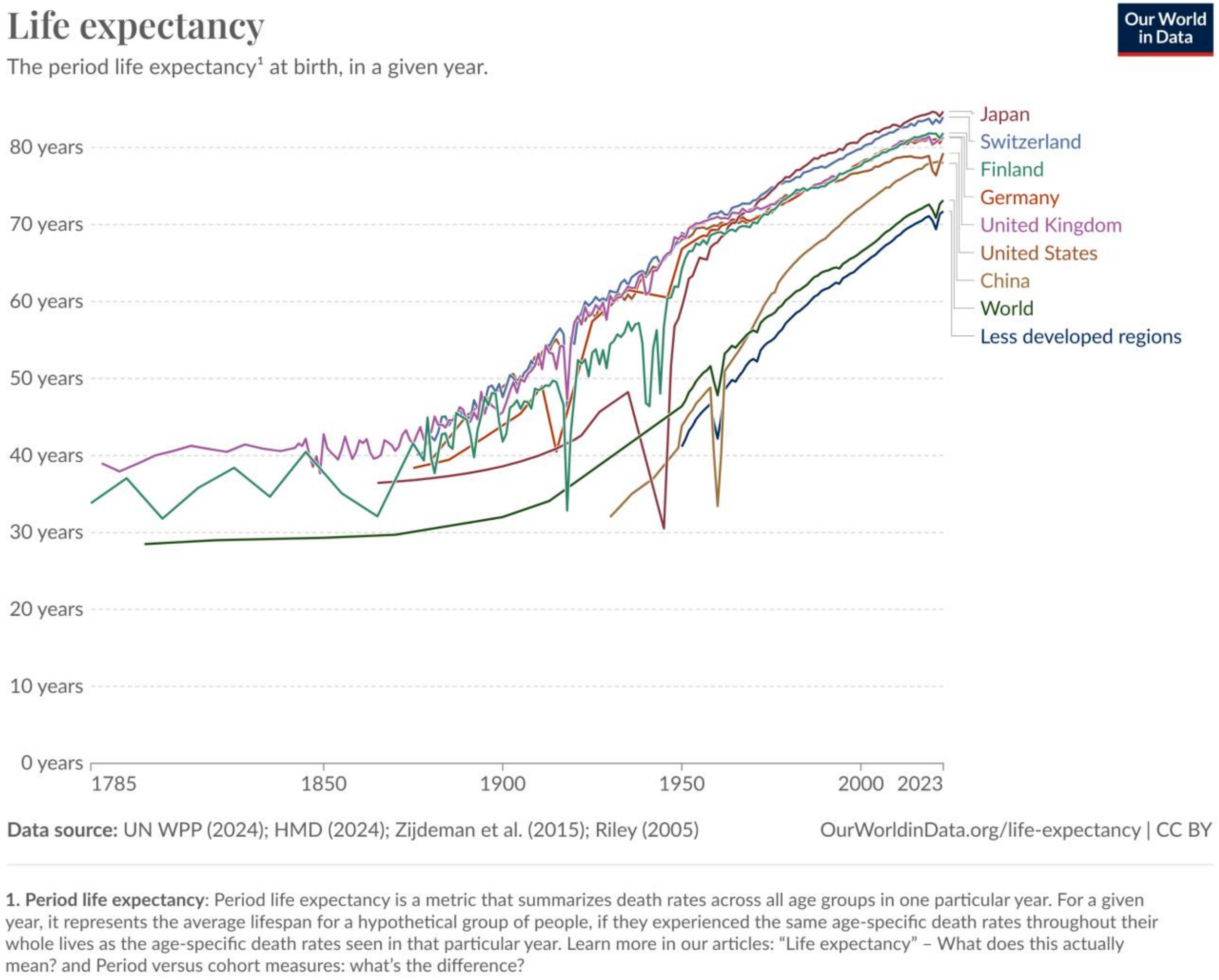
"Our health is at the mercy of fossil fuels," said University College of London health and climate researcher Marina Romanello, executive director of the Lancet Countdown. "We're seeing a persistent addiction to fossil fuels that is not only amplifying the health impacts of climate change, but which is also now at this point compounding with other concurrent crises that we're globally facing, including the ongoing COVID-19 pandemic, the cost-of-living crisis, energy crisis and food crisis that were triggered after the war in Ukraine."



[Doctors say 'fossil fuel addiction' kills, starves millions | AP News]

Towards being healthy

- 116-year-old Tomiko Itooka (b. 23 May 1908) is now the world’s oldest living woman and oldest living person



Life Expectancy - Our World in Data

116-year-old Japanese woman confirmed as world’s oldest living person | Guinness World Records

Use phase emissions - how we travel matters

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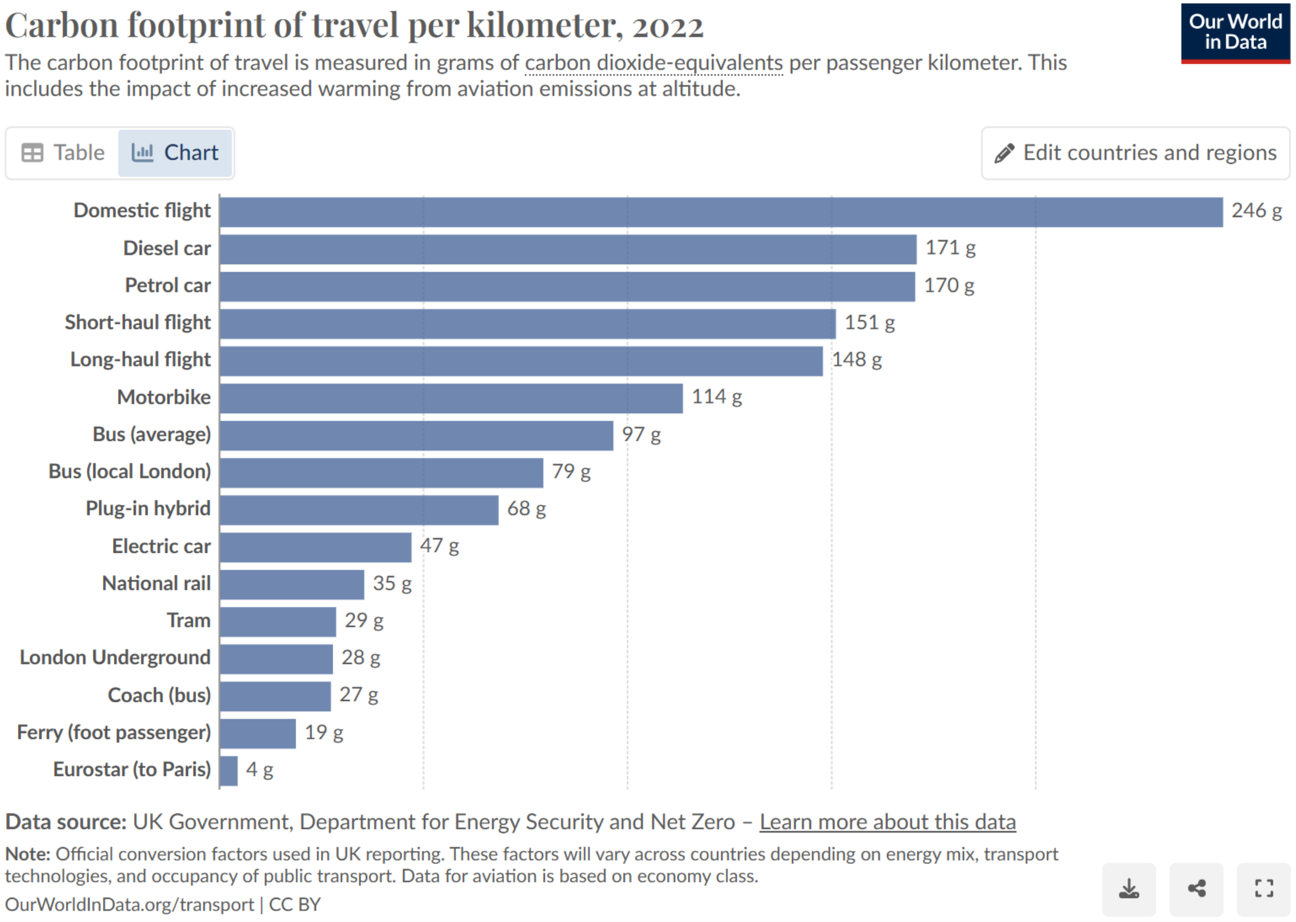
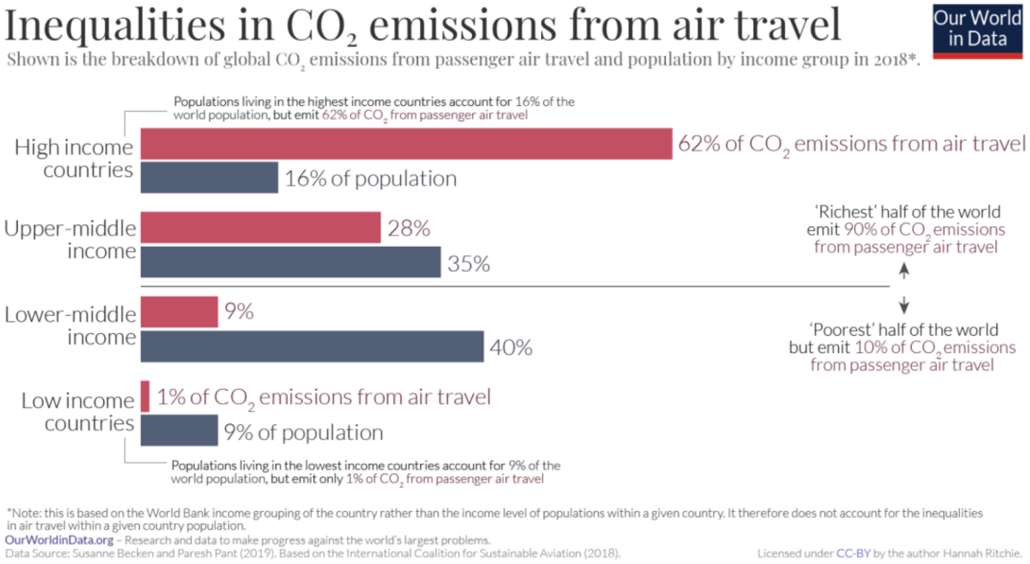
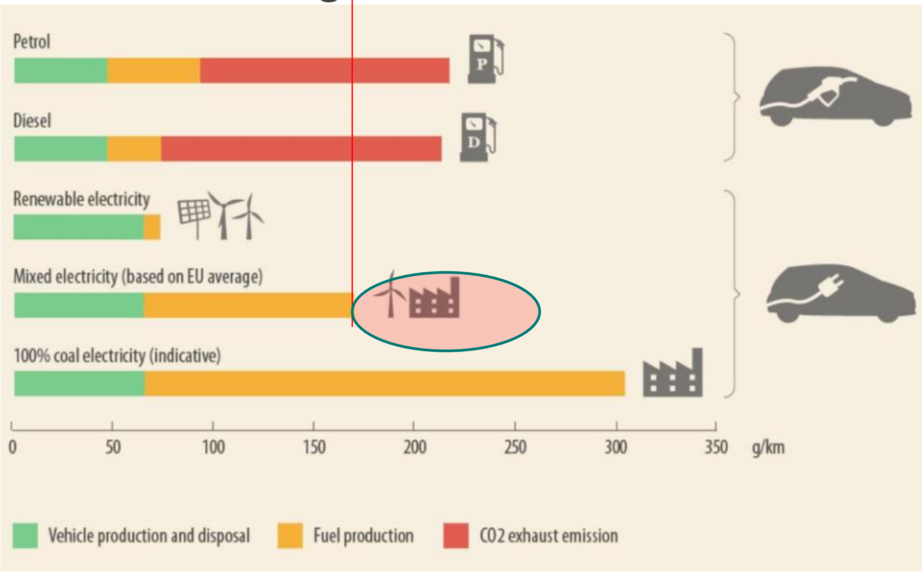


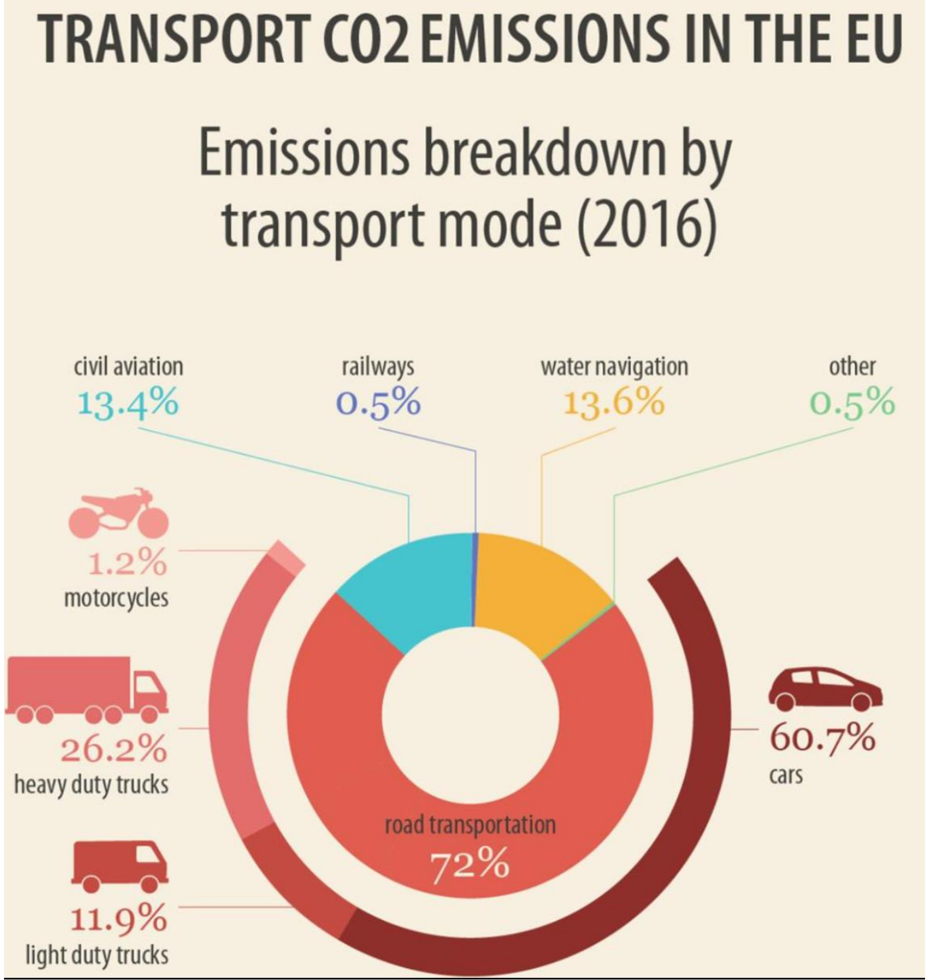


Which form of transport has the smallest carbon footprint? - Our World in Data

Passenger vehicle transport use phase CO_2

- Social evolution vs. Technological evolution
- Road transport = 75% of emissions from the sector
- By 2050, number of cars increase by 2x
- Vehicles much more efficient today but offset by our driving more km



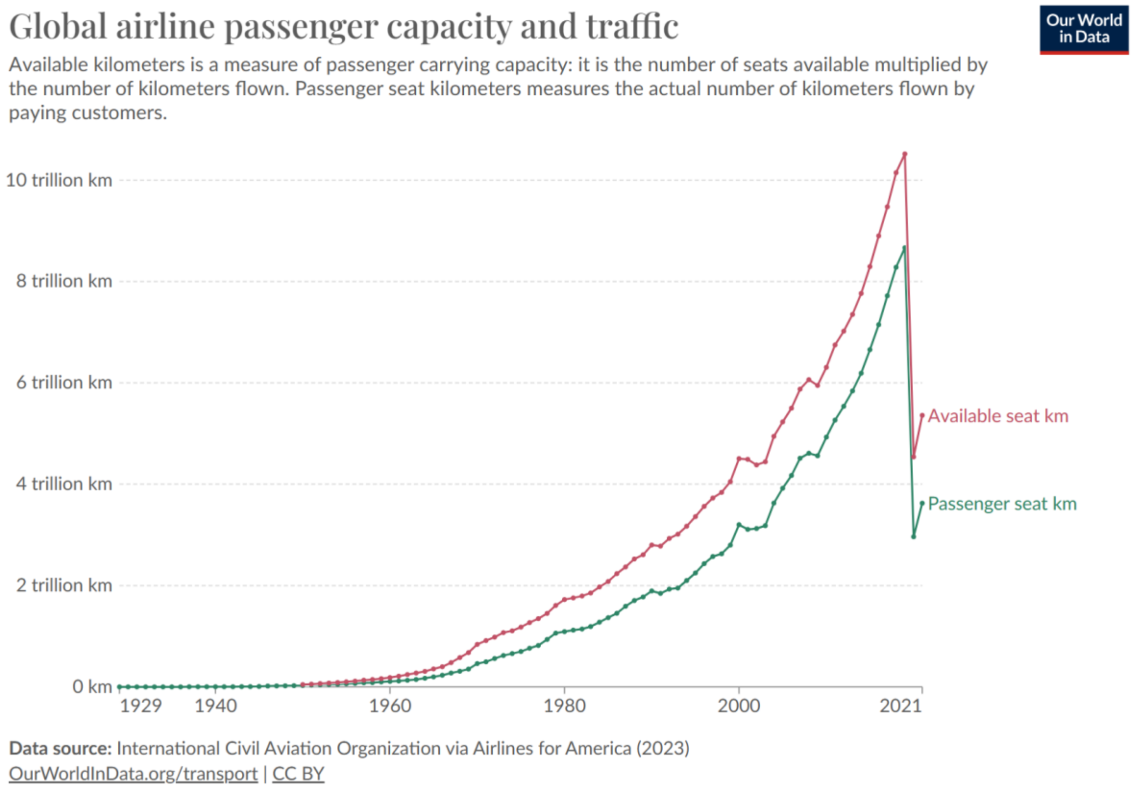


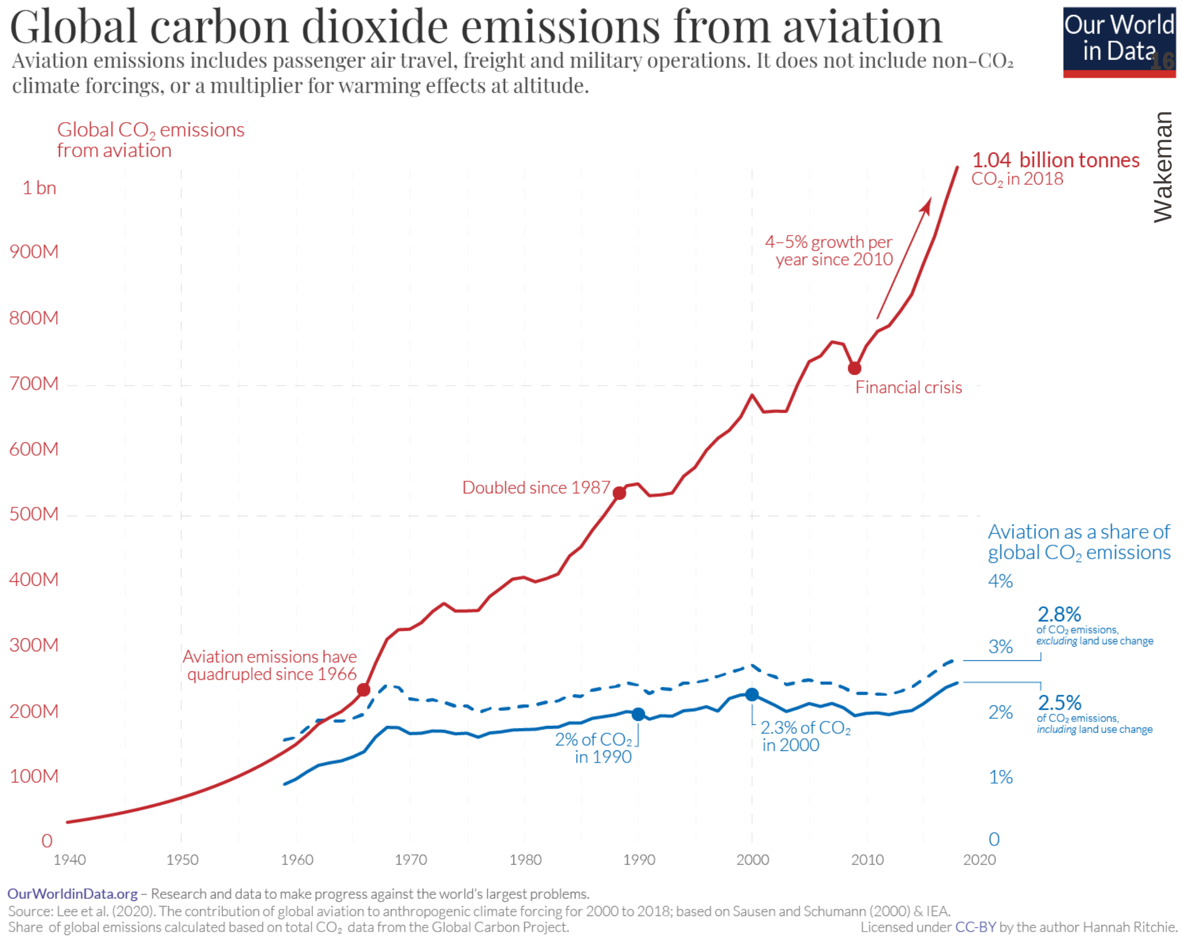
https://www.europarl.europa.eu/news/en/headlines/society/20190313STO31218/co2-emissions-from-cars-facts-and-figures-infographics

We need to power EVs with renewable energy, not coal
Not enough renewable energy to recharge world's EVs

https://qph.fs.quoracdn.net/main-qimg-434b21caa94121cf2d1f22e75a9dbaa1

Aviation emissions





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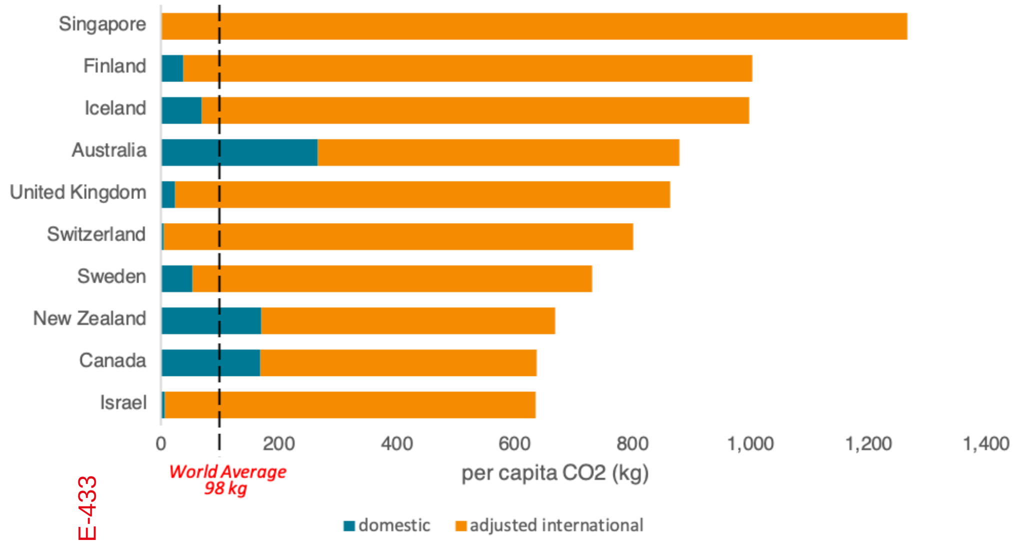
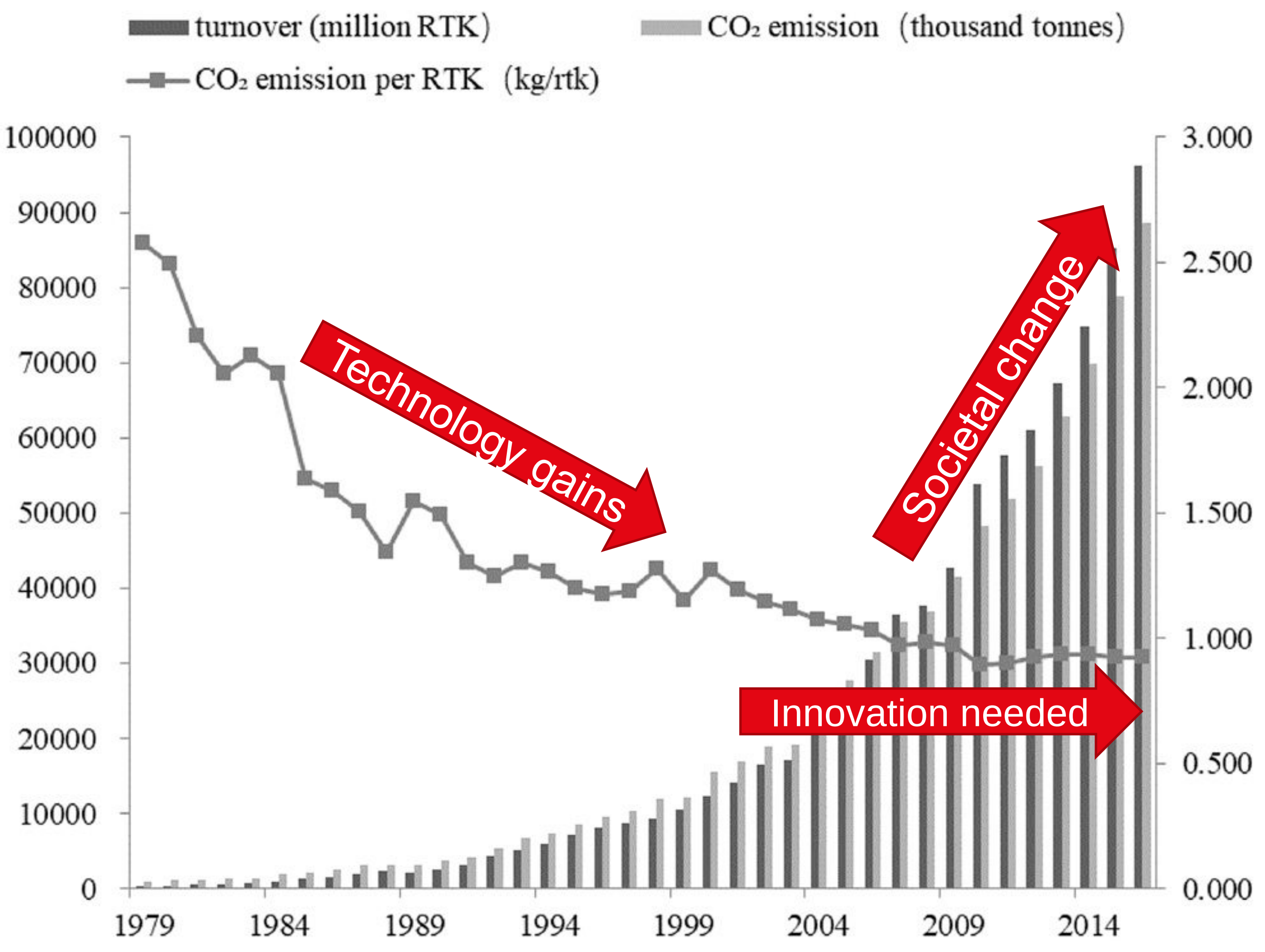
- Domestic and international; passenger and freight, accounts for:
  - 1.9% of greenhouse gas emissions (which includes all greenhouse gases, not only CO2)
  - 2.5% of CO2 emissions
  - 3.5% of 'effective radiative forcing' – a closer measure of its impact on warming.
- Aviation emissions have doubled since the mid-1980s.
- But, they've been growing at a similar rate as total CO2 emissions – this means its share of global emissions has been relatively stable: in the range of 2% to 2.5%.

Climate change and flying: what share of global CO2 emissions come from aviation? - Our World in Data

Aerospace – use phase

- The CO_2 emissions per revenue tonne km, (RTK) has decreased over time witl efficiency gains
  - a tonne of "revenue load" of passengers or freight being carried one kilometer
- Overall aviation turnover and emissions have increased dramatically, e.g. in China over the past few decades Source: Yu, J. et al. (2020).





Not every tonne of aviation CO2 is created equal | International Council on Clean Transportation (theicct.org)

Emissions from Chinese aviation 'could quadruple by 2050' - Carbon Brief

'akeman

We use toxic materials for our safety

- Strontium chromate
  - Anti-corrosion aluminum treatment (banned for automotive, permitted in aerospace, being phased out)

Introducing more eco-efficient chemical treatments for aircraft structure

Towards a chromate-free Airbus

The future of the aircraft industry's impact on the environment is paramount to Airbus, continuously searching for more eco-efficient values, from the first step of the design and throughout the aircraft's entire life cycle (see figure 1). Airbus integrated eco-efficiency values into its core strategy and was the first aeronautical company to obtain the ISO 14001 environmental certification for all its European Union (EU) manufacturing sites and product related activities. Proactive approach, anticipating the future regulatory framework at the earliest possible stage in design, rather than implementing reactive solutions, has proved to be the most appropriate response to the various growing environmental challenges. Therefore, Airbus has launched initiatives to progressively replace the most hazardous substances and processes. This article introduces the Airbus roadmap for replacing chromate containing materials and processes with more environmentally friendly ones.

François MUSEUX
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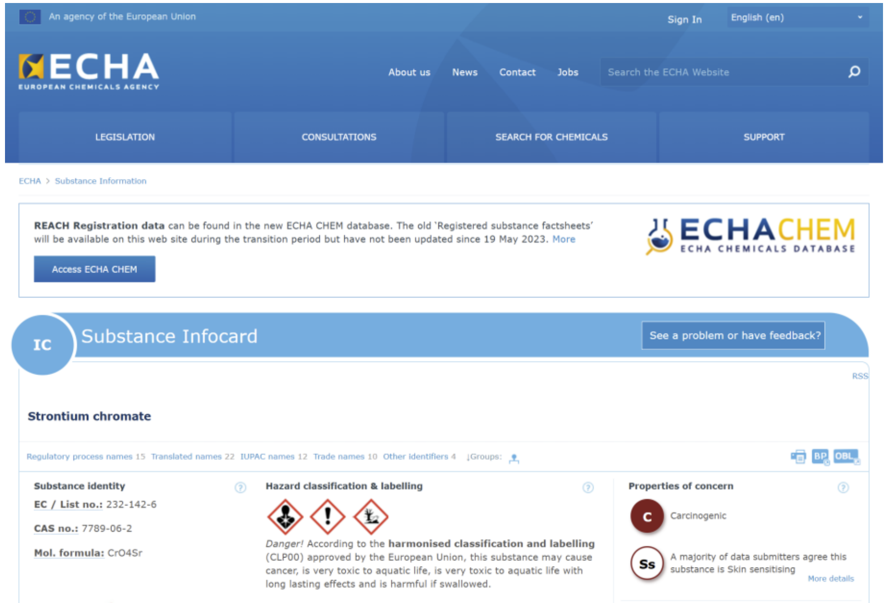
Airbus Customer Services

Ralf THEILMANN
ACF Project Manager
Engineering Structure
Materials and Processes
Airbus Engineering



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ECHA EUROPEAN CHEMICALS AGENCY

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ECHA > Substance Information

REACH Registration data can be found in the new ECHA CHEM database. The old 'Registered substance factsheets' will be available on this web site during the transition period but have not been updated since 19 May 2023. More

Access ECHA CHEM

ECHA CHEM ECHA CHEMICALS DATABASE

IC Substance Infocard — See a problem or have feedback?

RSS

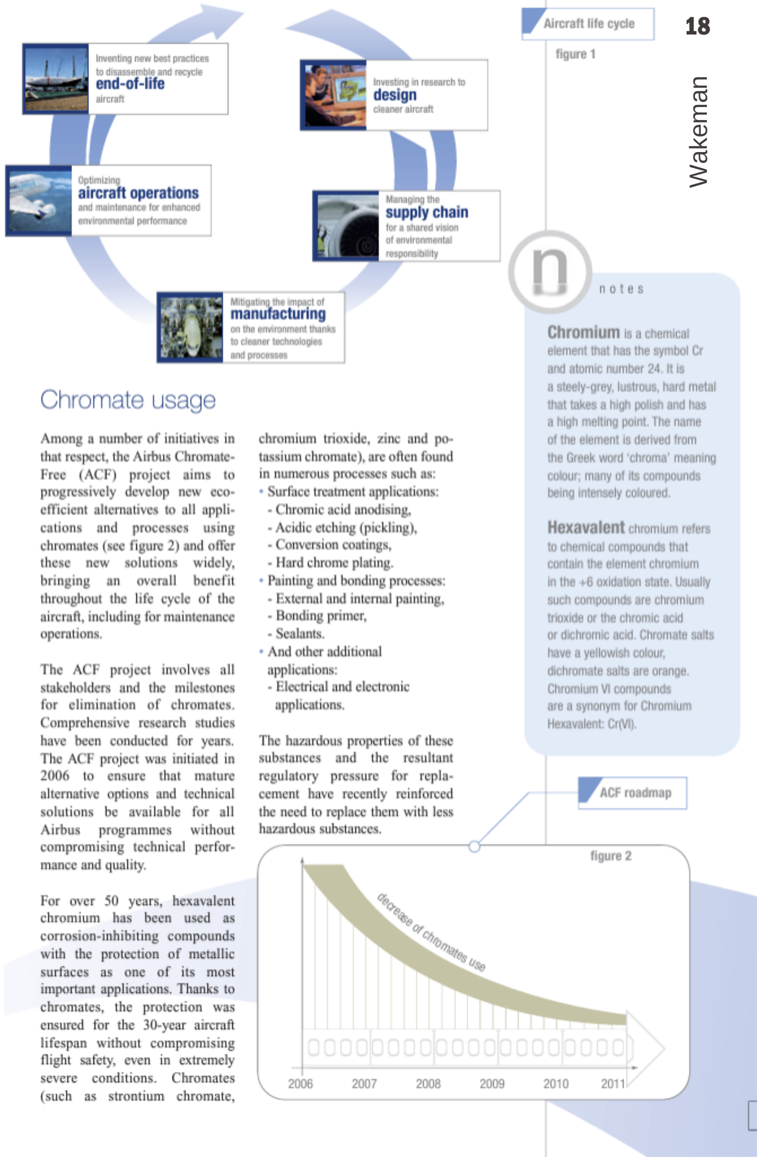
Strontium chromate

Regulatory process names 15 | Translated names 22 | IUPAC names 12 | Trade names 10 | Other identifiers 4 | Groups:

Substance identity
EC / List no.: 232-142-6
CAS no.: 7789-06-2
Mol. formula: CrO4Sr

Hazard classification & labelling
Danger! According to the **harmonised classification and labelling** (CLP00) approved by the European Union, this substance may cause cancer, is very toxic to aquatic life, is very toxic to aquatic life with long lasting effects and is harmful if swallowed.

Properties of concern
C — Carcinogenic
Ss — A majority of data submitters agree this substance is Skin sensitising
More details



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Chromate usage

Among a number of initiatives in that respect, the Airbus Chromate-Free (ACF) project aims to progressively develop new eco-efficient alternatives to all applications and processes using chromates (see figure 2) and offer these new solutions widely, bringing an overall benefit throughout the life cycle of the aircraft, including for maintenance operations.

The ACF project involves all stakeholders and the milestones for elimination of chromates. Comprehensive research studies have been conducted for years. The ACF project was initiated in 2006 to ensure that mature alternative options and technical solutions be available for all Airbus programmes without compromising technical performance and quality.

For over 50 years, hexavalent chromium has been used as corrosion-inhibiting compounds with the protection of metallic surfaces as one of its most important applications. Thanks to chromates, the protection was ensured for the 30-year aircraft lifespan without compromising flight safety, even in extremely severe conditions. Chromates (such as strontium chromate, chromium trioxide, zinc and potassium chromate), are often found in numerous processes such as:

- Surface treatment applications:
  - Chromic acid anodising,
  - Acidic etching (pickling),
  - Conversion coatings,
  - Hard chrome plating.
- Painting and bonding processes:
  - External and internal painting,
  - Bonding primer,
  - Sealants.
- And other additional applications:
  - Electrical and electronic applications.

The hazardous properties of these substances and the resultant regulatory pressure for replacement have recently reinforced the need to replace them with less hazardous substances.

notes

Chromium is a chemical element that has the symbol Cr and atomic number 24. It is a steely-grey, lustrous, hard metal that takes a high polish and has a high melting point. The name of the element is derived from the Greek word 'chroma' meaning colour; many of its compounds being intensely coloured.

Hexavalent chromium refers to chemical compounds that contain the element chromium in the +6 oxidation state. Usually such compounds are chromium trioxide or the chromic acid or dichromic acid. Chromate salts have a yellowish colour, dichromate salts are orange. Chromium VI compounds are a synonym for Chromium Hexavalent: Cr(VI).

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[Substance Information - ECHA](#) [FAST45.pdf](#)