

# ARTE FACTS

HOW DO WE WANT TO DEAL WITH THE FUTURE  
OF OUR ONE AND ONLY PLANET?



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## ARTEFACTS

### How do we want to deal with the future of our one and only planet?

In the summer of 2017, the European Commission's Science and Knowledge Service, the Joint Research Centre (JRC), decided to try working hand-in-hand with leading European science centres and museums. Behind this decision was the idea that the JRC could better support EU Institutions in engaging with the European public. The fact that European Union policies are firmly based on scientific evidence is a strong message which the JRC is uniquely able to illustrate. Such a collaboration would not only provide a platform to explain the benefits of EU policies to our daily lives but also provide an opportunity for European citizens to engage by taking a more active part in the EU policy making process for the future.

### A pilot programme

To test the idea, the JRC launched an experimental programme to work with science museums: a perfect partner for three compelling reasons. Firstly, they attract a large and growing number of visitors. Leading science museums in Europe have typically 500 000 visitors per year. Furthermore, they are based in large European cities and attract local visitors as well as tourists from across Europe and beyond.

The second reason for working with museums is that they have mastered the art of how to communicate key elements of sophisticated arguments across to the public and making complex topics of public interest readily accessible. That is a high-value added skill and a crucial part of the valorisation of public-funded research, never to be underestimated. Finally museums are, at present, undergoing something of a renaissance. Museums today are vibrant environments offering new techniques and technologies to both inform and entertain, and attract visitors of all demographics.

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ARTEFACTS exhibition hall at the Museum für Naturkunde Berlin

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A photograph of a museum gallery. The wall is white and features a framed abstract artwork with black, orange, and white elements. The ceiling has exposed wooden beams and track lighting. The floor is a light-colored, polished material.

# INTRODUCTION

by **David Wilkinson**

In the summer of 2017, the European Commission's Science and Knowledge Service, the **Joint Research Centre** (JRC), decided to try working hand-in-hand with leading European science centres and museums. Behind this decision was the idea that the JRC could further support EU Institutions in engaging with the European public. The fact that European Union policies are firmly based on scientific evidence is a strong message which the JRC is uniquely able to illustrate. Such a collaboration would not only provide a platform to explain the benefits of EU policies to our daily lives but also provide an opportunity for European citizens to engage by taking a more active part in the EU policy making process for the future.

## ■ A PILOT PROGRAMME

To test the idea, the JRC launched an experimental programme to work with science museums: a perfect partner for three compelling reasons. Firstly, they attract a large and growing number of visitors. Leading science museums in Europe have typically 500 000 visitors per year. Furthermore, they are based in large European cities and attract local visitors as well as tourists from across Europe and beyond.

The second reason for working with museums is that they have mastered the art of how to communicate key elements of sophisticated arguments across to the public and making complex topics of public interest readily accessible. That is a high-value added skill and a crucial part of the valorisation of public-funded research, never to be underestimated.

Finally museums are, at present, undergoing something of a renaissance. Museums today are vibrant environments offering new techniques and technologies to both inform and entertain, and attract visitors of all demographics.

Consequently, the JRC set out to explore the possibilities and initiated two pilot projects. The projects focused on two important issues: environment and climate, as well as artificial intelligence. The environment and climate theme was an ideal opportunity to explain what the EU has already achieved and how it plans to move forward. Artificial intelligence, on the other hand, provided the chance to better engage the public and inform them about developing policies for the future.

## ARTEFACTS

The ARTEFACTS exhibition, described in detail in this brochure, is our first pilot project. The exhibition was open at the Museum für Naturkunde Berlin from 8 October 2018 to 20 October 2019. Organised around 5 themes, energy, food, climate, water and air, ARTEFACTS asks the question 'how do we want to deal with the future of our one and only planet'. It combines striking aerial photographs from artist J Henry Fair with a scientific explanation of how humankind is affecting planet Earth today. It provides a perfect showcase for explaining some of the key EU policies in areas ranging from electrification of road transport to the common agricultural policy, and from pollinators to plastic waste.

The ongoing work by the JRC in these areas will undoubtedly provide part of the essential scientific foundation of the European Green Deal which is one of the key themes of European Commission President Ursula von der Leyen's new EU policy agenda for 2020 to 2025.

approximately  
**800 000**  
people visited  
the museum  
and **75 % of these**  
have seen ARTEFACTS

The content of the ARTEFACTS exhibition was co-created by the Museum für Naturkunde Berlin, the JRC and artist J. Henry Fair. The museum then took responsibility for all design aspects and constructed the physical exhibition in Berlin, while JRC took charge of preparing the digital and virtual reality versions of ARTEFACTS.

During the 12 months of the exhibition approximately 800 000 people visited the museum and an estimated 75 % of these saw ARTEFACTS, including 300 000 who dedicated 20 minutes or more to carefully understanding its messages. More than 90 % of visitors indicated that they were either 'very satisfied' or 'satisfied' with the exhibition. ARTEFACTS was responsible for a significant increase in the number of museum visitors in comparison with the previous 12 months. Interestingly, only 7 % of visitors came from the Berlin region, 13 % from Germany (excluding Berlin), 55 % from the EU (excluding Germany) and 25 % from outside the EU.





#### DIGITAL EXHIBITION

<https://ec.europa.eu/jrc/en/artefacts/digital-exhibition>

The ARTEFACTS project was more than just an exhibition. During the 12 months, around 40 'Meet the Scientist' sessions' took place, with JRC scientists appearing by videoconference in the museum and engaging in a dialogue with visitors. These sessions were very well received both by visitors but also by the scientists involved who found it an excellent opportunity to meet people of all ages and levels of understanding to explain their work.

ARTEFACTS has also been created in digital versions: one downloadable for use on a PC and a full virtual reality version. The latter, in particular, has been a significant success with over 1 500 demonstrations, including to senior policy makers, with at least 26 public events during the 12 months from the start of the exhibition. This is just the start, as ARTEFACTS Digital will now stay in use for at least four years after the physical exhibition closed.

An external evaluation of ARTEFACTS was carried out for the JRC by a professional firm. It concluded that the total cost to the JRC of the ARTEFACTS project, including all expenditure and staff resources, works out at around 1.4 euros for each of the 300 000 visitors who spent 20 minutes or more in the exhibition.

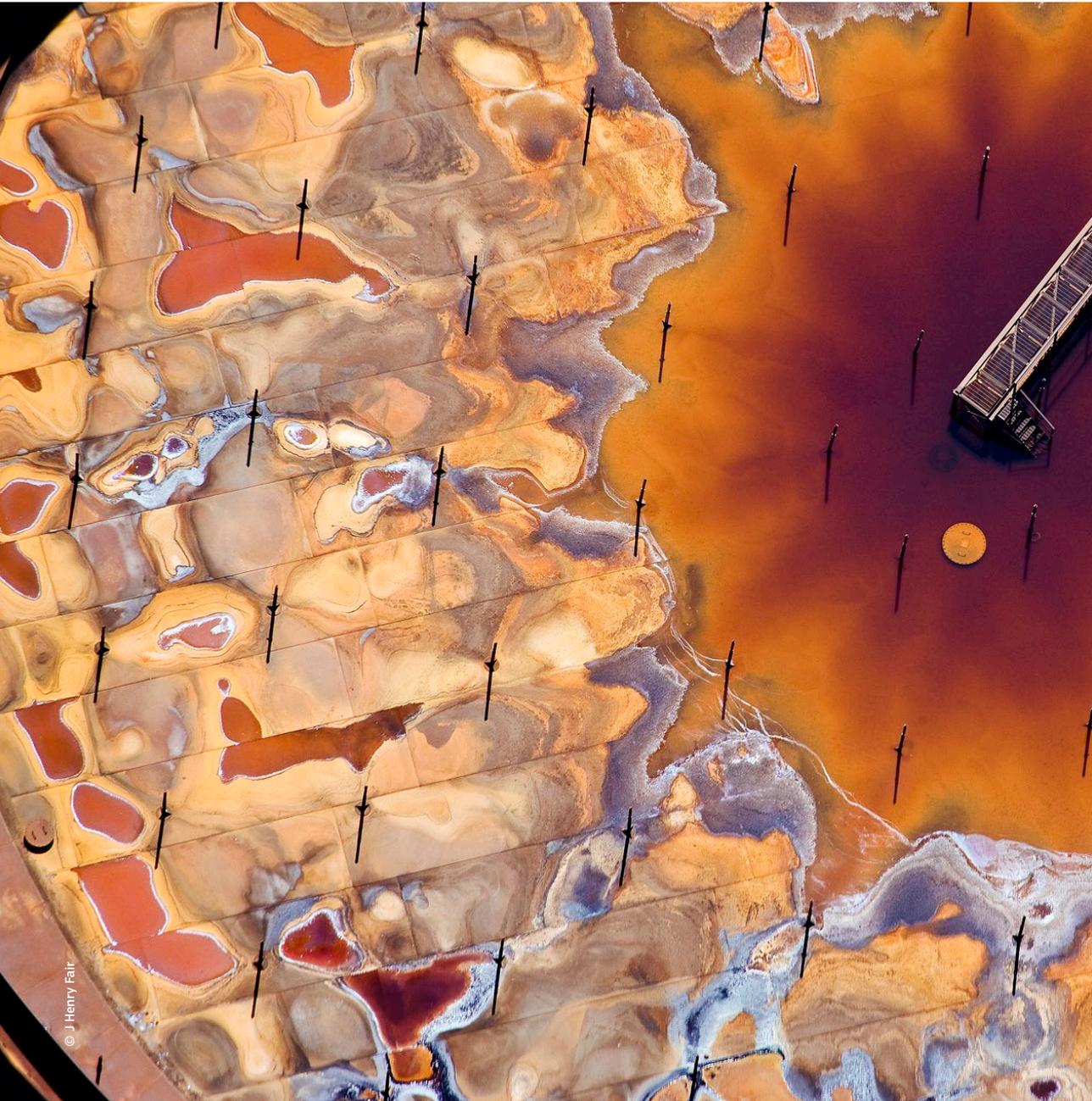
**ARTEFACTS**  
encouraged visitors  
to **rethink their**  
**behaviour**

This represents a very good return on investment. The evaluation gives recommendations on how the JRC can best continue working with museums with the focus on more interactivity with the public and increased scalability, giving access to an ever widening audience.

I hope you enjoy this summary where we illustrate the stories told in ARTEFACTS as highlights of the full breadth of the work of the JRC. The exhibition, which also included a wealth of excellent background material prepared by the museum, ultimately became a project created from good teamwork, endless enthusiasm and close collaboration among those involved. Moreover, if ARTEFACTS helped to encourage some visitors to rethink their own behaviours and how they might help protect our one and only planet, then I consider it a success.



Inauguration day, October 2018.  
From left to right:  
Stephen Junker, Richard Kuhnel,  
Vladimir Sucha,  
Rita Schwarzelühr-Sutter,  
Johannes Vogel, David Wilkinson



© J Henry Fair

**Upgrader**  
Fort McMurray, Canada

## THE ARTIST'S VIEW

J Henry Fair

“ We see a walkway out to the covered inspection hatch and standing water, which has caused some rust. The rust does not impede its functioning: storing 400 000 to 500 000 barrels of the world’s dirtiest oil. Tar sands, a layer of bitumen-saturated earth which can be refined into petroleum, are primarily extracted in Canada. The first step in the process is to remove the old growth boreal forest, home to countless endangered species and a deep sink for tremendous amounts of carbon. The raw material is excavated with giant electric shovels (baggers) and trucked away to be crushed and boiled, which begins with the toxic process of producing a usable fuel from this tar. ”

# SUSTAINABLE TRANSPORT

## MOBILITY

### Mobility spending

In Europe, it is estimated that transport accounts for around 13% of individual households' total expenditure. Today there are a wide range of alternative mobility choices. For example, young people are increasingly turning away from individual car ownership.

### Trains vs flights

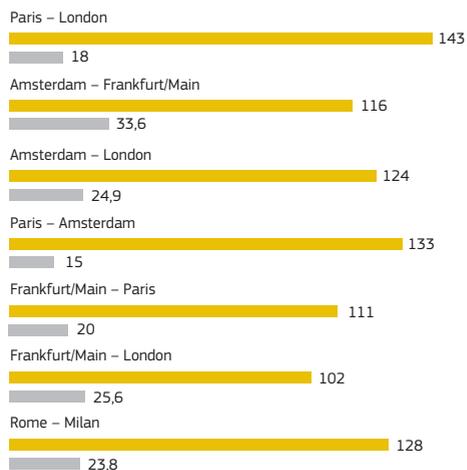
Recently, **JRC scientists** compared the CO<sub>2</sub> emissions (per person, per kilometre) for some popular EU city to city trips when using high-speed trains or aeroplanes. Trains were shown to have the potential to be between 3 to 9 times better for the climate. However, high-speed trains require long-term investments and fast, attractive service schedules to become competitive.

**Emitted CO<sub>2</sub> equivalents**  
per person-kilometre (gCO<sub>2</sub>/PKM)  
for typical EU-domestic city-to-city routes

by plane



by train

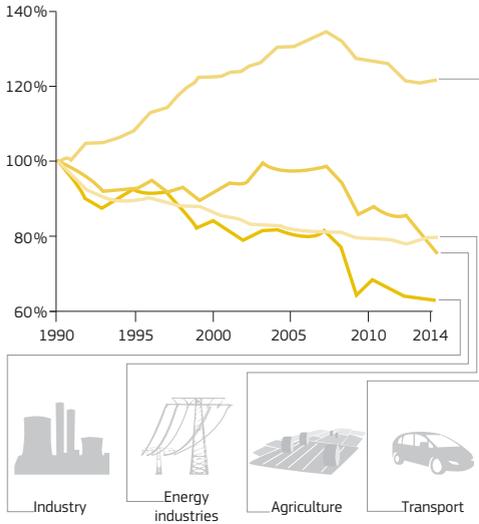


Source

<https://publications.jrc.ec.europa.eu/repository/handle/JRC111726>  
doi:10.1155/2018/6205714

## CO<sub>2</sub> emissions

Relative development per sector



Source

European Environment Agency (EEA)

## SUSTAINABLE TRANSPORT

### Decarbonisation of individual and public road transport

Although the EU is on track with its promise to reduce overall CO<sub>2</sub> emissions by 20% by 2020, we need to accelerate the decarbonisation of road transport. New technologies that enable more sustainable mobility choices are key to this. Of all the factors contributing to the overall CO<sub>2</sub> balance in the EU, the transport sector has not seen the same gradual decline in emissions as other sectors.

### Biofuels: land use change

The JRC calculates how much greenhouse gas emissions can be reduced by the use of biofuels and advises on land use change. Land use change refers to the process of moving food production from agricultural fields to other areas such as forests, which must be cleared to make space for the agricultural activities. Land use change risks negating the greenhouse gas savings that result from increased use of biofuels, because forests typically absorb high levels of CO<sub>2</sub>.

# THE EU TAKES ACTION

To combat the impact of indirect land use change, the **EU** introduced new rules in 2015, amending **biofuels legislation**.

The **EU** sets rigorous sustainability criteria for biofuels, which are implemented through national systems or voluntary schemes, recognised by the European Commission.

The **EU** is working to overcome remaining challenges, including those linked to battery capacity, the availability of charging stations and raw materials used in batteries and e-motors.

### Ecosystem for batteries

The EU will create an 'ecosystem for e-car batteries' to ensure efficient recycling. The **Commission's communication on Sustainable Mobility for Europe** includes a detailed Strategic Action Plan. It combines targeted measures at EU level on raw materials, research, innovation-financing and standardisation, as well as trade and skills development. In the context of a circular economy, the goal is to make Europe a global player in sustainable battery production and use.



### Biofuels: sustainability criteria

For biofuels to reduce greenhouse gas emissions without adversely affecting the environment or social well-being, they must be produced in a sustainable way.

#### ■ ELECTROMOBILITY

##### Challenges

Electric vehicles have the potential to significantly improve air quality in urban areas. They are also climate-friendly if electricity from renewable sources is used for recharging them.

##### Range concerns

**JRC analysis of car usage** in typical European towns shows that over 90% of all daily trips are shorter than 150 km. People typically travel around 30 km a day, and 80% of them drive less than 65 km daily. This shows the potential of electric vehicles to serve urban mobility needs.

## WHAT CAN I DO?

**Use public transport/ car-sharing/ e-cars and bicycle** whenever possible in urban areas.

Consider my **holiday transportation needs**. They do not need to determine my vehicle choice for the whole rest of the year.

**Choose my vehicle** according to my needs. What size, speed and power do I really need?

**Buy regional food and products** to minimise emissions through transportation.

Consider **teleconferences** instead of travelling for meetings.

# THE JRC SUPPORTS

#### ■ TESTING AND RESEARCH

##### Hyper fast charging

The JRC **'European Interoperability Centre for Electric Vehicles and Smart Grids'** carries out tests on a wide range of hybrid and fully electric vehicles, including prototypes. Using a climatic chamber, with a temperature range simulating winter and summer conditions from -30°C to +50°C, JRC scientists test the performance of electric vehicles and new high-power charging columns. The latest charging columns can recharge the next generation of electric vehicles in about 20 minutes, giving them autonomy for up to 400 km.

##### Image

Charging columns are tested at the JRC for safe and standardised fast charging (50kw), at the European Interoperability Centre for Electric Cars and Electric Grids

##### Safety and reliability

Through testing of electromagnetic emissions from electric vehicles and fast charging columns, the **JRC** helps industry to develop safe and reliable products that do not interfere with other wireless communication devices. This work contributes to international standards for the successful deployment of electro-mobility with price-competitive, reliable vehicles and infrastructure.





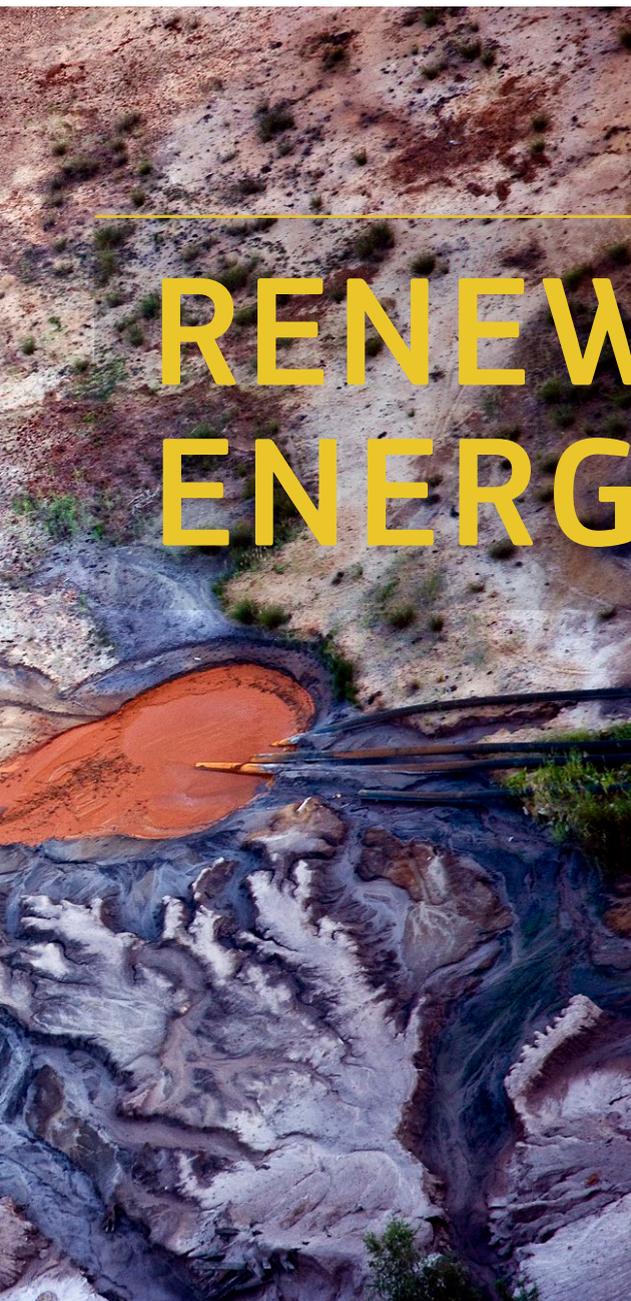
© J Henry Fair

**Arsenic in water**  
Spremberg, Germany

## THE ARTIST'S VIEW

J Henry Fair

“ Many toxic elements are found in coal. Some vaporise and go up the chimney, others become concentrated in the solid wastes, particularly arsenic, chromium, lead, mercury, and selenium, which can contaminate groundwater. Lignite accounts for 25 % of German electricity production and provides about 20 000 jobs. But it pollutes our air and adds to the climate crisis that we pass on to the next generations. Sustainable energy sources are on the brink of being able to satisfy our demand. Wind energy employs 142 900 people and provides 12.3 % of Germany's electricity. If priorities were shifted from coal to wind, those jobs could easily be moved and more created cleaning up the toxic remains from coal combustion. ”



# RENEWABLE ENERGY

## ■ RENEWABLE ENERGY

### EU and renewable energies

As part of its **Energy Union initiative**, the EU has set a clear target to cover 20% of its total energy use from renewable sources by 2020. The EU Member States are on track to meet this target. Furthermore, they have recently agreed that by 2030, the target should be 32%, thus making Europe a leader in the global clean energy transition.

The **JRC** supports the EU's renewable energy policies with pre-normative research on energy technologies. JRC scientists have produced detailed maps of renewable energy potential for the EU and world-wide. As part of the EU's **Strategic Energy Technology Plan (SET-Plan)**, the JRC monitors progress on research, innovation and investments in renewables.

## ■ SOLAR, WIND AND BIOENERGY

### Energy from renewables

Renewable energy sources, for example wind and sun, are abundant. Tapping into their potential to generate power and heat is much cheaper today than it was a few years ago.

THE EU  
TAKES  
ACTION

## Costs are falling

Renewable electricity technologies are becoming cheaper than electricity generation from fossil sources. This is a global trend and a result of hundreds of projects around the world. The prices of renewable energy components such as photovoltaic modules and lithium-ion battery cells are falling fast.

## Biomass

Biomass energy comes from burning trees, and other biological sources. It is considered renewable because new trees can be grown to replace those burned. As the new trees grow, they absorb the carbon dioxide that was emitted into the atmosphere when the old trees were burned. Whether or not biomass is carbon neutral (and hence sustainable in the long run), depends on the type of biomass, the time it takes to regrow, the combustion technology used, the fossil fuel it replaces, and, the forest management techniques deployed.

## CHANGES IN INFRASTRUCTURE

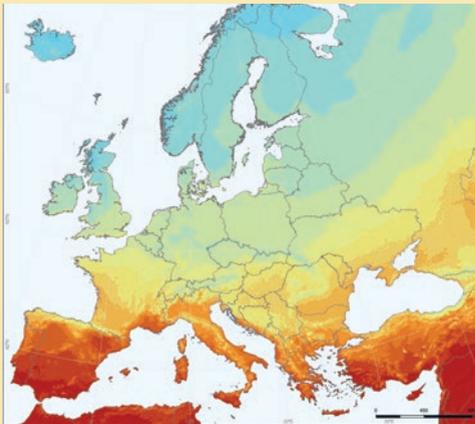
### More transmission and storage capacity needed

Wind and solar energy are becoming cost competitive. However, they are weather-dependent and not always available. At present, some renewable electricity is wasted because it cannot be easily stored or fully transmitted. In Germany, from 2015 to 2017, almost 5 % of the total wind harvest was lost. The electricity network urgently needs more strategically placed transmission lines and more integrated storage facilities.

### Electric car batteries as energy storage

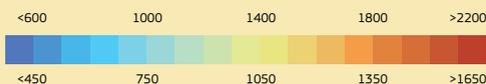
A battery that has come to the end of its useful life in an electric vehicle still has around 80 % of its original electricity storage capacity.

## Photovoltaic solar electricity potential in European countries



### Global irradiation kWh/m<sup>2</sup>

Yearly sum of global irradiation incident on optimally-inclined, south-oriented photovoltaic modules



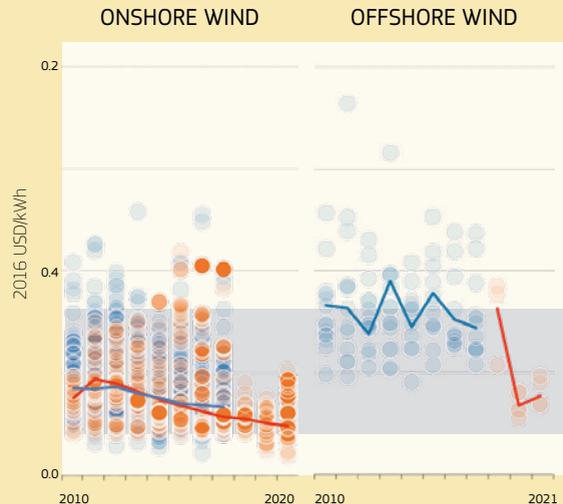
### Solar electricity kWh/kW peak

Yearly sum of solar electricity generated by optimally-inclined, 1kW<sub>p</sub> system with a performance ratio of 0.75

#### Source

<https://re.jrc.ec.europa.eu/pvgis.html>

## Cost development of renewable energies: competitive with conventional energy from fossil fuels



Electricity cost trends for onshore and offshore wind, solar PV and concentrating solar power (2010-2020).

#### Source

Renewable Cost Database and Auctions Database, International Renewable Energy Agency (IRENA)

It can then be used for several years for other purposes – for example to store renewable electricity generated by sunshine and wind. At the very end of its life, the battery can be systematically recycled, in order to re-use all its lithium and electrode materials.

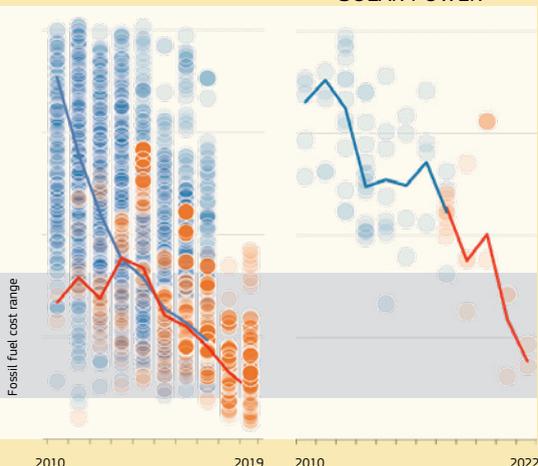
### Smart electricity grids in the digital society

A smart electricity grid communicates digitally with electricity users and providers. It facilitates the supply and use of local renewable electricity. It enables to better manage electricity storage, whilst keeping the electricity network stable. A smart grid can also signal to industrial users and smart-home owners the possibility to strategically time certain processes and electricity consumption. This enables customers to better control their energy use and reduce their bills. It also helps avoid demand peaks, without drawbacks for the service quality or the welfare of citizens.

## THE JRC SUPPORTS

### SOLAR PV

### CONCENTRATING SOLAR POWER



- Auction database
- Levelised costs of electricity database (LCOE)

Each circle represents an individual project or auction result, while the solid line is the capacity-weighted average from each database.

## WHAT CAN I DO?

**Be careful** with my energy consumption.

Use the **EU energy efficiency class system** in appliances and lighting system.

**Program washing machines/ dishwashers** so they don't run in the morning or evening to avoid unnecessary electricity demand peaks.

**Avoid stand-by** power consumption.

Contract power from **renewable sources**.

Go for **smart appliances** and smart meters.

Improve the **energy efficiency of my home**

**Produce my own electricity** through photovoltaic panels.

Join a **renewable energy community** or a citizen energy community.

Connected to the smart grid, the batteries of electric cars can be used as temporary power storage devices: when the car is not being driven, it stores energy and feeds it back into the grid when needed.



Test the JRC Photovoltaic Geographical Information System to find out more

PVGIS

Source

[https://re.jrc.ec.europa.eu/pvg\\_tools/en/tools.html](https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html)



© J Henry Fair

**Fertiliser waste**  
Huelva, Spain

**THE ARTIST'S  
VIEW**

J Henry Fair

“The phosphorous component of fertiliser is obtained from refining phosphate rock with sulphuric acid. It contains traces of radioactive material which are concentrated during treatment making the waste both radioactive and acidic. After this plant had to stop disposing directly into the Huelva River, it filled large ‘gypsum stacks’, which breached during a storm in December 1998 causing a tremendous toxic spill. Legal actions by environmental groups and the EU forced the company to close the dumps and remove all the material. Production has been moved to Morocco and Saudi Arabia, locations with presumably lower environmental protections.”

An aerial photograph showing a narrow, winding river with greenish water flowing through a dry, rocky, and hilly landscape. The terrain is light-colored with some darker patches, suggesting a semi-arid environment. The river is the central focus, cutting through the rugged terrain.

# SUSTAINABLE AGRICULTURE

## How do EU policies shape agricultural landscapes?

Agriculture accounts for almost half of the EU land surface. Over the past two decades, there has been a shift in the focus of the EU's **Common Agriculture Policy** (CAP) from stimulating production towards promoting more sustainable farming practices. The **JRC** supports the design of policy measures to make agriculture more environmentally sustainable.

## The Greening Package

The EU's **Greening Package** has introduced incentive schemes to safeguard biodiversity in farmed land. For instance, maintaining hedgerows and tree lines are important for pest control and pollination. Farmers are obliged to diversify their crops and they can be compensated for including more natural vegetation in their fields. EU legislation includes measures for restoring, preserving and enhancing ecosystems related to agriculture and forestry to support rural development.

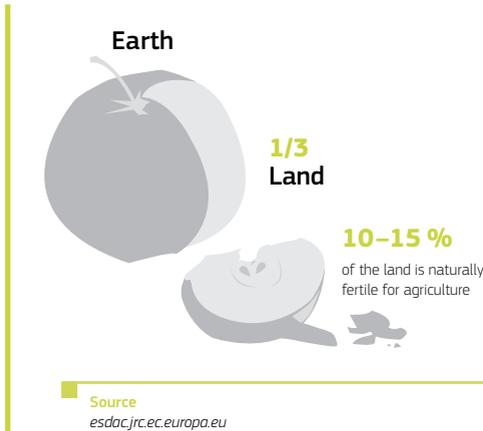
## ■ AGRICULTURE AND SOIL

### Key natural capital

Soil is a key natural capital resource. It is critical for life on this planet. Soil supports plants through soil nutrient cycling. Therefore, it is the basis of all agriculture. Soil also plays a major role in regulating global climate, limiting flooding, ensuring clean water, filtering pollutants and sustaining biodiversity.

### Threat to the natural balance

On the planet, only about 10-15% of the land is naturally fertile! Insects and soil organisms are vital for soil fertility. Soils are depleted due to continuous harvesting, soil erosion and the inappropriate use of chemicals. Intensive agriculture threatens the natural balance of the soil nutrient cycle and biodiversity.



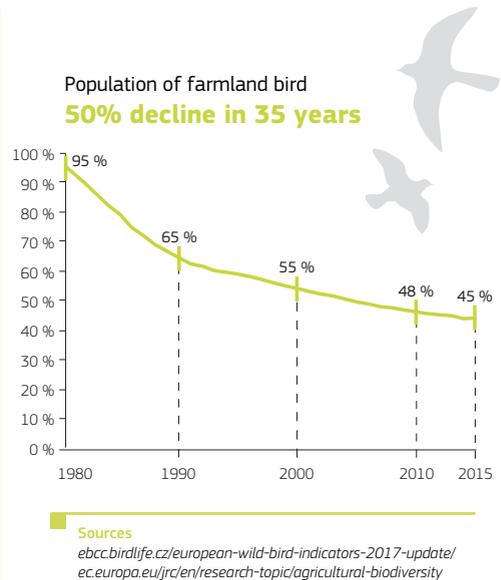
## ■ AGRICULTURE AND POLLINATORS

### Loss of biodiversity

Environmental changes happen so slowly that you may hardly notice them. Scientists are now detecting subtle changes, for example the decline of bird and insect populations. Four out of five crops depend on pollinators - not only the 300 bee species but also butterflies, beetles and other flying insects.

### Economic value of pollinators

Insect pollination is vital for crop production. € 15 billion of EU's annual agricultural output is directly attributed to insect pollinators.



# THE EU TAKES ACTION

### Policies for soil protection

The European Commission, through the **EU Soil Thematic Strategy**, is committed to soil protection. Enhanced soil protection is expected to be at the core of both the new **Common Agricultural Policy** as well as future climate change mitigation measures.

The European Commission has taken important steps to prevent bee mortality. These include the banning of certain pesticides. The **EU Initiative on Pollinators** aims to better understand and tackle the causes of their decline. It also aims to engage citizens, provide guidance, incentives and educational material, and support collaborative community projects.

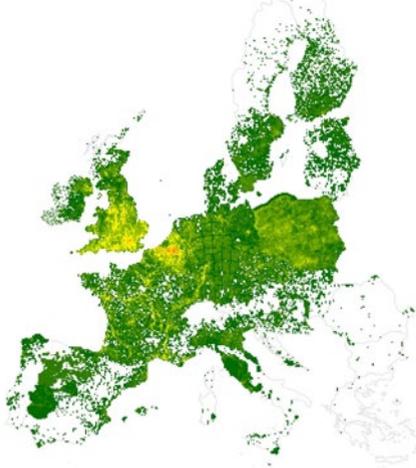
## ■ AGRICULTURE AND INVASIVE SPECIES

### Regulations to act against invasive species

There are many invasive alien species in Europe, of which about 1 000 of them can cause damage to native species and ecosystems. For example, the Asian Hornet originally comes from Asia. Introduced into France in 2004, it is a highly aggressive predator of native honeybees and wild pollinators.

By providing a geographical baseline of invasive alien species of Union concern across Europe, the **JRC** is helping all EU Member States to comply with EU law by taking actions to control populations in their own country and prevent their spread to others that are not yet 'invaded'.

### Distribution of the invasive alien species of Union concern at grid 10x10 km level in EU



Source

<https://ec.europa.eu/jrc/en/news/mapping-europes-invasive-alien-species>



Invasive Alien Species  
(IAS) Europe APP Google

Source

<https://easin.jrc.ec.europa.eu/easin>



## WHAT CAN I DO?

**Be aware** that my consumer choices can make a real difference.

**Support** environment-friendly production. It might have a higher price but cheap products often have a lot of hidden costs as well.

Buy more **regional/seasonal/organic products**, and ask where they come from.

**Promote biodiversity** in my garden by leaving parts of it wild.

## THE JRC SUPPORTS

The **EU Regulation on Invasive Alien Species** (IAS, 2014) provides a framework for action.

The **JRC's Alien Species Information Network** (EASIN) is the EU's official IAS information platform.

### Citizen Science

Citizens can help improve the information available on the distribution of invasive alien species. Their input facilitates the official surveillance and the adoption of efficient control measures to reduce their ecological and economic damage. The **Invasive Alien Species (IAS) Europe APP** developed by the **JRC** enables citizens to report sightings of invasive alien species.



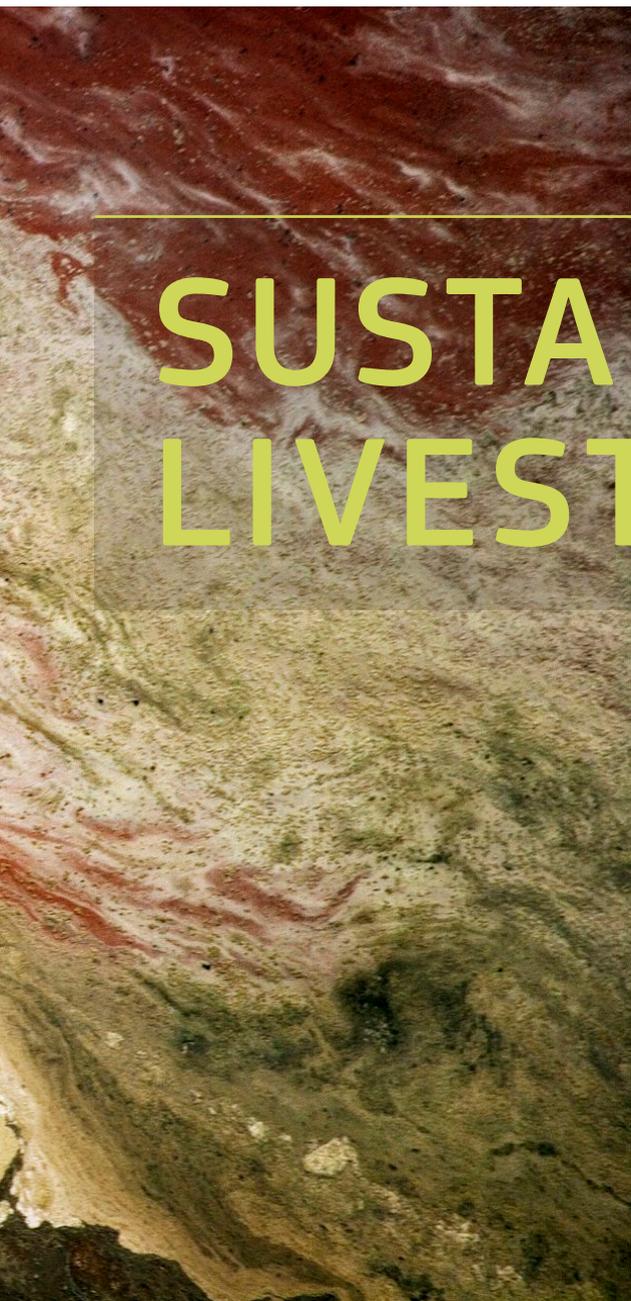
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**Hog Faecal Waste Lagoon**  
Warsaw, North Carolina, USA

**THE ARTIST'S  
VIEW**

J Henry Fair

“To produce pork at the low price consumers expect, pigs are manufactured at giant industrial hog farms where they are kept in sheds that hold thousands of animals. The largest concentration of these ‘factory farms’ is between Bremen and Osnabrück, Germany, a region known as ‘liquid manure belt’. A pig produces 3 times as much fecal waste as a human. The excrements are sprayed on farm fields for disposal, often more than it’s needed for fertilisation. This overload causes nitrate contamination in water. In June 2018, Germany was convicted for violation of EU nitrate limits.”



# SUSTAINABLE LIVESTOCK

## ■ FACTS ABOUT LIVESTOCK

### **Impact of livestock production on climate**

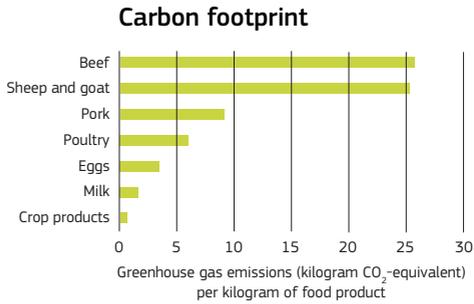
In the EU, agriculture contributes to global warming with about 10 % of the greenhouse gas emissions. Specifically, non-CO<sub>2</sub> gases are present, with methane (CH<sub>4</sub>) from enteric fermentation (flatulence) from animals, particularly cattle and the nitrous oxide (N<sub>2</sub>O) from the nitrogen fertilisers in soils. Manure from livestock emits both gases.

### **Meat first, then eggs and milk**

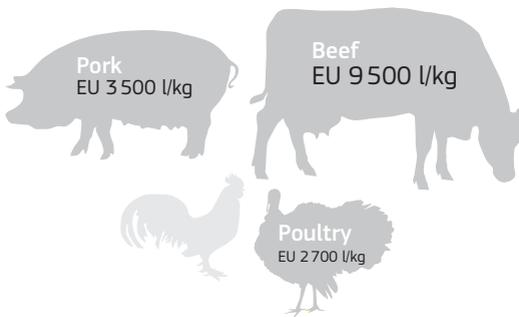
In Europe, 65% of the agricultural land is devoted to livestock, with croplands for animal feed and pastures for grazing. The production of meat, milk and eggs contributes to about three quarters of the agricultural greenhouse gas emissions.

### **Impacts on water and air quality**

Ammonia contributes to air quality problems. Nutrients (nitrogen) surpluses in soil lead to an excess of nitrates. They pollute surface and underground water. In coastal waters they cause algal blooms, which are harmful to aquatic species. Besides water pollution, another major concern is the high volume of freshwater used to produce animal products i.e. in Europe, 5 500 litres on average for 1 kilogram of meat.

**Source**

<https://ec.europa.eu/jrc/en/publication/impacts-european-livestock-production-nitrogen-sulphur-phosphorus-and-greenhouse-gas-emissions-land>  
doi:10.1088/1748-9326/10/11/115004

**Water footprint for production****Source**

<https://ec.europa.eu/jrc/en/news/water-footprint-eu-different-diets-9674> doi:10.1016/j.ecolind.2013.02.020

**SUSTAINABLE LIVESTOCK PRODUCTION****Agricultural emissions have declined**

The EU Greenhouse Gas emissions for each kilogram of food are below the average global value and the total EU agricultural emissions have declined by 20% in the last 25 years. This is mainly due to a reduced number of livestock and more efficient farming practices.

**THE BENEFITS OF SMALL CHANGES IN FOOD CHOICES****Reducing food waste**

Reducing food waste will help reduce greenhouse gas emissions and is a priority within the EU circular economy. Food waste in the EU represents around 20% of the food produced every year, 88 million tons with associated costs estimated at 143 billion euros.

**Food choices, water and climate**

Eating less animal products is good for the environment. There are alternative sources of proteins such as pulses and legumes. For the average European a 50% reduction of meat intake would still provide sufficient daily intake of protein meeting ranges recommended by the World Health Organization. With appropriate land management options, this 50% reduction would reduce the diet related carbon footprint by 20-40% and reduce the water footprint by about a quarter.

# THE EU TAKES ACTION

The **EU Nitrates Directive** has led to a reduced use of factory-produced synthetic fertilisers and to a better management of manure. But much more needs to be done. The **EU Common Agriculture Policy** is increasingly shifting from an intensive production-based mechanism towards higher environmental and climate ambitions.

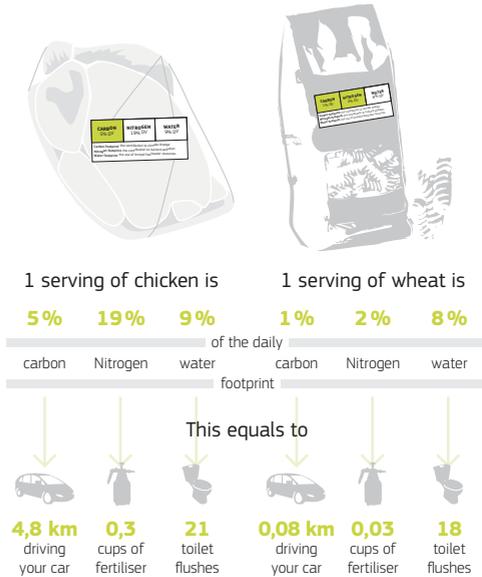
**Modern technologies for livestock**

The **JRC** has reviewed available modern technologies that can help reduce emissions from livestock, particularly ruminants, for instance changing animal diets, breeding animals with lower methane emissions, or better ways of using manure as organic fertiliser. Scientists at the JRC are studying the best cost/benefit options for introducing these techniques and lowering their cost.

### Proposed environmental food labels

| CARBON<br>n% DV*   | NITROGEN<br>n% DV* | WATER<br>n% DV* |
|--|--------------------|-----------------|
| <b>Carbon footprint:</b> the contribution to climate change<br><b>Nitrogen footprint:</b> the contribution to nutrient pollution<br><b>Water footprint:</b> the use of limited freshwater resources. |                    |                 |

\* Daily value (DV) is the percent of a consumer's total daily footprint used in the consumption of a given product



Source  
<https://publications.jrc.ec.europa.eu/repository/handle/JRC101518> doi:10.1016/j.foodpol.2016.03.006

## WHAT CAN I DO?

**Look for food labels.** Such as on eggs which certify high animal welfare standards.

**Buy food produced from sustainable activities** with lower GHG footprints.

**Reduce food waste.** Do not buy, cook, or take more than is needed. Be creative with leftovers.

**Reduce overconsumption.** A balanced diet with the right amount of energy, proteins and nutrients is healthier and helps the environment.

Cut down on beef and pork, but in general **eat less meat** (WHO recommendations). Proteins are important in our diet, but **there are many alternatives to meat** like eggs, fish or plant proteins like lentils, legumes, tofu and other soya products.

**Organic products help protect biodiversity.** They need more land but I can compensate with wasting less food and eating less meat.

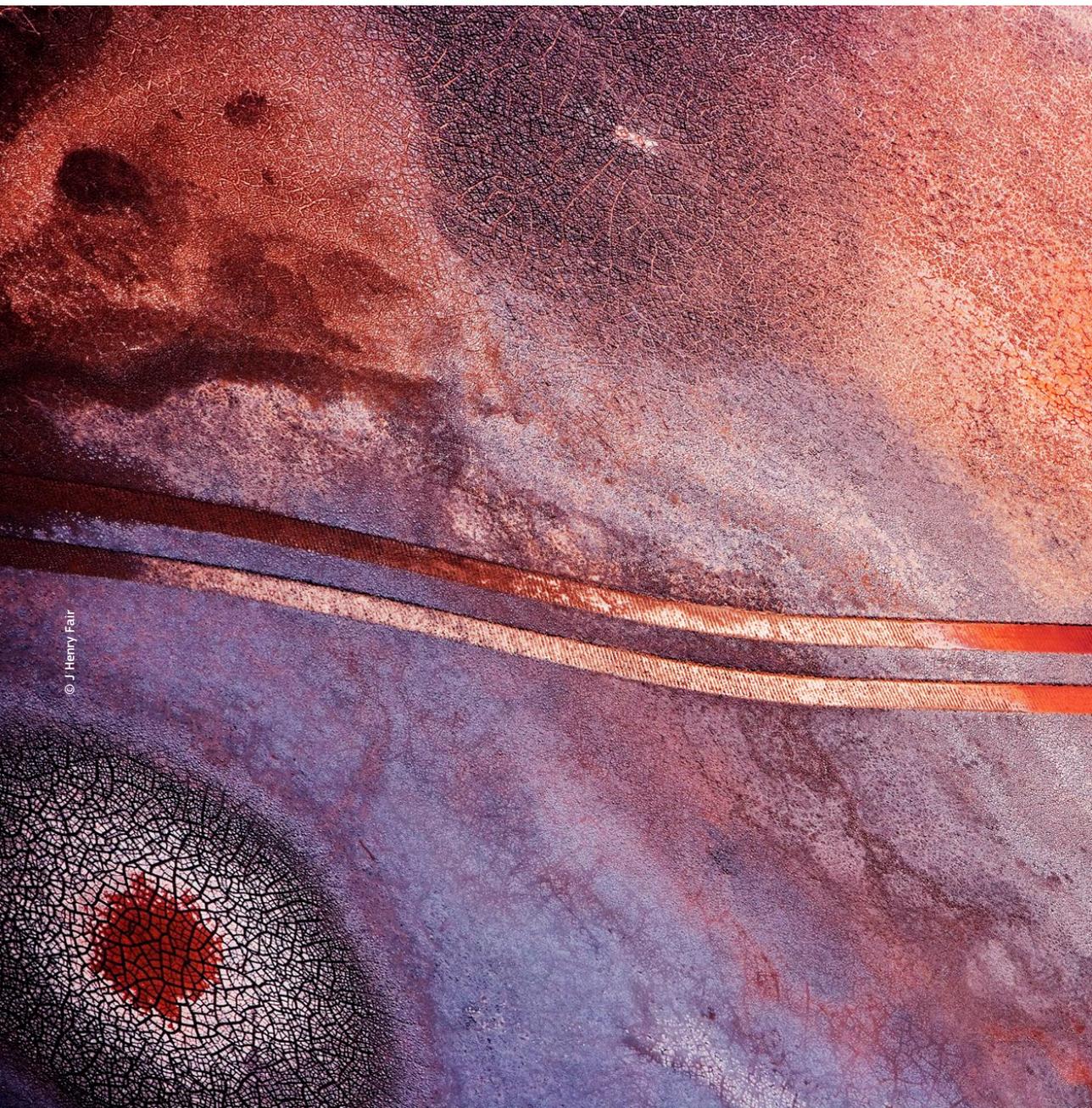
## THE JRC SUPPORTS

### Future policies to produce more climate-friendly meat

The **JRC** identifies the best policy scenarios for EU agriculture for example, financial incentives to farmers, raising taxes or imposing reduction targets for greenhouse gas emissions. One key aspect is to make sure that livestock production will not be displaced to other parts of the world with higher emissions and less control, thus with no benefit for the global carbon budget.

### Improving food labels

The environmental impacts of the production and consumption of food is seldom depicted to consumers. The **JRC** addresses how to improve food labelling, which better informs consumers about their choices. This will facilitate choosing and comparing climate-, water- and soil-friendly products.



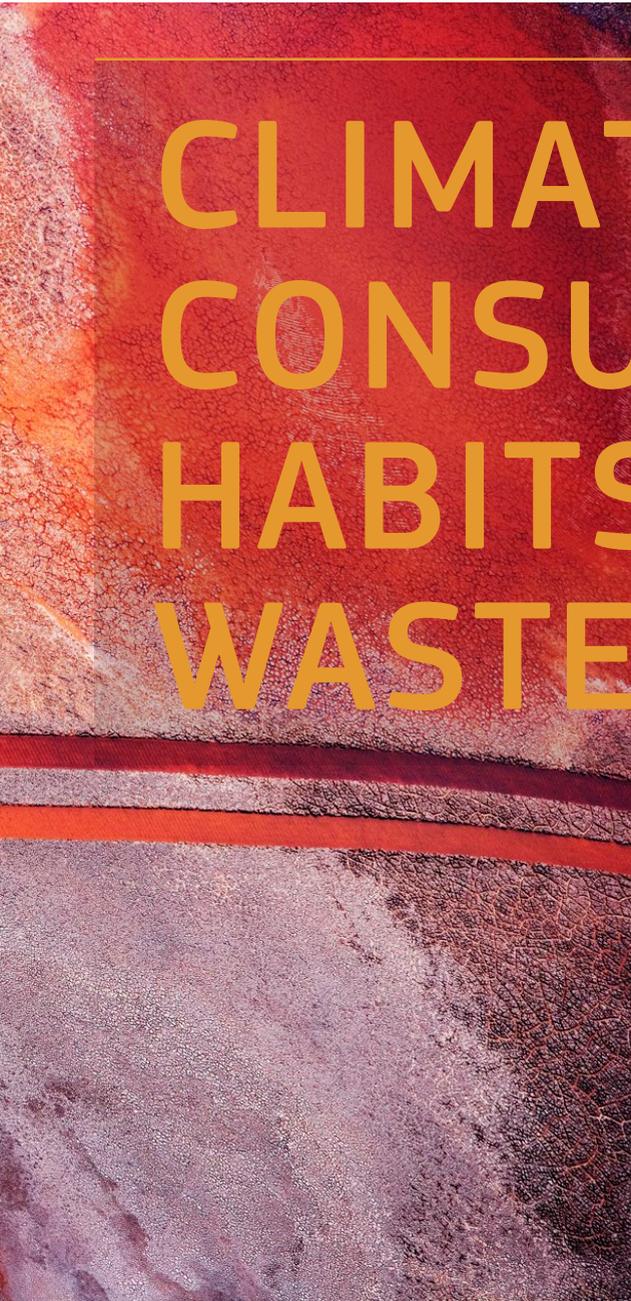
© J Henry Fair

**Excavator tracks**  
Gramercy, Louisiana, USA

**THE ARTIST'S  
VIEW**

J Henry Fair

“Aluminium, strong and lightweight, vital for airplanes, computers, wiring, cookware and soda cans, is the most common metal in the earth’s crust, though it is never found in a free state. Refining the metal from its ores is a complex process with numerous environmental impacts. The tremendous amount of electricity used has its own repercussion and the chemical reaction releases significant greenhouse gases and produces large volumes of solid waste which is extremely caustic. This is the same toxic waste that spilled in Hungary in 2010, killing up to 8 people, destroying parts of 3 villages, and poisoning the Danube.”



# CLIMATE, CONSUMER HABITS AND WASTE

## ■ CLIMATE CHANGE AND TROPICAL DEFORESTATION

### **Impact of deforestation on global warming**

Tropical forests represent more than half of the world's forests and their deforestation contributes about 10% of global carbon emissions. Deforestation hotspots are located throughout the tropical forest areas in Africa, South-America and South-East Asia. An area the size of Croatia (5.5 million hectares) was deforested in these regions each year between 2010 and 2015. This rate is expected to increase, mainly due to the growing demand for food, animal feed and grazing.

### **Assuming responsibility**

Stopping tropical deforestation and forest degradation is a priority to respond to climate change. At local level, it is key to protecting biodiversity and benefits people that depend on a healthy environment for their living. The EU, the world's biggest donor of international aid, helps to address these challenges through the United Nations Conventions on Climate Change and Biological Diversity.

## ■ OUR CHOICES AS CONSUMERS HAVE AN IMPACT

### Food, textiles and wood products

Without realising it, consumers indirectly cause tropical deforestation when they use products that require forests to be cleared in tropical areas. In total, between 1990 and 2008, the EU consumed the equivalent of 9 million hectares of deforested land in the tropics. After the regions of production, the EU was the largest consumer of products associated with deforestation. Deforestation is primarily driven by food production and, to a lesser extent, by textiles and wood products.

### Food choices and future trends

The consumption of oil crops (such as soy and palm oil), the processed goods derived from them, and meat play a major role in deforestation. Modest changes in food consumption choices can make a difference! Opting for a vegetarian or vegan diet just one day per week, could have a significant impact on reducing tropical deforestation.

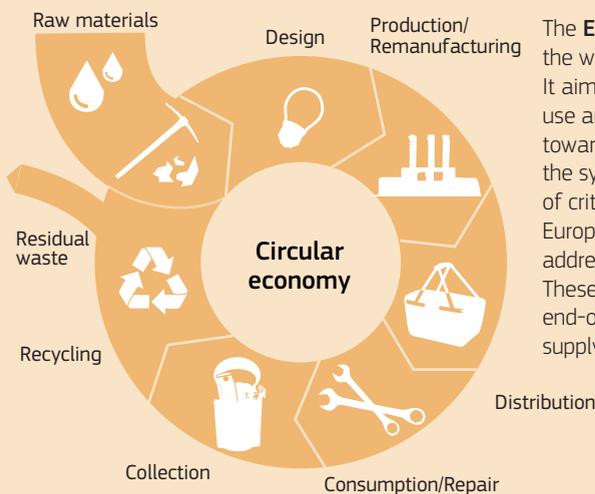
## Impact of EU consumption by sector on tropical deforestation



#### Source

[https://ec.europa.eu/environment/forests/pdf/1\\_Report\\_analysis\\_of\\_impact.pdf](https://ec.europa.eu/environment/forests/pdf/1_Report_analysis_of_impact.pdf) doi:10.2779/82226

# THE EU TAKES ACTION



The **EU Circular Economy action plan** covers the whole lifecycle of products and materials. It aims to steer away from the 'take, make, use and throw away' approach and to gear towards energy and material efficiency through the systematic reuse, recycling and dismantling of critical components. In collaboration with European and international partners, the **JRC** addresses essential circular economy issues. These include end-of-waste treatment, end-of-life recycling, and the sustainable supply and circular use of raw materials.

#### Source

<https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/critical-raw-materials-and-circular-economy-background-report> doi:10.2760/378123

## Conversion of forest to oil palm plantation, Indonesia

#### Source

[forbs.jrc.ec.europa.eu/trees3](https://forbs.jrc.ec.europa.eu/trees3)

## ■ ELECTRICAL AND ELECTRONIC PRODUCTS

### Mining and toxic waste

It is not only food choices that matter. When buying a smartphone or a car, are consumers aware of the unregulated mining of metals and minerals, including iron for steelmaking and cobalt for producing batteries? The contribution of mining to global tropical deforestation is small, but has an increasingly important local effect and produces toxic waste.

### Electronic waste

When throwing away a computer, do we consider illegal exports and local treatment of waste? Every year, 1.3 million tonnes of electrical and electronic waste leaves Europe, much of it ending up in other parts of the world including Africa.

### Circular economy

Good management of waste is a priority objective for the EU. It saves valuable resources and minimises environmental damage.

## WHAT CAN I DO?

Be aware of the **CO<sub>2</sub> footprint of my diet** and consumer products.

**Repair instead of buying new devices:** use mobile phones, computers, etc. as long as possible. Consider buying reconditioned and refurbished devices.

Correctly **sort** and **recycle** electrical and electronic **waste**.

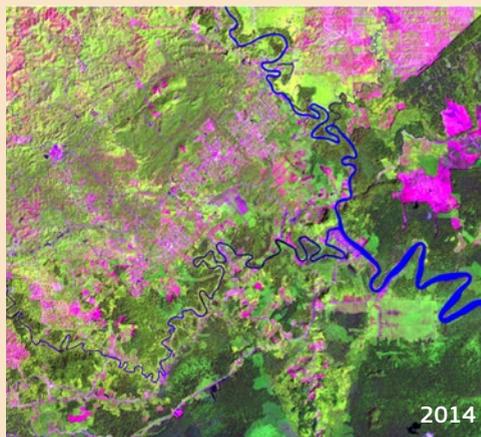
Become active and **plant trees** at home.

# THE JRC SUPPORTS

## Monitoring and building capacity

Scientists at the **JRC** work with international organisations and local partners in tropical countries to build capacity for monitoring deforestation and its impact. Using satellite images from the EU's **Earth Observation**

**Programme (Copernicus)**, JRC scientists provide expertise, datasets and geospatial tools. This helps developing countries to sustainably manage their lands, and increase their crop yields while reducing pressures on natural resources.





© J Henry Fair

**Acid Mine Drainage**  
Niederzier, Germany

## THE ARTIST'S VIEW

J Henry Fair

“ On this spot stood an ancient forest, untouched even by agriculture. Hambach Forest is nearly 12000 years old, and comprised primarily of oak and hornbeam. It is home to 13 of the threatened species listed in Europe’s 1992 Habitats Directive. In 1978, when it was bought by a power company to dig for the brown coal buried deep below, the forest covered 5500 hectares (about the size of Manhattan). Now, only 10 percent of that remains. In its place is the largest man-made hole in Europe, from which is torn and on average of 496 million tonnes of brown coal each year. It is a tragedy, but by the time this exhibition opens those last 10% of this ancient German forest will probably be history. ”



# THE CLIMATE CHALLENGE

## **The Paris Agreement**

More ambitious action is required to combat climate change. In 2015, at the United Nations climate change conference in Paris, representatives of 196 states adopted a new universal, legally binding global climate deal. The European Union played a key role in brokering this historic agreement. The Paris Agreement sets out a global action plan to avoid dangerous climate change by limiting global warming to well below 2°C relative to pre-industrial levels. The agreement covers reduction of greenhouse gas emissions, adaptation to the consequences of climate change, and the financing of necessary measures.

## **Emissions Database for Global Atmospheric Research**

The **JRC** maintains the Emissions Database for Global Atmospheric Research (EDGAR), a global dataset of atmospheric emissions from human activities. It helps monitor and verify greenhouse gas emissions under international climate agreements. Graphs and maps of greenhouse gases and air pollutants are compiled, making the EDGAR database a unique and robust tool to assess emission trends and drivers.

## THE JRC SUPPORTS

## CLIMATE AND FORESTS

### Climate and forests

Worldwide, forests currently remove nearly one third of the carbon dioxide (CO<sub>2</sub>) humans add to the atmosphere. They help to keep climate change from getting even worse. Forests in Europe are growing in area and in volume. They absorb the equivalent of nearly 10% of all EU Greenhouse Gas Emissions (GHGs) each year. If we are to meet the Paris Agreement's climate target, it is essential to preserve our forests and to promote sustainable forestry and climate-smart use of wood. **JRC** scientists assess the role of forests in slowing down climate change in the context of the **Intergovernmental Panel on Climate Change (IPCC)**.

### Avoiding deforestation

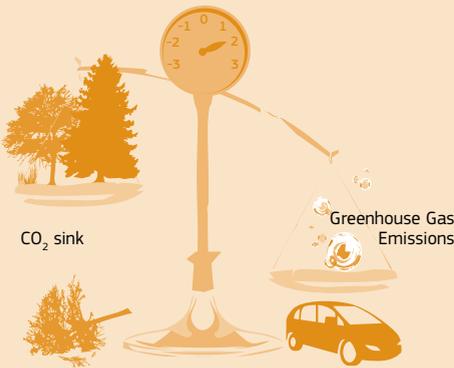
Deforestation is primarily occurring in tropical countries. Avoiding deforestation is central to

the **United Nations Framework Convention on Climate Change**. The mechanism known as '**Reduced Emissions from Deforestation and Forest Degradation in Developing Countries**' (REDD) provides financial support to developing countries for sustainably managing their forests, and for increasing forest carbon stocks (i.e. the amount of carbon the forests absorb from the atmosphere). Scientists at the **JRC** provide technical and scientific expertise to the developing countries within this context and beyond.

### Forest management

It can be challenging to find the best balance between letting forests grow (thus increasing their capacity to absorb CO<sub>2</sub>) and using them to produce wood. In a good forest management strategy, less wood is removed than the amount newly produced. Scientists at the **JRC** monitor how forest area and tree mass evolve and study how to manage our forests without overexploiting them.

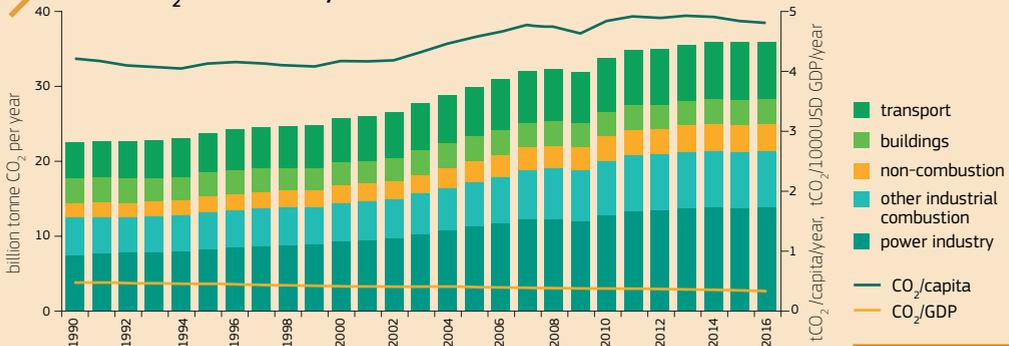
# THE EU TAKES ACTION



### EU Forest Strategy and wood

The EU supports sustainable use of wood as raw material through the **EU Forest Strategy (2013)**. The strategy emphasises the need to make sure that forest resources and wood materials are used and reused efficiently. This improves the EU's balance of trade and its self-sufficiency in wood, boosts the competitiveness of its forest sector, helps reduce unsustainable forest management, protects the environment, and reduces deforestation in countries outside the EU.

### Fossil CO<sub>2</sub> emissions by sector



## ■ WOOD AS MATERIAL

### Wood as material: the hidden hero

Wood is the hidden hero of human civilisation. It allowed humanity to progress from the Stone Age to the Industrial Revolution. Today, almost everything can be made with plastic, aluminium or other energy-intensive materials. Such production relies on finite resources and can contribute to climate change, pollution and toxic waste. For a sustainable economy, wood is part of the answer: a gift from nature.

## WHAT CAN I DO?

### **Treat climate change as a fact.**

Be aware of my **CO<sub>2</sub> footprint**.

Use **certified wood** materials.

An open chimney is beautiful, but not efficient and produces lot of particulate matter.

Switch to **green electricity**: if more sustainable energy is requested, the market will adapt to it.

**Prefer wooden alternatives** to cement, aluminium and steel when they exist and are appropriate.

**Use public transport**/car-sharing/e-cars and bicycle whenever possible in urban areas.

## THE JRC SUPPORTS

### Climate-smart use of wood

The production of wood is continuously renewed by forests. Nevertheless, we should make the best possible use of it by reducing material losses and maximising the use of all by-products.

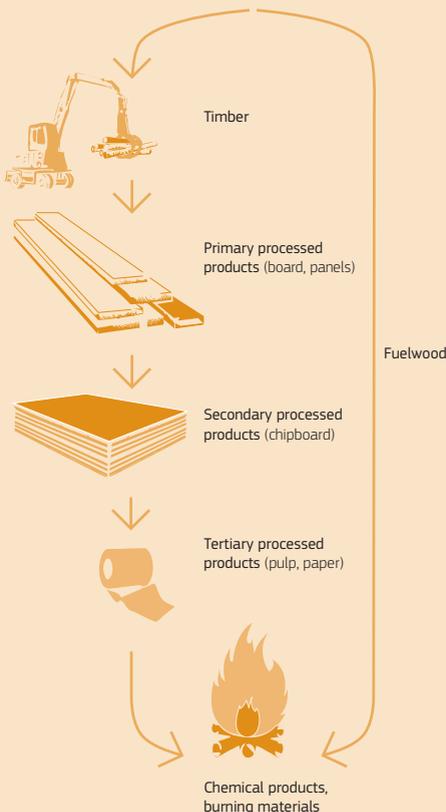
**JRC** scientists study how to efficiently manage the wood cycle. They analyse how to maximise the climate benefits of using wood as a substitute to other more carbon-intensive energy sources and materials. The best strategy is to use wood first to produce products and, when the wooden object is no longer needed, to use it for energy when there are no viable alternative uses.

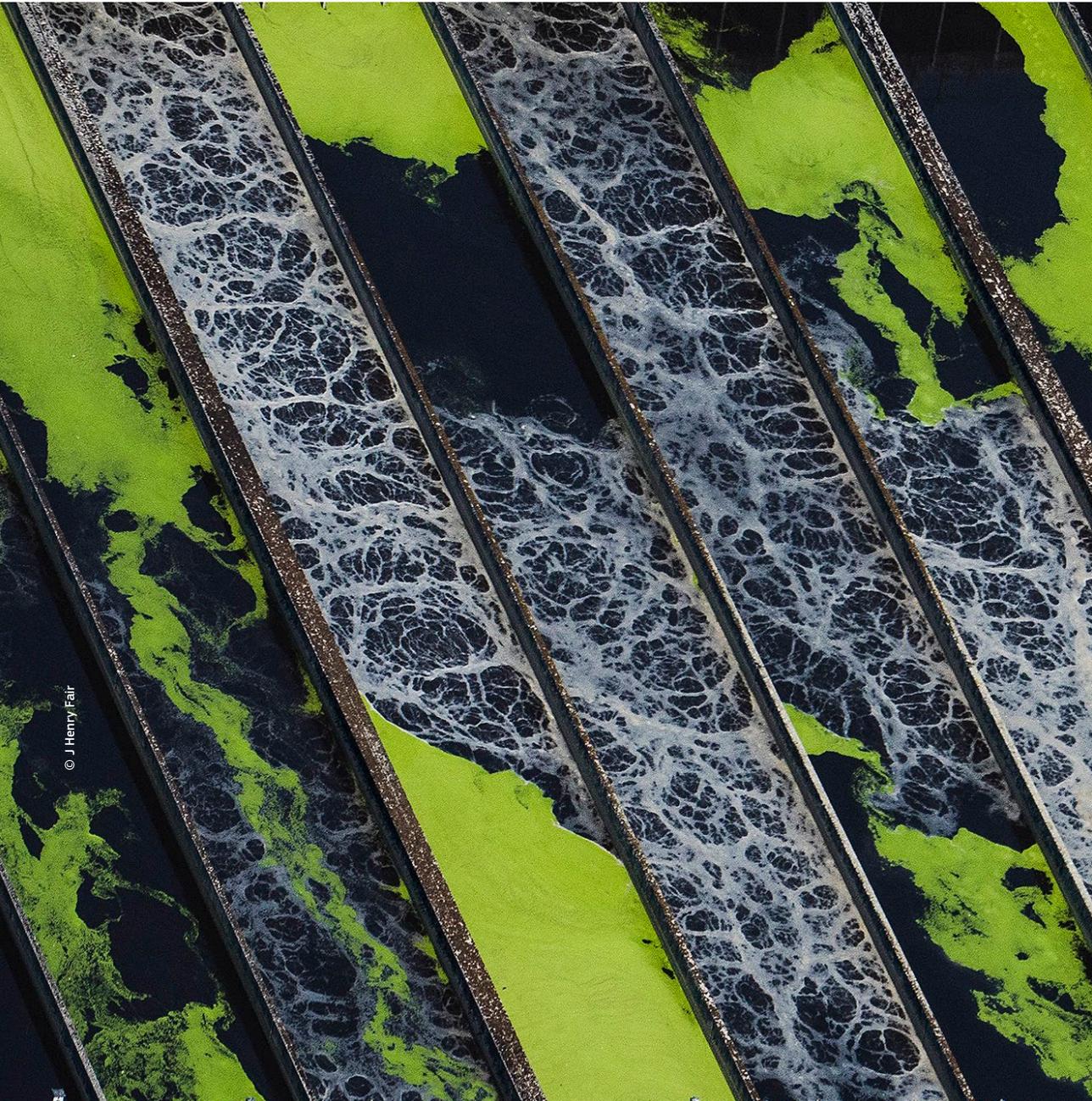
#### Source

<https://edgar.jrc.ec.europa.eu/overview.php?v=booklet2019>  
doi:10.2760/687800



Forest





© J Henry Fair

**Water treatment plant**  
Duisburg, Germany

## THE ARTIST'S VIEW

J Henry Fair

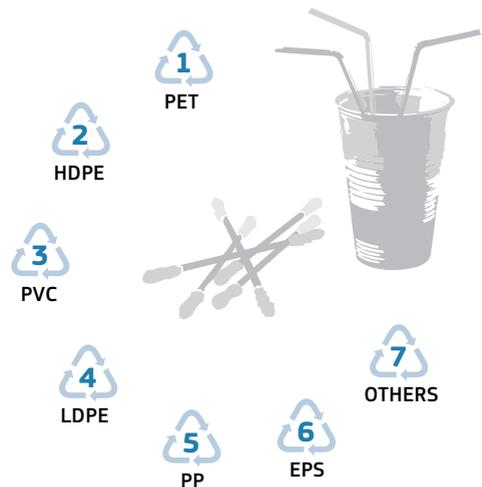
“Plastic is the wonder of the age. With it we can make anything from soda bottles to guns and automobiles. It's everywhere. Really everywhere. Even in sea-salt. We intake it in multiple ways: chemicals leach into our food and drinks, from plastic containers, particles from plastic clothing come in to our water supply as they are washed, plastic waste of all types and sizes comes finally to the ocean. And in the end, once it's in the environment, it's almost impossible to remove, like the particles in our water supply which cannot be cleaned by our water treatment systems.”

# MARINE PLASTIC LITTER

## ■ PLASTIC FACTS

### Not enough recycling

In 2017, 480 billion plastic drinking bottles were sold worldwide. Only half were recycled! If not recycled, they may have ended up in a landfill. Or perhaps the bottle simply tumbled down the road, the next rain washed it into a stream, and it went down the river and into the sea.



### Recycling symbols

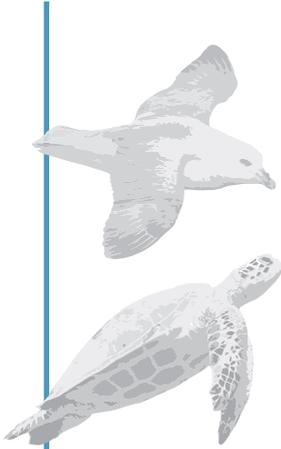
with the numbers 1 to 7 identify different plastics and enable sorting for processing

### Plastics on seashores and beyond

Plastic waste litters our beaches and is found on the seafloor. 50% of the litter found on EU beaches derives from single-use plastics, such as packaging material, cups, lids and bottles. Plastic degrades in the environment into ever-smaller pieces. These so-called microplastics can be found in the water, inside animals, even in the deep sea and in the polar regions.

### Effect on wildlife

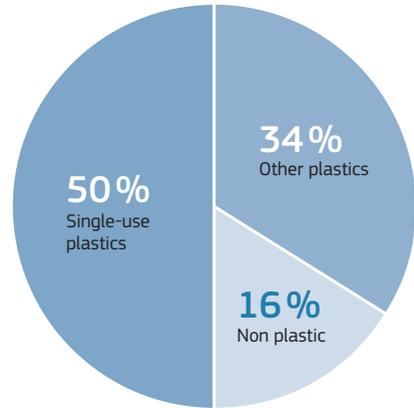
Plastic (and microplastics) can affect wildlife and cover or trap small animals.



**93%** of the **Fulmar** birds examined in the **North Sea** had ingested some plastic.

**85%** of the dead **turtles** found in the **Mediterranean Sea** had ingested an average of 16 plastic particles weighing 1.3 g.

### Items found on EU beaches



#### Source

[https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108181/technical\\_report\\_top\\_marine\\_litter\\_items\\_eur\\_29249\\_en\\_pdf.pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108181/technical_report_top_marine_litter_items_eur_29249_en_pdf.pdf) doi:10.2760/496717

## THE EU TAKES ACTION

### ■ PLASTIC STRATEGIES

**Acting against plastic litter** is part of the **EU Marine Strategy Framework Directive**, and EU Member States are committed to its implementation.

### Circular use of plastic

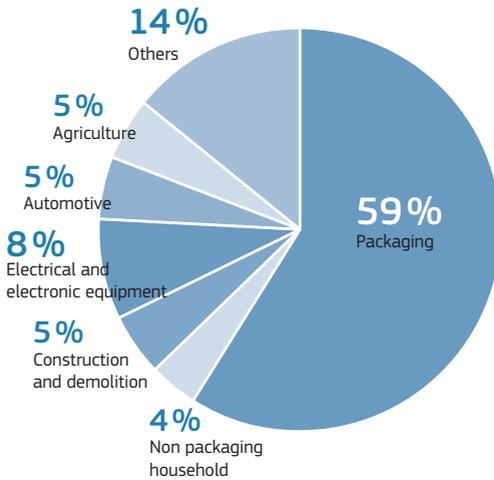
The **European Strategy for Plastics in a Circular Economy** aims to ensure that plastic products are produced, used and recycled with a smaller environmental burden and kept in the economy for longer.

The European Commission made a proposal for a new law to reduce the litter stemming from the consumption of single-use plastics and fishing gear. It encourages the use of long-term products whenever possible. For instance, using mugs instead of plastic cups, and reusable containers instead of throw-away packaging.

### Alternatives to plastic

The European Commission proposes promoting the use of suitable and more sustainable alternatives when available. It also encourages innovative solutions using more sustainable business models, and the re-use and substitution of materials.

## EU plastic waste generation in 2015



**Source**

<https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf>

## WHAT CAN I DO?

**Reduce** use of *single use plastic* and plastic in general.

**Think of** other material and *reusable options*.

**Have my own water bottle** to carry and refill when I am around.

If using plastic bottles, **recycle**.

**Tap water** has a higher or equal quality as bottled water – and it even can be turned into sparkling water.

**Say no to** drinking straws, **plastic** bags and unnecessary packaging.

**Buy unpackaged food** if possible.

Get informed about the **waste management** in my area.

**Never throw waste** into the environment/city.

If I see plastic litter at beaches or in the environment, **pick it up** and dispose correctly.

## THE JRC SUPPORTS

JRC scientists work closely with various institutions, regional sea conventions and coastal countries to estimate how much plastic is in the seas, where it comes from, where it goes, and how to avoid it.

JRC scientists are assessing the environmental impacts of different types of materials, including bio-based products and recycled plastics, and comparing these with current material sources (mainly oil).

### Design for recyclability

Plastics are made from a range of polymers with specific additives to meet each manufacturer's needs. This diversity can complicate the recycling process and affect the quality and value of recycled plastic. Design improvements could reduce the cost of recycling plastic packaging waste.





**'Cosmetic wipes'**  
Terrace bay, Ontario, Canada

**THE ARTIST'S  
VIEW**

J Henry Fair

“This aeration pond is part of the effluent treatment system. The primary task of the treatment is to remove organics, wood fibre, from the water before it is returned to its source. Water pollution from paper mills contains such toxics as lead, mercury, chlorine compounds and dioxin. The Kenogami National Forest, source of the wood for this mill, is home for a multitude of valuable species from wolves and bears to the moss on the forest floor. It is an immensely diverse and complex ecosystem that gives us clean air and water, and it will be replaced by a monoculture of factory farmed trees and a polluted river.”

# WATER QUALITY AND WATER REUSE

## ■ WATER QUALITY

In the past 20 years, the quality of EU rivers and lakes has greatly improved. EU drinking water quality standards are among the highest in the world. Over 99% of our drinking water supplies comply with all limit values set by EU law. This makes Europe a global frontrunner in ensuring clean water for all. Our know-how places us as a global water technology leader, with over half a million full-time jobs in the sector.

**Europe is the global  
front runner for ensuring  
clean drinking water**

THE EU  
TAKES  
ACTION



## ■ USE AND IMPACT

### Agriculture has an impact

Despite the achievements to date, more needs to be done. As the planet's population grows and urban areas expand, there is a growing demand for food. What does this mean for our water resources? Groundwater and surface water resources are affected by the chemicals used for crop protection, livestock management and fertilisers.

**50 %** of the available water resources in EU Member States are used by **agriculture** and the demand will further increase.

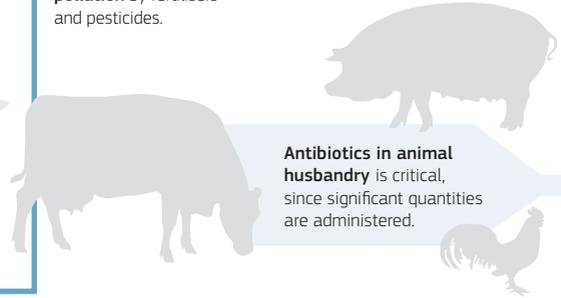


### Industrial and domestic water users

Residues of a steadily growing number of chemicals appear in industrial and urban wastewater. Many household products are also contributing to this chemical pollution. Accidental spillages and contamination exacerbate the situation, often with dramatic consequences for the environment.

Agriculture puts significant pressure on water mainly because of **over-use and pollution** by fertilisers and pesticides.

**Antibiotics in animal husbandry** is critical, since significant quantities are administered.



# THE EU TAKES ACTION

## ■ ACTING WATER-WISE

### Can we become water-wise?

The challenge of today is to harmonise our water demands with the natural water cycle. In other words, we should become water-wise. Legislation based on scientific analysis is one of the ways in which the EU helps improve this balance.

### Water and the Common Agricultural Policy

In the EU, around 50% of the available water resources are used by agriculture, 25% by the public water supply, and 25% by the energy/industry/service sectors. By 2030, agricultural demand for water is predicted to increase, while climate change will reduce the available supply. The re-use and recycling of our wastewater will therefore become crucial, especially in southern Europe.

The new **EU Common Agricultural Policy (CAP)** aims to raise awareness and introduce incentives for smart water management.

### Revision of the EU water directives

The **Urban Waste Water Treatment Directive** is central to achieving the EU's water quality objectives. Wastewater treatment has progressed significantly and there is general consensus about the need to clean and reuse our wastewater as much as possible. The Commission proposal to modernise the 20-year-old Drinking Water Directive is a response to the **European Citizens' Initiative 'Right2Water'**, which seeks to recognise water as a public good that is vital to human life rather than as a commodity.

## Pharmaceuticals in the environment

There is growing concern about pharmaceuticals in the environment and the largely unknown effects of chemical mixtures released into the water by human activities.

### Whatever we eat, drink or consume can be traced to water

Water quality mirrors and keeps a memory of human activities, transporting the respective **'chemical footprint'**

Patient is sick and takes medication.

Only a minimal fraction of the active ingredient is absorbed by the body.

The rest is expelled...

...reaches the sewer system, and the sewage treatment plant.

Treated wastewater (effluent) is released to the natural water cycle.

Unknown effects of chemicals might travel through the urban water cycle and reach, for instance, our food chain.

## WHAT CAN I DO?

**Avoid wasting drinking water** by fitting a water saving nozzle to your taps at home.

**Be aware** that my lifestyle and choices have an **impact on water** on a global level.

**Buy fewer clothes** and wear them for longer.

Use **eco-friendly** washing powder, beauty and **self-care products** e.g. toothpaste.

**Reduce** my use of **herbicides/pesticides/fertilisers** in my garden.

Clean my car in the **carwash**, not in the driveway.

**Avoid flushing** certain **pollutants** (paints and varnishes, medicine, oil...) into the **water system**.

If I can, **collect my rainwater** and reuse it.

The **Urban Waste Water Treatment Directive** asks for at least two treatment steps

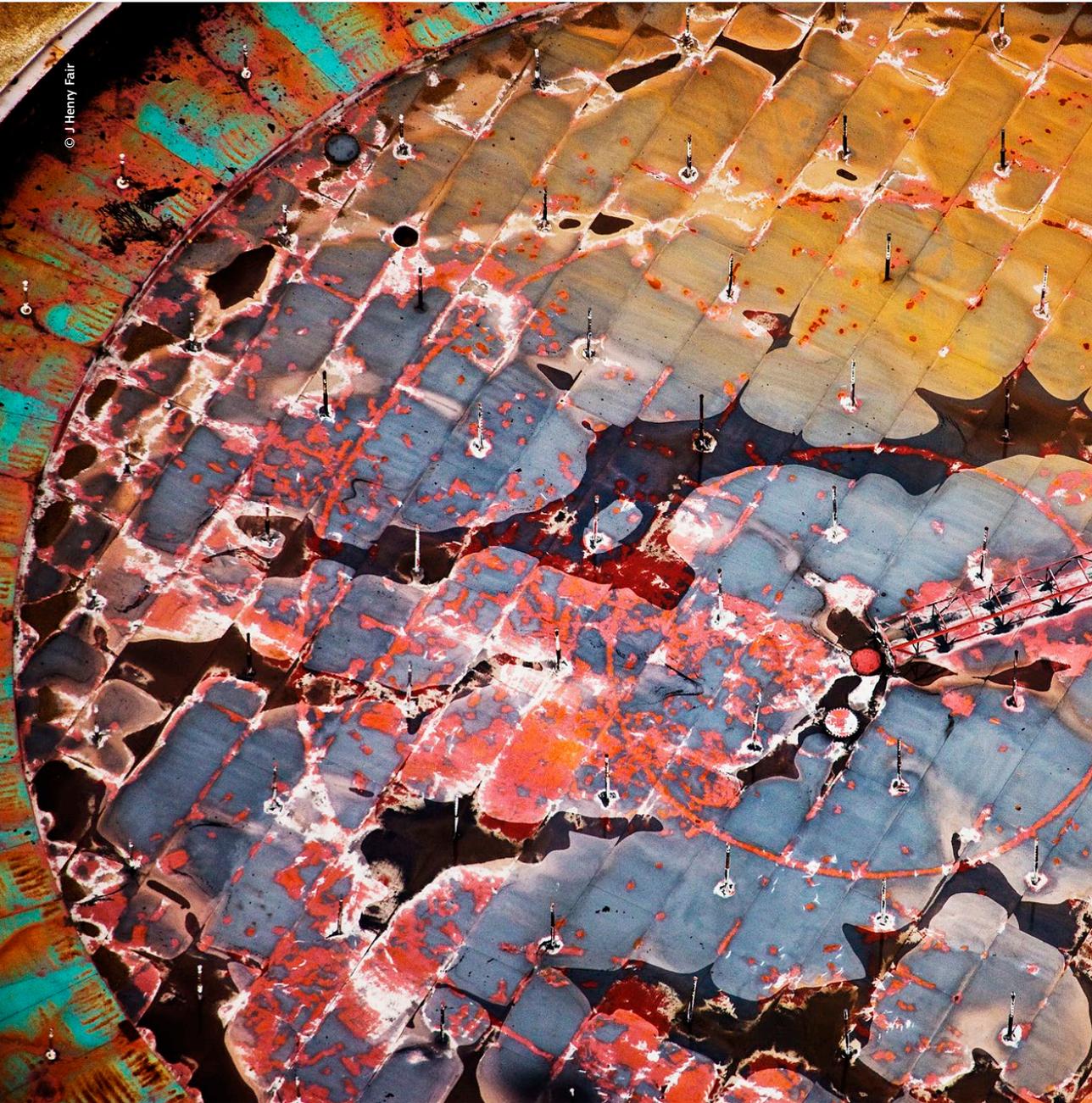
As defined by the **European Water Framework Directive**, the ecological status describes how healthy a water body is.



## THE JRC SUPPORTS

Through its scientific research, the **JRC** strives to broaden our understanding about how such chemicals affect the environment in order to support EU policy decisions.

Source  
<https://www.right2water.eu>



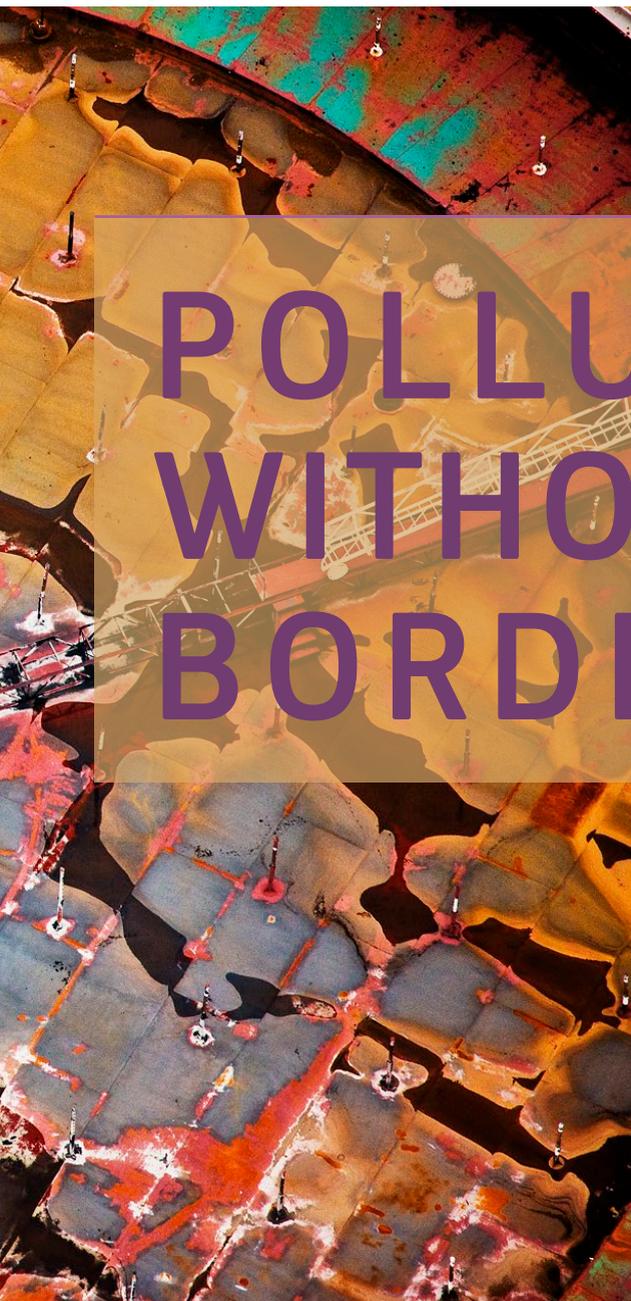
© J Henry Fair

**Oil tank**  
Pascagoula, Mississippi, USA

**THE ARTIST'S  
VIEW**

J Henry Fair

“Burning hydrocarbons has numerous known and unknown effects. Climate change is the result most often in the news, but air pollution, and the death and disease it causes are also getting attention. Interestingly, these two pollutants also interact in unpredictable ways: new research is showing that the particles in clouds of air pollution are actually slowing the rate of climate change by shading certain areas and reducing heat gain. But the wrong areas are being shaded, specifically the oceans, which is disrupting monsoon rainfall patterns around the world.”



# POLLUTION WITHOUT BORDERS

## **Air pollution and human health**

Air pollution arising from transport, industry and agriculture remains a major concern, especially because of its negative health impacts. It is estimated that in Europe, as many as 412 000 premature deaths per year can be attributed to air pollution.

## **Sans frontières (without borders)**

Air pollutants can travel long distances, across national borders. The air quality in a country can also depend on pollution coming from other countries. For instance in The Netherlands and Belgium, about a third of the air pollution their citizens breathe originates from national sources. The rest comes from other countries. This is why no country can solve its air pollution issues alone, and why international and EU regulations are needed.

## All human activities generate emissions that have an impact on air pollution

Exposure to fine particulate matter (PM<sub>2.5</sub>) is responsible of an average life loss of about 8 to 10 months in the most polluted European regions and cities.

Source  
World Health Organization (WHO), 2015



# THE EU TAKES ACTION

## Limit values

Air pollutants are regulated by EU standards. Yet in 2015, up to 8 % of the EU's urban population were exposed to concentrations of **fine particulate matter** (PM<sub>2.5</sub>) above the EU annual target value (25 µg/m<sup>3</sup>). Over 82 % were exposed to levels above the much stricter guideline value of the World Health Organization (10 µg/m<sup>3</sup>).



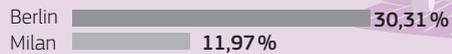
Urban PM<sub>2.5</sub> Atlas: Air Quality in European cities

## Where do air pollutants come from? A comparison of two European cities

### Industry



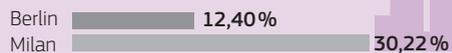
### Agriculture



### Transport



### Residential



## ARTEFACTS VIDEOS FACES OF SCIENCE

“The Joint Research Centre has developed tools that help city and regional authorities to identify sources impacting the air quality and where these sources are.”

Elisabetta Vignati  
JRC



### Source

<https://www.youtube.com/watch?v=dZy2ksVHBJo&feature=youtu.be>

## WHAT CAN I DO?

**Feel responsible** not only for myself but also for my ‘neighbours’.

**Do not burn** wood/plant residues or trash in my garden.

Help **reduce** the use of **fossil fuel** by **lowering the heating** in my house.

**Reduce** the use of wood **fires** or use more efficient wood burning stoves.

**Support organisations** that work on the environment.

Be sure that my car and my heating system are **regularly checked for their emissions**.

# THE JRC SUPPORTS

## City level support

Through its integrated tools, the **JRC** supports both local and regional authorities with the design of their air quality plans as well as with the assessment of their potential impacts on air quality.

## Actions on air quality in Europe

The ‘**Urban PM<sub>2.5</sub> Atlas: Air Quality in European cities**’ published by the **JRC** provides information on the origins of fine particulate matter (PM<sub>2.5</sub>) in 150 European cities. This helps administrations design action plans to implement EU air quality legislation. The Atlas describes the main sources of pollution for each city and suggests possible remedial actions.

### Source

<https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/urban-pm25-atlas-air-quality-european-cities> doi:10.2760/336669

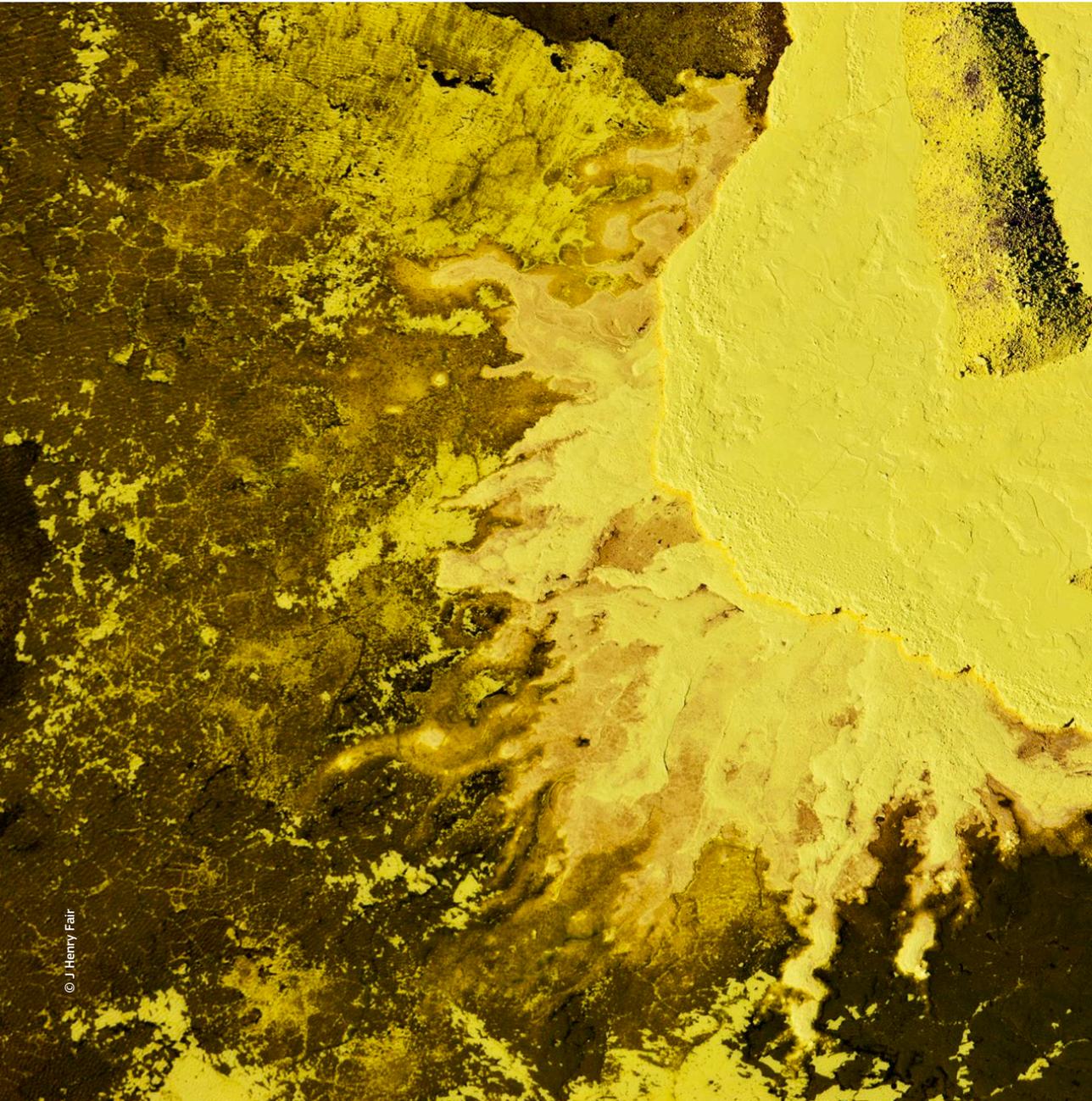
## The European Commission Atmospheric Observatory

was inaugurated in July 2017. This state-of-the-art laboratory was built to host the station which has been measuring air pollution for over thirty years. The Atmospheric Observatory provides essential observations on air pollutants and greenhouse gases. Its observations are used to assess the effectiveness and impact of European policies.



### Image

30 years of observations in support to policy - the EC Atmospheric Observatory JRC Ispra



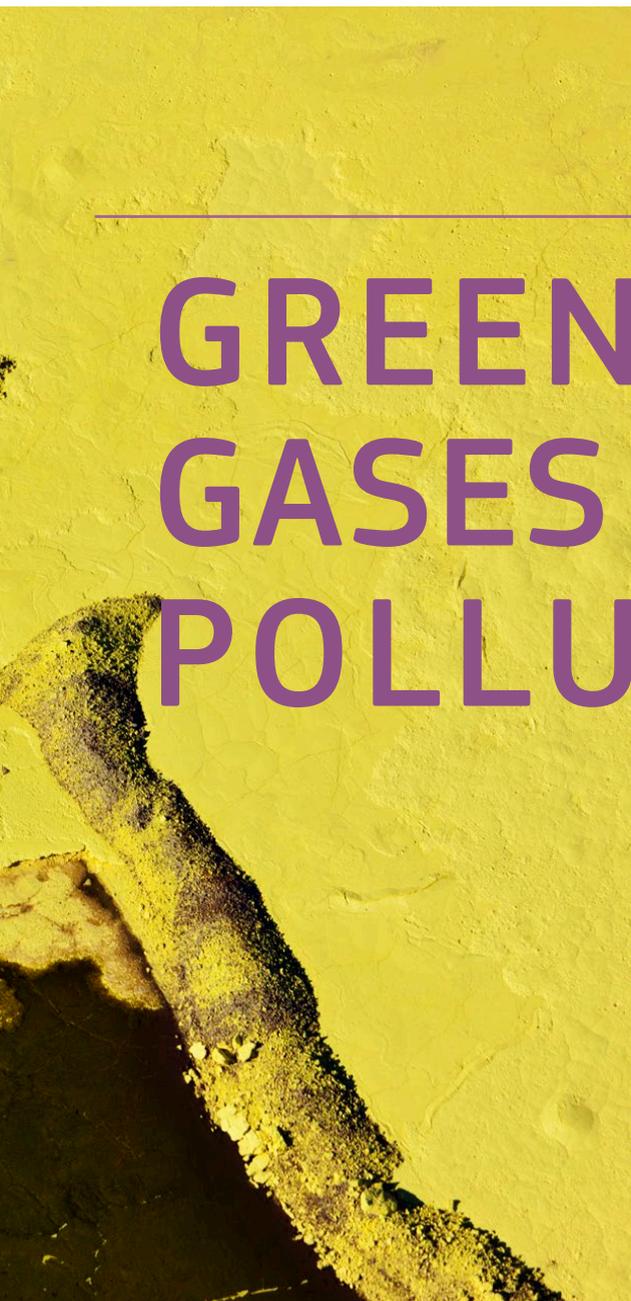
© J. Henry Fair

**Sulphur dross**  
Baton Rouge, Louisiana, USA

**THE ARTIST'S  
VIEW**

J Henry Fair

“Air pollution is the leading cause for premature death in the EU. Research continues to expose unexpected links between air pollution and disease, such as dementia, kidney disease, and diabetes. We encounter this contamination through many vectors: micro particles, gases, even precipitation through rainwater. The vector sources vary: from the car standing beside us to the power plant on the other side of the planet. The root cause is the same: our reliance on hydrocarbons. The sulphur content of various fuels is a direct health threat through sulphur-dioxide, an invisible gas, and the formation of airborne soot.”



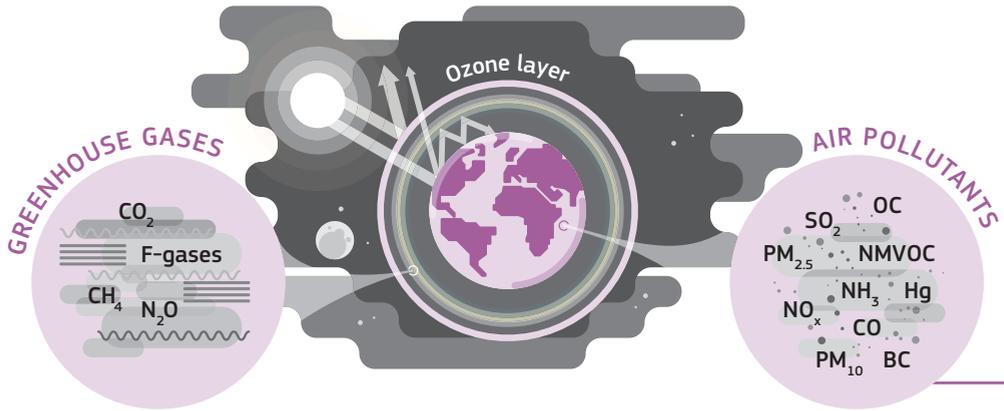
# GREENHOUSE GASES AND AIR POLLUTANTS

## What's the difference?

Both air pollutants and greenhouse gases (GHGs) are emitted from sources including energy production, transport, agriculture and industry. Air pollutants (e.g. nitrogen dioxide) affect the quality of the air we breathe and consequently our health. Greenhouse gases (e.g. carbon dioxide) affect our climate.

## Decarbonised electricity production

Most strategies that focus on improving air quality also benefit the climate, and vice versa. It is, however, important to assess these strategies carefully. For example, the overall emissions of an electric vehicle depend on whether the electricity needed to charge the battery is sourced from fossil fuels or renewable energy. This is one reason why energy production needs to be decarbonised at all levels.



# THE EU TAKES ACTION

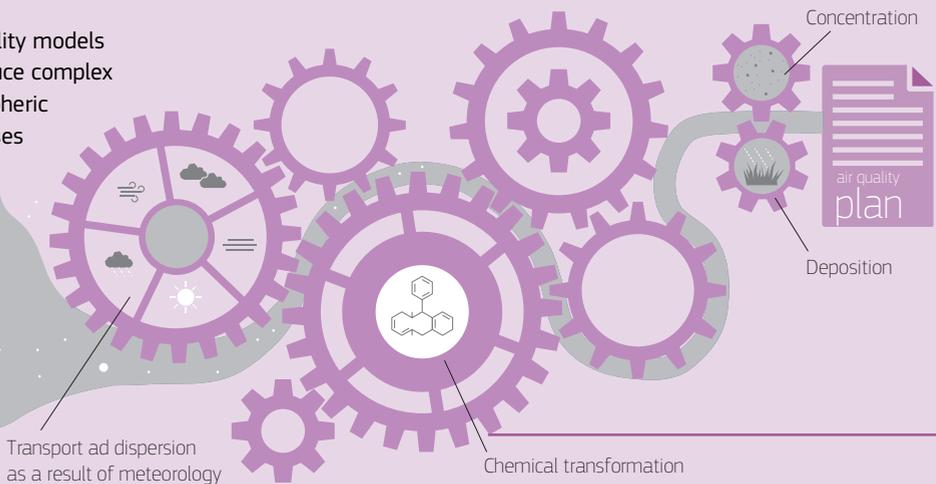
## Assessments

The **European Commission** works continuously on measures to improve air quality, and is deeply committed to tackling climate change. EU legislation requires that both air pollutants and greenhouse gases are constantly assessed. To support this, the 'Covenant of Mayors' initiative encourages local authorities to implement sustainable energy policies. The **JRC** supports these authorities in designing their air quality plans.

## The Covenant of Mayors (CoM)

The **JRC** provides scientific and technical support to the Covenant of Mayors initiative with particular attention to the evaluation of co-benefit measures (win-win measures for climate and air quality) with the aim of avoiding as much as possible climate-orientated measures that might be detrimental for air quality.

Air quality models reproduce complex atmospheric processes



## Co-benefits

The use of renewable energies, phasing out of fossil fuels, improved energy efficiency and positive changes in our habits (e.g. increased use of public transport) benefit both air quality and the climate.



**EDGAR**  
The Emissions Database  
for Global Atmospheric  
Research

Source

<https://edgar.jrc.ec.europa.eu/EDGAR-infographics.pdf>

# THE JRC SUPPORTS

The **JRC** has developed tools and expertise for cities and towns to test air quality control measures and understand how to efficiently combine air quality and climate change control.

**SHERPA** (Screening for High Emission Reduction Potential on Air) is a tool that calculates how changes in emissions – stemming from actions on traffic or residential heating for example – affect air quality. It has been designed by the **JRC** to support public authorities in selecting sound policies to improve air quality in urban areas.



**SHERPA TOOL**  
presentation

Source

<https://www.youtube.com/watch?v=dZy2ksVHBJo&feature=youtu.be>

## WHAT CAN I DO?

Investigate if my city has signed the CoM and get informed on how to **coordinate efforts with my fellow citizens**.

Explore opportunities for **teleworking**.

**Use public transport**, car-sharing, electric car/smaller car, walk and use my bike.

Drive cars in line with my real needs, and which adhere to the **cleanest emission category**.

**Reduce** garden **fires** and open wood fires.

**Support** NGO's/Politicians that work on environment.

## ARTEFACTS VIDEOS FACES OF SCIENCE

“Most of the strategies focusing on the improvement of air quality also benefit the climate and vice versa.”

Philippe Thunis  
JRC



# CITIZEN EMPOWERMENT



This pilot project aimed to step away from the classic corporate communications style when delivering EU-related content and messages. ARTEFACTS strived to inspire the visiting public through entertainment and by providing a platform from which the opinions and concerns of citizens could be heard.

## ■ COMMUNICATION WALL

An interactive communication wall allowed visitors to provide instantaneous feedback, their thoughts and perspectives on the topics covered in the exhibition.

## ■ FACES OF SCIENCE

In order to put a face to the science behind the stories, videos were integrated into each of the 10 JRC panels. The short videos introduced the scientists who talked about their passion for science and provided examples from their own lives about how they and their respective families seek to address issues such as reducing food waste.



## ■ MEET THE SCIENTIST SESSIONS

Lately, citizens have become increasingly interested to play an active role in societal change. They want to have a say in important issues like air pollution and the use of plastic. Taking inspiration from this passion and conviction to be more involved, over 40 'Meet the Scientist' sessions took place during the course of ARTEFACTS. This provided an opportunity for members of the public to talk to scientists - the very same scientists helping to provide solid scientifically proven facts to EU policymakers. From 'personal mobility choices' to 'agriculture and challenges of sustainability' these sessions reached an audience untouched by typical communication methods of the JRC.





## ■ 'WHAT CAN I DO' PANELS

The panels promoted self-empowerment by suggesting some actions that individuals can do to contribute to the improvement of serious environmental issues. They invited citizens to read more about a particular topic or to consider their own behaviour. For example, they encouraged visitors to think about their daily mode of transportation and look at what other suitable options might be available. Also, encouraging people to plant trees in their own garden supports the recent EU Action to Protect and Restore the World's Forests.

## ■ EVENTS

### High-level discussion and large-scale participation

Throughout the duration of the physical exhibition, several events took place, which saw the participation of representatives from Germany's Federal Government, the European Commission, academia, and industry. These events provided opportunities for open discussions with the public, helped raise awareness on specific topics like the decline of biodiversity, but also strengthened networking and the relationships between policymakers, experts and society.

Helping to promote citizen engagement in science, JRC scientists were physically present at several events, which took place in the ARTEFACTS exhibition hall. One of them was 'Die Lange Nacht der Museen', which involved over 75 Berlin museums opening their doors throughout the night. For the event, the JRC offered interactive workshops and activities including the virtual reality version of the exhibition. The event attracted over 10 000 people to the museum in one night!

## ■ ARTEFACTS VIRTUAL REALITY

ARTEFACTS Virtual Reality allows visitors to experience the exhibition via the innovative use of technology. Being mobile, the tool disseminated the exhibition's core messages to audiences not reached in Berlin. It went to over 25 events which reached out to policymakers including European Commissioners, strategic partners attending the 'Science Meets Parliaments' event, and other outreach efforts such as 'World Science Journalists Conference' in Lausanne, Switzerland.



## ■ WHAT VISITORS SAID ABOUT ARTEFACTS...

100% of visitors liked ARTEFACTS 'very much' and found the exhibition 'very interesting' or 'interesting'

“fascinating,,

“ very beautiful, very informative, and very interesting,,

“We need a fundamental change in how we communicate knowledge.”

Vladimir Šucha  
JRC



# LIST OF CONTRIBUTORS

ARTEFACTS was a joint collaboration between the Joint Research Centre, Museum für Naturkunde and J Henry Fair

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