International Cadmium Association

Technical Session

October 7th, 2021
15:00 -17:00

Agenda

15:00	Welcome, Statement of Compliance
15:05	Positive communication on cadmium
	Website renewal
	Application sheets
15:35	Water framework Directive (WfD) and sources of cadmium releases
15:50	Update on ICdA workplace monitoring observatory OCdBio and OCdAir
16:05	Occupational exposure to cadmium:
	Status of the Cd OEL revision in the Carcinogens and Mutagens directive
16:25	Update on Reach activities
16:40	Emerging topics: the EU Green Deal and potential implication for cadmium industry
16:55	Cadmium market update
17:00	End of the meeting

STATEMENT OF COMPLIANCE

- The purpose of the meeting is to address, under the applicable confidentiality rules, issues concerning Cadmium and Cadmium compounds producers and importers and more particularly their obligations under the several regulations.

- The minutes kept during the meeting will have to reflect all significant matters discussed during the meeting.

- No discussions will be held, formally or informally, during specified meeting times or otherwise, involving, directly or indirectly, express or implicit agreements or understandings related to: (a) any company's price; (b) any company's terms or conditions of sale; (c) any company's production or sales levels; (d) any company's wages or salaries; (e) the division or allocation of customers or geographic markets; or (f) customer or suppliers boycotts; or (g) any disclosure of information which may affect applicable rules on Competition Law.

- The International Cadmium Association (ICdA), as a group will make no recommendations of any kind and will not try to reach any agreements or understandings with respect to an individual company's prices, terms or conditions of sale, production or sales levels, wages, salaries, customers or suppliers.

Positive communication on cadmium

ICdA Website renewal

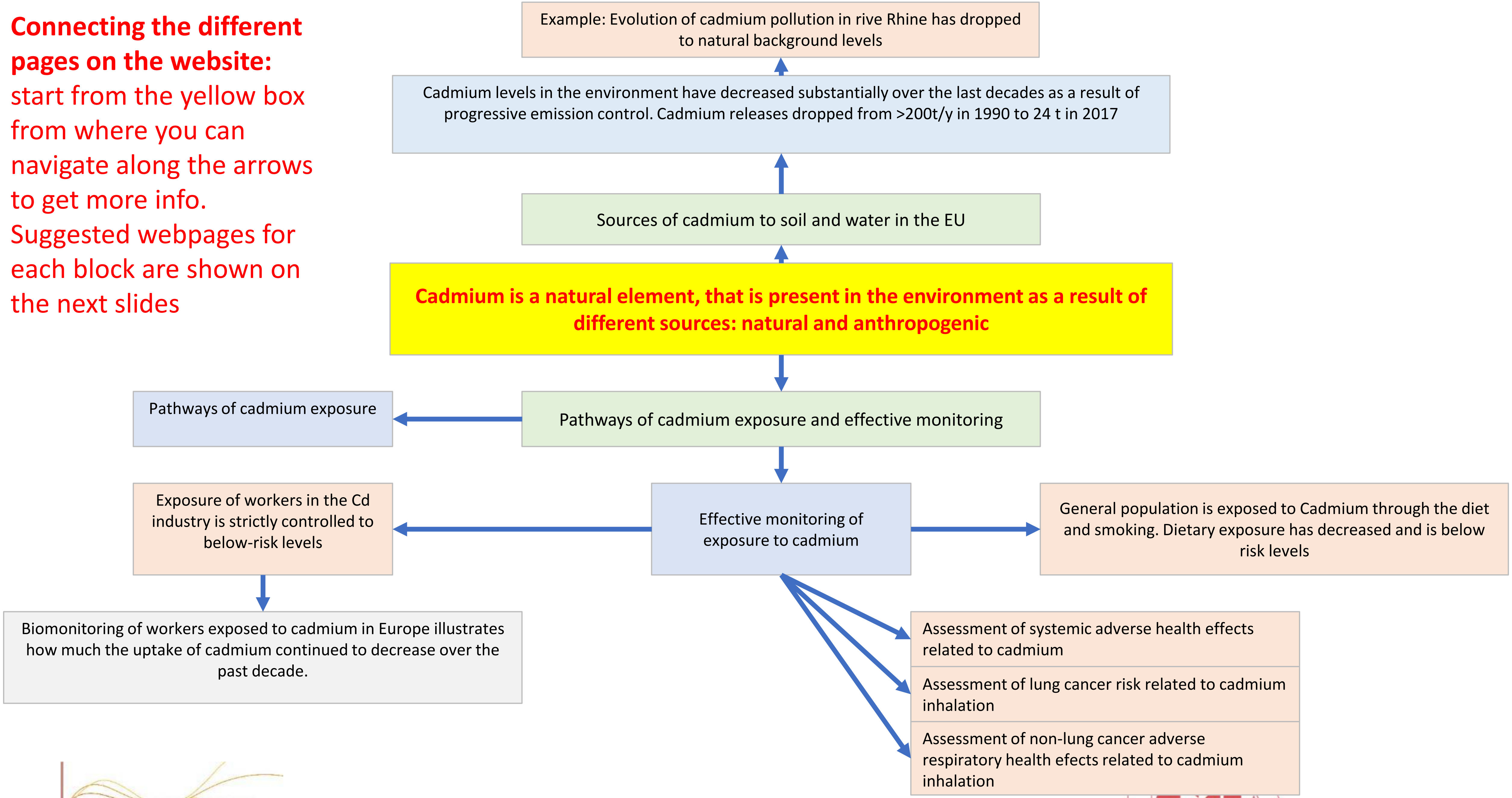
- The look and feel needs to be addressed
  - More visual presentation
  - Focus on key messages
    - ✓Application sheets
    - ✓Cadmium in the environment
    - ✓Exposure to cadmium

ICdA Website renewal

Cadmium in the environment and exposure to cadmium

- Cadmium is a natural element, that is present in the environment as a result of different sources: natural and anthropogenic
- Cadmium levels in the environment have decreased substantially over the last decades as a result of progressive emission control.
  - ➢ In 2017, non-ferrous metal sector contributed only 4% to total Cd releases.
- Pathways of cadmium exposure and effective monitoring
  - ➢ General population:
  - ➢ Occupational exposed population:
    - ✓ Exposure of workers in the Cd industry is strictly controlled to below-risk levels
  - ➢ Assessment of toxic effects and recommended exposure limit values

Connecting the different pages on the website: start from the yellow box from where you can navigate along the arrows to get more info. Suggested webpages for each block are shown on the next slides



Example: Evolution of cadmium pollution in rive Rhine has dropped to natural background levels

Cadmium levels in the environment have decreased substantially over the last decades as a result of progressive emission control. Cadmium releases dropped from >200t/y in 1990 to 24 t in 2017

Sources of cadmium to soil and water in the EU

Cadmium is a natural element, that is present in the environment as a result of different sources: natural and anthropogenic

Pathways of cadmium exposure and effective monitoring

Pathways of cadmium exposure

Effective monitoring of exposure to cadmium

Exposure of workers in the Cd industry is strictly controlled to below-risk levels

Biomonitoring of workers exposed to cadmium in Europe illustrates how much the uptake of cadmium continued to decrease over the past decade.

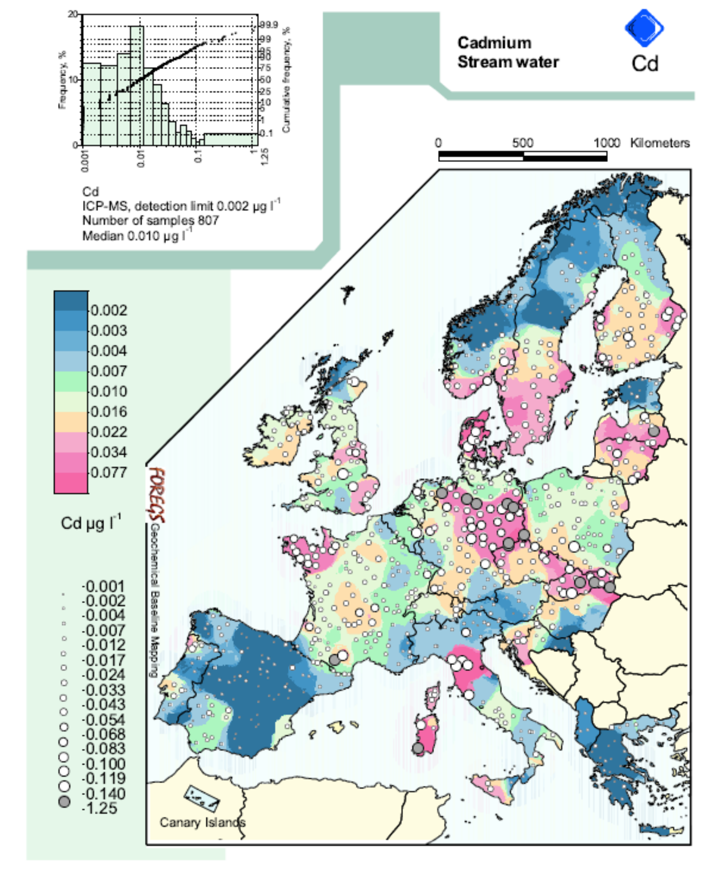
General population is exposed to Cadmium through the diet and smoking. Dietary exposure has decreased and is below risk levels

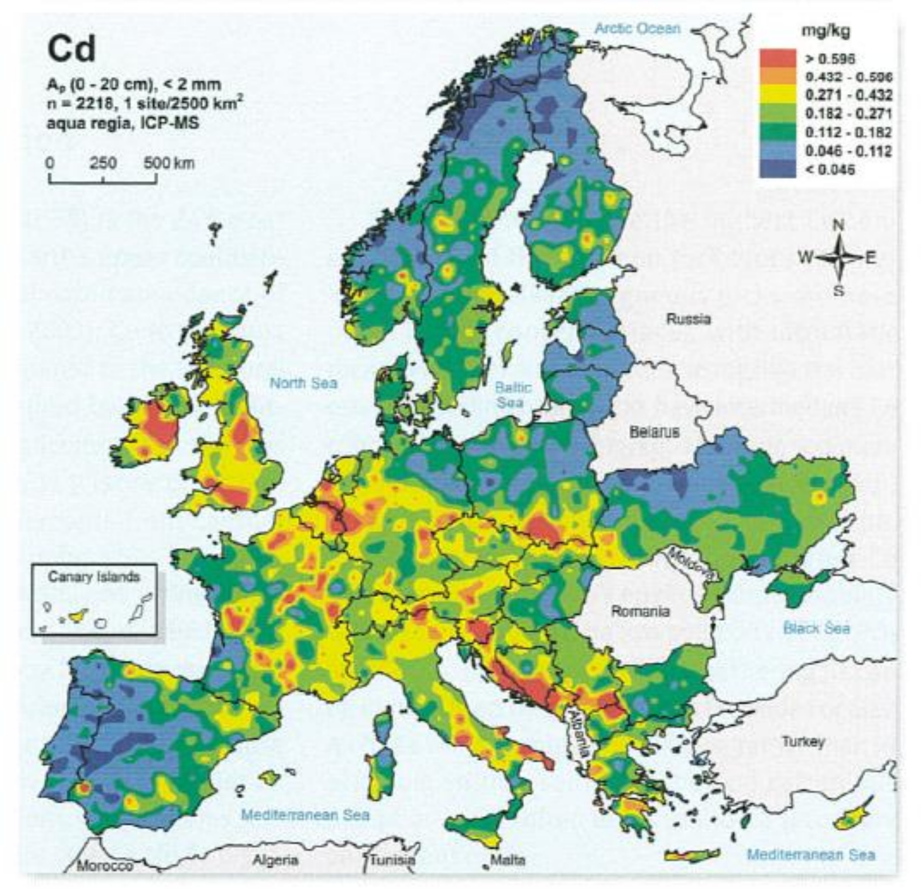
Assessment of systemic adverse health effects related to cadmium

Assessment of lung cancer risk related to cadmium inhalation

Assessment of non-lung cancer adverse respiratory health efects related to cadmium inhalation

Cadmium is a natural element, that is present in the environment as a result of different sources: natural and anthropogenic





Median ambient levels of cadmium in freshwater streams across Europe is 10 ng Cd/L

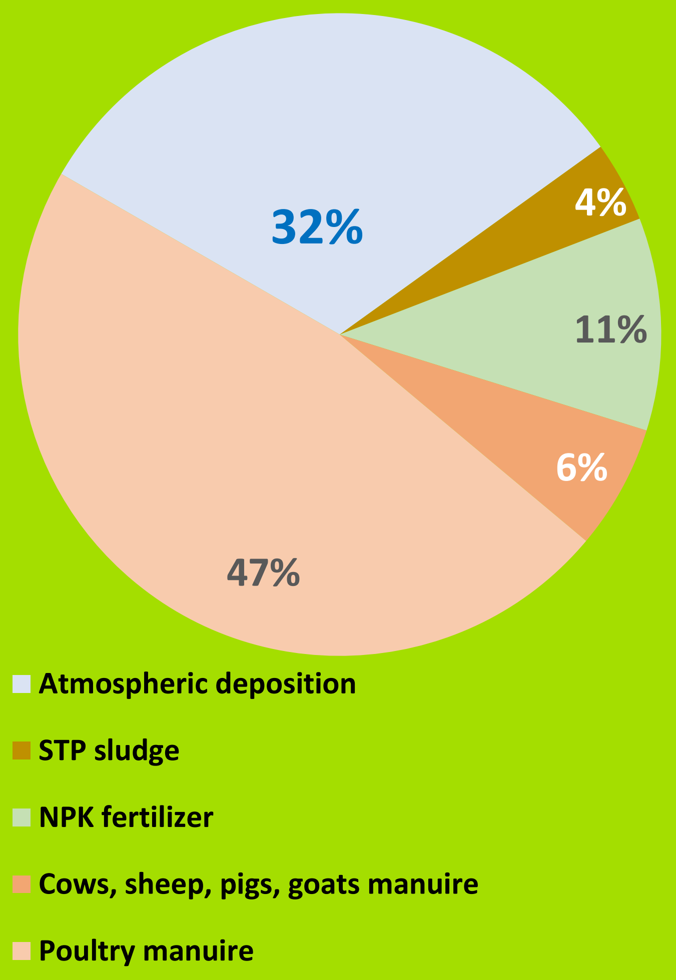
Ref.: Foregs database http://weppi.gtk.fi/publ/foregsatlas/ForegsData.php

EU27 average cadmium content of top soil is 0.31 mg Cd/kg of soil

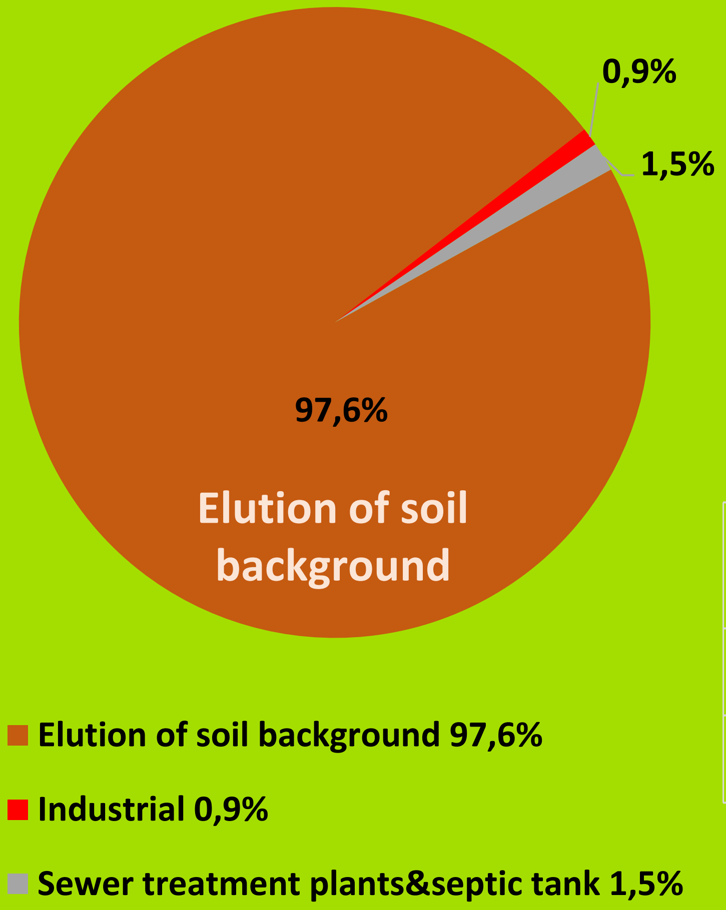
Ref.: Chemistry of Europe's Agricultural Soil. Part A: Methodology and Interpretation of the GEMAS Data Set. Ed.: Clemens Reimann; Manfred Birke; Alecos Demetriades; Peter Filzmoser & Patrick O'Conner. 2015

Sources of cadmium to soil and water in the EU

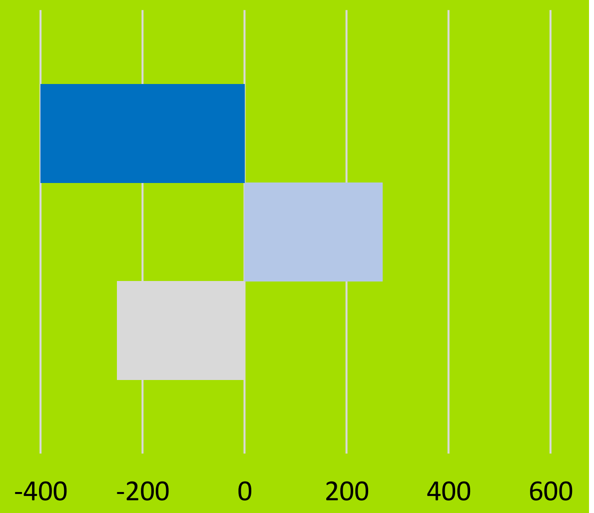
Sources of cadmium to soil



Sources of cadmium to river waters



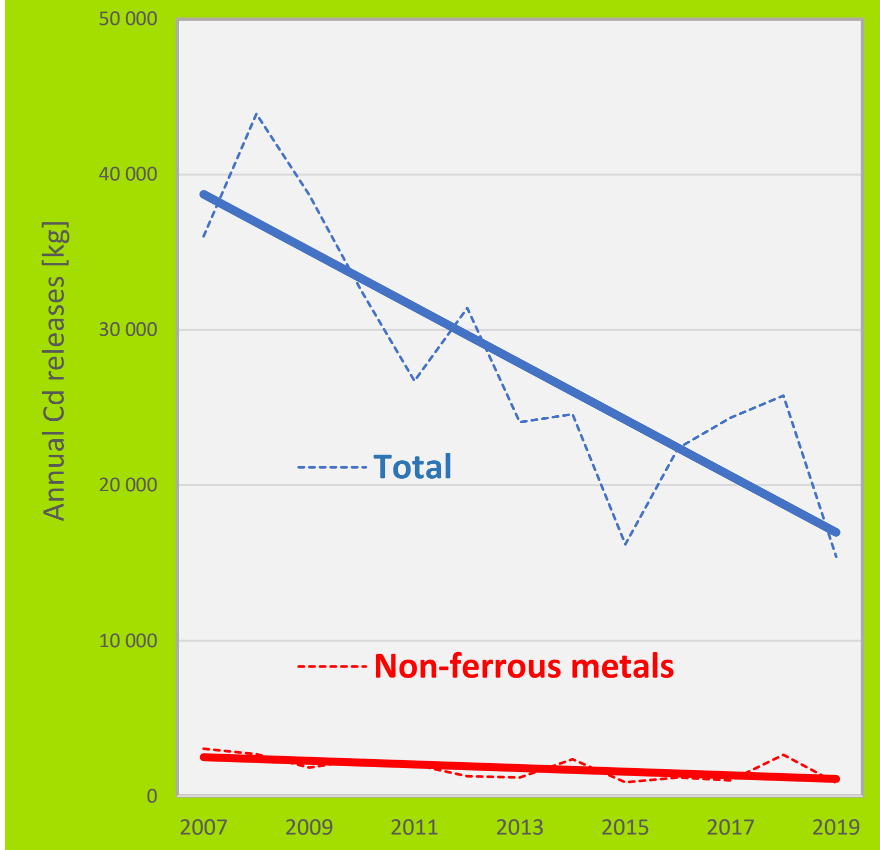
Balance of cadmium to soil



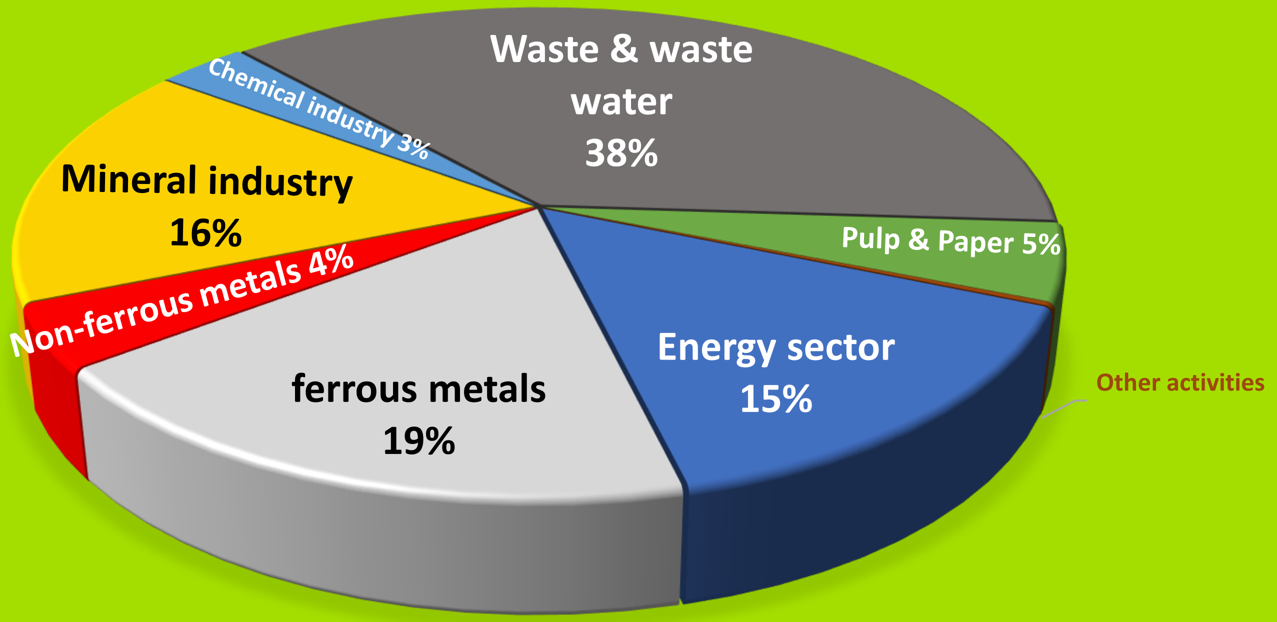
	kg Cd/day
■ Daily elution of cadmium from soil	-521
■ Daily cadmium deposit to soil	271
■ net evolution of cadmium to soil	-250

Sources of antropogenic cadmium releases to air and water

European cadmium releases dropped by 50% over the past decade (ref.: E-PRTR)



Contribution of industrial acivities to cadmium releases in Europe (ref.: E-PRTR 2017)

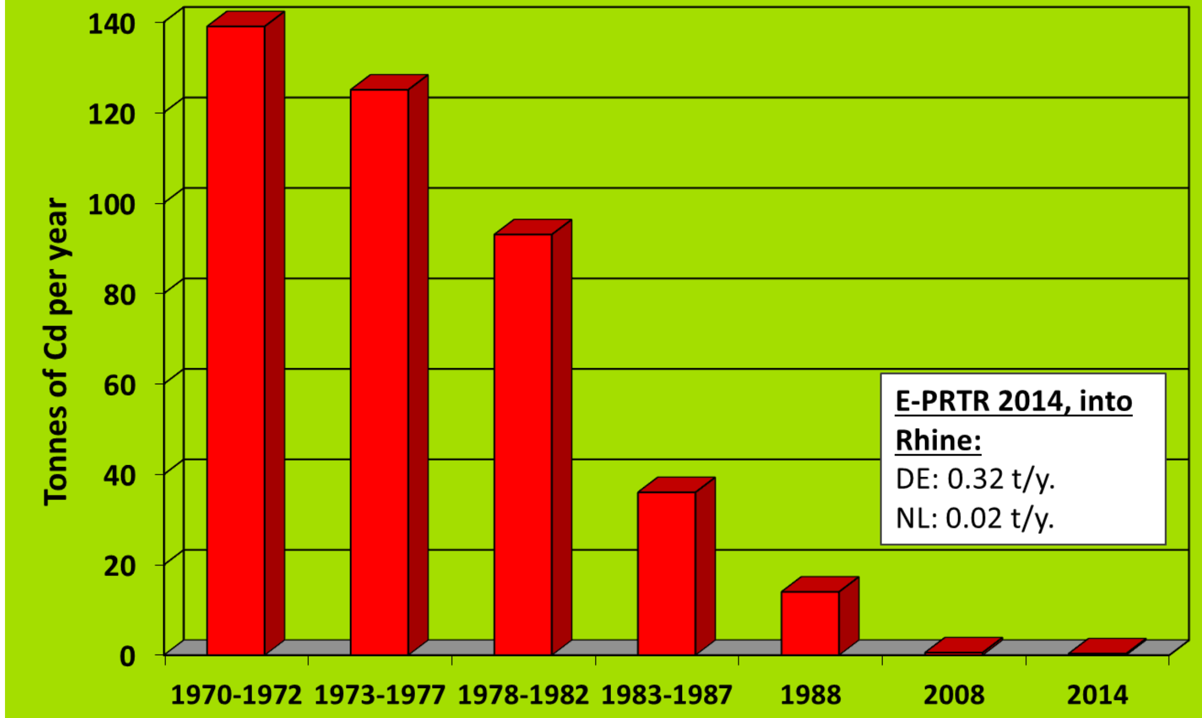


Total Cd Releases: 24341kg

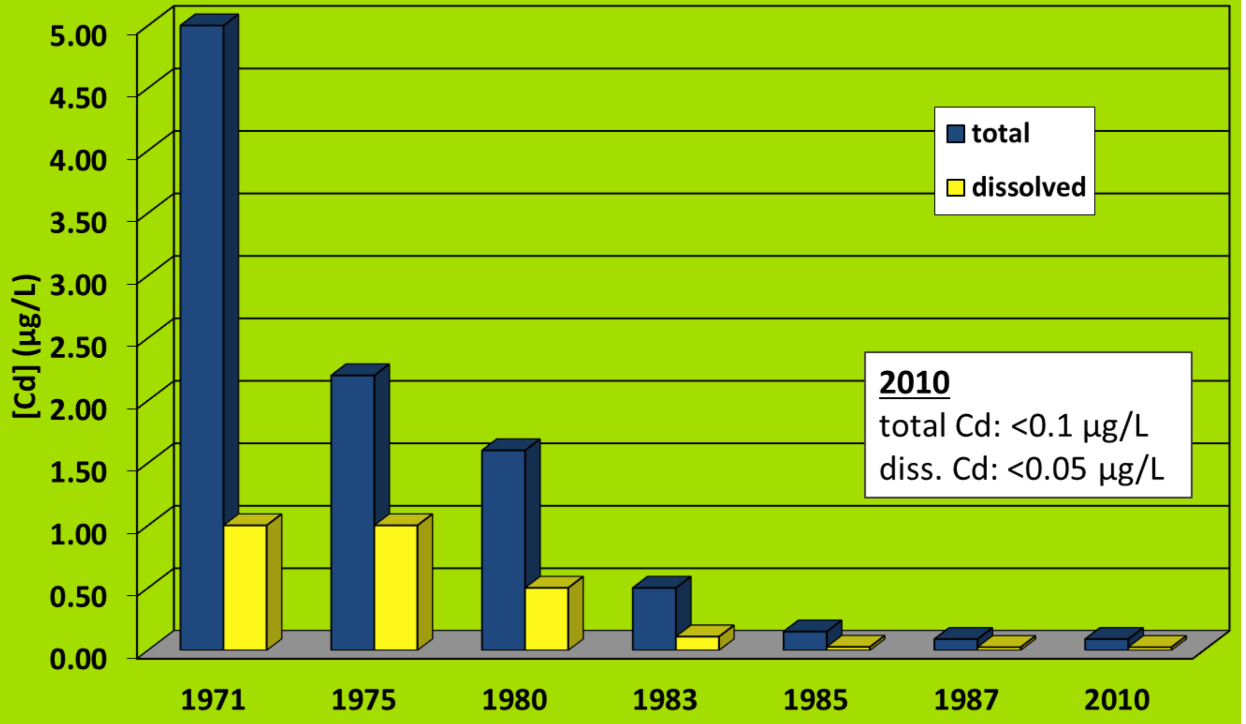
- In 1990, annual cadmium releases in Europe were above 200 t/y
- Over the past decade, Cd release to the environment dropped from 40 to 20 t/y which is similar to the natural emissions of Cd.
- **In 2017, non-ferrous metal sector contributed only 4% to total releases.**

Example:

Evolution of cadmium pollution in rive Rhine has dropped to natural background levels



E-PRTR 2014, into Rhine:
DE: 0.32 t/y.
NL: 0.02 t/y.



2010
total Cd: <0.1 µg/L
diss. Cd: <0.05 µg/L

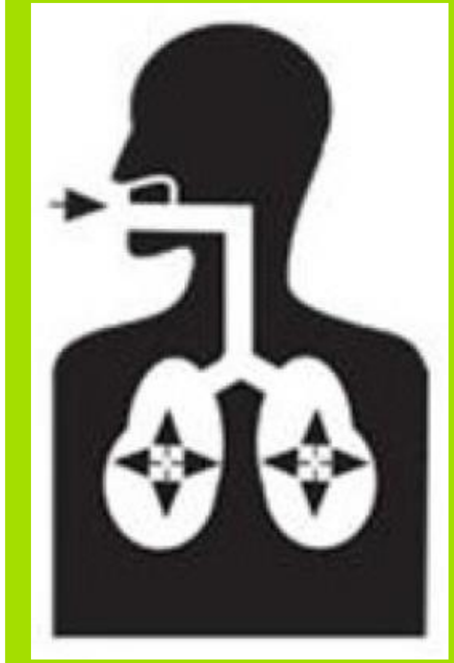
Pathways of cadmium exposure and effective monitoring

Ingestion

- Typically 5% of ingested cadmium is absorbed by the human body and can cause systemic health effects.
- Cadmium in urine correlates very well with retained cadmium.
- **Urinary cadmium is an excellent indicator to asses the risk of all cadmium related systemic health effects like kidney deficiency.**

NOTE: Urinary cadmium is not a reliable indicator to asses the risk of local respiratory effects.

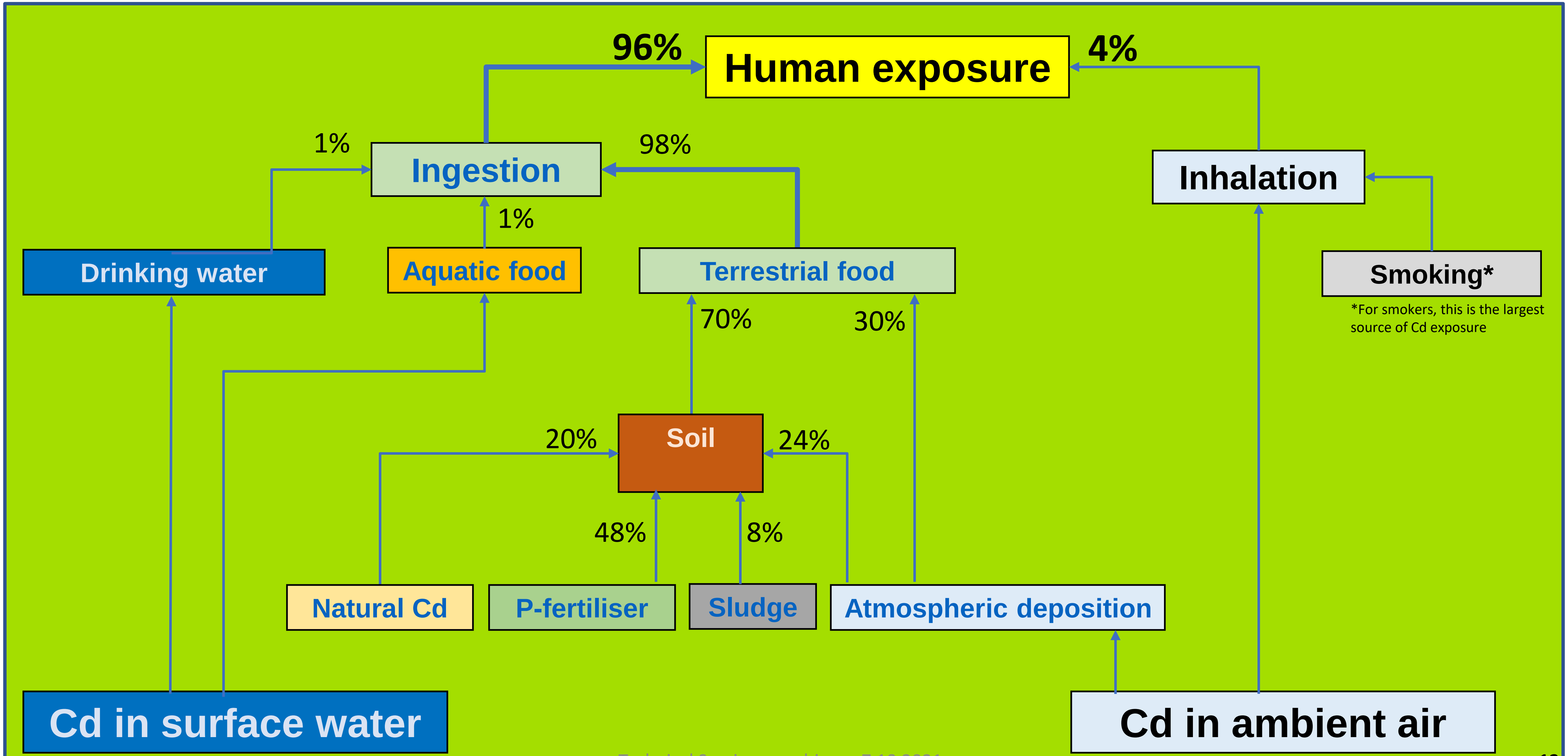
Inhalation



- Adverse health effect to the respiratory tract correlate with quality of inhaled air.
- For adverse lung effects, only the fraction of very fine particles that can penetrate into the lung are of relevance.
- This fraction of the inhaled air is referred to as the respirable fraction.
- **Respirable air is a reliable indicator to asses the risk local respiratory effects like lung diseases.**

NOTE: Respirable air is not a reliable indicator to asses the risk of systemic health effects.

Typical pathways of cadmium exposure

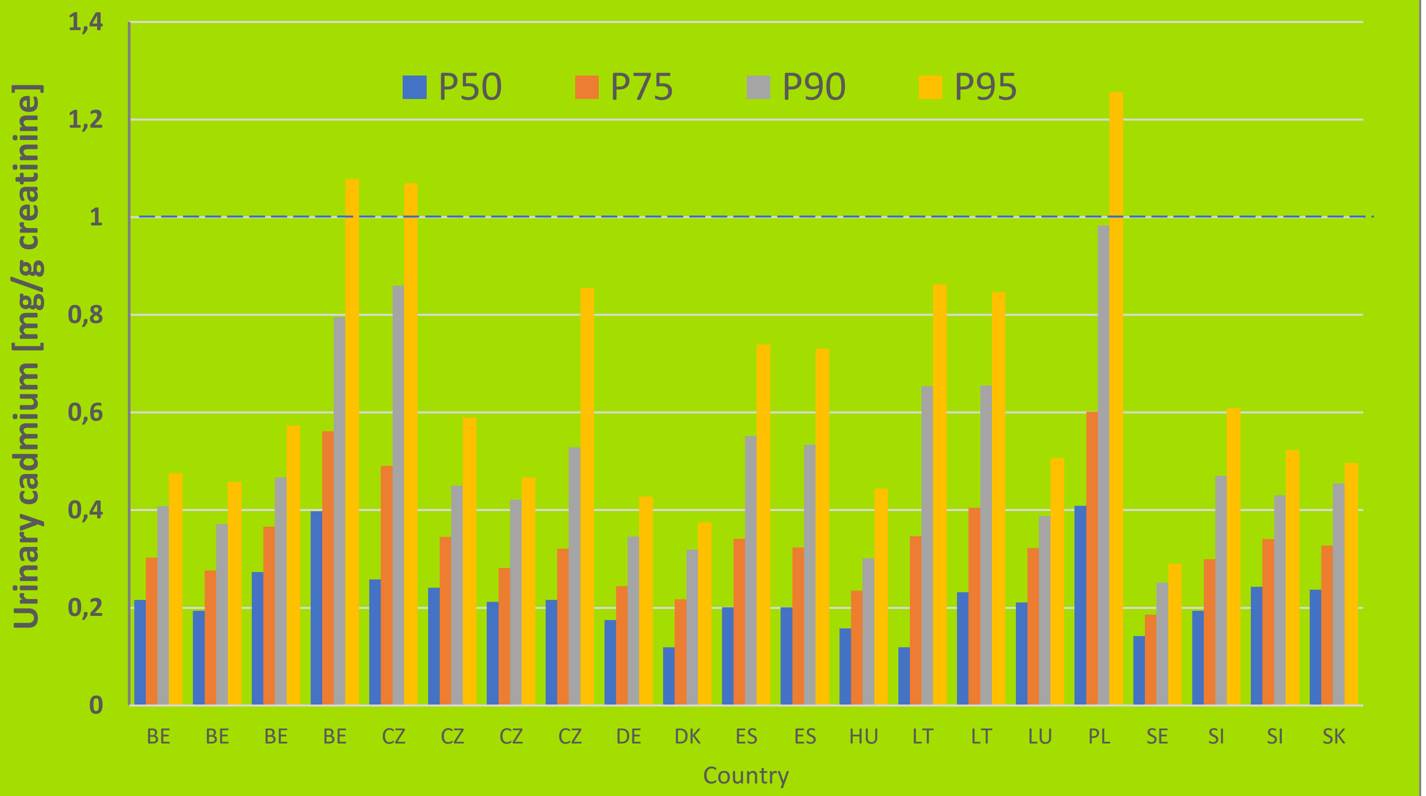


*For smokers, this is the largest source of Cd exposure

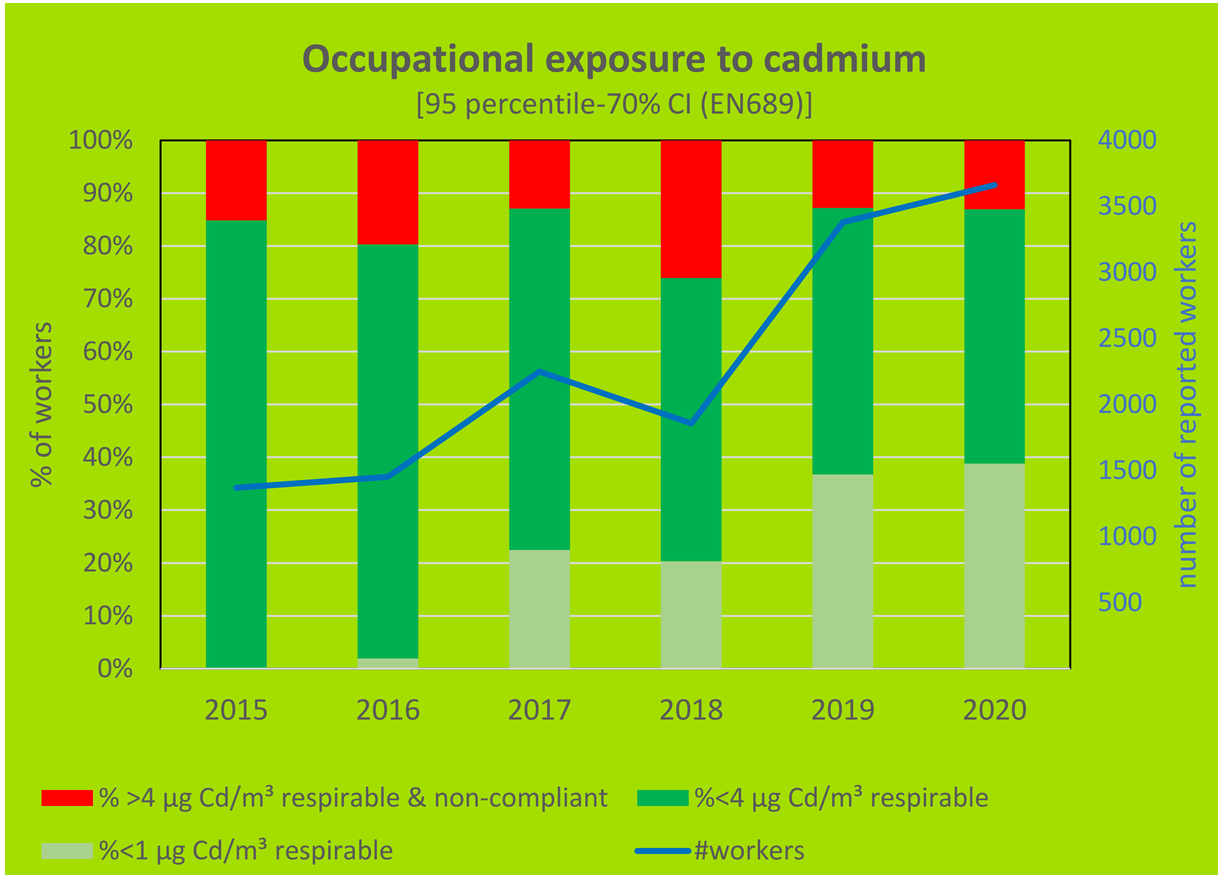
Human beings are exposed to Cadmium through the diet and smoking.
Dietary exposure has decreased and is below risk levels

- The 95 percentile of urinary cadmium in the general population has a median value of 0,56 mg Cd/g creatinine
- In 25% of the reporting countries the 95 percentile exceeds 1mg Cd/g creatinine. (ref.: HBM4EU)
- The number of persons and countries reporting in this study is small which gives uncertainty on the representativeness of the data for the EU.
- Occupational doctors in SE and CZ confirmed that pre-work medical screening of new hired worker revealed that several candidates are at more than 1 mg Cd/g creatinine

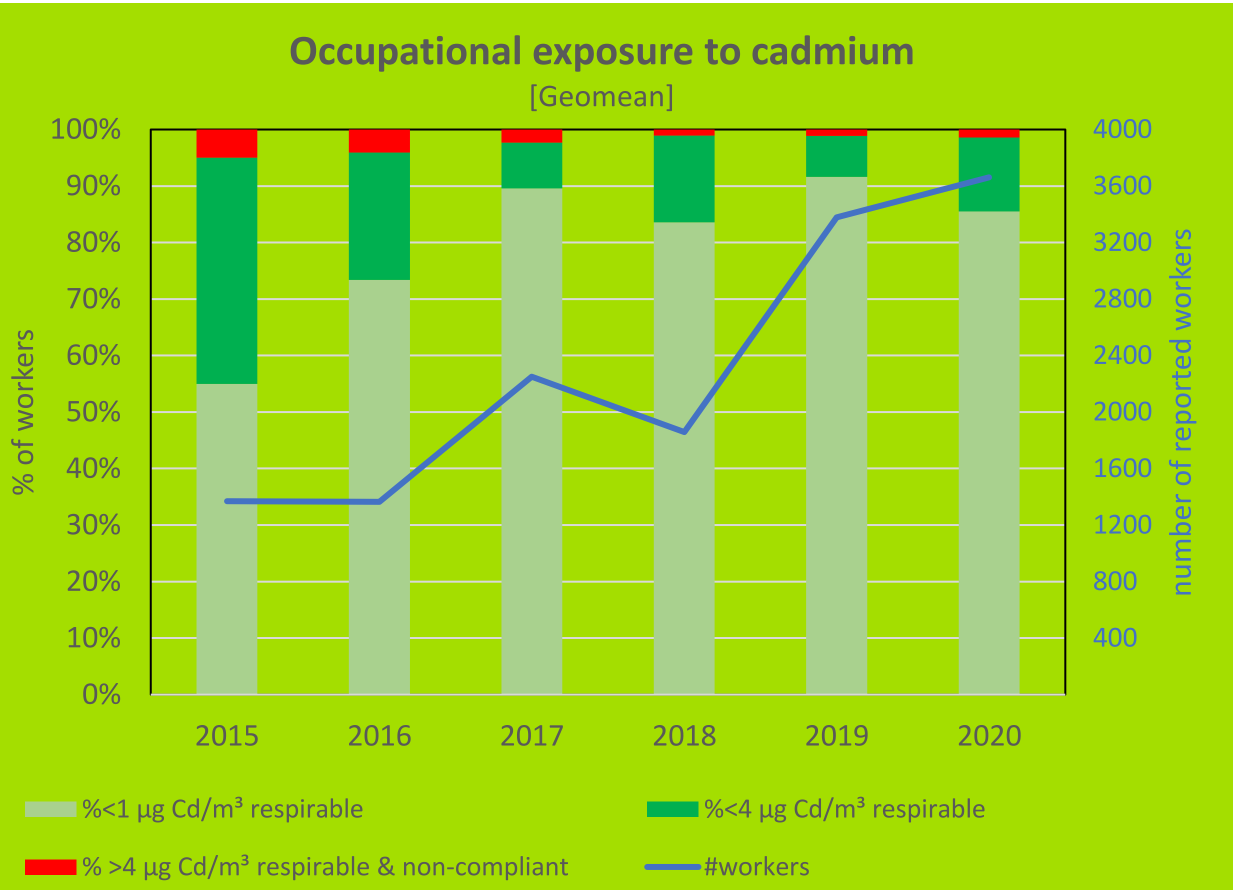
Urinary cadmium levels in the general population (adults >20y) ref.: HBM4EU



Exposure of workers in the Cd industry is strictly controlled to below-risk levels


Occupational exposure to cadmium

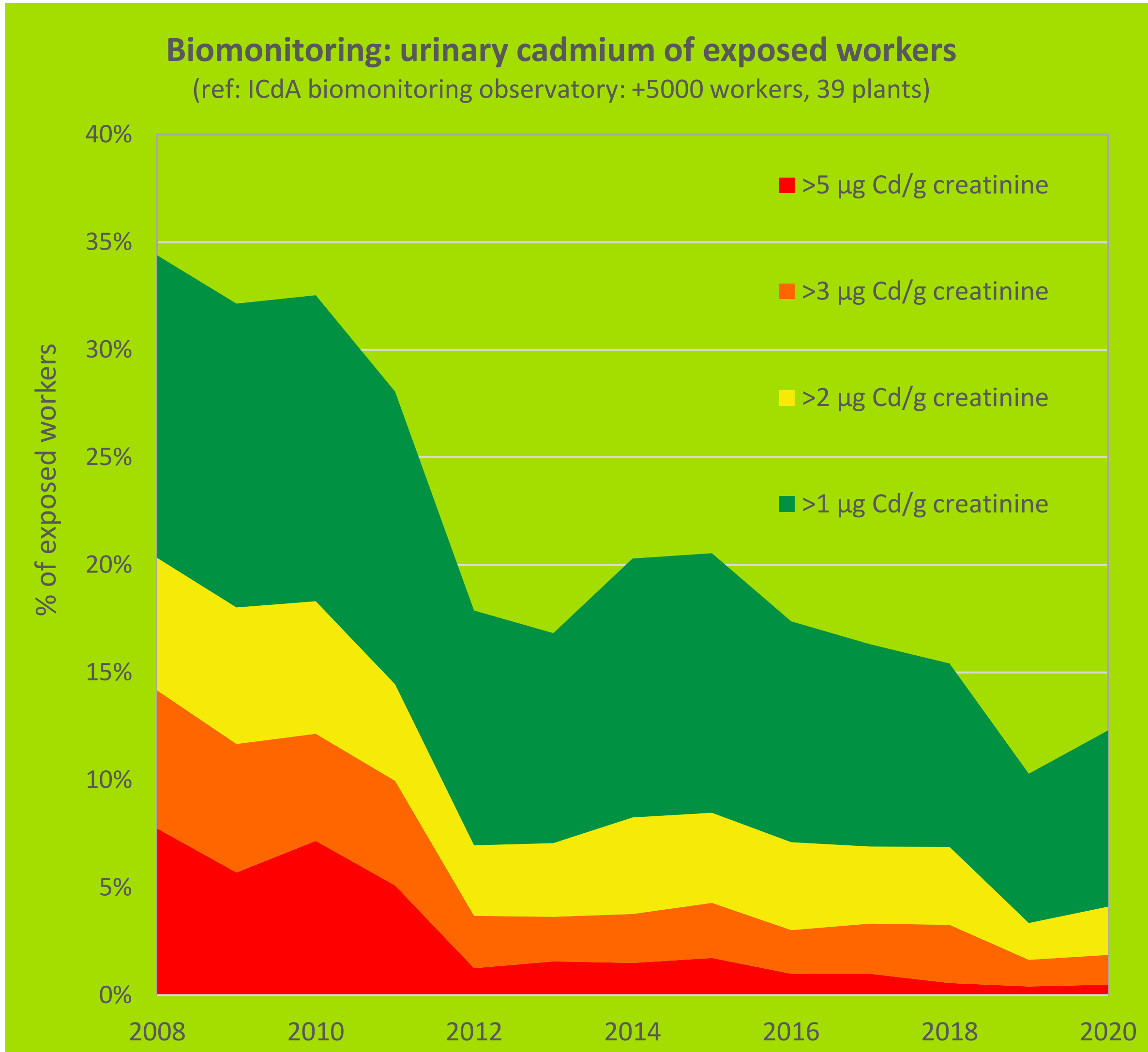
[95 percentile-70% CI (EN689)]


Occupational exposure to cadmium

[Geomean]

- Exposure levels in the workplace have decreased over years.
- Although monitoring according to EN 689 suggest 60% of worker is exposed at concentration above 1µg Cd/m³ respirable air, the geometric mean assessment shows only 10-15% workers are above that level of exposure while only 1% is exposed to levels >4µg Cd/m³.

Biomonitoring of workers exposed to cadmium in Europe illustrates how much the uptake of cadmium continued to decrease over the past decade.



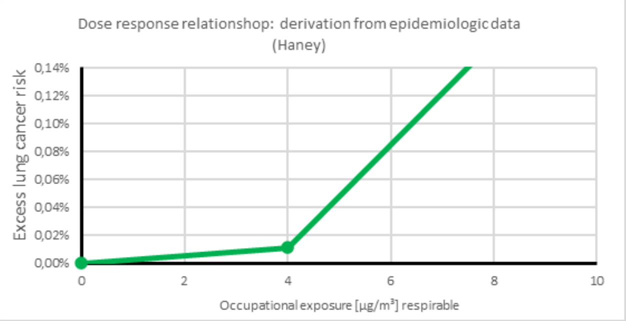
- The decreased exposure of workers has ongoing positive effect on biomarker values

- Today, less than 4% of exposed workers has urinary cadmium levels above 2µg Cd/g creatinine

Assessment of lung cancer risk related to cadmium inhalation

- **Risk calculated from most relevant and extensively documented study on occupational exposure to cadmium**: exposure assessment at the Globe cadmium plant in Colorado, initiated by Thun in 1985

  - ✓ Doubt on confounding factors expressed in Thun study was cleared in later studies (Stayner 1992, Park 2012, Haney 2016)
  - ✓ Long term follow-up of 601 workers from 1920 to 2002 (74% of these workers were deceased by 2002, including 36 from lung cancer)
  - ✓ Extensive documentation of lifetime exposure of each individual worker to cadmium and arsenic, smoking, ethnicity
  - ✓ Lung cancer risk related to cadmium calculated
- **Clear evidence of threshold carcinogenicity**
  - ✓ Methodology developed by BAUA to include threshold effect in dose response relationship.
- **Calculated lung cancer risk: 1/10 000 at 4µg Cd/m³ respirable fraction.**



BAUA calculated the risk at 4/1 000 at 2.6 µg/m³ (respirable fraction) based on animal studies on wistar rats which are more sensitive to tumours than humans. This makes it far less accurate to translate this towards a risk to humans and explains large difference with the assessed risk from the human occupational exposure

Note: RAC proposed a limit value 1 µg/m³ (inhalable fraction) referring to an older German study where systemic health effect were also addressed by translating a urinary cadmium value in an air value. Systemic effect should be addressed more directly by considering urinary cadmium values.

Assessment of non-lung cancer adverse respiratory health effects related to cadmium inhalation

- The recent risk assessment by Nordberg et al. (2018) agreed on the 500 µg/m^3 x years as the LOAEC for respiratory effects(Cortona et al. 1992), which corresponds to 40 years exposure at a level of 12.5 µg Cd/m^3.
- Applying an extrapolation factor of 3 (LOAEL to NOAEL) would result in a NOAEL value of 4 µg Cd/m^3 (respirable fraction).
- Nordberg et al. (2018) stated that *“None of the more recent studies has documented effects of cadmium at lower exposures that can be considered caused by cadmium and not by smoking”*.

Conclusion:

4 µg Cd/m^3 (respirable fraction) corresponds to:

- No non-lung cancer adverse respiratory health effects
- A residual lung cancer incidence of 1/10 000.

  (total number of exposed EU workers <10.000)

Assessment of systemic adverse health effects related to cadmium

- There is an abundant data base on the systemic health effects of cadmium and its compounds, including human studies. (Ref. ECHA Scientific report 2020)
- The most significant adverse health effects are kidney dysfunction and to a minor extend bone demineralisation

ICdA recommended biologic limit value: 2µg Cd/g creatinine

NOTE: Some data indicates effects in the general population at concentrations < 2 µg/g creatinine (even as low as 0.5 µg/g creatinine). The causality of the associations between urinary cadmium and biomarkers of kidney effects in populations with low levels of exposure (general population) has been seriously challenged (Bernard et al., 2016). At low environmental exposures, urinary cadmium is more a reflection of functional integrity of the nephron than of the cadmium exposure or of the cadmium body burden (Chaumont et al. 2012).

ICdA Website renewal

Application sheet

Most of the applications of cadmium are unique with no equivalent alternatives available

- Highly robust and safe rechargeable batteries for critical applications
  - ✓ Safety systems in aviation, trains& metro, hospitals
- Extremely stable colours that do not fade
  - ✓ Essential for risk and hazard marking, artist paintings, high temperature decoration
- CdTe IR and gamma ray detectors
- Thin film CdTe PV cells
  - ✓ Higher yields than Si based PV cells in warm climates
- Cd coatings in aviation
  - ✓ Unequalled high corrosion, wear and fatigue resistance of critical parts
- Cd alloys
  - ✓ Highest conductivity combined with high strength and low melting temperature

Suggestion for application sheet layout

Nickel-cadmium batteries

Benefits in brief

Nickel-cadmium batteries offer key benefits that make them ideal for demanding applications:

- Very long life
- Resistant to mechanical and electrical abuse
- Resistant to temperature swings and extremes
- Gradual loss of capacity rather than sudden death
- Limited maintenance requirements
- Attractive Total Cost of Ownership

Key applications

Nickel-cadmium batteries placed on the EU market today are almost exclusively used in industrial applications. Main areas of use are:

Public transportation

Nickel-cadmium batteries provide critical back-up power functionalities to ensure public transportation systems operate safely in case of main power failure:

> **Aviation**: Due to their unique benefits, industrial nickel-cadmium batteries are the preferred battery technology for both civilian aircraft (Airbus, Boeing, Embraer and others) and military aircraft. They provide back-up power for avionic and other critical on-board systems should the principal power source fail, and also start aircraft engines on the ground.
>
> **Rail**: Industrial nickel-cadmium batteries are widely used as back-up power in railways and underground metro systems. They ensure that emergency braking, coach lighting, heating & air conditioning, and driver-to-passenger communication remain fully functional should the main power source fail. They also provide locomotive starting and trackside back-up power for signalling and warning lights in harsh climate areas.

Mission-critical industrial assets

Nickel-cadmium batteries are an important tool in a company's industrial strategy through their ability to supply back-up power to mission-critical industrial assets. These include nuclear power plants, steel mills, sea-based oil exploration and extraction platforms, refineries, emergency lighting and alarm systems in hospitals, as well as navigation assets such as lighthouses and buoys.

Nickel-cadmium batteries in the circular economy

Manufacturers of industrial nickel-cadmium batteries have developed an extensive network of Bring Back Points (BBPs) in the countries which they serve. These facilities provide a free of charge, easy to use, environmentally compliant end-of-life service for end users of BBPs are tasked by manufacturers to receive, consolidate and ship used nickel-cadmium batteries to fully permitted recyclers which specialize in the treatment of cadmium-containing waste. All transport is carried out in compliance with applicable Dangerous Goods regulations and with Basel Convention requirements which regulate transborder shipment of hazardous waste.

The recyclers heat up the cadmium-containing fraction of the used batteries to over 800 °C, which is the temperature at which cadmium vaporizes. The cadmium is then cooled and condensed into high-purity ingots. Most of the recycled cadmium is then used to manufacture new batteries.

Besides cadmium, other metals present in these batteries, such as iron, copper and nickel, are extracted and resold to be further reused by industry.

Unmatched excellence

No other technology matches the industrial nickel-cadmium chemistry in its areas of excellence.

When it comes to use life, reliability, sturdiness and operational temperature range, its performance exceeds that of the standard industrial battery technology.

New technologies such as Li-ion batteries which display a superior cycling ability and a higher energy density have made new applications possible. The most significant ones are electrical mobility and grid-connected energy storage systems.

However, the Li-ion battery technology does not display the intrinsic properties of nickel-cadmium batteries. Furthermore, they require an embedded electronic management system to continuously ensure the proper surveillance of their functioning. The presence of such a system reduces the reliability of this technology.

Benefits in depth

Very long life

A nickel-cadmium battery lasts three to five times longer than an equivalent standard technology battery.

Resistant to mechanical and electrical abuse

These batteries have the mechanical strength to withstand harsh operating conditions associated with vibrations and shocks. They survive electrical abuse which would destroy a conventional battery, such as overcharging, deep discharging, and high ripple currents.

Resistant to temperature swings and extremes

Nickel-cadmium batteries have the ability to operate with limited performance loss in both low and high temperature environments, as well as in settings with large temperature swings.

Limited maintenance requirements

The nickel-cadmium battery is one of the most reliable battery systems available today. It has thus become an obvious first choice for users looking for a reliable, long life, low maintenance system. It can be left in remote locations without the need for any maintenance.

Gradual rather than sudden loss of capacity

A critical issue with standard (industrial) technology batteries is the "sudden death syndrome", which can lead to catastrophic consequences, particularly in mission-critical applications. Nickel-cadmium batteries, on the other hand, age and lose their capacity gradually. This enables preventive maintenance; a nickel-cadmium battery can be replaced before it no longer meets the requirements of the application.

Attractive Total Cost of Ownership

While the initial cost of a nickel-cadmium battery can be three to five times higher than an equivalent standard industrial battery, its Total Cost of Ownership is significantly lower. This is explained by the combination of longer life, reduced maintenance, and low failure rates.

More information

To discover more about cadmium and its use, check out the website of the International Cadmium Association.

Address your specific questions to contact@cadmium.org.

Cadmium in thin-film photovoltaics

Cadmium and tellurium form a stable semiconductor compound, CdTe, that is used in thin-film photovoltaic (PV) cells. CdTe PV cells are used in some of the world's largest photovoltaic solar facilities. They are the second most common PV technology in the world marketplace after crystalline silicon.

Benefits in brief

Thin-film PV technologies based on CdTe are used in the most energy- and eco-efficient solar panels currently available. They offer a combination of unmatched benefits:

Better energy return on investment

Thin-film PV technologies require much less energy during production and can generate more electricity than other PV technologies in real-world conditions. This leads to a faster Energy Payback Time (EPBT) and higher Energy Return on Energy Invested (EROI).

Smaller environmental footprint

Thanks to production technology that is highly resource and energy efficient, electricity produced using thin-film PV technologies has a lower environmental impact, on a lifecycle basis, than electricity generated with any other PV technology.

Proven recycling

For over a decade, thin-film PV module recycling technology has been operated at commercial scale to recover substrate materials and semiconductors for reuse in new thin-film PV panels and other products.

Unique versatility

Thin-film PV can be easily integrated into vehicles to power hybrid and fully electric drivetrains, and into building materials such as walls, roof tiles, windows and smart appliances.

Lower costs

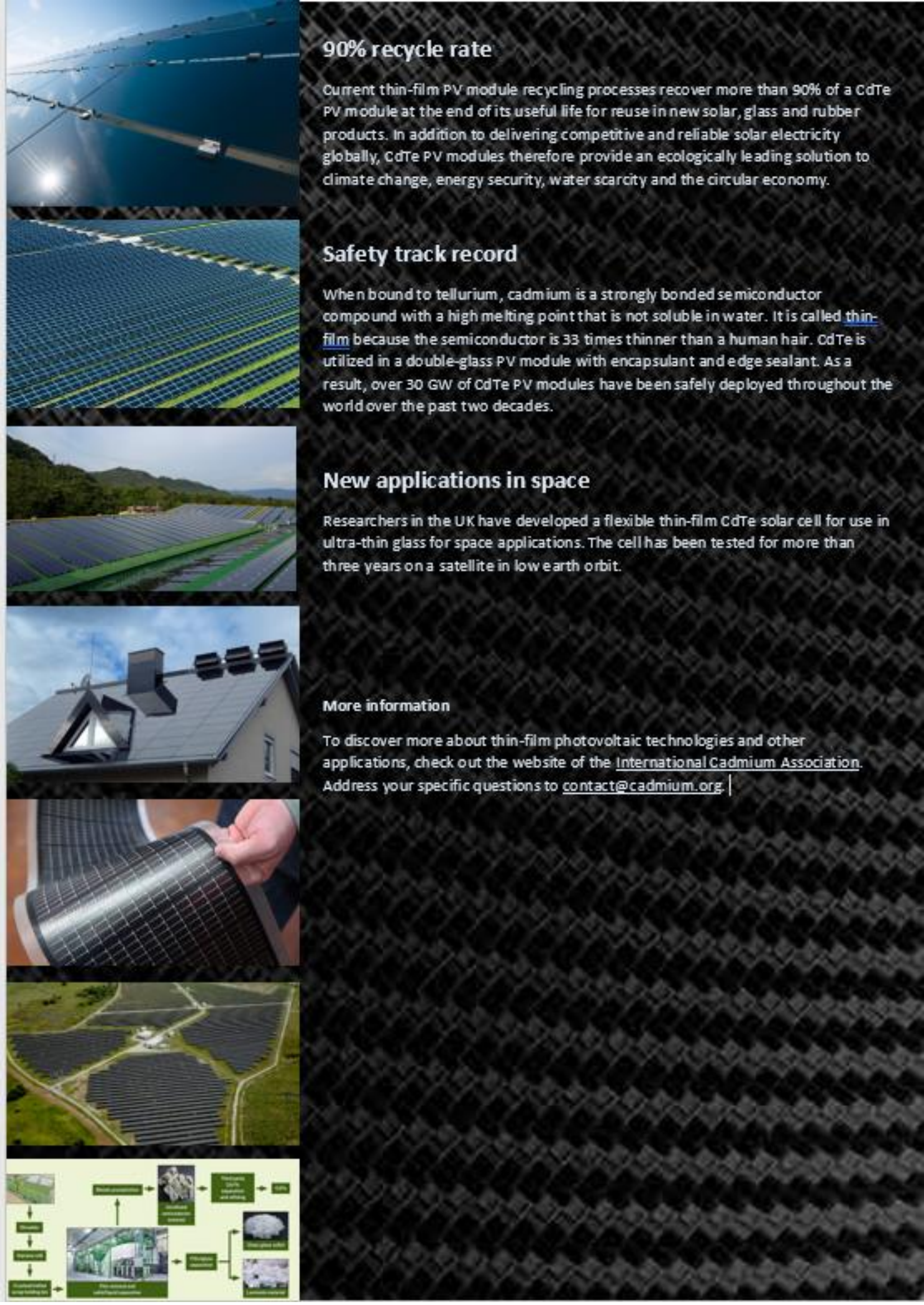
Thin-film PV achieves lower electricity production costs when compared with other PV technologies. This is because it uses integrated manufacturing technologies that are highly energy efficient, and it can generate more electricity than other PV technologies in real-world conditions.

High durability

With its monolithic design and direct deposition to substrates, thin-film PV is less prone to mechanical damage and *related performance losses, for example from hail.*

High efficiency potential

Thin-film PV technologies have the fastest innovation rate in the industry. The next cutting-edge step looks set to be tandem applications which will allow thin-film PV technologies to overcome conventional efficiency limitations, improve performance, and further decrease the cost of electricity generation.



90% recycle rate

Current thin-film PV module recycling processes recover more than 90% of a CdTe PV module at the end of its useful life for reuse in new solar, glass and rubber products. In addition to delivering competitive and reliable solar electricity globally, CdTe PV modules therefore provide an ecologically leading solution to climate change, energy security, water scarcity and the circular economy.

Safety track record

When bound to tellurium, cadmium is a strongly bonded semiconductor compound with a high melting point that is not soluble in water. It is called thin-film because the semiconductor is 33 times thinner than a human hair. CdTe is utilized in a double-glass PV module with encapsulant and edge sealant. As a result, over 30 GW of CdTe PV modules have been safely deployed throughout the world over the past two decades.

New applications in space

Researchers in the UK have developed a flexible thin-film CdTe solar cell for use in ultra-thin glass for space applications. The cell has been tested for more than three years on a satellite in low earth orbit.

More information

To discover more about thin-film photovoltaic technologies and other applications, check out the website of the International Cadmium Association. Address your specific questions to contact@cadmium.org.

Suggestion for application sheet layout

Suggestion for application sheet layout

Cadmium coatings

Cadmium coatings are applied to iron, steel, brass and aluminium. They are particularly useful in the electrical, electronics, aerospace, mining, offshore and defence industries, where they are applied to bolts and other fasteners, chassis, connectors and other components.

Benefits in brief

Cadmium coatings offer a combination of benefits that are not provided by other coatings.

Primary benefits:

- ✓ Excellent corrosion resistance
- ✓ Good bondability to adhesives
- ✓ High lubricity (friction reduction)
- ✓ Exceptional electrical conductivity
- ✓ Easy solderability

Secondary benefits:

- ✓ Cathodic protection of steel
- ✓ Galvanic compatibility with aluminium
- ✓ Freedom from stick-slip when torquing
- ✓ Good malleability
- ✓ Resistance to hydrogen embrittlement

Key applications of cadmium coatings

The use of cadmium coatings in the EU is restricted to articles and/or components used in the aeronautical, aerospace, mining, offshore and nuclear sectors for applications that require high safety standards; in safety devices in road and agricultural vehicles, rolling stock and vessels; and in electrical contacts in any sector where high reliability is paramount.

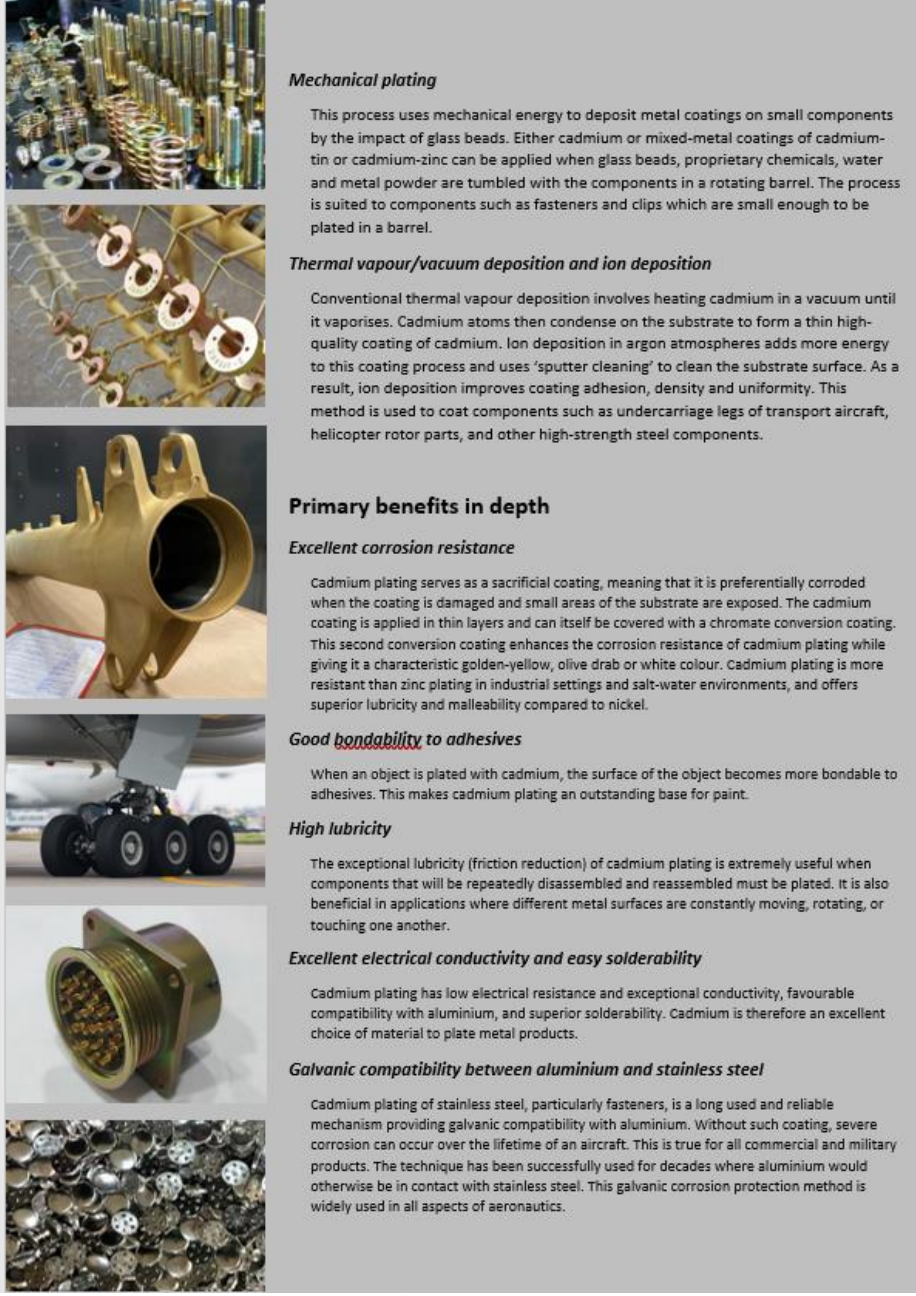
Under the European rules ELV (End-of-life Vehicles), WEEE (Waste Electrical and Electronic Equipment) and RoHS (Restriction of Hazardous Substances), cadmium is restricted to no more than 0.01 wt% of any vehicle and electronic material or coating, with exemptions for aircraft and equipment necessary for the protection of security interests of Member States (military use). Exemptions for use of cadmium and cadmium compounds in electrical contacts are described in Annex III to Directive 2011/65/EU.

The three main processes for applying a cadmium coating are described below.

Electroplating

Electroplating accounts for over 90% of all cadmium coatings. The coating is normally specified in thicknesses between 5 µm and 25 µm depending on the severity of the atmosphere. Chromate post-treatment of the cadmium coating can increase the life of the coating.

Cadmium is electrodeposited on the metal article from an electrolyte solution of cadmium salts in barrels or vats. These electrolyte solutions are nearly always based on the alkaline cyanide system. Other solution types are used, such as those based on fluoroborates, but these have not proved popular as they lack the excellent combination of brightness, covering power, throwing power and wide operating parameters of the alkaline cyanide system. When a current is passed through the electrolyte, cadmium is electrodeposited on the metal article at the cathode, and cadmium from the anode goes into solution. Typically, cadmium in the electrolyte is replenished by cadmium balls in an anode basket. Large or delicate articles are attached to racks and vat-plated whilst small components, such as bolts, washers, nuts, springs and clips can be vat-plated in drum cages or plated in a rotating barrel.



Mechanical plating

This process uses mechanical energy to deposit metal coatings on small components by the impact of glass beads. Either cadmium or mixed-metal coatings of cadmium-tin or cadmium-zinc can be applied when glass beads, proprietary chemicals, water and metal powder are tumbled with the components in a rotating barrel. The process is suited to components such as fasteners and clips which are small enough to be plated in a barrel.

Thermal vapour/vacuum deposition and ion deposition

Conventional thermal vapour deposition involves heating cadmium in a vacuum until it vaporises. Cadmium atoms then condense on the substrate to form a thin high-quality coating of cadmium. Ion deposition in argon atmospheres adds more energy to this coating process and uses 'sputter cleaning' to clean the substrate surface. As a result, ion deposition improves coating adhesion, density and uniformity. This method is used to coat components such as undercarriage legs of transport aircraft, helicopter rotor parts, and other high-strength steel components.

Primary benefits in depth

Excellent corrosion resistance

Cadmium plating serves as a sacrificial coating, meaning that it is preferentially corroded when the coating is damaged and small areas of the substrate are exposed. The cadmium coating is applied in thin layers and can itself be covered with a chromate conversion coating. This second conversion coating enhances the corrosion resistance of cadmium plating while giving it a characteristic golden-yellow, olive drab or white colour. Cadmium plating is more resistant than zinc plating in industrial settings and salt-water environments, and offers superior lubricity and malleability compared to nickel.

Good bondability to adhesives

When an object is plated with cadmium, the surface of the object becomes more bondable to adhesives. This makes cadmium plating an outstanding base for paint.

High lubricity

The exceptional lubricity (friction reduction) of cadmium plating is extremely useful when components that will be repeatedly disassembled and reassembled must be plated. It is also beneficial in applications where different metal surfaces are constantly moving, rotating, or touching one another.

Excellent electrical conductivity and easy solderability

Cadmium plating has low electrical resistance and exceptional conductivity, favourable compatibility with aluminium, and superior solderability. Cadmium is therefore an excellent choice of material to plate metal products.

Galvanic compatibility between aluminium and stainless steel

Cadmium plating of stainless steel, particularly fasteners, is a long used and reliable mechanism providing galvanic compatibility with aluminium. Without such coating, severe corrosion can occur over the lifetime of an aircraft. This is true for all commercial and military products. The technique has been successfully used for decades where aluminium would otherwise be in contact with stainless steel. This galvanic corrosion protection method is widely used in all aspects of aeronautics.

Suggestion for application sheet layout

Cadmium pigments

Cadmium pigments are stable, inorganic colouring agents that are produced in a range of rich, vibrant shades of lemon, yellow, orange, red and maroon. Few if any other pigments can match the intensity and cleanliness of tone of cadmium pigments, nor their high stability and opacity. This makes them indispensable in certain niche applications for this critical colour space.

Modern cadmium pigments are carefully engineered products manufactured in regulated chemical plants with full Health, Safety and Environmental permits under Responsible Care management. These pigments have a well-defined crystal structure and engineered particle size, surface area and surface treatment to ensure they are not only correct for colour but also meet extremely low solubility requirements and other key quality and property values.

Cadmium pigments made by member companies of the International Cadmium Association have undergone EU Risk Assessments and are fully REACH registered. They present no significant risk to people or the environment and are thus classified as non-hazardous with no requirement for any hazard labelling.

Benefits in brief

Cadmium pigments are highly versatile colouring agents that display the following benefits:

- Excellent and unique full and continuous lemon-yellow-orange-red-maroon colour range with complete inter-mixability to give mid tones
- Sharp light absorption edges resulting in cleanliness of shade in this key colour space
- Good chemical and physical stability allowing mixing with virtually any other pigment to achieve the desired shades
- Excellent light and weather fastness (including UV)
- Outstanding temperature stability up to 450°C, rising to >900°C when suitably encapsulated
- Excellent opacity with high tinting strength
- Insoluble in water and organic solvents with no bleeding or migration in normal use
- Good chemical resistance, especially to detergents, alkalis and some acids
- Easily dispersible and able to be mixed with whiteners to give clean opaque and reduced shades

Key applications

Owing to their unique combination of benefits, cadmium pigments are used in a range of high performance or demanding products and niche market segments. In many of these fields of application, no colourants exist that can match the properties and value of cadmium pigments.

The main application areas are described below – the supply chain requirements dictate that the uses are industrial or professional only, with no direct consumer powder-pigment use.

Plastics

Their inherently high temperature resistance makes cadmium pigments ideal for polymers such as polycarbonates, nylons and PTFE that are processed at or above 300ºC. This high temperature resistance also enables all moulding sprues and off-cuts to be easily recycled. In comparison, conventional organic pigments tend to start decomposing during moulding and may be unable to withstand further heating.

Artists' colours

Cadmium pigments have long been the standard against which other pigments are judged by artists. They continue to be the only choice for top-quality oil and water colours. Also, on account of their authenticity and long-term stability, they are typically specified for art restoration work.

Coil coatings

Coil coatings often require resistance to the high temperatures that can be reached during their processing. Cadmium pigments meet this need perfectly. Moreover, their excellent lightfastness enables bright yellows, oranges and reds to be achieved with the appropriate level of shade, opacity and performance required for coil coatings.

Powder coatings

Cadmium pigments are used in thermoplastic and thermosetting powder coatings due to their high performance and heat resistance.

Road markings

Cadmium pigments are ideal for use in road markings. Here, their unique shade, excellent lightfastness and high thermal stability make them particularly suitable in a defined colour space, where they outperform other pigments or blends.

Ceramic, glass and enamels

The colouration of decorative ceramic, glass and enamel products often depends on the use of cadmium pigments. They are genuinely the only pigments available for the bright yellows, oranges and reds required in the colour palette and which are capable of withstanding the high temperature firing processes during manufacture and application. Already stable to over 400°C, the firing range for decoration can be extended to over 900°C when the cadmium pigment is encapsulated in glass systems. Typical applications include on-glaze colours, porcelain enamels for steel and glass, and colours for flat glass, tumblers and bottles.

Suggestion for application sheet layout

Cadmium in infrared detection

Cadmium is a key and irreplaceable ingredient in infrared detection technology. It is combined with mercury and tellurium to produce the MCT (Mercury-Cadmium-Tellurium) infrared detection material.

When layered on a sensor, an ultra-thin coating of MCT of only a few microns enables high-quality infrared detection. Each sensor contains approximately 0.5 mg of cadmium. The quantity of cadmium present in all infrared detectors produced every year in the world is less than 10 grams.

Key applications of MCT technology

Infrared detection is a crucial technology in a variety of applications. Historically it was first used in military and space-based deployment. Over the decades it transitioned to industrial and commercial applications, for the preservation of resources and the protection of lives and properties. Examples include the surveillance of industrial sites, gas leak detection, medical imaging, meteorological observations, environmental and agricultural monitoring and surveillance, pharmaceutical formulation development, and plastics recycling. Art restoration experts are now using infrared cameras to examine paintings for artifacts under the pigment, such as original line drawings made with charcoal pencil or chalk.

In a nutshell, the current application sectors for MCT-based infrared cameras are:

- Military (50%): Airborne, ground-based, naval
- Space (20%): Satellite programmes, surveillance, early warning systems, meteorology, agriculture surveillance, global warming studies, planetary and asteroid studies
- Commercial (30%): Surveillance, thermography, hyperspectral imaging.

Benefits of MCT technology

MCT technology is used in so many different application areas on account of the multiple benefits it displays. It is a proven, reliable and readily available technology that comes with a competitive cost.

Big in space

MCT is the only IR detector technology covering the entire infrared spectrum (from 0.7 µm to 20 µm) and having a very large space heritage, hundreds of successful space missions having MCT detectors on board.

Strategic importance of MCT technology

MCT technology is strategically important for the European Union. The market for MCT infrared detectors is growing and continues to create jobs. Currently, around 1200 people are employed in this sector in the EU, notably at the manufacturers of MCT detectors Lynred in France (previously called Sofradir) and AIM in Germany

More information

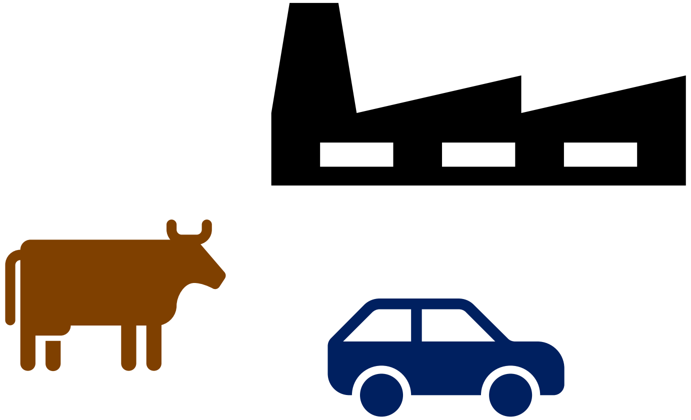
To discover more about cadmium, its use in MCT material, and the infrared applications that are possible, check out the website of the International Cadmium Association. Address your specific questions to contact@cadmium.org.

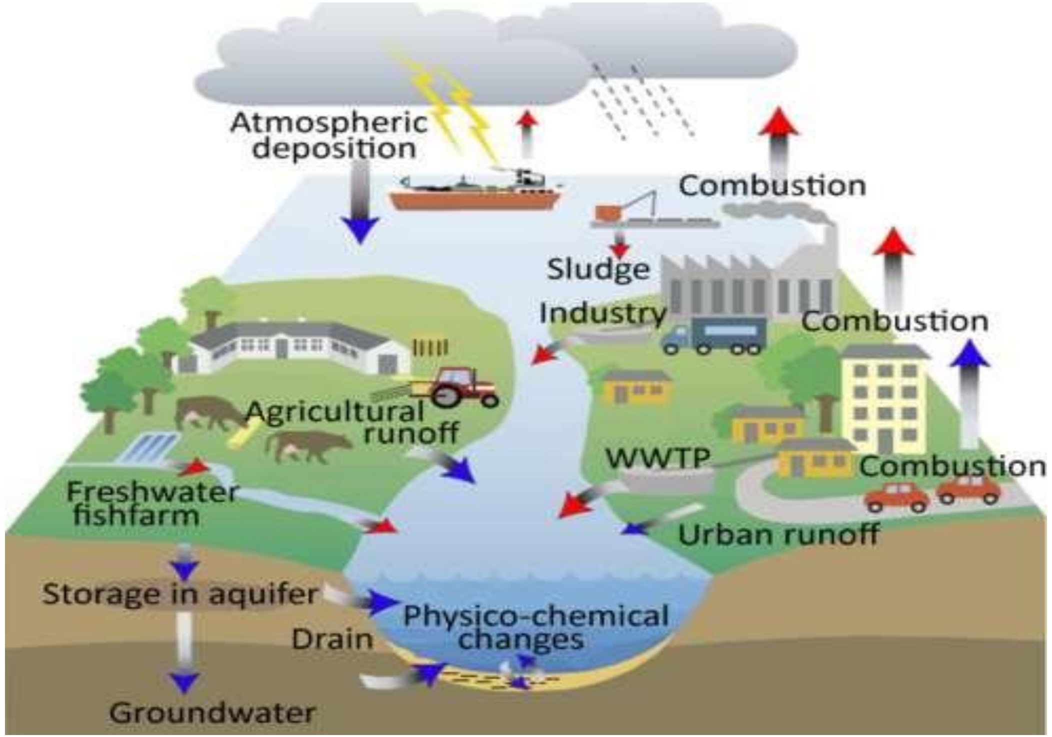
Water Framework Directive (WFD):

- Diffuse Sources
  - To Sewage Treatment Plants (STPs).
  - To the general environment.

Diffuse Source Emissions: Definition

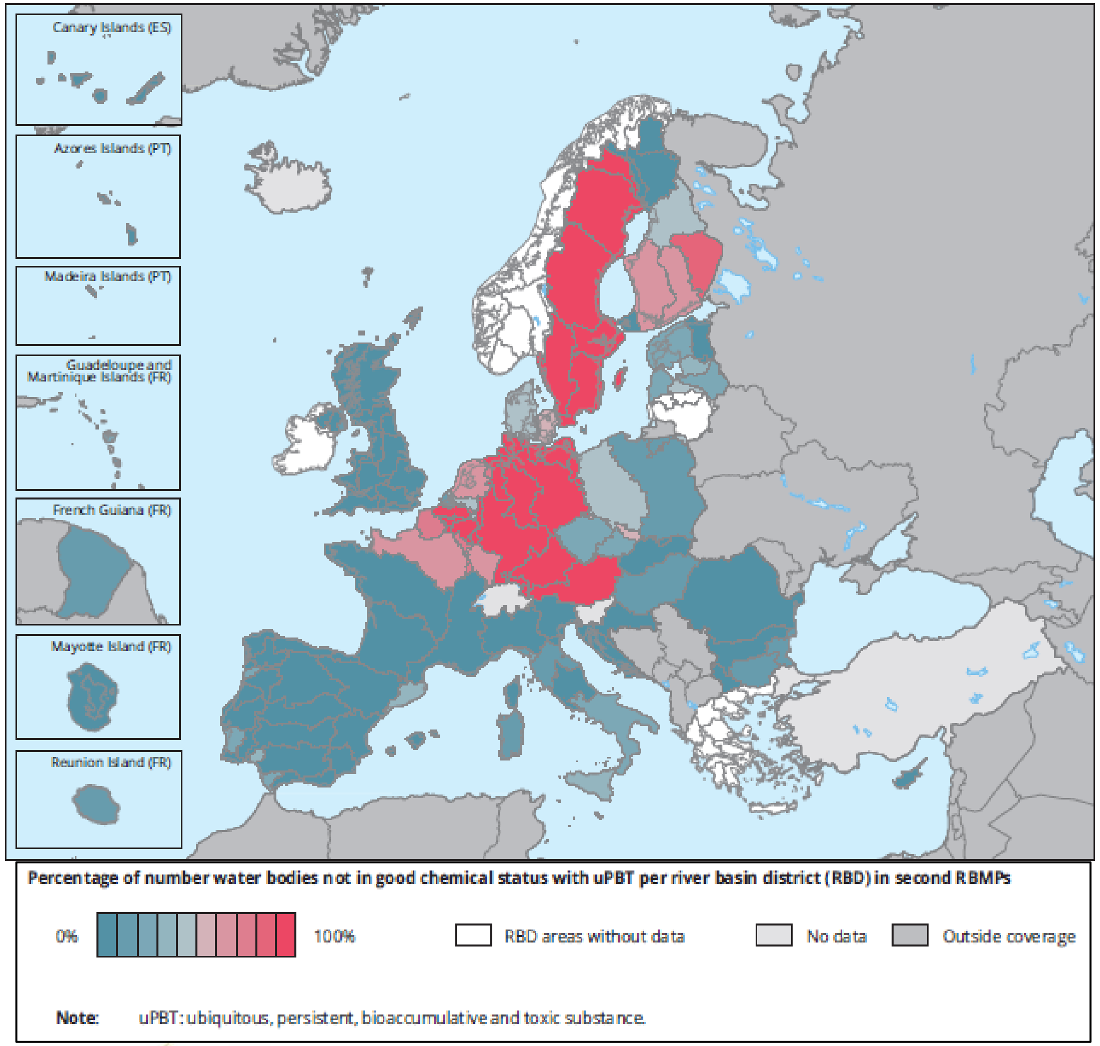
"No specific point of discharge and caused by a variety of activities. For this reason, they are usually dispersed over large surfaces"





(Legorburu, 2014)

Diffuse Source Emissions: Why?

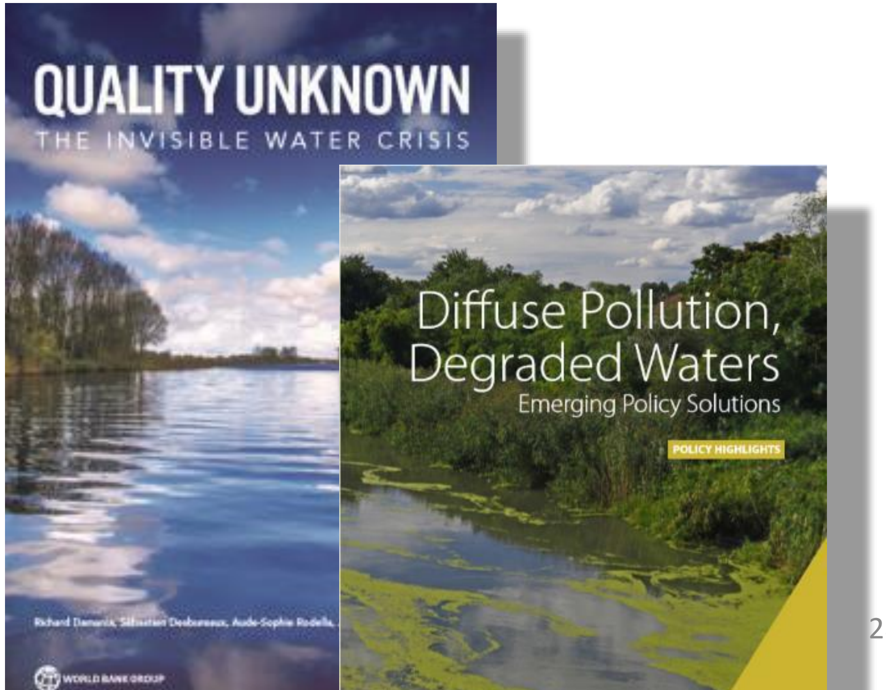


Percentage of number water bodies not in good chemical status with uPBT per river basin district (RBD) in second RBMPs

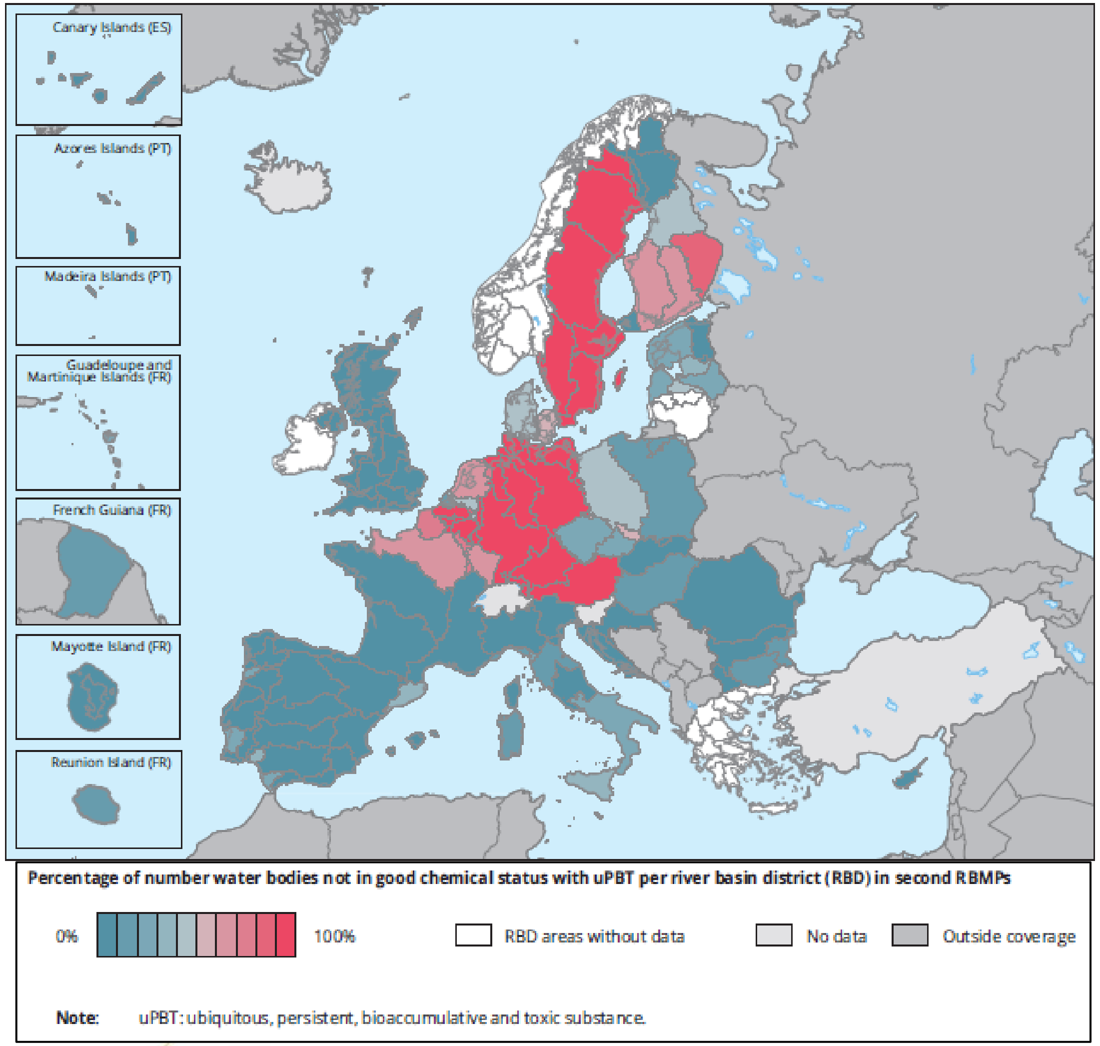
Note: uPBT: ubiquitous, persistent, bioaccumulative and toxic substance.

Assessment of status and pressures 2018, EEA

- 38% achieved good chemical status.
- 16% unknown.
- **46% not good chemical status (Hg).**



Diffuse Source Emissions: Why?



Percentage of number water bodies not in good chemical status with uPBT per river basin district (RBD) in second RBMPs

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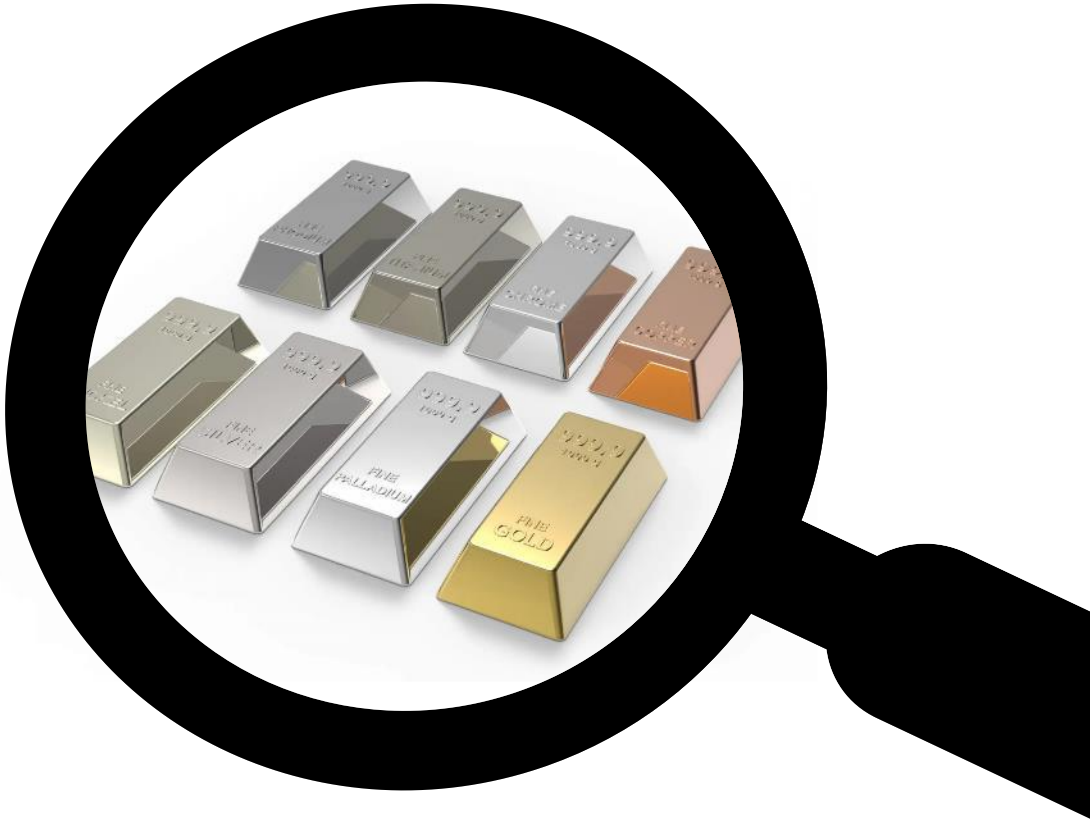


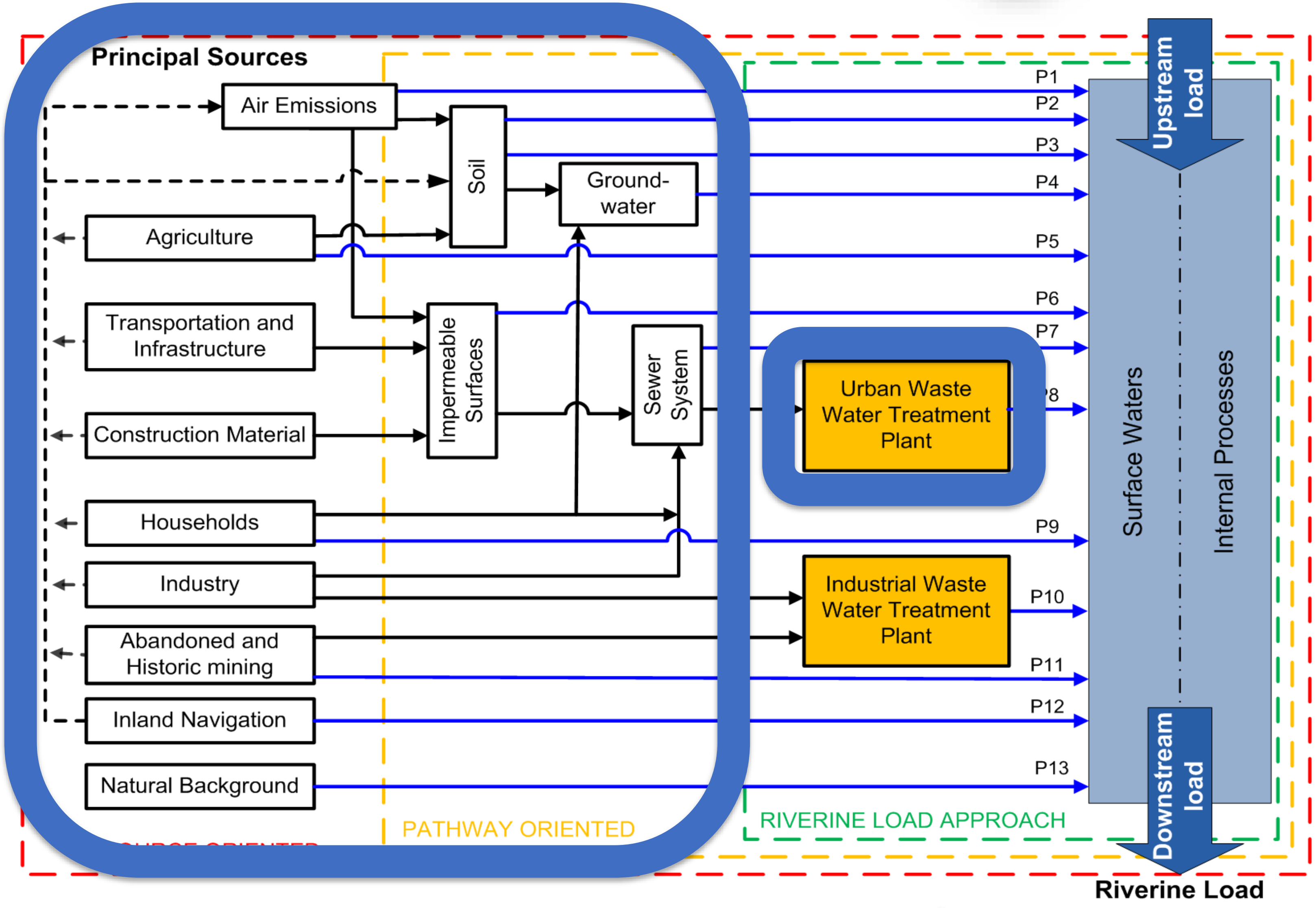
Diffuse Source Emissions: Plan?

European Commission

European Environment Agency & Deltares (NL)

Goals: (2019-2021):

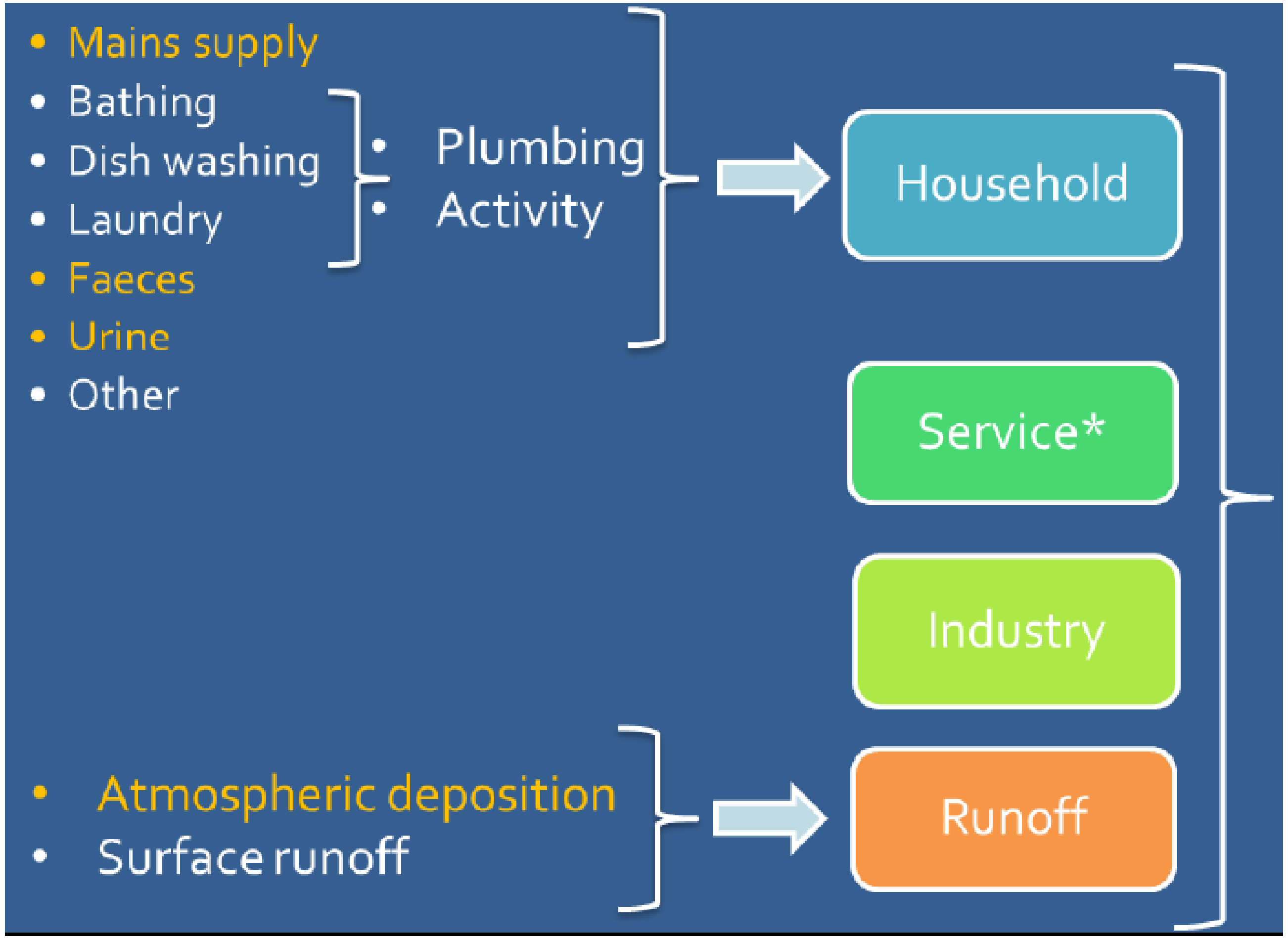
1. Emissions from Sewage Treatment Plants to water.
2. Establish major diffuse sources of *Cd, Ni, & Pb* to the environment.



CADMIUM Working Towards a Sustainable Future

International Cadmium Association

1. Diffuse Source Emissions: into Sewage Treatment Plants



- Mains supply
- Bathing
- Dish washing
- Laundry
- Faeces
- Urine
- Other

- Plumbing
- Activity

Household

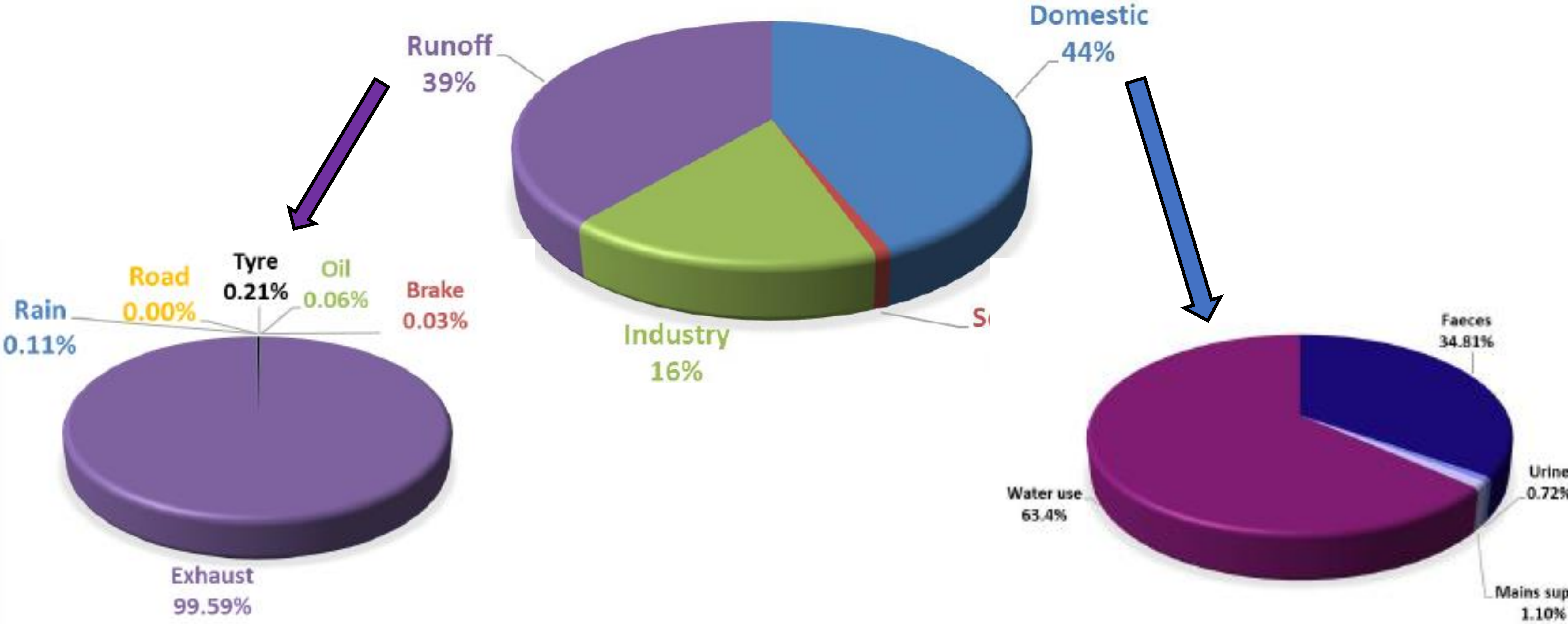
Service*

Industry

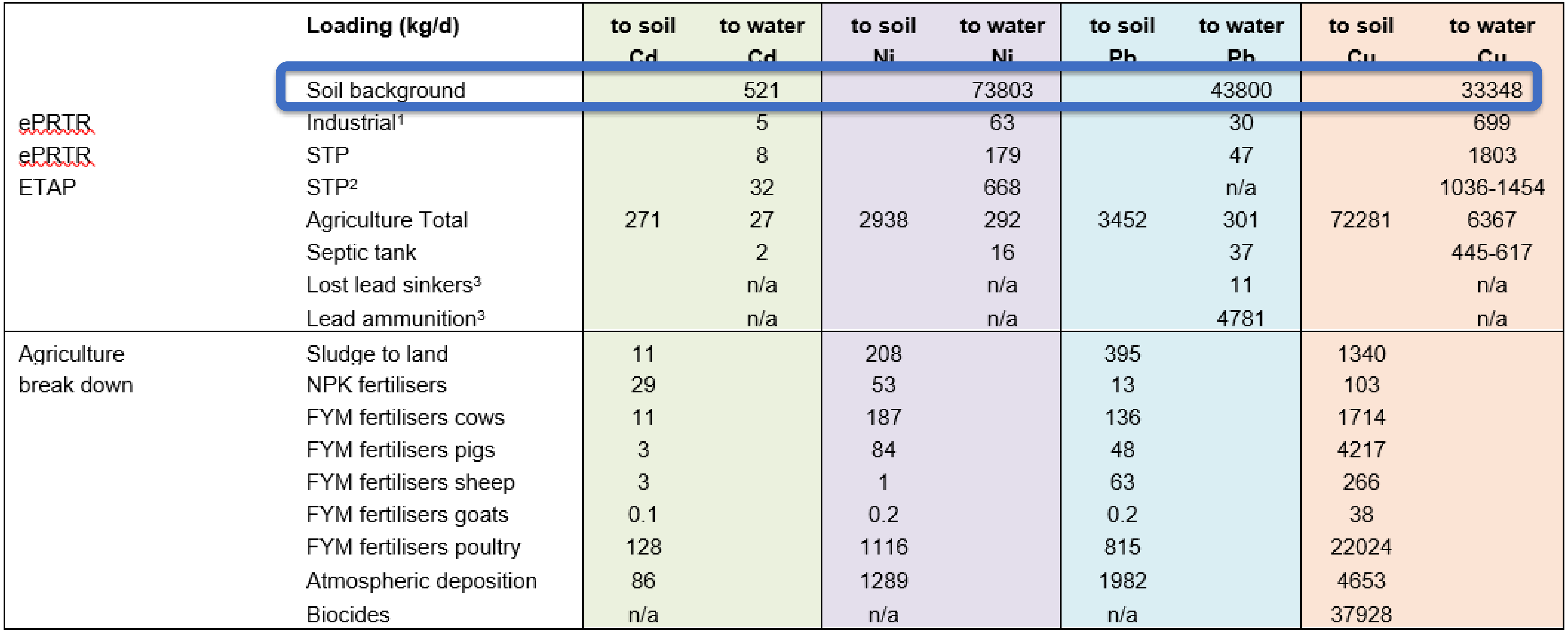
- Atmospheric deposition
- Surface runoff

Runoff

1. Diffuse Source Emissions: into Sewage Treatment Plants (DE)



2. Diffuse Source Emissions: into the environment (major sources)

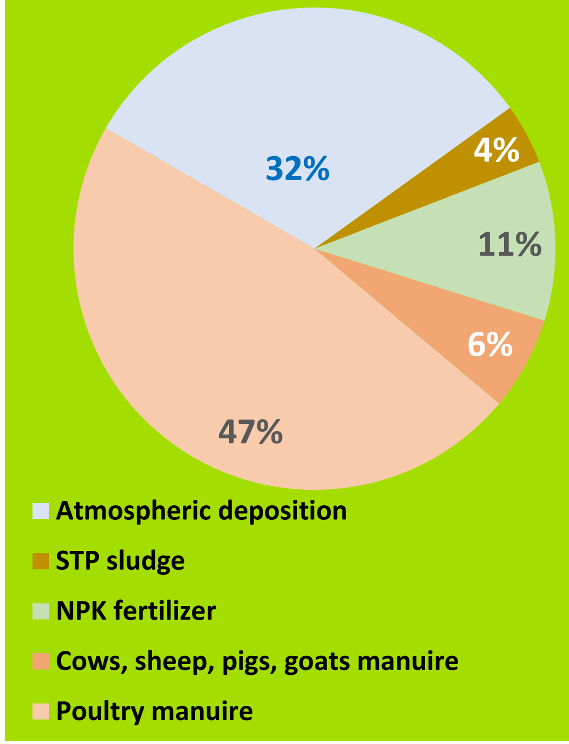


	Loading (kg/d)	to soil Cd	to water Cd	to soil Ni	to water Ni	to soil Pb	to water Pb	to soil Cu	to water Cu
	Soil background		521		73803		43800		33348
ePRTR	Industrial[1]		5		63		30		699
ePRTR	STP		8		179		47		1803
ETAP	STP[2]		32		668		n/a		1036-1454
	Agriculture Total	271	27	2938	292	3452	301	72281	6367
	Septic tank		2		16		37		445-617
	Lost lead sinkers[3]		n/a		n/a		11		n/a
	Lead ammunition[3]		n/a		n/a		4781		n/a
Agriculture break down	Sludge to land	11		208		395		1340	
	NPK fertilisers	29		53		13		103	
	FYM fertilisers cows	11		187		136		1714	
	FYM fertilisers pigs	3		84		48		4217	
	FYM fertilisers sheep	3		1		63		266	
	FYM fertilisers goats	0.1		0.2		0.2		38	
	FYM fertilisers poultry	128		1116		815		22024	
	Atmospheric deposition	86		1289		1982		4653	
	Biocides	n/a		n/a		n/a		37928	

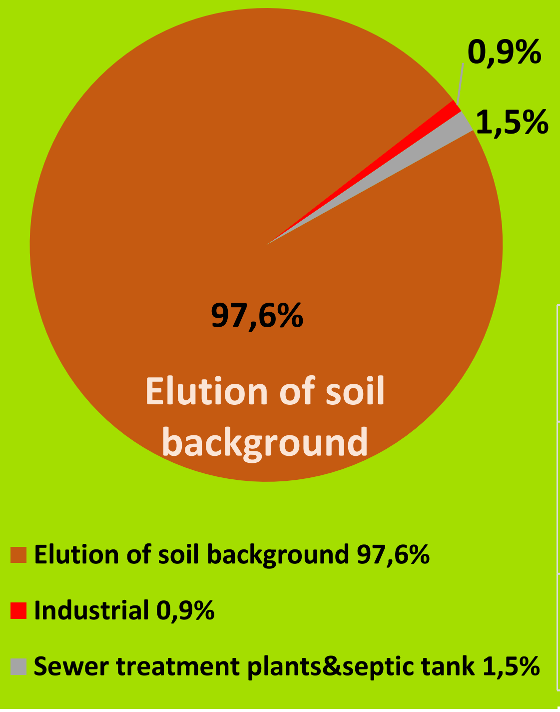
2. Diffuse Source Emissions: into the environment (major sources)

Sources of cadmium to soil and water in the EU

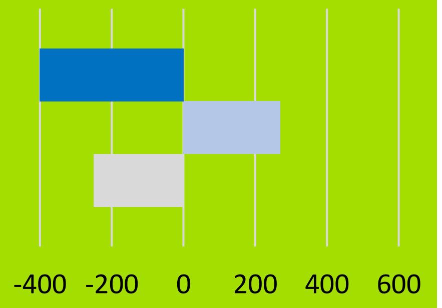
Sources of cadmium to soil



Sources of cadmium to river waters



Balance of cadmium to soil



	kg Cd/day
🟦 Daily elution of cadmium from soil	-521
▨ Daily cadmium deposit to soil	271
⬜ net evolution of cadmium to soil	-250

Update on ICdA workplace monitoring observatory OCdBio and OCdAir

OCdAir-8

- Personal air sampling at the workplace
  - Eight years of data collection
  - Excellent response related to earlier data collections

	2013	2014	2015	2016	2017	2018	2019	2020
Plants	12	22	20	16	30	25	31	33
SEGs	67	142	131	124	162	165	204	316
Workers	994	1548	1369	1278	2249	1857	3499	3662

- Good reporting quality
  - More samples for each SEG
  - All measurements mentioned respirable or inhalable fraction
  - Correction for Personal Protection Equipment during sampling

Cd exposure in SEGs : EN689

- 51% of all SEGs are compliant with EN689
- In 34 SEGs (15%) the Cd concentration in air is too high!
- In 71 SEGs (33%), there are insufficient samples to assess the exposure.
- In 15 SEGs (7%), the Cd concentration can be above 10µg Cd/m³

EN689	**number of SEGs in this range**					
Range [µg/m³] respirable	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
<4 µg Cd/m³ respirable	**12**	**35**	**78**	**74**	**109**	**111**
non-conclusive	**102**	**66**	**54**	**60**	**59**	**71**
4 <=> 7		6	10	9	9	9
7 <=> 10		3	5	9	7	3
> 10	1	6	15	8	9	15
other non-compliant	16	11		5	5	7
total	131	127	162	165	198	216

EN689	**% of SEGs in this range**					
Range [µg/m³] respirable	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
<4 µg Cd/m³ respirable	9%	28%	48%	45%	55%	51%
non-conclusive	78%	52%	33%	36%	30%	33%
4 <=> 7	0%	5%	6%	5%	5%	4%
7 <=> 10	0%	2%	3%	5%	4%	1%
> 10	1%	5%	9%	5%	5%	7%
other non-compliant	12%	9%	0%	3%	3%	3%
total	100%	100%	100%	100%	100%	100%

Workers exposure: EN689

- For 708 workers (19%), all samples are below 4µg/µg m³ but insufficient samples for statistical assessment, or don't have a log normal distribution.
- 478 workers (13%) are exposed to a too high Cd concentration
- 311 workers (8%) have (occasionally) an exposure > 10 µg Cd /m³

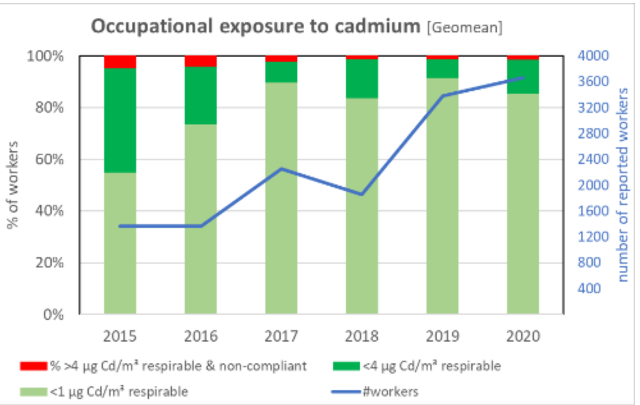
EN689	**number of workers in this range**					
Range [µg/m³] respirable	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
<4 µg Cd/m³ respirable	257	568	1441	852	2393	2476
non-conclusive	904	597	517	521	553	708
4 <=> 7		95	158	147	124	65
7 <=> 10		22	41	99	67	19
> 10	18	104	92	166	184	311
other non-compliant	190	65		72	58	83
total	1369	1451	2249	1857	3379	3662

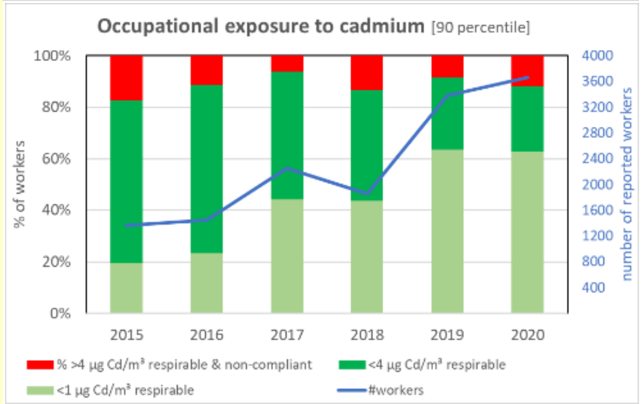
EN689	**% of workers in this range**					
Range [µg/m³] respirable	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
<4 µg Cd/m³ respirable	19%	39%	64%	46%	71%	68%
non-conclusive	66%	41%	23%	28%	16%	19%
4 <=> 7	0%	7%	7%	8%	4%	2%
7 <=> 10	0%	2%	2%	5%	2%	1%
> 10	1%	7%	4%	9%	5%	8%
other non-compliant	14%	4%	0%	4%	2%	2%
total	100%	100%	100%	100%	100%	100%

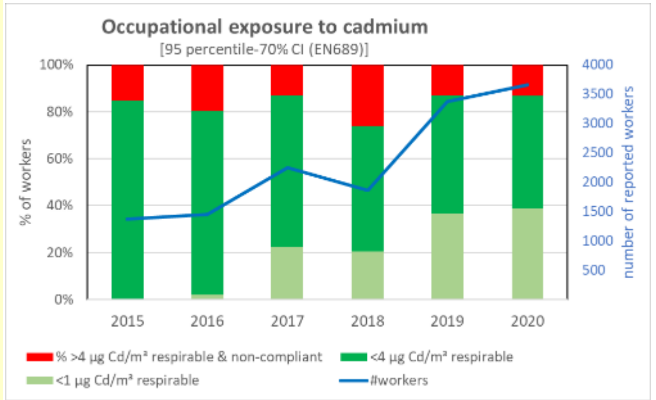
Summary on air quality

- When applying the most realistic assessment criterium (geomean), performance is excellent, with only 5 SEGs and 51 workers in exceedance of the 4µg Cd/m³ respirable limit workers value.
- Obviously, more efforts are needed to address the high exposure in these 5 SEGS.
- When assessed according to EN689, 15% of all SEGS and 13% of all workers exceed the limit value.
- More sampling is required in 33% of the SEGs to allow a conclusive assessment of the exposure.

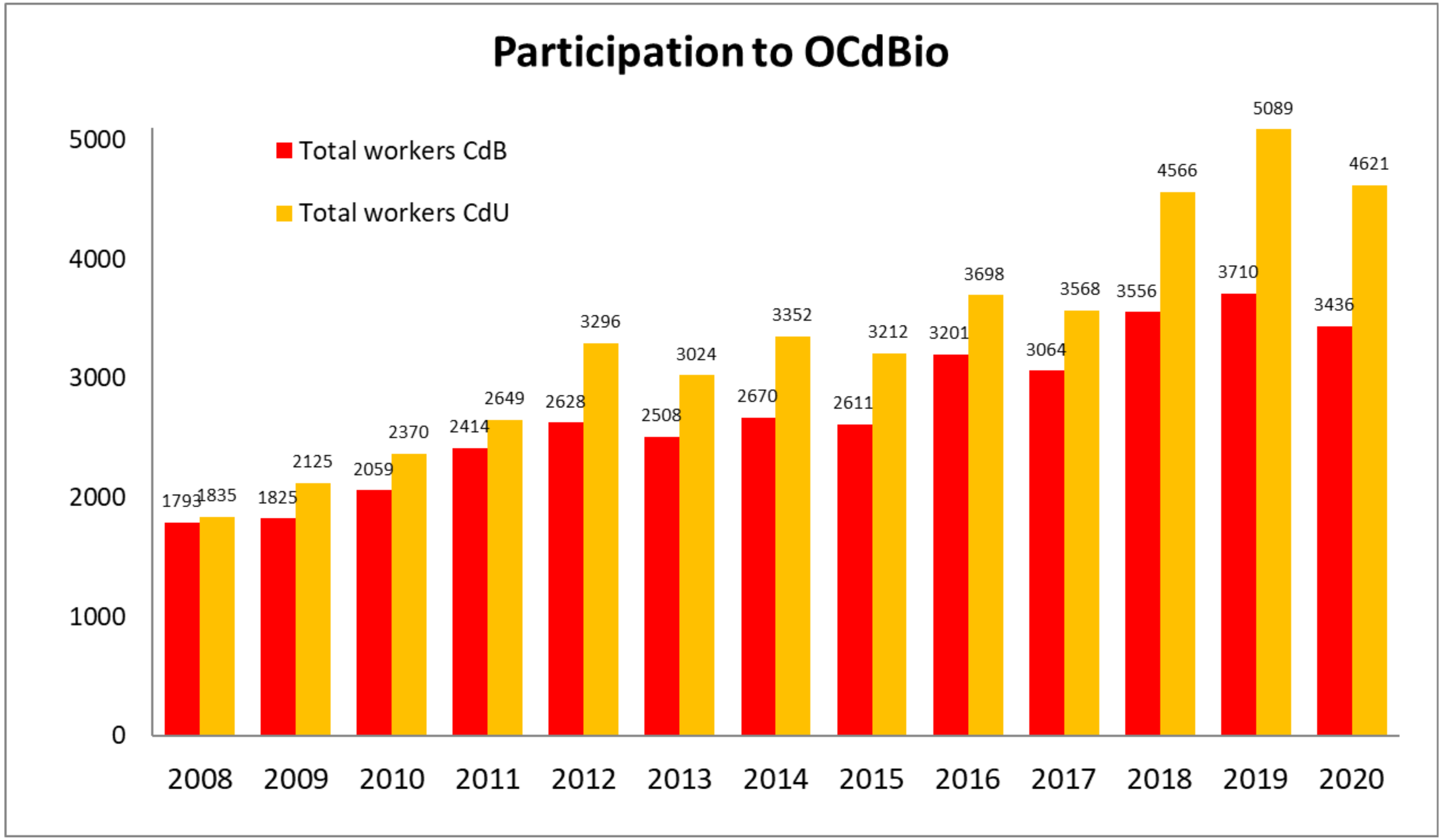
Remark: When, according to the draft RAC opinion, 1µg Cd/m³ <u>inhalable</u> fraction needs to be considered, more than 60% of SEGs will not be compliant.


Occupational exposure to cadmium [Geomean]


Occupational exposure to cadmium [90 percentile]


Occupational exposure to cadmium
[95 percentile-70% CI (EN689)]

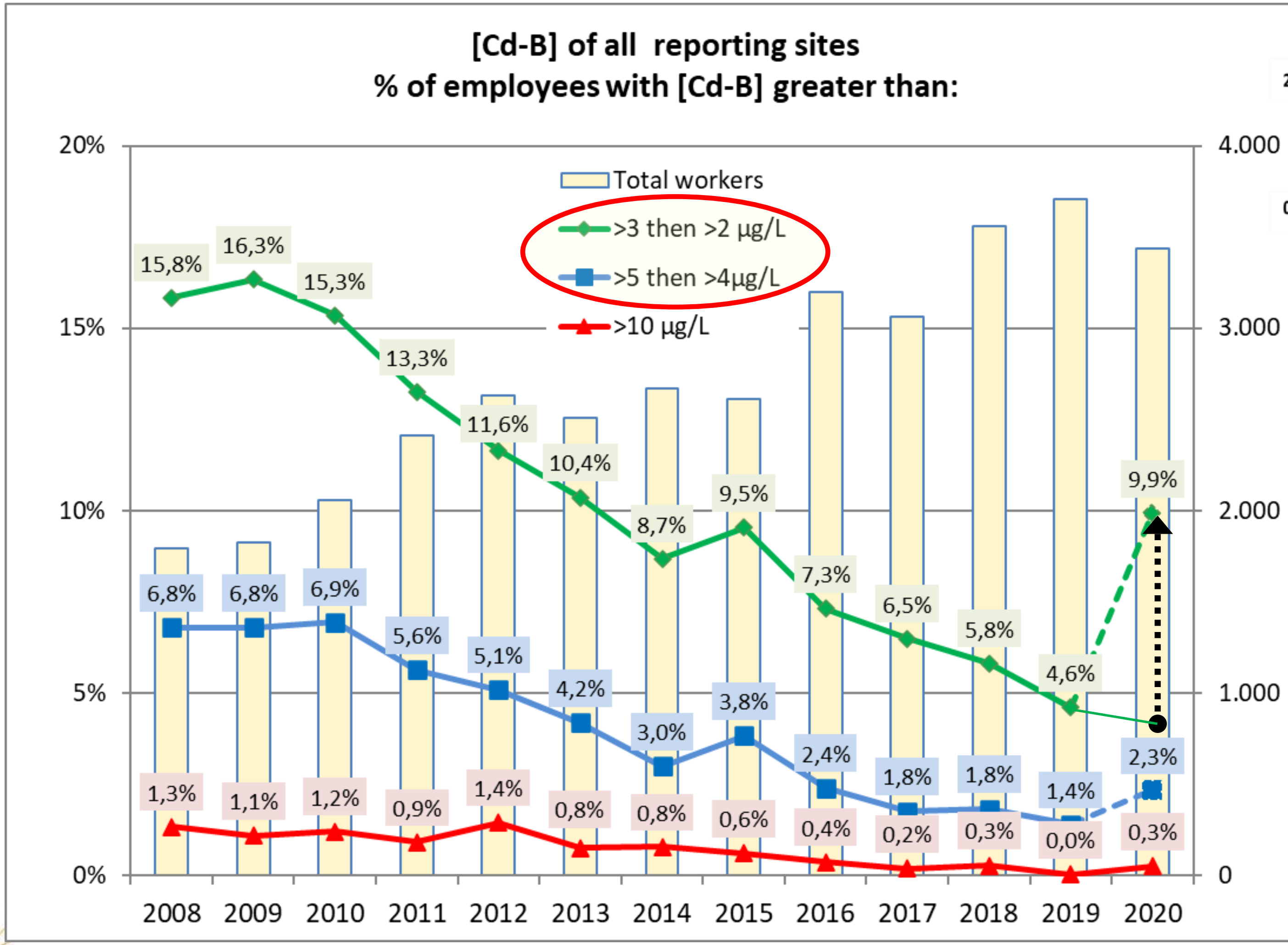
OCdBio biomonitoring: number of reported workers



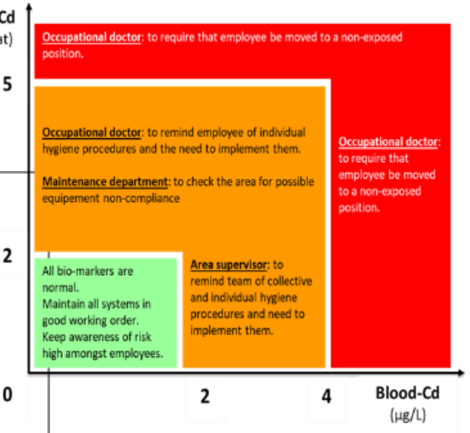
- Strong response but sometimes difficult to get the information from the doctor due to work overload during Covid crisis

Target values reset in line with ICdA Guidance

CdB distribution
- all sites in % -



[Cd-B] of all reporting sites
% of employees with [Cd-B] greater than:



Occupational doctor: to require that employee be moved to a non-exposed position.

Occupational doctor: to remind employee of individual hygiene procedures and the need to implement them.

Maintenance department: to check the area for possible equipement non-compliance

Occupational doctor: to require that employee be moved to a non-exposed position.

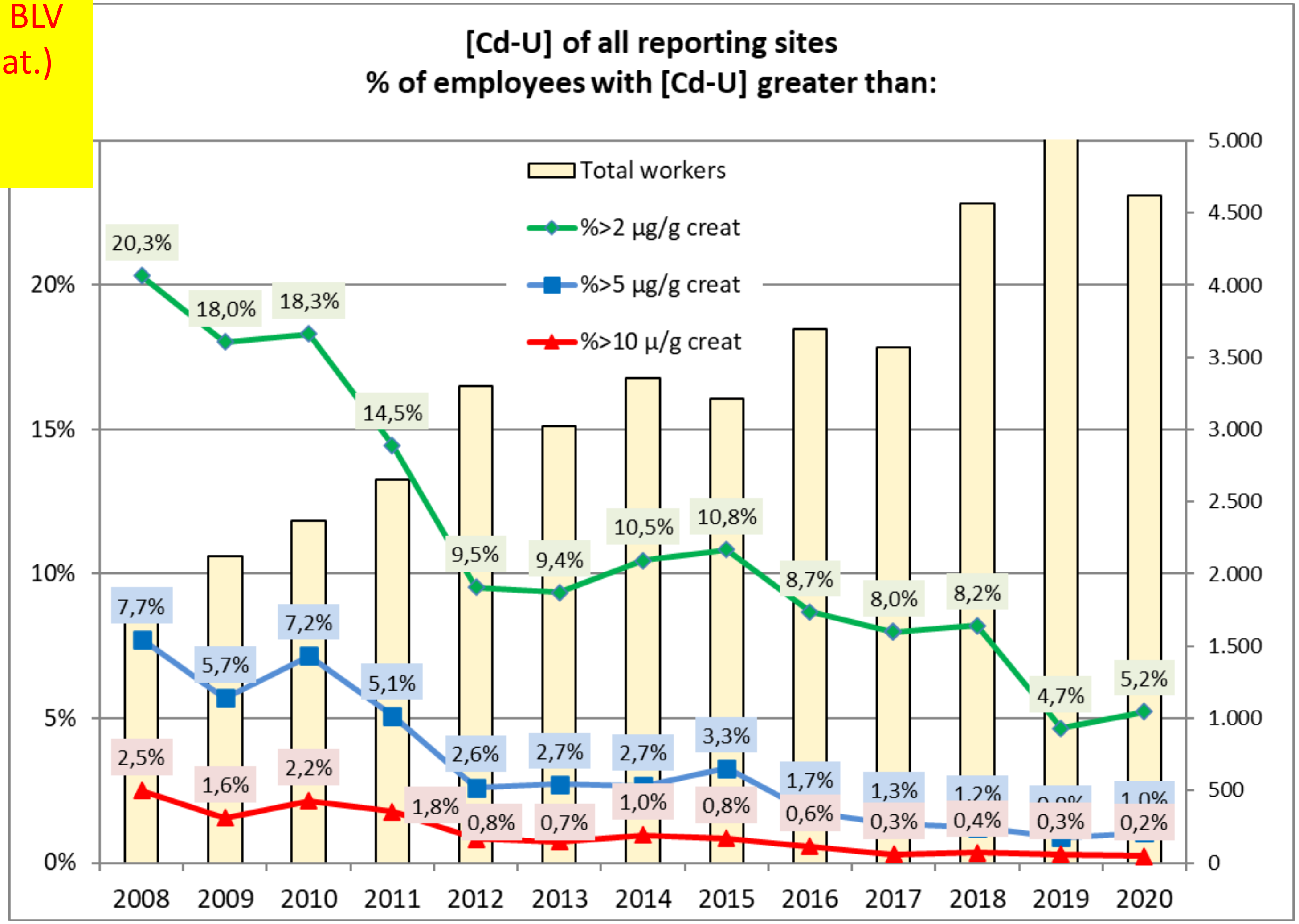
All bio-markers are normal.
Maintain all systems in good working order.
Keep awareness of risk high amongst employees.

Area supervisor: to remind team of collective and individual hygiene procedures and need to implement them.

from 2020, the green and blue lines represent workers with CdB >2µg Cd/L and with CdB >4µ Cd/L.
Previous target values were 3µg/L and 5 µg/L.
Hence the upwards jump in 2020. Without this change in criteria, the 2020 results would be very similar to 2019

CdU distribution
- all sites in % -

- Reduction of cadmium body burden flattens.
- 5,2% of workers above proposed BLV (CdU>2 µg/g creat.)



[Cd-U] of all reporting sites
% of employees with [Cd-U] greater than:

Conclusion bio-monitoring observatory

- ☐ CdB
  - Over the past 12 years, our industry has consistently improved the workplace exposure of its workers…and these efforts should continue
  - Exposure to Cd is continuously going down but levels are likely too high to keep all workers <2µg Cd/g creat.
  - The new CdB action levels now respectively set at 2µg/L and 4µg/L (see Guidance 2018) need to be strictly implemented by the occupational doctor to ensure that CdU of recent workers (hired since 2000) does not rise above 2 µg/g creat.
    - ✓ Today, 7,5% of these workers are above a CdB of 2µg/L and 1,6% are above 4µg/l!

- ☐ CdU:
  - Last years' decrease of workers in the segment 2-5 µg Cd/g creat. Is confirmed!
  - 22 workers (0,4%) with CdU> 5 µg Cd/g creat. are not removed from exposure => check assessment procedures with doctor.
  - 242 workers have > 2µg Cd/g creat and 120 of them above 3µg.
    Today 60 workers are removed from exposure.
    - ✓ Should a very stiff compliance with CdU>2 be regulated, this would mean that an additional 182 workers will have to be removed, yielding severe operational disruptions. ICdA advice is to ensure this number continues to go down through strict compliance with existing 2018 Guidance.

Occupational exposure

Status of the process for revising the occupational exposure limit (OEL) for cadmium in the Carcinogens and Mutagens directive (CMD)

Revision OELs under the Carcinogens and Mutagens Directive (Directive 2004/37/EC)

Directive (EU) 2017/2398

1st batch

2017

Directive (EU) 2019/130

2nd batch

2018

Cd

Directive (EU) 2019/893

3rd batch

2019

COM 2020/571/final

4thbatch

Sept 2020

3rd Revision of the Carcinogens and Mutagens Directive (CMD): Cd entry

- During transitional period (=8 years after entry into force: till 7/2027):
  - Option 1: BOEL of 4µg/m3 (inhalable fraction)

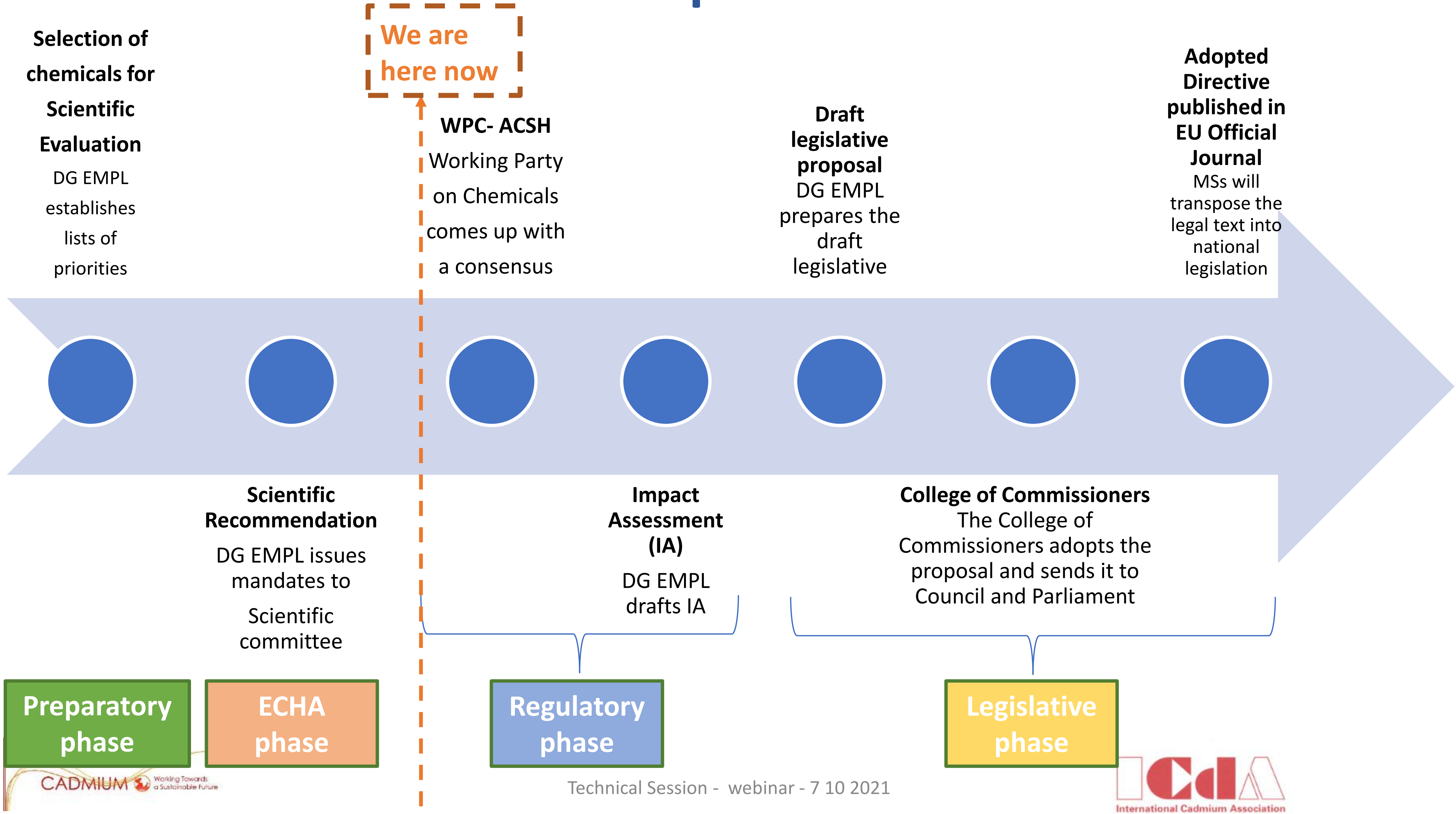
  - Option 2: only for MS that implement a biomonitoring system with a BLV not exceeding 2µg Cd/g creatinine in urine:

    BOEL of 4µg/m3 (respirable fraction) + BLV of 2µg Cd/g creatinine in urine

- After transitional period: BOEL of 1µg/m3 (inhalable fraction)

- No later than 3 years after entry into force, **COM shall assess** the option of amending this Directive to add provisions on a **combination of an airborne occupational exposure limit and a biological limit value** for cadmium and its inorganic compounds.

OEL process



We are here now

Selection of chemicals for Scientific Evaluation
DG EMPL establishes lists of priorities

Scientific Recommendation
DG EMPL issues mandates to Scientific committee

WPC- ACSH
Working Party on Chemicals comes up with a consensus

Impact Assessment (IA)
DG EMPL drafts IA

Draft legislative proposal
DG EMPL prepares the draft legislative

College of Commissioners
The College of Commissioners adopts the proposal and sends it to Council and Parliament

Adopted Directive published in EU Official Journal
MSs will transpose the legal text into national legislation

Preparatory phase

ECHA phase

Regulatory phase

Legislative phase

ECHA's OEL-setting review process

(X = input by ICdA)

ECHA – **call for evidence** (March2nd-June2nd 2020)	X
ECHA scientific report published Sept 14th, 2020 (to become an Annex to RAC opinion)	
Public consultation on ECHA's scientific report (September 14th -November 12th, 2020): 2 months	X
RAC commenting of first draft opinion started November 12th, 2020	
RAC-55: First RAC discussion on November 30th, 2020	X
RAC-56: Discussion and adoption on March 8th, 2021	X
RAC Final opinion published on March 18th, 2021	

RAC-55, November 30th

- First draft opinion presented by the RAC rapporteurs
- Representatives at RAC-55:
  - Industry (ICdA, N Lombaert)
  - Advisory Committee for Safety and Health at Work (ACSH) - Working Party on Chemicals (WPC), representing the Employers Interest Group (P Levy)
- Draft opinion recommendation:

OEL (8h TWA) = 1 µg Cd/m^3(inhalable fraction)

+

BLV of 1 µg Cd/g creatinine

RAC-55: outcome

Agreed by RAC

- Combination of an OEL and BLV is more effective in protecting the health of workers than using either of them alone
- General population epi studies should also be considered when discussing occupational exposure limits for Cd

NOT yet agreed by RAC: **VALUES :**

- **OEL*(8h TWA)*** *=*
  1 µg/m³(inhalable fraction) was proposed
  BUT requested more justification on the air limit value and the consideration of the recently updated sublinear German AGS approach
- **BLV -** 1µg/g creatinine can be justified based on:
  - Biomonitoring data, general population from HBM4EU project: P95= 0.57µg Cd/g creatinine
  - General population studies showing effects (renal, bone, cardiovascular, decreased birth weight) at exposure levels around CdU = 1µg/g creatinine

RAC-55: industry interventions

Agreed	Combination of an OEL and BLV	
Commented: **Values**	**OEL**: explained the relevance of **human** lung cancer data to consider in the derivation of the air limit value	Referred back to **industry comments** made in PC demonstrating the excess cancer risk is much lower when dose response calculations are made starting from human epidemiological data. Industry's view is that **air level** should protect against **local** effects (**respirable** fraction). The **systemic effects** will be covered by the **BLV**
	BLV: commented on the **uncertainties** associated with the **data** from the **general population** at very low exposure levels	**Epi studies in the general population at those very low exposure levels**, should be interpreted cautiously. **Cd-U may not reflect accurately the Cd body burden** at CdU = 1µg/g creatinine P95 CdU = 0.57 µg/g creatinine (>HBM4EU) does not reflect the background situation in all EU regions

RAC-56, March 8th

- Final draft opinion presented by the RAC rapporteurs and discussed by RAC
- Representatives at RAC-56:
  - Industry (ICdA, N Lombaert)
  - Advisory Committee for Safety and Health at Work (ACSH) - Working Party on Chemicals (WPC), representing the Employers Interest Group
    (M Wieske)
- Some additional information was added to the final draft opinion (in comparison to first opinion) but **conclusions remained unchanged**:

OEL (8h TWA) = 1 µg Cd/m^3(inhalable fraction)

+

BLV of 1 µg Cd/g creatinine

RAC-56: outcome (1)

RAC: discussions/agreements

- RAC agrees on a combination of OEL and BLV
- **an OEL value of 1µg Cd/m³ (inhalable fraction)** was proposed. The RAC rapporteurs referred to the risk of 4/10.000 at 0.9µg/m³(respirable) calculated by BAUA and to the 1µg/m³ inhalable which is already in the current CMD.

Industry/Employer's rep comments

OEL: Strong opposition to the implementation of the inhalable fraction:

- only the respirable fraction should be considered because the potential additional effect of the inhalable fraction is already covered when a BLV is imposed. This leads to 'double counting'.
- the BAUA value was a respirable fraction and that the CMD value was derived in absence of a biologic limit value

RAC-56: outcome (2)

RAC: discussions/agreements

- Based on a weight of evidence assessment, mainly based on renal, bone, and cardiovascular effects in the general population, **a BLV of 1 µg Cd/g creatinine** was proposed by the rapporteurs.

- RAC discussed the uncertainties concerning setting a BLV close to the background level in certain parts of Europe.

→ it was agreed for the final opinion:

1) to elaborate further details on how close the values for the BLV and the background levels would be
2) to include advice that may be relevant for the monitoring of the occupational health of employees such as taking into account background levels

Industry/Employer's rep comments

BLV

- monitoring data from the general population, collected by HBM4EU, and data reported by ICdA on Cd levels of new hired workers, show that in several member states or regions, the Cd background level was demonstrably at or above the value of 1 µg Cd/g creatinine.
- Uncertainties associated with the data from the general population at very low exposure levels

- Industry was given an opportunity to provide additional relevant information to the Secretariat on biomonitoring.
  A summary of data from the ICdA biomonitoring observatory and the ICdA Guidance were duly submitted

RAC 56: Conclusion and adoption of the opinion

RAC agreed with the biological and air limit values, as proposed in the final draft opinion

RAC chair concluded:

Discussed changes to be made to the final opinion by the rapporteurs

Opinion was supported (poll showed 36 members in support)

RAC adopted its opinion (with modifications agreed at RAC-56)

OEL (8h TWA) = 1 µg Cd/m^3(inhalable fraction)

+

BLV of 1 µg Cd/g creatinine

RAC Final opinion (March 18th, 2021): changes included

	Final opinion
Page 5: corrected on the 95P it was ‘wrongly’ said in draft opinion: the median urinary concentration of cadmium was calculated to 0.21 ug/g creatinine, and the 95-percentile to 0.57 ug cadmium/g creatinine	“According to a HBM4EU compilation of biomonitoring data from the general population (with exposure mainly through the diet) in different European countries, the median urinary concentration of cadmium was reported to be 0.21 µg/g creatinine in 21 studies (range 0.16-0.41), and **the 95-percentiles to range from 0.29 to 1.26 µg cadmium/g creatinine**. When data are analysed per country (the 21 studies represented 12 EU member states), **the range of the 95-percentiles was 0.29-0.86 for 11 of the member states, and 1.26 in the study from Poland.** RAC acknowledges that the data does not cover the whole EU, but it is the most recent (about 10 years old) and best data available.”

RAC Final opinion : changes included

	Final opinion
Page 8-9: para **(iii) Biological limit value (BLV)** is revised regarding again the P95 and the ICdA information is added.	Mean urinary cadmium levels in Europeans with no occupational exposure to cadmium is generally well below 1 µg cadmium/g creatinine as indicated by data from HBM4EU on biomonitoring conducted between 2005 and 2015 in Europe (range of median reported in 21 studies was 0.12-0.41 µg cadmium/g creatinine in urine). Twenty-one studies are reported, representing 12 EU member states. Most studies are about 10 years old, the number of persons participating varies (58-1848 persons) and their occupations are not known. These factors contribute to uncertainty as regards the true background concentration of cadmium in European countries. The data has therefore been analysed per country. **The 95-percentiles for 11 of the 12 countries are below 1 (range 0.29-0.86µg cadmium/g creatinine in urine), while the 95-percentile for 120 samples from Poland in 2011 was 1.26 µg cadmium/g creatinine in urine. The International Cadmium Association (ICdA) reports based on their biomonitoring data that many newly hired workers have Cd-U values at or above 1ug Cd/g creatinine in several EU regions. Whether these workers have had previous occupational exposure to cadmium is not clear. The ICdA guidance recommends monitoring workers before starting a task potentially resulting in cadmium exposure, and RAC supports that in order to be able to avoid further cadmium exposure in persons already having a high previous exposure.**

RAC Final opinion: derived limit values

OEL as 8 hour TWA (8h-TWA):	0.001 mg cadmium/m^3 (=1 µg cadmium/m^3 (inhalable fraction))
STEL:	--
BLV:	1 µg cadmium/g creatinine
BGV:	--

CMD revision process: next steps

The RAC final opinion sent to the COM to be discussed with the ACSH (Advisory Committee on Safety and Health at work)

WPC will make a proposal to the ACSH. The ACSH will draft an Opinion to the Commission.

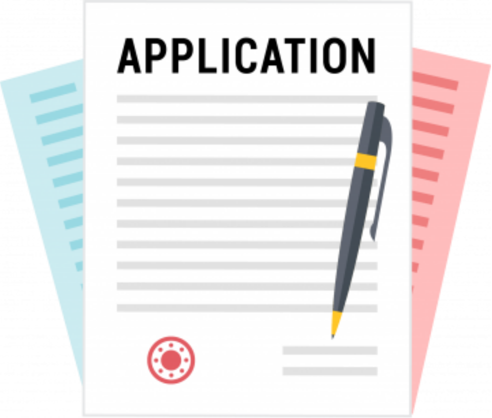
Cadmium not on the agenda → postponed to next WPC meeting

The Commission will do an impact assessment.
The Commission will draft a CMD amendment text for approval by EP and Council

ICdA will continue challenging the proposed limit values with the help of 2 employer representatives being full members in the WPC discussions

Update on EU Reach

- Authorisation process for cadmium



Cadmium Reach Authorisation

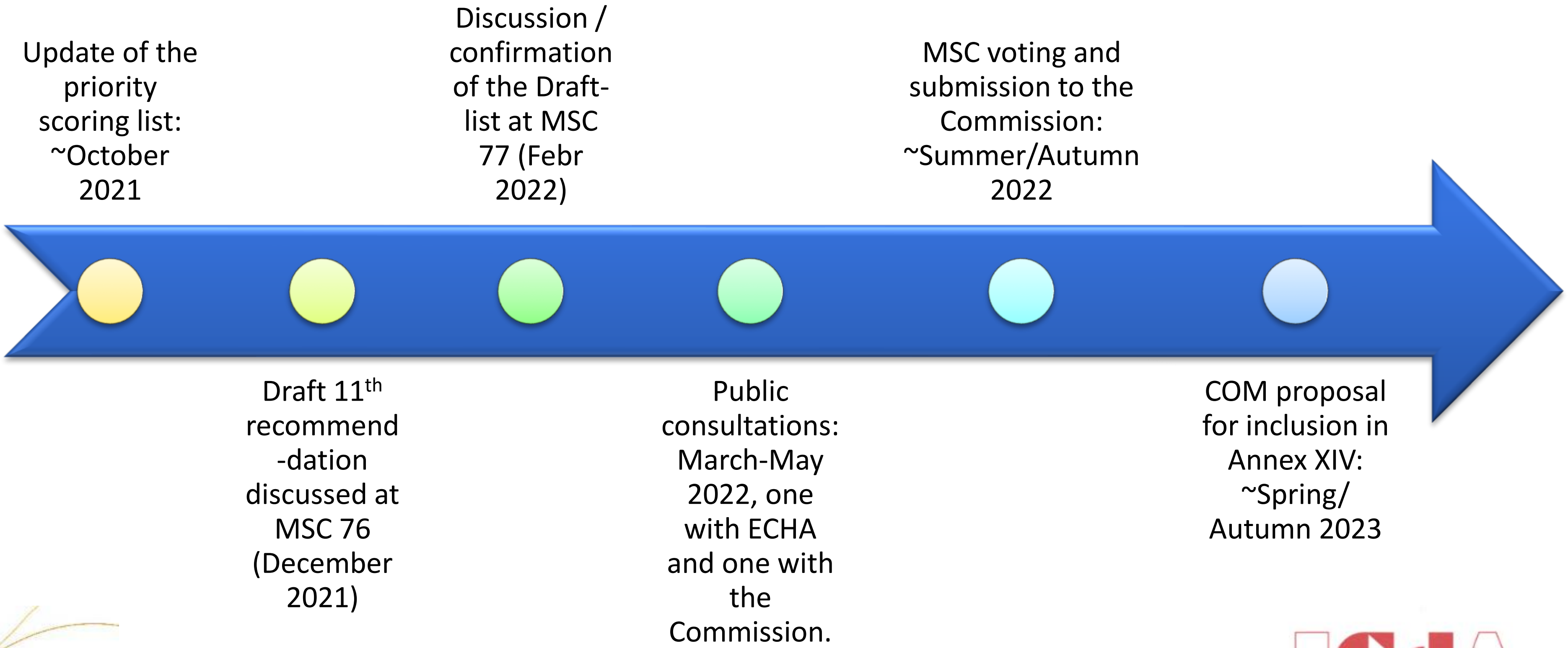
- End of September, ECHA's priority scoring table of the 11th prioritisation were provided to MSC members, and also to stakeholders observers for a written consultation period of 1 month (by November 1st)
- Outcome prioritization scoring: CONFIDENTIAL
  - Cd hydroxide and Cadmium oxide (still) score 18 and Cd metal 16. The score places are: 16, 17 and 21 respectively
  - ECHA selects annually 6 – 12 substances (on average 8) , so therefore far beyond the level of potential risk for selection due to many ED and PBT substances that are now included and score significantly higher.
  - However, a reference to potential grouping is included… but also for some organics that score higher
  - While not 100 % sure of course, it seems therefore rather unlikely that Cd compounds will be picked up… unless several MSs would express such wish.
- Draft 11th recommendation list (List of Substances Subject to Authorisation ("Annex XIV") will be discussed at MSC-76 (December 2021)

Although, is there another option?

- ECHA did NOT include Cadmium in the results table of the 11th prioritisation of Substances Subject to Authorisation
- Other substances received higher priority
  - With an OEL in place, there is less uncertainty on uncontrolled exposure
  - Due to the timing of the OEL and Biomonitoring, cadmium may be pushed back further to the 12th list in March 2023
  - With recent updates shared with ECHA on todays' low cadmium exposure plus a new CMD entry, ECHA could further reduce priority and consider these as appropriate alternative Risk Management Options (RMOs)to address cadmium rather than the authorisation procedure.
  - This will be followed attentively…

Authorization
Draft recommendation listing: 11th list

Cd-substances (notably $Cd(OH)_2$, CdO & Cd) **most probably not** nominated in the 11th recommendation-list of ECHA



Update of the priority scoring list: ~October 2021

Draft 11th recommend-dation discussed at MSC 76 (December 2021)

Discussion / confirmation of the Draft-list at MSC 77 (Febr 2022)

Public consultations: March-May 2022, one with ECHA and one with the Commission.

MSC voting and submission to the Commission: ~Summer/Autumn 2022

COM proposal for inclusion in Annex XIV: ~Spring/ Autumn 2023

Update on EU Reach

- CLP and Rapid degradability
- TDp-E

Rapid degradability & environmental transformation in chronic classification for aquatic effect

Under GHS & CLP, rapid degradation from the water column results in different chronic classification cut-off values and categories.

- ***Rapid degradation = classified one category less strict.***

Chronic 2 vs. chronic 3 comes with much more stringent downstream regulatory consequences, e.g., in transport, waste handling, Seveso,…

It is therefore important to make the difference for self-classification of sparingly soluble or insoluble cadmium containing substances, and some UVCB’s

However, ‘degradability’ is related to organic substances, it does not fit to metals…

- ***Hence: Transformation/Dissolution protocol - Extended (TDp-E) approach***

Transformation/Dissolution protocol - Extended (TDp-E)

As a surrogate for “degradability”, the metals industry has developed the concept of “environmental transformation and removal from the water column”

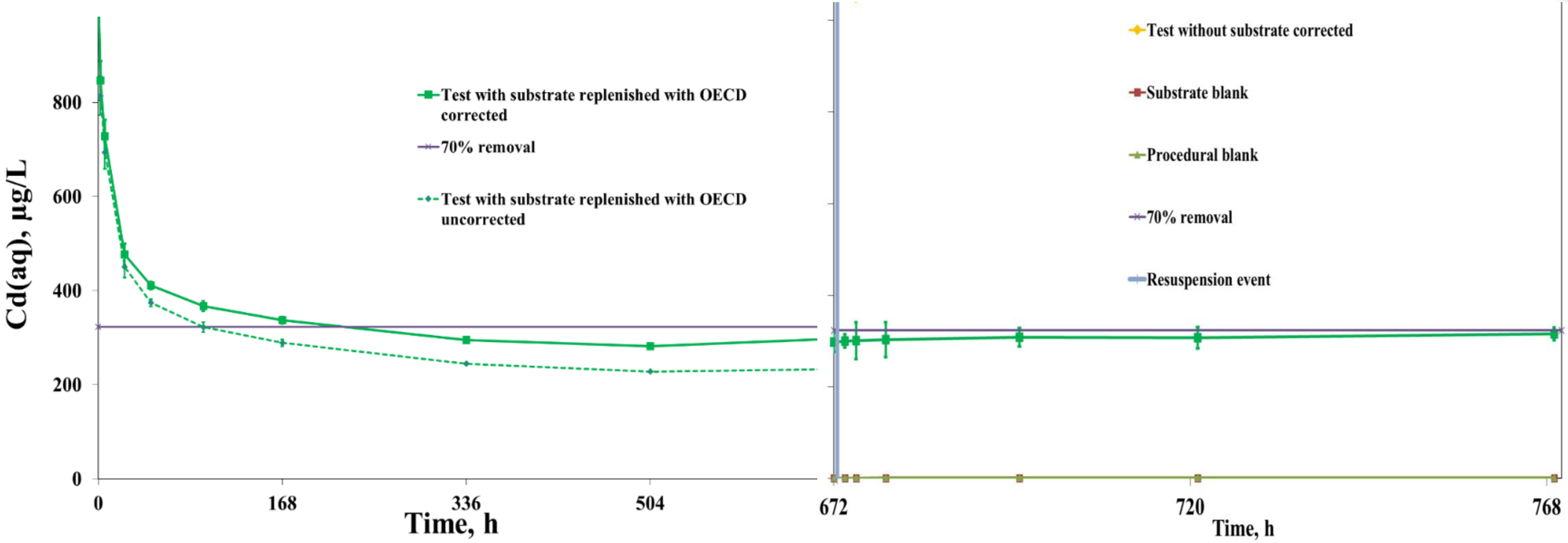
The approach tests the time metal remains in the water, before being “removed” by sedimentation, partitioning, etc.

The test is an extension from the existing Transformation/Dissolution test (TDp-E)

It provides key information to reinforce the case of ‘degradability’ of cadmium, allowing lower chronic aquatic effects category for self-classification (GHS/CLP)

Non-budgeted testing proposal (from CANMET) common with the Zn REACH Consortium: ~ 20 k€ for Cd REACH Consortium; **Final Report received**

Transformation/Dissolution protocol - Extended (TDp-E)



- >70% transformation/removal achieved.
- No release of Cd following resuspension (i.e., irreversibly bound).
  - Reinforces the case (modelling data, mesocosm data).
  - Creates the option to self-classify Cd-substances at lower chronic effects category.

Update on EU Reach

- MISA program: all Cd substances

Exposure assessment and risk characterisation:

- It was agreed with ECHA to revise the exposure scenarios of the Cd substances with highest tonnages: the Cd, CdO and $Cd(OH)_2$ dossiers first
  - Dossiers submitted on November 30th 2020
- EBRC in the process of working on the remaining Cd compounds
- EBRC (human health part) is coordinating with ARCHE for the environment part
- Aim to finish work by end 2021

Environment/ Human Health: contract ARCHE/EBRC

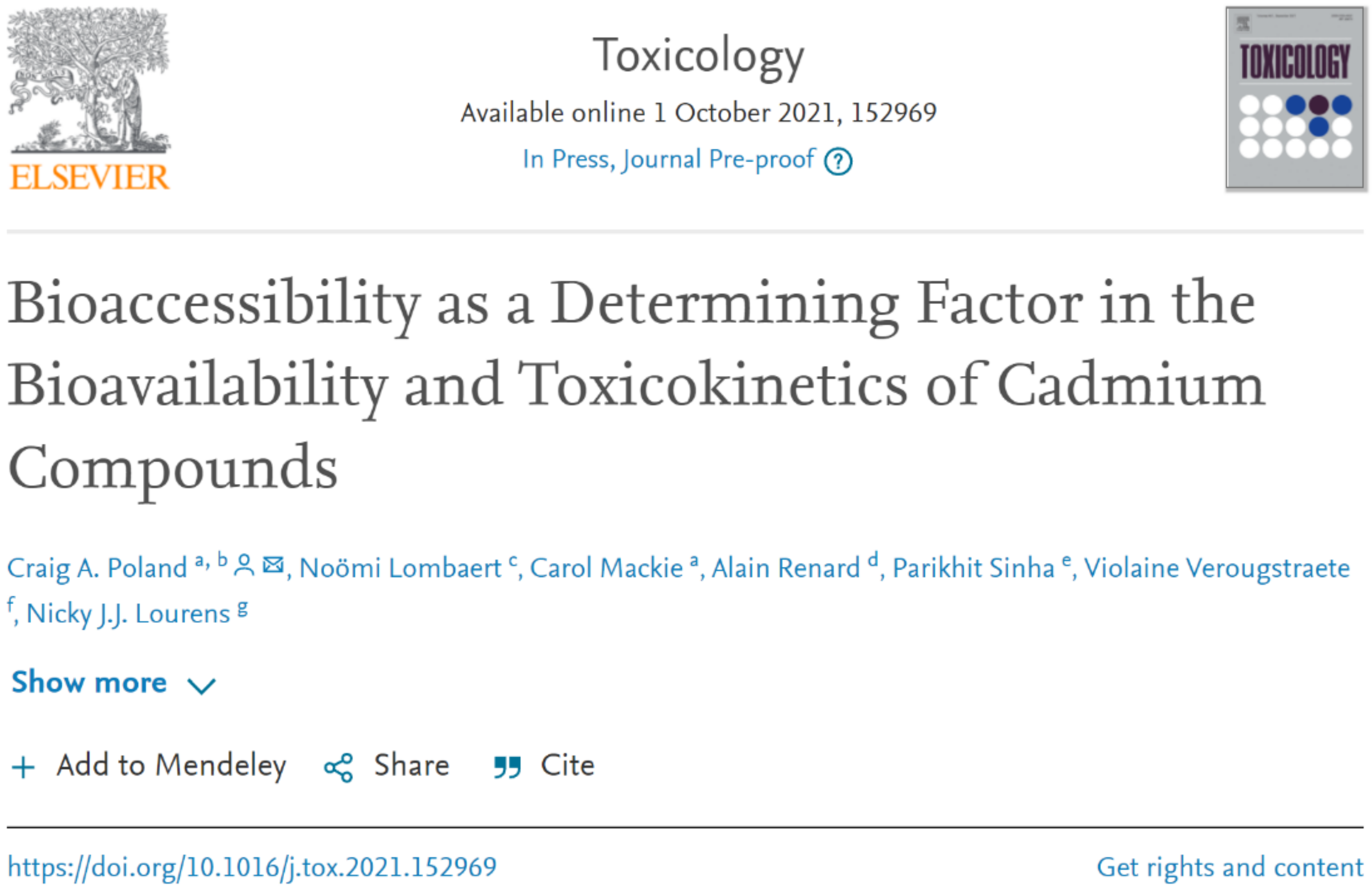
Update environmental fate and (eco)toxicity database and REACH dossier with new data

Update Read-across justification

Exposure assessment and risk characterisation in CHESAR:

In the light of the future authorisation process, an update of the Man via the Environment (MvE) scenario for Cd will be done

Publication in press



ELSEVIER

Toxicology
Available online 1 October 2021, 152969
In Press, Journal Pre-proof ?

Bioaccessibility as a Determining Factor in the Bioavailability and Toxicokinetics of Cadmium Compounds

Craig A. Poland [a], [b], Noömi Lombaert [c], Carol Mackie [a], Alain Renard [d], Parikhit Sinha [e], Violaine Verougstraete [f], Nicky J.J. Lourens [g]

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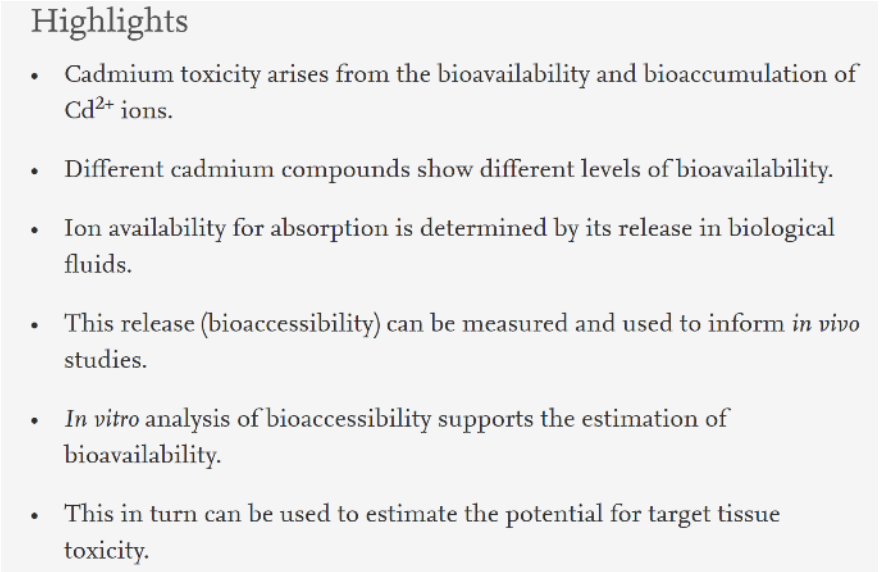
https://doi.org/10.1016/j.tox.2021.152969   Get rights and content



Highlights

- Cadmium toxicity arises from the bioavailability and bioaccumulation of Cd^{2+} ions.
- Different cadmium compounds show different levels of bioavailability.
- Ion availability for absorption is determined by its release in biological fluids.
- This release (bioaccessibility) can be measured and used to inform *in vivo* studies.
- *In vitro* analysis of bioaccessibility supports the estimation of bioavailability.
- This in turn can be used to estimate the potential for target tissue toxicity.

This work was funded by the EU REACH Cd Consortium Members, First Solar and 5N Plus Inc.

EU Green Deal and potential implications for Cadmium industry

The European Green Deal

European Commission

Designing a set of deeply transformative policies

Mainstreaming sustainability in all EU policies

Transforming the EU's economy for a sustainable future

Increasing the EU's Climate ambition for 2030 and 2050

A zero pollution ambition for a toxic-free environment

Supplying clean, affordable and secure energy

The European Green Deal

Preserving and restoring ecosystems and biodiversity

Mobilising industry for a clean and circular economy

From 'Farm to Fork': a fair, healthy and environmentally friendly food system

Building and renovating in an energy and resource efficient way

And leaving no one behind

Accelerating the shift to sustainable and smart mobility

Leave no one behind (Just Transition)

The EU as a global leader

A European Climate Pact

Financing the transition

CADMIUM Working Towards a Sustainable Future

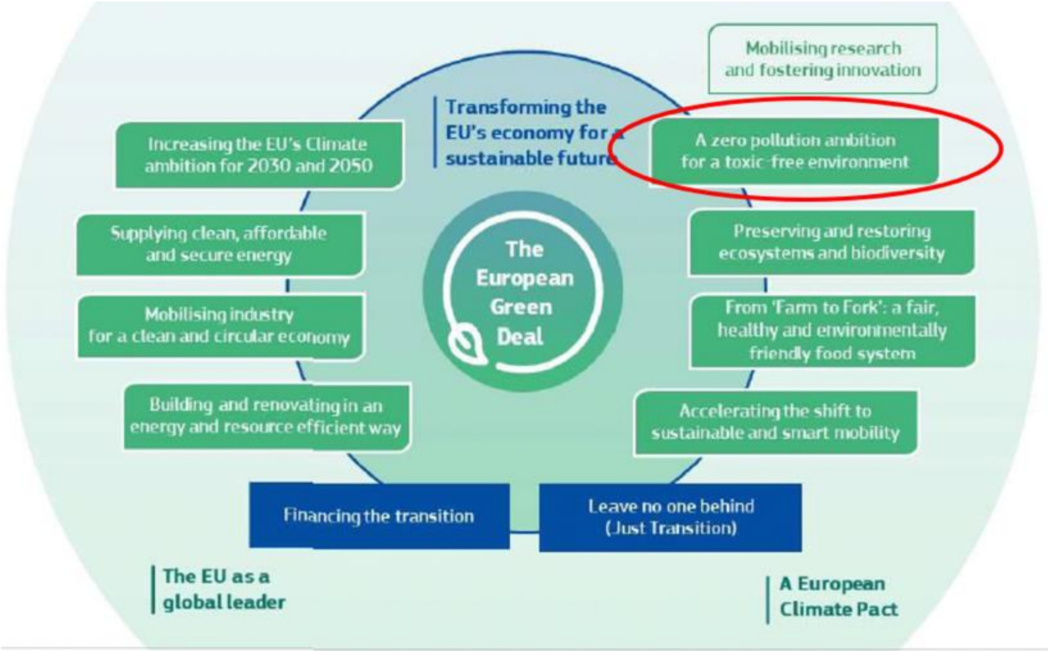
ICdA International Cadmium Association

EU Regulatory Landscape

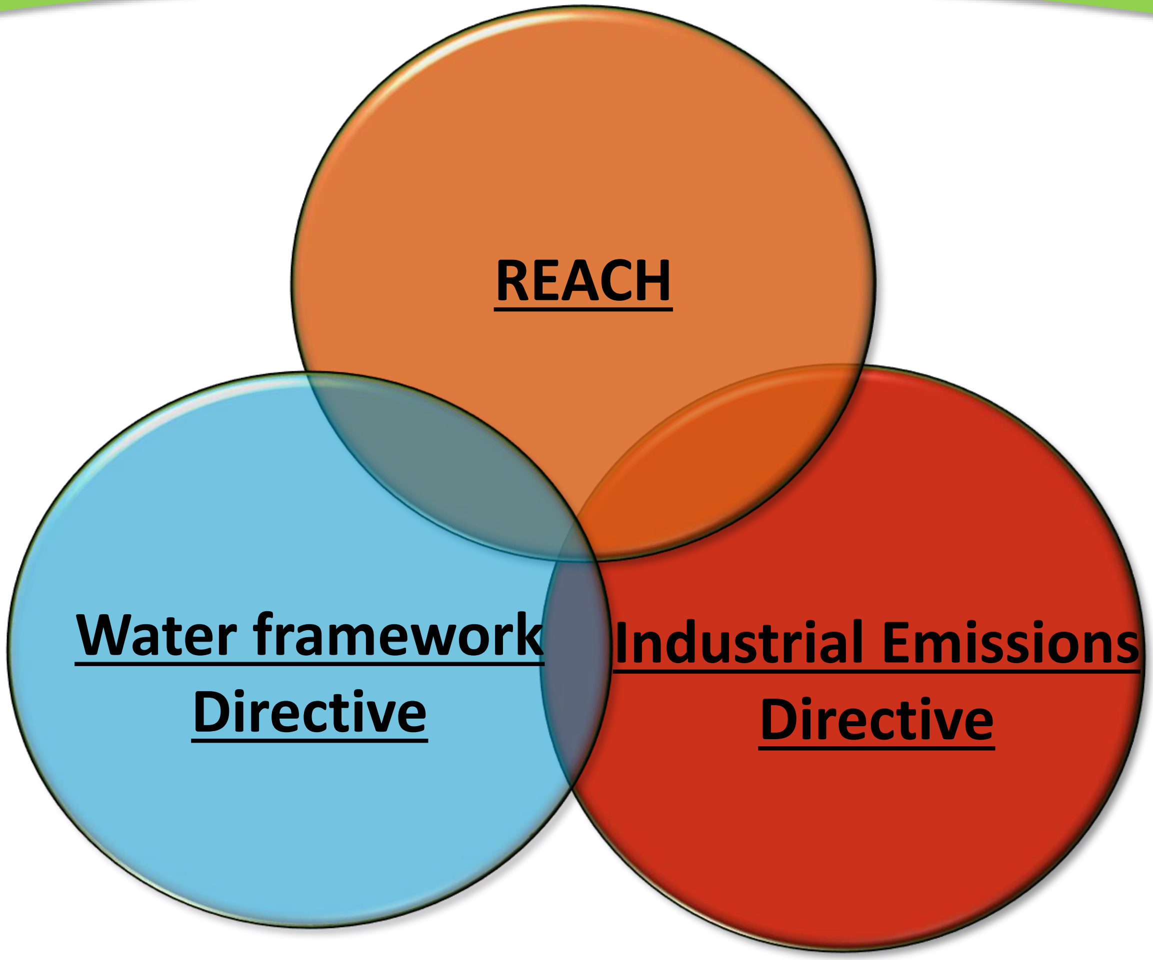
- Business as Usual requirements + new challenging EU Green Deal agenda, to be delivered via existing Regulations, eg:
  - Chemicals Strategy for Sustainability (CSS) via REACH and CLP
  - Zero Pollution Action Plan (ZPAP) via Water framework Directive (WfD), Industrial Emissions Directive (IED), and others
  - Circular Economy Action Plan (CEAP) via Waste, Sustainable Products/Green Claims/PEF, Batteries legislation…

REACH
COMPLIANCE

Water Framework Directive



EU GREEN DEAL



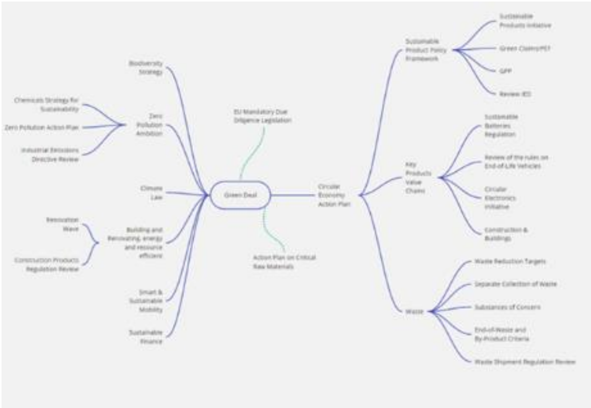
REACH

Water framework Directive

Industrial Emissions Directive

Q: How to react and organise?

=>Map the Green Deal;

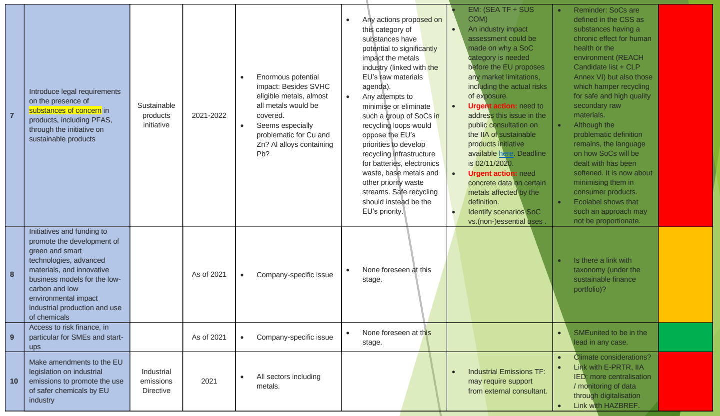


A1: Prioritise topics:

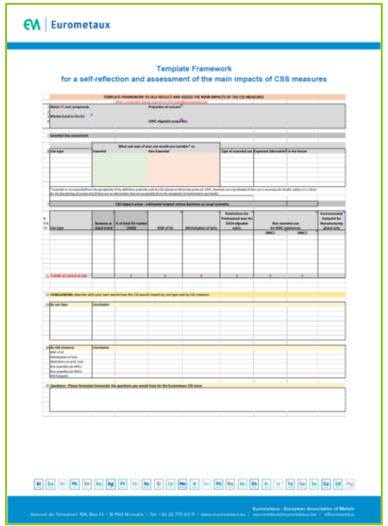
=>Identify and Prioritise topics by traffic light system

=> Understand and challenge new concepts

=> Assessment of impacts



7	Introduce legal requirements on the presence of substances of concern in products, including PFAS, through the initiative on sustainable products	Sustainable products initiative	2021-2022	• Enormous potential impact: Besides SVHC eligible metals, almost all metals would be covered. • Seems especially problematic for Cu and Zn? Al alloys containing Pb?	• Any actions proposed on this category of substances have potential to significantly impact the metals industry (linked with the EU's raw materials agenda). • Any attempts to minimise or eliminate such a group of SoCs in recycling loops would oppose the EU's priorities to develop recycling infrastructure for batteries, electronics waste, base metals and other priority waste streams. Safe recycling should instead be the EU's priority.	• EM: (SEA TF + SUS COM) • An industry impact assessment could be made on why a SoC category is needed before the EU proposes any market limitations, including the actual risks of exposure. • **Urgent action:** need to address this issue in the public consultation on the IIA of sustainable products initiative available here. Deadline is 02/11/2020. • **Urgent action:** need concrete data on certain metals affected by the definition. • Identify scenarios SoC vs.(non-)essential uses .	• Reminder: SoCs are defined in the CSS as substances having a chronic effect for human health or the environment (REACH Candidate list + CLP Annex VI) but also those which hamper recycling for safe and high quality secondary raw materials. • Although the problematic definition remains, the language on how SoCs will be dealt with has been softened. It is now about minimising them in consumer products. • Ecolabel shows that such an approach may not be proportionate.	🟥
8	Initiatives and funding to promote the development of green and smart technologies, advanced materials, and innovative business models for the low-carbon and low environmental impact industrial production and use of chemicals		As of 2021	• Company-specific issue	• None foreseen at this stage.		• Is there a link with taxonomy (under the sustainable finance portfolio)?	🟧
9	Access to risk finance, in particular for SMEs and start-ups		As of 2021	• Company-specific issue	• None foreseen at this stage.		• SMEunited to be in the lead in any case.	🟩
10	Make amendments to the EU legislation on industrial emissions to promote the use of safer chemicals by EU industry	Industrial emissions Directive	2021	• All sectors including metals.		• Industrial Emissions TF: may require support from external consultant.	• Climate considerations? • Link with E-PRTR, IIA IED: more centralisation / monitoring of data through digitalisation • Link with HAZBREF.	🟥

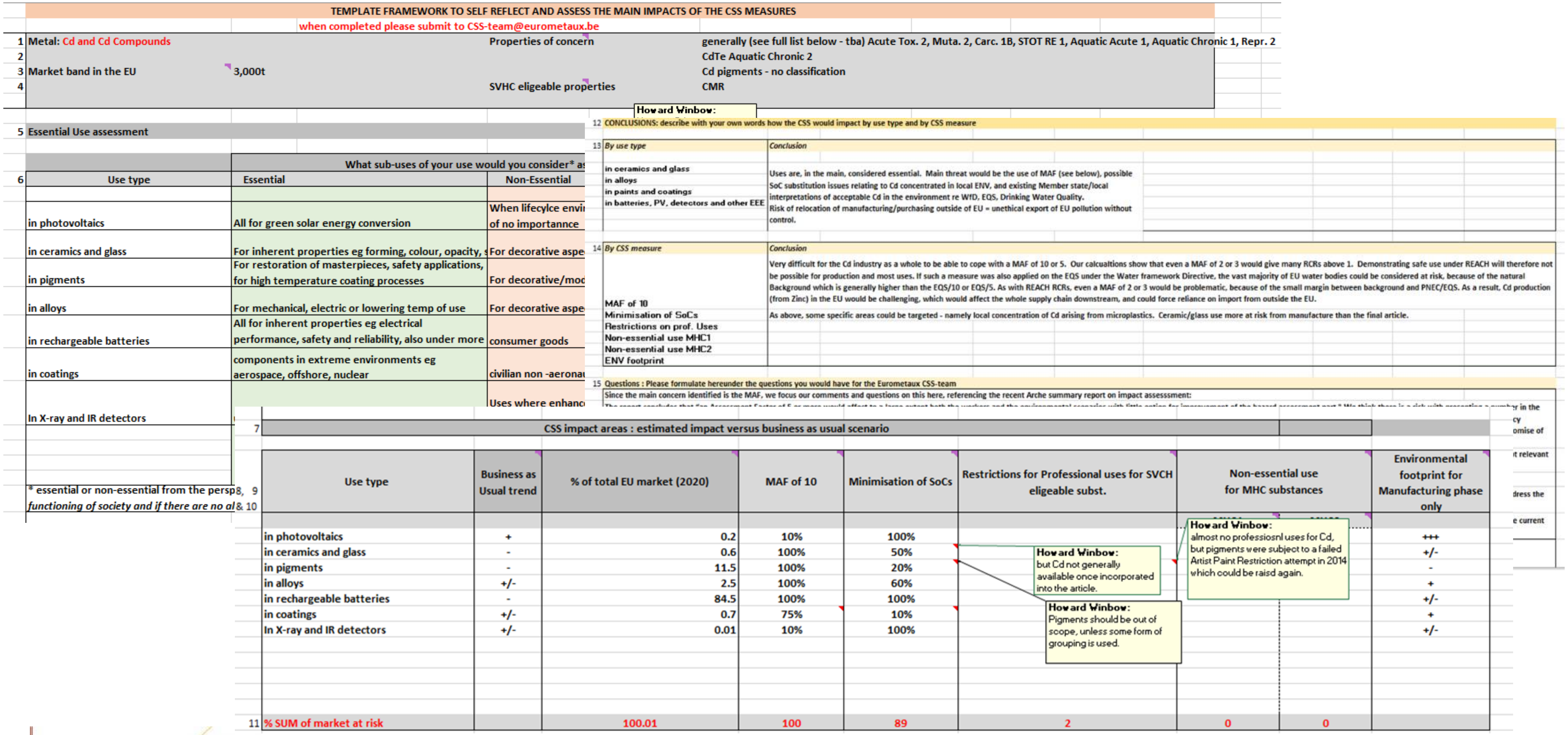


Eurometaux

Template Framework
for a self-reflection and assessment of the main impacts of CSS measures

TEMPLATE FRAMEWORK TO SELF REFLECT AND ASSESS THE MAIN IMPACTS OF THE CSS MEASURES

Action: Assessment of impacts



TEMPLATE FRAMEWORK TO SELF REFLECT AND ASSESS THE MAIN IMPACTS OF THE CSS MEASURES

when completed please submit to CSS-team@eurometaux.be

1	Metal: Cd and Cd Compounds		Properties of concern	generally (see full list below - tba) Acute Tox. 2, Muta. 2, Carc. 1B, STOT RE 1, Aquatic Acute 1, Aquatic Chronic 1, Repr. 2
2				CdTe Aquatic Chronic 2
3	Market band in the EU	3,000t		Cd pigments - no classification
4			SVHC eligeable properties	CMR

5 Essential Use assessment

6	Use type	What sub-uses of your use would you consider* as Essential	 Non-Essential
	in photovoltaics	All for green solar energy conversion	When lifecylce envi of no importannce
	in ceramics and glass	For inherent properties eg forming, colour, opacity, s	For decorative aspe
	in pigments	For restoration of masterpieces, safety applications, for high temperature coating processes	For decorative/mod
	in alloys	For mechanical, electric or lowering temp of use	For decorative aspe
	in rechargeable batteries	All for inherent properties eg electrical performance, safety and reliability, also under more	consumer goods
	in coatings	components in extreme environments eg aerospace, offshore, nuclear	civilian non -aeronau
	In X-ray and IR detectors		Uses where enhanc

* essential or non-essential from the persp

functioning of society and if there are no al

Howard Winbow:

12 CONCLUSIONS: describe with your own words how the CSS would impact by use type and by CSS measure

13	*By use type*	*Conclusion*
	in ceramics and glass in alloys in paints and coatings in batteries, PV, detectors and other EEE	Uses are, in the main, considered essential. Main threat would be the use of MAF (see below), possible SoC substitution issues relating to Cd concentrated in local ENV, and existing Member state/local interpretations of acceptable Cd in the environment re WfD, EQS, Drinking Water Quality. Risk of relocation of manufacturing/purchasing outside of EU = unethical export of EU pollution without control.

14	*By CSS measure*	*Conclusion*
	MAF of 10	Very difficult for the Cd industry as a whole to be able to cope with a MAF of 10 or 5. Our calcualtions show that even a MAF of 2 or 3 would give many RCRs above 1. Demonstrating safe use under REACH will therefore not be possible for production and most uses. If such a measure was also applied on the EQS under the Water framework Directive, the vast majority of EU water bodies could be considered at risk, because of the natural Background which is generally higher than the EQS/10 or EQS/5. As with REACH RCRs, even a MAF of 2 or 3 would be problematic, because of the small margin between background and PNEC/EQS. As a result, Cd production (from Zinc) in the EU would be challenging, which would affect the whole supply chain downstream, and could force reliance on import from outside the EU.
	Minimisation of SoCs	As above, some specific areas could be targeted - namely local concentration of Cd arising from microplastics. Ceramic/glass use more at risk from manufacture than the final article.
	Restrictions on prof. Uses	
	Non-essential use MHC1	
	Non-essential use MHC2	
	ENV footprint	

15 Questions : Please formulate hereunder the questions you would have for the Eurometaux CSS-team

Since the main concern identified is the MAF, we focus our comments and questions on this here, referencing the recent Arche summary report on impact assesssment:

7 CSS impact areas : estimated impact versus business as usual scenario

8, 9 & 10	Use type	Business as Usual trend	% of total EU market (2020)	MAF of 10	Minimisation of SoCs	Restrictions for Professional uses for SVCH eligeable subst.	Non-essential use for MHC substances		Environmental footprint for Manufacturing phase only
	in photovoltaics	+	0.2	10%	100%				+++
	in ceramics and glass	-	0.6	100%	50%				+/-
	in pigments	-	11.5	100%	20%				-
	in alloys	+/-	2.5	100%	60%				+
	in rechargeable batteries	-	84.5	100%	100%				+/-
	in coatings	+/-	0.7	75%	10%				+
	In X-ray and IR detectors	+/-	0.01	10%	100%				+/-
11	% SUM of market at risk		100.01	100	89	2	0	0	

Howard Winbow:
but Cd not generally available once incorporated into the article.

Howard Winbow:
Pigments should be out of scope, unless some form of grouping is used.

Howard Winbow:
almost no professiosnl uses for Cd, but pigments were subject to a failed Artist Paint Restriction attempt in 2014 which could be raisd again.

Summary of top new priority issues identified:

1. **'Substances of Concern (SoC)': New concept, not fully defined.**
   - For Cd – to be watched but already several are SVHC.
2. **'Essential Uses (EU)': New concept, not fully defined.**
   - For Cd, to be watched but many Uses are covered by Restrictions with Essential Uses niche applications remaining.
3. **'Mixture Assessment Factor (MAF)': re-emerging topic.**
   - Approach to combined toxicity will be critical for many substances… technical and political advocacy needed. Projects planned.

... plus Endocrine Disruptors (EDs)

- Appears in 5 action areas, including to include in REACH, CLP, SDSs
- Scope and Definitions being defined – being followed..

Mixture Assessment Factors MAFs:

why a problem for cadmium and other metals?

In REACH, ‘safe use’ is demonstrated by Risk Characterization Ratios, RCRs being <1

- RCRs are used to cover all end-points, populations, exposure routes and time scales, both environmental and human.
- RCRs are derived by comparing exposure levels to suitable predicted no-effect concentrations (PNECs) or derived no-effect levels (DNELs).

For the environmental end-points, this is the ratio of predicted environmental concentration (PEC) to PNEC and should be <1:

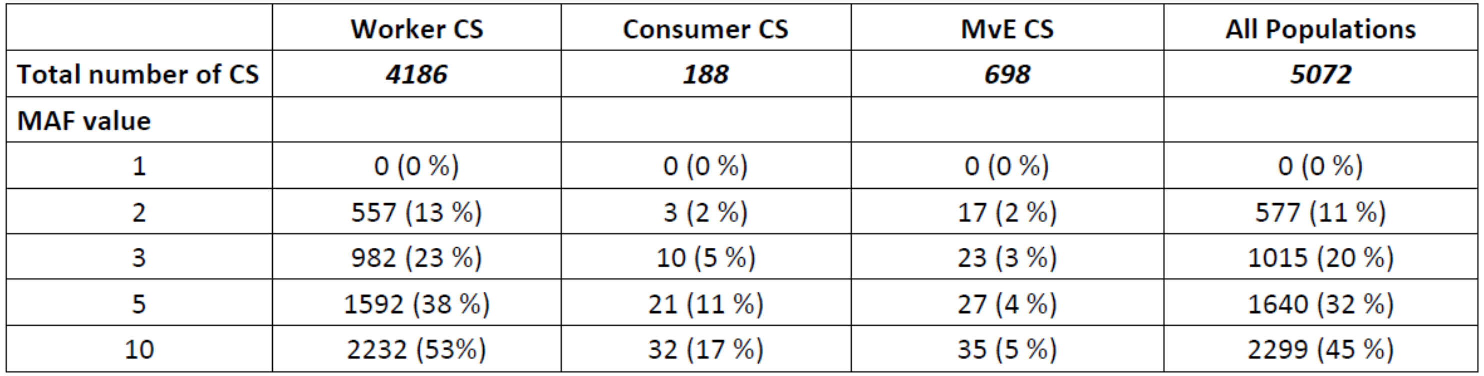
RCR = PEC/PNEC

- In a simplistic approach to deal with potential ‘cocktail effect’ of substances together, the MAF would simply be applied to this ratio.

- How many RCRs would go >1 with different MAFs applied?...

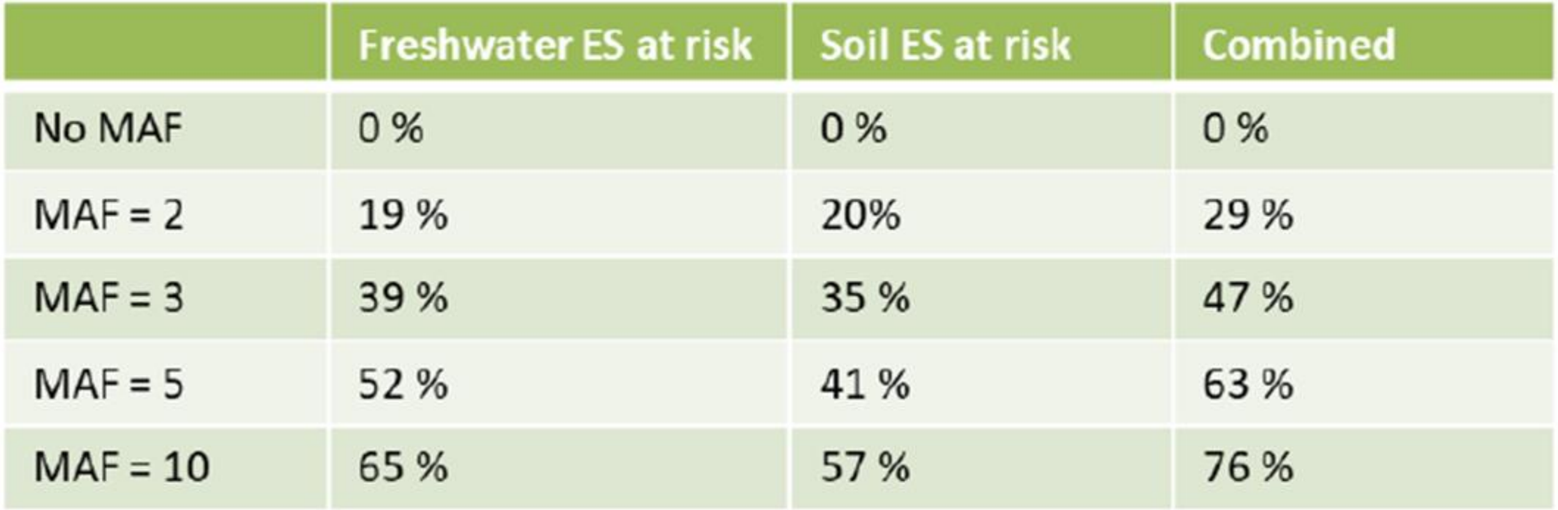
MAFs – Multi-metal impact for HH and ENV end points

Table 1: Number of CS exceeding a RCR of 1 at given MAF values



	Worker CS	Consumer CS	MvE CS	All Populations
Total number of CS	***4186***	***188***	***698***	***5072***
MAF value				
1	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)
2	557 (13 %)	3 (2 %)	17 (2 %)	577 (11 %)
3	982 (23 %)	10 (5 %)	23 (3 %)	1015 (20 %)
5	1592 (38 %)	21 (11 %)	27 (4 %)	1640 (32 %)
10	2232 (53%)	32 (17 %)	35 (5 %)	2299 (45 %)

Environment Example

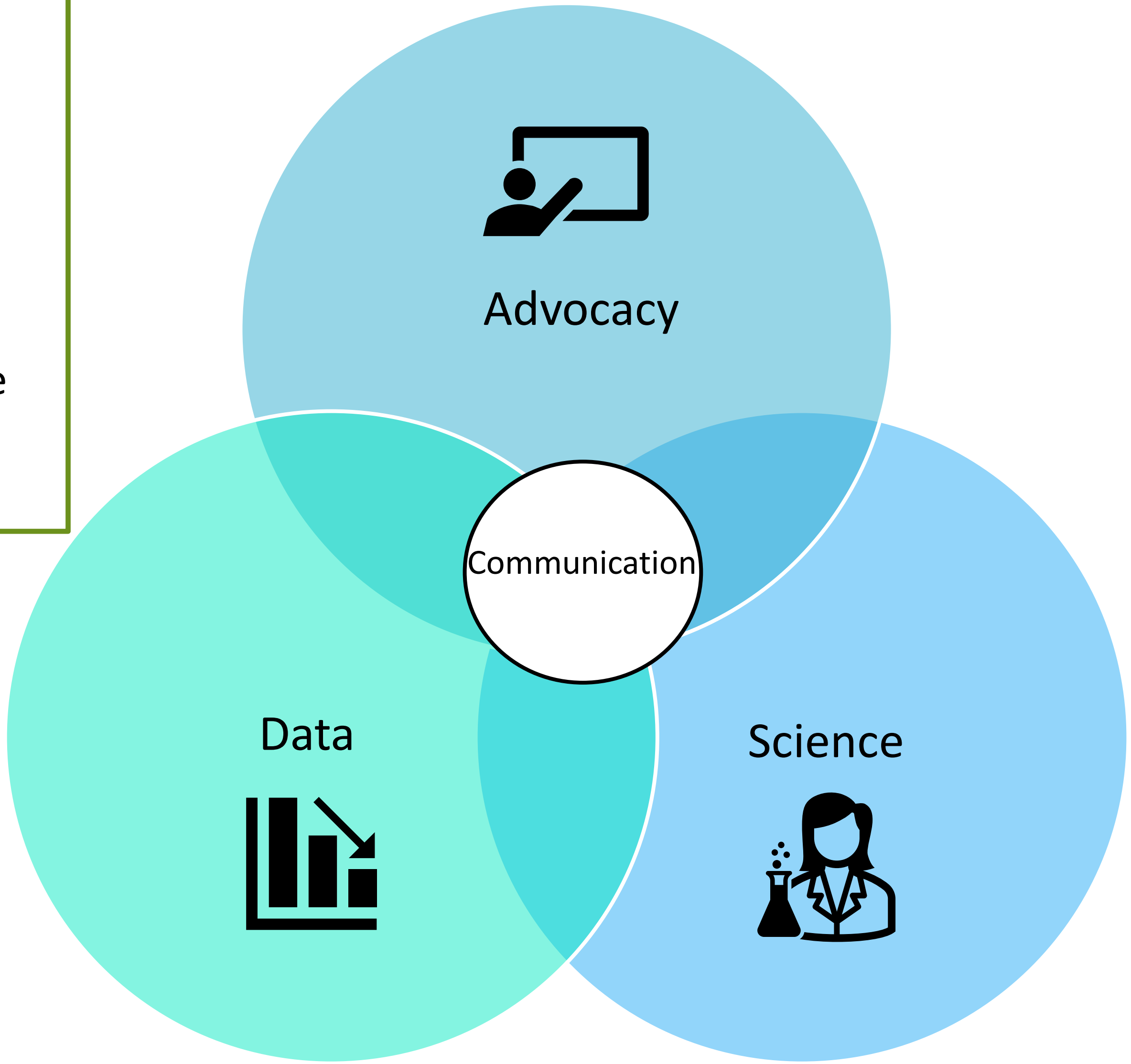


	Freshwater ES at risk	Soil ES at risk	Combined
No MAF	0 %	0 %	0 %
MAF = 2	19 %	20%	29 %
MAF = 3	39 %	35 %	47 %
MAF = 5	52 %	41 %	63 %
MAF = 10	65 %	57 %	76 %

How to React and Organise?

So need to further develop and use best available data, science and risk-assessment methodology to:

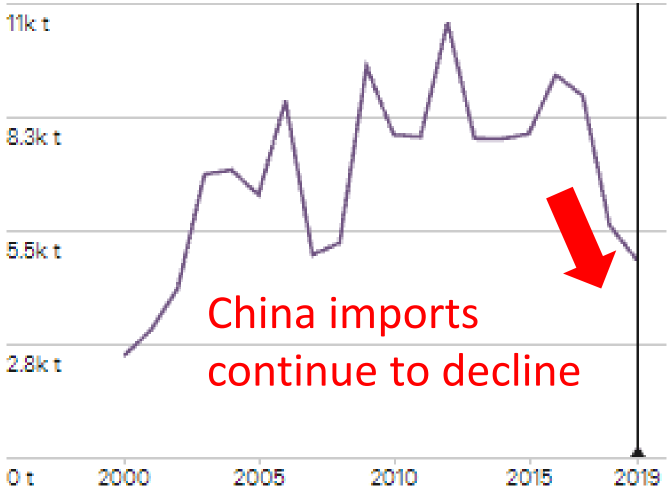
- reactively defend positions, and
- proactively challenge and advocate where identified..



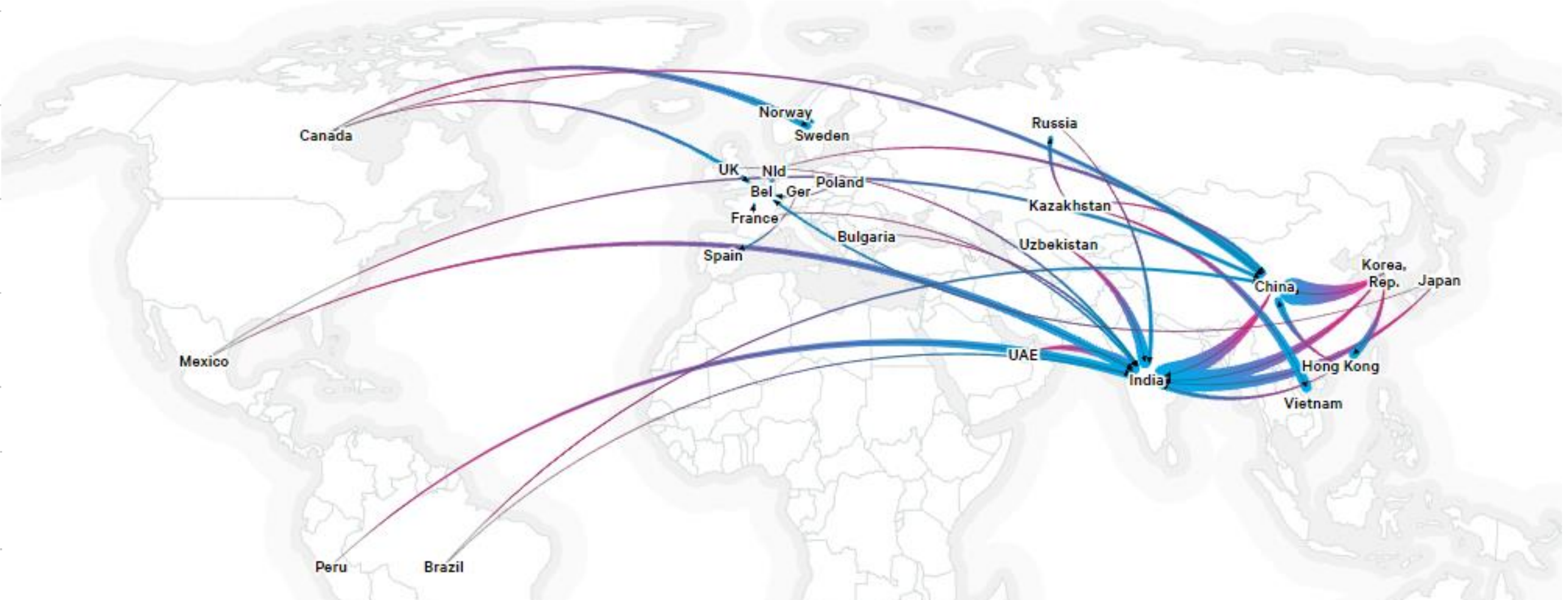
Cadmium market update

Changing cadmium markets and trade

India imports grow faster every year



China imports continue to decline



Consumption shift from China to India continues.

In 2019, India imported 47% of all worldwide export