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REACH – Comments and documentation

4,4'-isopropylidenediphenol (Bisphenol A)
 and structurally related bisphenols of similar concern for the environment

Green Warriors of Norway/Norges Miljøvernforbund (NMF) raise several concerns regarding the increased use of Bisphenol A (BPA) and related chemicals and their impact on onshore and offshore environment and ecosystems. Much of the current and future impact will come from relatively new sources, and from sources that will increase in new areas and environments. One of the main sources of concern is from micro and nano sized particles released into the environment from epoxy-based products by erosion. Such particles that contain BPA related substances will protect its containing chemicals and protect them from degradation while they remain inside the particle materials, and like a Trojan Horse, be released into the food chain through organisms when in contact with their digestive system. It is also concerning that research show that BPA do generational harm to organisms according to a recent study of Rainbow trout.

These factors and more raise serious concerns as the development and placement of new installations reliant upon BPA containing epoxy structures reaches new frontiers with harsher and more challenging weather conditions. While chemicals like BPA in its pure form is degraded normally in a normal environment, salt water and colder temperatures in more arctic and sub-arctic environments will likely impact the rate of degradation significantly, which make them remain a potent biochemical pollutant for a much longer period than in more tempered environments. Within the protection of a micro-sized particle, they will remain a potent biochemical pollutant significantly longer than the chemical in its pure form.

With micro and nano sized particles found in larger and larger quantities on the farthest parts of the planet, from the furthest away glaciers to sediments on the deepest seabed, the concern is that our human impact on the various onshore and offshore environments accumulate and is irreversible.

We therefore need much stricter regulations and also serious incentives for the industry to find better alternatives and in the meantime stop the placement of new installations that release micro and nano sized particles containing BPA and similar chemicals to the environment.

You will find our concerns and demands in more detail on the following pages.

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Summary and demands

We will in our comments show that epoxy compounds is a Trojan Horse regarding to the spread of Bisphenol A (BPA, EC No.: 201-245-8 CAS No.: 80-05-7, 4,4'-isopropylidenediphenol1) to the environment and to our food chain.

Regarding the concerns we raise, we will put forth some demands in accordance with a precautionary principle. Based on the documentation we present in this brief, we are significantly concerned for the biochemical pollution BPA can cause in unknown proportions in regard to the environment, biodiversity, marine and fresh water sources, and the food chain we all are dependent upon.

We do ask on what scale is BPA levels a threat as a biochemical pollutant in different environments and towards different food chains? Do we as humans have enough knowledge to predict long term effects and harm?

“This is the first systematic review, to our knowledge, to assess and quantify MP contamination of seafood and human uptake from its consumption, suggesting that action must be considered in order to reduce human exposure via such consumption. Further high-quality research using standardized methods is needed to cement the scientific evidence on MP contamination and human exposures.

Seafood is an important source of protein for populations around the world, and it may be time to implement the precautionary principle (Kriebel et al. 2001), based on the existing scientific evidence, and take steps in policy, industry, and society to minimize human exposures to foodborne MPs where possible.”¹

Our demands below is sound and reasonable and is based on a precautionary principle. We need more strict regulations to avoid as much BPA and BPA in a combination with micro and nano sized particles of epoxy plastics released into the environment as possible.

Here are our demands:

1. We would like the placement of new large-scale installations that may cause the release of BPA and related chemicals into the environment may stop, **but acknowledge that strict regulation and standards must be put in place to reduce the impact on the environment, ecosystems, food chain and on human health.**

Scientific research must be prioritized where there is a lack of knowledge. A proper risk assessment must be conducted before new projects that may cause release of BPA and similar chemicals to the environment. All deployment of epoxy related industries must be put on halt until proper scientific standards are met to show them safe to the environment, climate, biodiversity and human health. This applies to both production, use and dismantling, recycling and deposit of such materials.

2. **Complete product declaration on all products that contain BPA and similar chemicals must be present and follow the product on all stages from production until its recycled and reused or deposited.** The product declaration should also reflect restrictions and hazards through

¹ <https://ehp.niehs.nih.gov/doi/10.1289/EHP7171>

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its intended life cycle, also including terms of application for sales and transfer of goods in accordance with applying directives.

The terms of a product declaration must include the following:

- Data sheet as a product declaration of amount, percentage, weight and volume of BPA and similar chemicals for all industries excluding food purposes.
- Content description/product declaration on all products for Activities of Daily Living (ADL) and food purposes. This will empower all customers to take responsible consumer decisions within a health- and environmental perspective.
- Branch based product declaration complying to set life cycle standards.
- Restrictions and regulations to product declarations and import/export applications to maintain national overview and control to meet nationally and internationally environmental standards and goals. This must also adhere to the goals set in the UN sustainability goals.

Industry and branches that is large scale consumers of epoxy related materials must be the first to undergo regulations that also meets the demands of a sustainable and environmentally friendly circular economy. Regulations must also include management of waste and deposal in compliance with the appropriate EU directives.

3. Relevant information must be given to public and governing bodies and to the public in general regarding the hazards of BPA and similar chemicals to human health and to the environment. Conscious consumers, both corporate and private must be a definitive goal regarding legislation, standards and procedures regarding handling of BPA containing products within a life cycle timeframe.
4. Follow advice from WHO to decrease levels of pollutants in all water systems as soon as possible. Implement stricter levels of tolerance much earlier than 2026. The reasoning for this is based on current plans to implement new installations that contain BPA-related materials both onshore and offshore. This is most significantly related to wind power generation where the turbine blades are increasing in both size, volume and numbers on an exponential rate. There is a significant problem with micro particles released into the environment due to Leading Edge Erosion (LEE). As we will show other places in this brief, this is potentially a much more environmental risk for the eco systems and our food chain than the same chemicals in their pure form due to the Trojan Horse effect.
5. Scientific research into the environmental and health related effects must be prioritized. We do have too little knowledge, especially towards long time effects, and the data we do have available show negative effects of grave concerns. Micro particles of epoxy, rubber, other plastics do seem to accumulate in the environment for each and every year, and thus also remain an ever growing and lasting environmental problem. Especially relevant to highlight the issues at hand is found in the following three quotes;
 - ***“Bisphenol A in eggs causes development-specific liver molecular reprogramming in two generations of rainbow trout”²***

² https://www.researchgate.net/publication/320630432_Bisphenol_A_in_eggs_causes_development-specific_liver_molecular_reprogramming_in_two_generations_of_rainbow_trout/fulltext/59f37f8ca6fdcc075ec349ab/Bisphenol-A-in-eggs-causes-development-specific-liver-molecular-reprogramming-in-two-generations-of-rainbow-trout.pdf?origin=publication_detail

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- **“An increase in temperature or a pH change can cause the ester bonds between the BPA molecules in polycarbonate plastic and epoxy resin to be broken through hydrolysis and thus release BPA to the environment.”**^{3 4}
- (Original text-Swedish) *“Effekter från intag av plast har konstaterats för växt- och djurplankton, musslor, marina maskar, kräftdjur, fisk och fåglar. Biologiska effekter kan också orsakas av att tillsatskemikalier, som används för att ge vissa egenskaper till plasten, läcker ut och tas upp. På samma sätt kan monomerer och biprodukter som finns kvar i plasten från framställningsprocessen läcka ut. Dessutom så kan även kemikalier från den omgivande miljön, såsom långlivade organiska föroreningar ofta med hög affinitet till plast, adsorberas till partikelytan.”*
(Our translation) **“Effects from consumption of plastics has been ascertained for phytoplankton and zooplankton, mussels, marine worms, shellfish, fish and birds. Biological effects can also be caused by added chemicals, that is used to give certain characteristics to the plastic material, is released and absorbed. In the same way, monomers and by-products from the production process can leak out. External chemicals from the surrounding environment, such as long-lasting organic pollutants with high level of affinity to plastic, is to be absorbed to the surface of the plastic particle.”**⁵

There must be set significant effort and resources towards scientific research that is aimed at establishing possible effects and mechanisms that can secure sound and environmentally friendly products and procedures.

The impact from BPA to our environment and food chain

The amounts of BPA and similar chemicals released to the environment can be enormous due to the huge increase in use of epoxy related materials in challenging environments. The research we refer, do show negative impact on the food chain at large, from the smallest plankton to large mammals, and even humans. If phytoplankton is significantly affected, their ability to capture CO₂ and release oxygen may similarly be affected. BPA is also shown to have generational impact on organisms.

The Trojan Horse effect in micro particles keep the chemicals inside shielded from environmental impact, and thus reduce the degradation of the chemicals. When consumed by organisms they are released into the organism when in contact with their digestive, often acidic fluids.

“An increase in temperature or a pH change can cause the ester bonds between the BPA molecules in polycarbonate plastic and epoxy resin to be broken through hydrolysis and thus release BPA to the environment.”⁶

Another problem with micro and nano sized particles is that they likely stay in the upper levels of the water body much longer and therefore is more likely be able to be consumed and absorbed into by small plankton and organisms and accumulated up through the food chain. Therefore, such micro and nano

³https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_metabolic_syndrome_and_breast_cancer_A_review

⁴<https://diegofdezsevilla.wordpress.com/2014/07/17/could-plastic-debris-coarse-fine-and-molecules-polymers-affect-oceans-functions-as-climate-regulator-co2-sink-albedo-evaporation/>

⁵<https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6772-4.pdf?pid=20662>

⁶https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_metabolic_syndrome_and_breast_cancer_A_review

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sized particles do potentially represent a much more significant threat to the environment than each chemical in its pure form. The micro and nano sized particles in itself can be a serious health issue to the affected organisms, not to mention the added impact from contained chemicals. Brain damage and behavioral disorders in fish induced by plastic nanoparticles delivered through the food chain is recorded by scientists. ⁷

The potential risks from BPA are not only connected to life and health only, but may also affect the planets potential to collect CO₂ from the environment and also only its ability to produce oxygen through the mechanisms of phytoplankton.

“Effects from consumption of plastics has been ascertained for phytoplankton and zooplankton, mussels, marine worms, shellfish, fish and birds. Biological effects can also be caused by added chemicals, that is used to give certain characteristics to the plastic material, is released and absorbed. In the same way, monomers and by-products from the production process can leak out. External chemicals from the surrounding environment, such as long-lasting organic pollutants with high level of affinity to plastic, is to be absorbed to the surface of the plastic particle.” (original text in Swedish – our transl.) ⁸

Researchers has discovered plastic microparticles in the digestive system of deep sea schrimp as far down as 11 km below the surface in and around the Pacific. Over 72% of the schrimp collected had one or more plastic microparticles in their body. Micro and nano sized plastic particles can now be found in every far away corner of our planet. ⁹

“Seafood is an important source of protein for populations around the world, and it may be time to implement the precautionary principle (Kriebel et al. 2001), based on the existing scientific evidence, and take steps in policy, industry, and society to minimize human exposures to foodborne MPs where possible». ¹⁰

“Upon uptake, micro- and nanoplastics can reach the brain, although there is limited information regarding the number of particles that reaches the brain and the potential neurotoxicity of these small plastic particles”. ¹¹

“Although the transport of hydrophobic contaminants by plastic debris is not relevant in terms of masses, under authors’ point of view their capability to act as a Trojan Horse for these contaminants to living organisms cannot be underestimated”.

“Hence, their toxicity may be caused by the plastic polymer itself, the additives that it contains, and/or by other chemicals associated to MPs that might be released to the aquatic media”.

⁷https://www.researchgate.net/publication/319683370_Brain_damage_and_behavioural_disorders_in_fish_induced_by_plastic_nanoparticles_delivered_through_the_food_chain

⁸<https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6772-4.pdf?pid=20662>

⁹<https://mikroplast.wordpress.com/2019/02/28/mikroplast-i-tarmen-pa-dypvannsreker/>

¹⁰<https://ehp.niehs.nih.gov/doi/10.1289/EHP7171>

¹¹https://www.researchgate.net/publication/342019198_The_plastic_brain_Neurotoxicity_of_micro-And_nanoplastics

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In fact, the highest contribution from beached plastics to seawater corresponded to the leaching of plastic additives (flame retardants and plasticizers) followed by PCPs, being also relevant that a significant proportion of less hydrophobic contaminants can be desorbed from plastics to seawater in the first 24 h.

There are 7 mechanisms that affect the role of MPs as carriers of co- contaminants summarized by Koelmans et al. as follow:

- 1. absorption – ingestion-egestion of plastic, with chemical transferred from plastic to organism*
- 2. cleaning – ingestion-egestion of plastic, with an increase of chemical excreted from organism*
- 3. source – plastic acting as a source of co-contaminant in the environment*
- 4. sink – plastic accumulate co-contaminants from the seawater and organisms*
- 5. indirect source, dietary – desorption of chemical from plastic to natural food/prey followed by ingestion of prey*
- 6. dietary – uptake of chemical by ingestion of regular contaminated food (i.e., NPs), and*
- 7. dermal – uptake of chemical from any medium other than plastic and natural prey. In addition to hydrophobic contaminants such as POPs, some authors investigated how MPs and plastic debris may also concentrate metals.*

This is possible due to the oxidised form of the plastic surface that can carry functionalities that may bind metals. This last finding was unexpected, and it emphasizes the necessity to further investigate the behaviour of MPs in the environment with special attention to ageing MPs.

MNPs due to their small size, similar to plankton, can be ingested by aquatic organisms, and therefore be introduced into marine food web. Setälä et al. observed that polystyrene (PS) microspheres can be transferred via planktonic organisms from one trophic level (mesozooplankton) to a higher one (macrozooplankton).

The study also confirmed the ingestion of PS based MP by mysid shrimps, copepods, cladocerans, rotifers, polychaete larvae and ciliates although some of the species ejected the microspheres after 12 h of ingestion.

*MPs and NPs may also pose a risk to human health due to their potential accumulation in seafood reaching the consumers. For example, mussel *Mytilus edulis* have been reported as marine species able to ingest MPs.*

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However, MPs and NPs can be retained in some organs, and they may be translocated in living tissues.

Furthermore, evidence of physical size alteration of microplastics by a planktonic crustacean has been recently demonstrated. It is estimated that some of the plastics can reach concentration factors inside the organisms near to 1 million-fold increase".¹²

«Action must be considered in order to reduce human exposure».¹³

“Furthermore, phthalates and bisphenols are not covalently bound to the polymeric structure, from which with time, or due to physical and/or chemical factors such as heat and acidity, can be gradually released into the external environment, contaminating water, soil and sediments, and later the rest of the agro-food chain.”.¹⁴

BPA levels has been observed in urine samples from humans with extremely high frequency (up till 99%) (Ye et al. 2015)¹⁵, which indicate a which level of pollutants in the environment¹⁶. BPA has been found in most samples of blood, brest milk og amniotic (Vandenberg et al. , 2007)¹⁷. Even low levels of BPA seems to have a very negative effect on the health of humans.

«It was concluded that low doses of BPA (1 and 10 nM) inhibit adiponectin secretion by human adipocytes cultures in vitro and stimulate the secretion of inflammatory adipokines such as interleukin-6 (IL-6) and tumor necrosis factor α suggesting its possible involvement in obesity, metabolic syndrome and insulin resistance (Hugo et al., 2008; Alonso-Magdalena et al., 2011)».

¹⁸

¹²https://www.researchgate.net/publication/341349798_Microplastics_in_Mediterranean_coastal_area_toxicity_and_impact_for_the_environment_and_human_health

¹³ <https://ehp.niehs.nih.gov/doi/10.1289/EHP7171>

¹⁴ <https://pubmed.ncbi.nlm.nih.gov/27504873/>

¹⁵ <https://pubs.acs.org/doi/abs/10.1021/acs.est.5b02135>

¹⁶ <https://www.osti.gov/pages/biblio/1470902>

¹⁷ <https://pubmed.ncbi.nlm.nih.gov/17825522/>

¹⁸https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_metabolic_syndrome_and_breast_cancer_A_review

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The occurrence of BPA in different types of products

BPA is used in rubber, polycarbonates (PC), but make up between 40 to 60% of the content of epoxy resin before adding the 2-component hardener. Ready hardened epoxy contains between 30 to 40% Bisphenols. The most commonly used Bisphenol is Bisphenol A (BPA).

Regarding BPA polluting the environment, it seems like the research has been concentrated around polycarbonates (PC). It also seems that the available research also has been concentrated around BPA as a free chemical in already hardened plastics.

Scientific research on the effect that PC and BPA has on the environment, nature and climate has been and still is a vast field in both volume and complexity, that also span across several fields of theme and competence. To get the overview of all these effects and contexts is an almost impossible task. Maybe this complexity has been a cover for the industry to expand this much under this kind of cover.

It is therefore of high importance to take the precautionary principle into all activities and regulations.

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The fact that BPA enter the food chain is relatively new knowledge

It's first in recent years, science and research has concluded that epoxy plastics ends up un the digestive system of marine and aquatic species like algae, schrimps, shellfish, molluscs, fisk, ampfibians, mammals, and also land based microbes, insects and animals. This causes BPA introduced into and accumulated up through the food chain through their digestive systems.

“Recently, the environmental obesogen hypothesis, suggesting that environmental chemicals contribute to development of metabolic disorders in humans, including obesity, insulin resistance, type 2 diabetes, hepatic injury, dyslipidemia and cardiovascular diseases, is gaining weight

*In this context, the implementation of greater restrictions on the use of these substances in the products of daily use and the conduction of future studies to (i) identify other substances with potentially similar effects on animals and human health and (ii) investigate the mechanisms behind should be given particular consideration”.*¹⁹

Even if the inflicted harm from BPA is well documented, it seems that we still do not have the full knowledge of the total impact on health and the environment.²⁰

In all cases, it seems like epoxy plastics and compounds might act as a Trojan Horse of significant dimensions in the environment with its harmful load. This might impose severe implications for all nature, environment, climate and all earthly life itself.

In the following list we have included some of the references relevant to the subject at hand. This is only a partial list as there is much more research to be found on the various subjects within the scientific system of publications.

¹⁹ <https://pubmed.ncbi.nlm.nih.gov/27504873/>

²⁰ https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_m etabolic_syndrome_and_breast_cancer_A_review

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We know that:

1. **A long range of epoxy related products is exposed to erosion which release micro and nano particles from epoxyplastics into the environment.** The most significant sources stem from the auto industry, shipping and boat industry and from the wind power industry.^{21 22 23 24}
2. **We do not have a thorough collected overview on the total amount of epoxy related micro and nano sized particles** released into the environment within Europe, but we can clearly estimate the amount to be in the several hundred tons range, as it is **estimated from car lacquer/coating at 225 tons in 2013.**²⁵
3. **Car tires and polycarbonates (PC) do also contain BPA**^{26 27}. There is significant amounts of micro and nano sized particles released into the environment.
4. **The production of wind turbine wings are among those with the highest consumption of epoxy plastics.** In 2013, 27% (69 000 tons) of all epoxy resin went to this production, and the production and use within this segment has undergone a significant increase since then. It's further estimated that a significant increase also will come in the coming years.²⁸
5. **Yearly global production of BPA is more than 10 million tonnes, and a significant increase is expected in the coming years.**²⁹
6. **Our water sources, waterways and oceans are all contaminated with high levels of BPA and related chemicals and micro and nano sized particles of epoxyplastics.**^{30 31}
7. **Epoxyplastics are made with Bisphenols, mainly with BPA, which make up approximately between 30-40 % of the total product by weight.**^{32 33}

²¹ <https://www.sciencedaily.com/releases/2010/03/100323184607.htm>

²² https://www.researchgate.net/publication/330151272_Temporal_and_Spatial_Distributions_of_Bisphenol_A_in_Marine_and_Freshwaters_in_Turkey

²³ https://www.researchgate.net/publication/319683370_Brain_damage_and_behavioural_disorders_in_fish_induced_by_plastic_nanoparticles_delivered_through_the_food_chain

²⁴ https://www.researchgate.net/publication/343209522_Leading_edge_erosion_of_wind_turbines_Effect_of_solid_airborne_particles_and_rain_on_operational_wind_farms

²⁵ https://epoxy-europe.eu/wp-content/uploads/2015/07/epoxy_erc_bpa_whitepapers_automotive-2.pdf

²⁶ https://www.researchgate.net/publication/343184657_Car_Tire_Crumb_Rubber_Does_Leaching_Produce_a_Toxic_Chemical_Cocktail_in_Coastal_Marine_Systems

²⁷ https://en.wikipedia.org/wiki/Bisphenol_A

²⁸ https://epoxy-europe.eu/wp-content/uploads/2018/11/Epoxy_Socioeconomic_Study_Main_Findings_August-2017.pdf

²⁹ https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_metabolic_syndrome_and_breast_cancer_A_review

³⁰ <https://www.miljodirektoratet.no/globalassets/publikasjoner/M176/M176.pdf>

³¹ https://www.researchgate.net/publication/330151272_Temporal_and_Spatial_Distributions_of_Bisphenol_A_in_Marine_and_Freshwaters_in_Turkey

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8. **BPA and similar chemicals are very harmful for all life**, including algae, fish, invertebrates and vertebrates when introduced through their digestive systems. It is considered carcinogenic, reduces the reproductive abilities, reduces weight, may cause brain damage, cause metabolic syndrome, cause insuline resistance and more. ^{34 35 36 37 38 39}
9. **Nanoplastics can penetrate the blood-brain barrier** in fish and cause altered behavior. ⁴⁰
10. **Most of the chemicals in the Bisphenol group are hazardous and have different impacts on the environment, food chain and health** ^{41 42}
11. **BPA and epoxyplastics (nano- and micro sized particles) are accumulated up through the food chain**, from phytoplankton and zooplankton and up to large fish, mammals and humans. ⁴³
12. **Epoxyplastics will release its harmful chemical compounds when introduced to the digestive system of marine- and landbased species in all levels through the food chain.** This is the main cause why micro and nano sized particles can be of more environmental harm than the same chemicals in its pure form. ⁴⁴
13. **Epoxy is broken down through hydrolysis - ie in an environment that is acidic, wet and hot such as in the gastrointestinal tract of mammals.** *"An increase in temperature or a pH change can cause the ester bonds between the BPA molecules in polycarbonate plastic and epoxy resin to be broken through hydrolysis and thus release BPA to the environment".* ^{45 46}

³² https://epoxy-europe.eu/wp-content/uploads/2015/07/epoxy_erc_bpa_whitepapers_automotive-2.pdf

³³ https://www.epoxy-europe.eu/wp-content/uploads/2015/07/epoxy_erc_bpa_whitepapers_wind-energy-2.pdf

³⁴ https://www.researchgate.net/publication/320630432_Bisphenol_A_in_eggs_causes_development-specific_liver_molecular_reprogramming_in_two_generations_of_rainbow_trout/fulltext/59f37f8ca6fdcc075ec349ab/Bisphenol-A-in-eggs-causes-development-specific-liver-molecular-reprogramming-in-two-generations-of-rainbow-trout.pdf?origin=publication_detail

³⁵ <https://forskning.no/kjemi-miljogifter-hjernen/bisfenol-a-kan-skade-nyfodte-hjerner/743277>

³⁶ <https://www.sciencedirect.com/science/article/abs/pii/S0300483X11003453>

³⁷ https://www.researchgate.net/publication/319683370_Brain_damage_and_behavioural_disorders_in_fish_induced_by_plastic_nanoparticles_delivered_through_the_food_chain

³⁸ <https://www.sciencedaily.com/releases/2010/03/100323184607.htm>

³⁹ https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_m_etabolic_syndrome_and_breast_cancer_A_review

⁴⁰ https://www.researchgate.net/publication/319683370_Brain_damage_and_behavioural_disorders_in_fish_induced_by_plastic_nanoparticles_delivered_through_the_food_chain

⁴¹ <https://www.miljodirektoratet.no/globalassets/publikasjoner/M176/M176.pdf>

⁴² https://www.researchgate.net/publication/343184657_Car_Tire_Crumb_Rubber_Does_Leaching_Produce_a_Toxic_Chemical_Cocktail_in_Coastal_Marine_Systems

⁴³ <https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6772-4.pdf?pid=20662>

⁴⁴ https://www.researchgate.net/publication/319683370_Brain_damage_and_behavioural_disorders_in_fish_induced_by_plastic_nanoparticles_delivered_through_the_food_chain

⁴⁵ <https://bora.uib.no/bora-xmlui/handle/1956/21135>

⁴⁶ https://www.researchgate.net/publication/306184402_Human_exposure_to_endocrine_disrupting_compounds_Their_role_in_reproductive_systems_m_etabolic_syndrome_and_breast_cancer_A_review

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14. **The degradation period of epoxy and epoxy related materials in nature can be very long**, if we disregard the time its reacting to the chemicals in the digestive systems in organisms. This is of significant concern, as it is both accumulated into the environment and its chemical package is accumulated up through the food chain. ^{47 48}
15. **UV-based filtrations systems doesn't degrade epoxyplastics**, and thus, BPA contained inside particles of epoxy will likely remain undamaged throughout the filtration process in facilities for purification- and drinking water.
16. **When the 2-component process is finished, not all the initial BPA is hardened** and will remain inside the material in its pure form. This might be small amounts but it is still a major concern due to the Trojan Horse Principle mentioned above.
17. **BPA has a relative long degradation period in water**, especially in salty sea water at temperatures sub 25 degrees Celsius. This is a significant concern given that the northern parts of Europe and Scandinavia has even lower temperatures than that, especially during the autumn and winter season. In an arctic and sub arctic climate very low temperatures will be present most of the year, which may give a more severe negative impact on the environment than in more tempered parts of Europe. ⁴⁹
18. **It may also be of concern that micro and nano sized particles from all corners of the earth may find its way to the same areas, so it is also important that countries and regions outside Europe implement stricter regulations as well.** ⁵⁰

⁴⁷ <https://www.sciencedaily.com/releases/2010/03/100323184607.htm>

⁴⁸ <https://diegofdezsevilla.wordpress.com/2014/07/17/could-plastic-debris-coarse-fine-and-molecules-polymers-affect-oceans-functions-as-climate-regulator-co2-sink-albedo-evaporation/>

⁴⁹ https://www.researchgate.net/publication/334505340_Degradation_of_Bisphenol_A_in_Natural_and_Artificial_Marine_and_Freshwaters_in_Turkey

⁵⁰ <https://pubs.acs.org/doi/10.1021/acs.est.7b03889>

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Little seems to have been done on research on the combined context between the release of micro and nano sized particles of epoxyplastics to the environment and the total effects this has on the environment, food chain and on human health. Much of the research seems to be focused on either the chemical in its pure form itself, or on the particles separately. We need therefore to address more of the scientific research on the combined effects and on the effects caused by the Trojan Horse Principle.

Can micro sized plastics and BPA affect the climate?

How much of the illness and extermination within the plantbased and animal kingdom is caused by the release of micro and nano sized particles of epoxy plastics containing BPA and other harmful chemicals?

“So, could plastic polymers interfere with the biota involved in fixing CO₂ in our oceans? And if so, what kind of impact could we expect from a disturbance in the correct performance of this biota?”

“Even though I have not found any research aiming to look at the effect of polymers over the oceanic biota responsible of fixing CO₂ and the consequent impact in the environment, there are studies showing the connections between the aquatic chemistry of seas and the biota such as temperature and acidification, which give us an idea about the impact we can expect if polymers affect Carbonate fixing biota.”

“Lead researcher Dr Thomas Mock points out that Phytoplankton, including micro-algae, are responsible for half of the carbon dioxide that is naturally removed from the atmosphere. As well as being vital to climate control, it also creates enough oxygen for every other breath we take, and forms the base of the food chain for fisheries so it is incredibly important for food security.”

⁵¹

What if those micro and nanosized particles from epoxyplastics do hurt plankton and microbes on such a scale that it impacts the very ability of the phytoplankton to capture CO₂ and produce oxygen? The same question can also be asked regarding earthbased microbes that is essential for the quality of the very soil the plants is reliant on to grow and capture carbon from the atmosphere? Less natural oxygen production and carbon capture will impact us all? ⁵²

⁵¹ <https://diegofdezsevilla.wordpress.com/2014/07/17/could-plastic-debris-coarse-fine-and-molecules-polymers-affect-oceans-functions-as-climate-regulator-co2-sink-albedo-evaporation/>

⁵² <https://diegofdezsevilla.wordpress.com/2014/07/17/could-plastic-debris-coarse-fine-and-molecules-polymers-affect-oceans-functions-as-climate-regulator-co2-sink-albedo-evaporation/>

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Coastal and offshore based wind power may be a significant contributor of micro and nano sized particles to the environment through leading edge erosion (LEE)

The problem with the spread of toxic compounds through micro/nanoparticles from offshore wind farms is a far more significant risk in arctic and sub-arctic areas than what we experience further south in the North-Sea basin. The reason being due to a much harsher and more unstable weather conditions combined with lower temperatures and much more sub-zero conditions throughout the year. Another factor that significantly contributes to this in a more negative way is the fact that it is expected that more of the sites of offshore wind farms will be in deep waters. All these factors will contribute severely to a negative direction regarding Wind turbine blade leading edge erosion (LEE), where distance, availability and complexity of maintenance operations will unquestionably lead to longer maintenance cycles and more toxic LEE to the environment.

Even in the shallow waters in the southern parts of the North-Sea basin, the maintenance and replacing eroded and damaged wind turbine blades is an overly complex and costly operation that demands rigorous planning. There they mostly use special vessels mounted on the seabed which allow them to operate in a much wider range of weather conditions than what can be possible in deep water areas. Here we must expect the maintenance vessel and operation to be far more dependent on a narrow set of weather conditions to be present for a maintenance operation. It is therefore highly likely that offshore wind farms in the northern parts of the North Sea and further north through Sub-Arctic and Arctic parts of the ocean will have much longer intervals between maintenance, which again will lead to an exponential increase in the amounts of micro/nano-sized particles containing Bisphenol types of toxic chemicals to the environment and ecosystems.

In the northern parts outside coastal Norway there is also an added risk due to the very unpredictable Arctic low-pressure weather systems that are so difficult predict and that can arise to violent winds in a short timeframe.

A turbine blade in normal operation on land can reach speeds of 300 km/h and more. With offshore wind turbines it is estimated bigger and higher-powered wind generators and longer wind turbine blades than we have on land. Therefore, wind turbine blades will much likely operate at speeds exceeding 300 km/h more of the time. This will significantly also increase LEE from impact against airborne particles from salt, rain, and hail. More sub-zero temperature days will enhance the level of erosion even further. Another factor of concern is that there is no way to have an independent or timely independent monitoring of LEE in an offshore environment, and all monitoring must therefore rely totally upon the same companies that is economically invested in the project. This is also due to the availability of the construction itself which is out of reach from all outside monitoring. This raises a significant concern for the uncontrollable release of significant amounts of toxic micro- and nanosized particles to the environment and to the fragile marine ecosystems.

A further concern is that the amount of erosion from the wind turbine blades is exponential as a partially eroded blade release more particles than a new blade. We have also seen that large parts of the coating breaks up and fall off. Deep water wind farms will due to availability, complexity and cost of maintenance operations most likely have far longer periods between when turbine blades is replaced as there for each operator is to base upon purely economic considerations rather than environmental. This is also a very significant concern that should impact the idea and implementation of offshore wind farms in general and deep-sea wind farms especially as they will be a significant contributor of toxic micro-

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and nanosized particles with high content of Bisphenol type of chemicals to the marine environment and to the fragile marine ecosystems we all depend upon. The Ocean is one of our and humanities most important food supplies, we have already put severely stress upon its many intricate and fragile mechanisms and ecosystems.

The UN Goals of Sustainable development

The UN Goals of Sustainable development is signed by a majority of the earths countries and raises the concerns for our water resources, waterways and our marine ecosystems. It is equally as important as, if not more, than our concern for climate change. Without a clean ocean, waterways and marine environment, all humanity is at risk. Introducing new and significant sources of micro/nanoparticles and toxins to our waterways and oceans inevitably lead to the fall of the civilizations inhabiting this planet. UN Goal 6 of Sustainable development concerns our drinking water and Goal 14 concerns Life Below Water. ^{53 54}

⁵³ <https://www.un.org/sustainabledevelopment/oceans/>

⁵⁴ <https://www.un.org/sustainabledevelopment/water-and-sanitation/>

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The correlation between finds in research and the many unanswered questions raise several concerns

Many of the most relevant questions remain unanswered by the current scientific research. Many finds raise several questions on the volume and speed we introduce these chemicals in their pure chemical form and in combination with micro and nano sized particles introduced and accumulated in the environment. The concerns raised on this issue is in most part in way it may affect different parts of the ecosystem and how it affects it in the totality combined with other environmental pollutants and impacts. We must as responsible humans take our direction and way forward based on a precautionary principle. If we don't, we may well be responsible for very severe and unforeseen consequences that we as humans are equally as dependent on as our fellow beings and organisms. A collapse within the very fragile ecosystems can affect us back several times. We need to implement very strict regulations on the production, sale, use and decommissioning of parts and materials containing BPA and other harmful chemicals and micro and nano sized particles of epoxy- and other plastic related materials. They do accumulate in the environment and we must prevent at all cost that we enter the point of no-return. After all, much of the impact we cause on the environment regarding micro and nano sized particles are accumulated and its impact may also be irreversible.

The biggest sources of such pollutants must be regulated first, and less harmful replacements must be incentivized for the industries involved. Furthermore, a circular economy must reduce the environmental impact. As it stands today, the wind farm industry as one of the largest polluters of micro and nano sized particles containing BPA and other harmful chemicals do fail on most and all of these factors.

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The revised 2020/2184/EC Directive still doesn't comply to the recommendations set by the WHO

As of closing, we like to point out that 98/83/EC Directive on the quality of water intended for human consumption is replaced by 2020/2184/EC.⁵⁵ In the revised version, stricter regulations on BPA and plastics has been implemented. ECHA must take these into its work towards new regulations and standards.

However, it seems that the allowed values set in Directive 2020/2184/EC for BPA at 2,5 µg/l, and its allowed margin of error at 50 % on measurements in water for human consumption doesn't satisfy the recommended values set by the WHO. The margin of error set by the WHO as of 2017 is set at 0,1 µg/l.

In other words, Directive 2020/2184/EC do allow values that is 37,5 times higher than recommended by the WHO. ECHA has still a long way to go regarding the allowed values of BPA in water for human consumption before the recommendations set by the WHO can be met.

Request for action

We do hope that the concerns we have raised in this document can lead to better, more strict set of rules and regulations that aim at a better and more environmentally friendly use of BPA and similar hazardous chemicals and their use in epoxy- and plastic based chemicals. Our own future depends upon our own actions. We need better regulations now.

With green regards,
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⁵⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020L2184&from=EN>

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