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NANOMATERIALES: ESTADO DE SITUACIÓN
EN BOLIVIA Y LATINOAMÉRICA
Modalidad: Virtual
Fechas: 3 y 4 de diciembre

Socio-economic and environmental implications of nanotechnologies

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Workshop: Nanomateriales. Estado de Situación en Bolivia y Latinoamérica. 03-04 Dic., 2020

CONTENT *

1. Health and Environmental Risks

2. Nanotechnology and Employment

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3. Twenty years from the U.S. National Nanotechnology Initiative with a lack of Regulation in nano

4. Main social & environmental nanotechnology indebted issues to society

* Only main implications (not considering legal, surveillance, capital concentration, S&T, etc.

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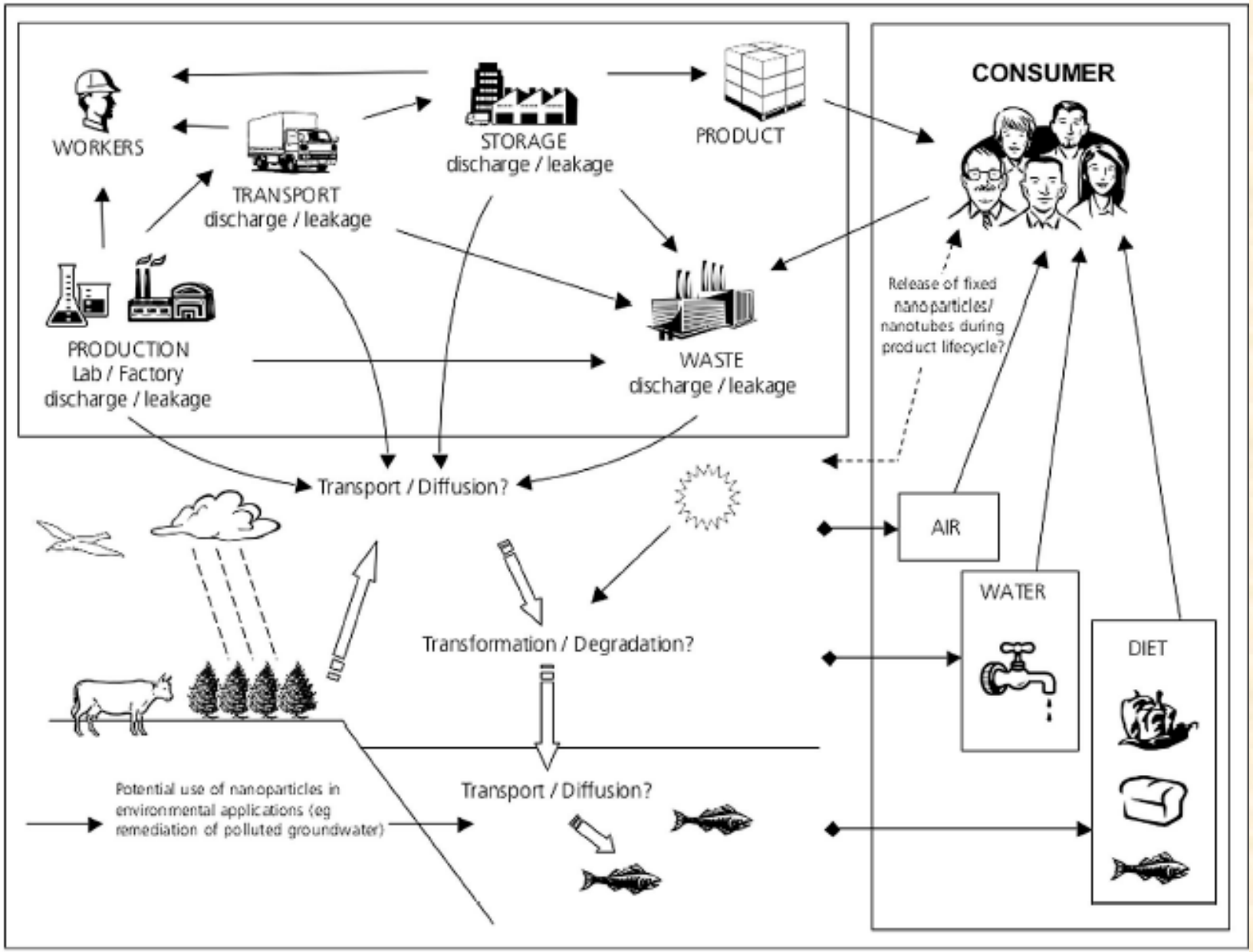
Human risks associated with nanoparticles

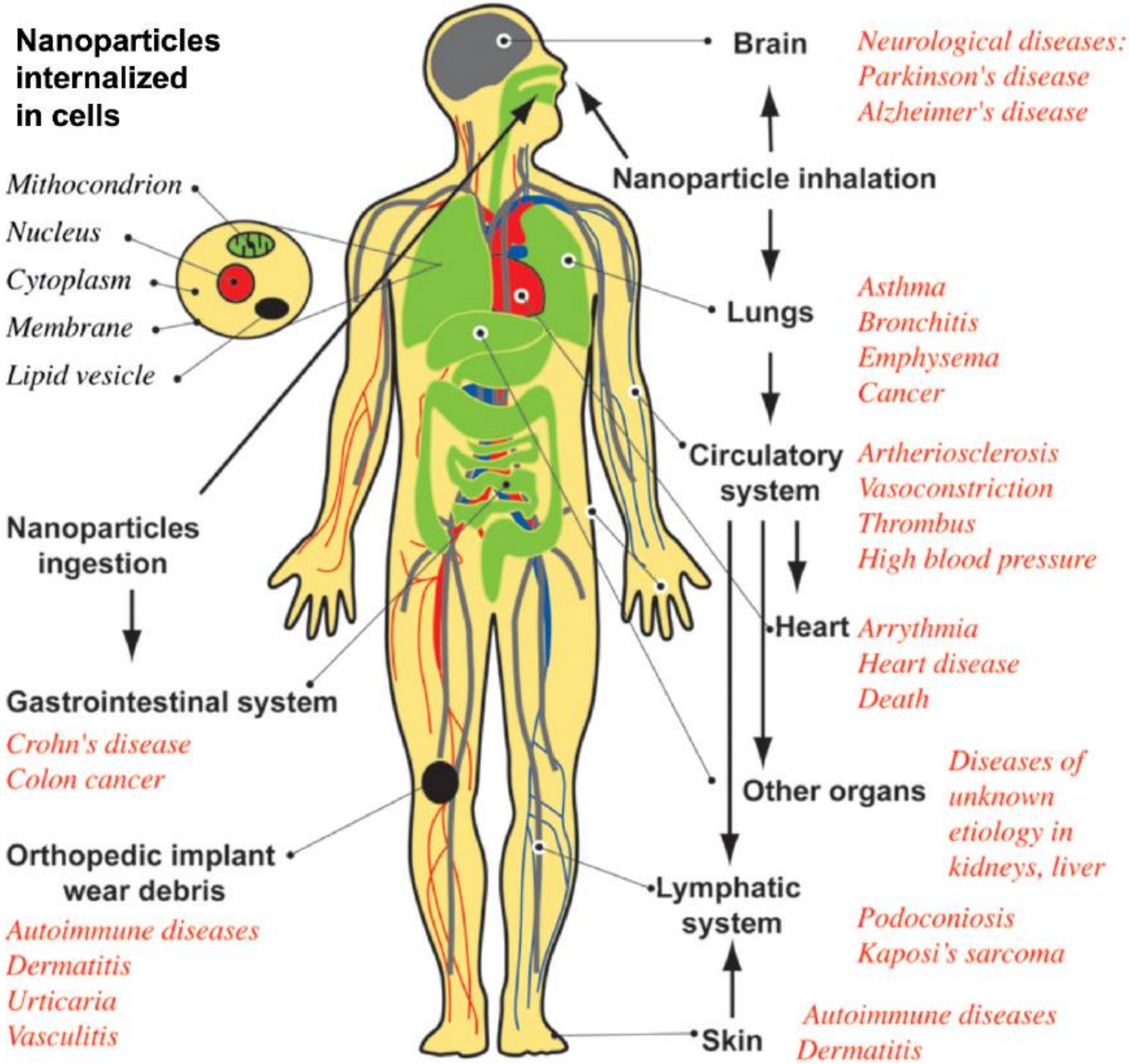
- **Nanoparticles** can reach, adhere and penetrate cells, organs, tissues, etc., with ***disease consequences*** (e.g. mitochondrial damage, DNA mutations and cell apoptosis/death; including heart diseases, cancers, and even death).
- Only ***few toxicity assays*** have been conducted on them
- Swedish non-profit organization *ChemSec* included ***Carbon Nano Tubes*** in the SIN list, believing they ***should be banned in the EU*** (https://chemsec.org/sin-list/) [S. F. Hansen and A. Lennquist, *Nat. Nanotechnol*. **15**, 3–4; 2020)]

Exposure of workers and consumers to engineered nanoparticles



Royal Society & Royal Academy of Engineering. (2004). *Nanoscience and nanotechnologies: Opportunities and uncertainties*. Royal Society : Royal Academy of Engineering.
Pag. 37

Diseases associated with nanoparticles exposure



Tan, K. X., Barhoum, A., Pan, S., & Danquah, M. K. (2018). Risks and toxicity of nanoparticles and nanostructured materials. In A. S. H. Makhlouf & A. Barhoum (Eds.), *Emerging applications of nanoparticles and architectural nanostructures: Current prospects and future trends* (pp. 121–139). Elsevier. Pag. 123

Table 5.1 Various Toxicity Assessments Conducted on Different Types of NPs

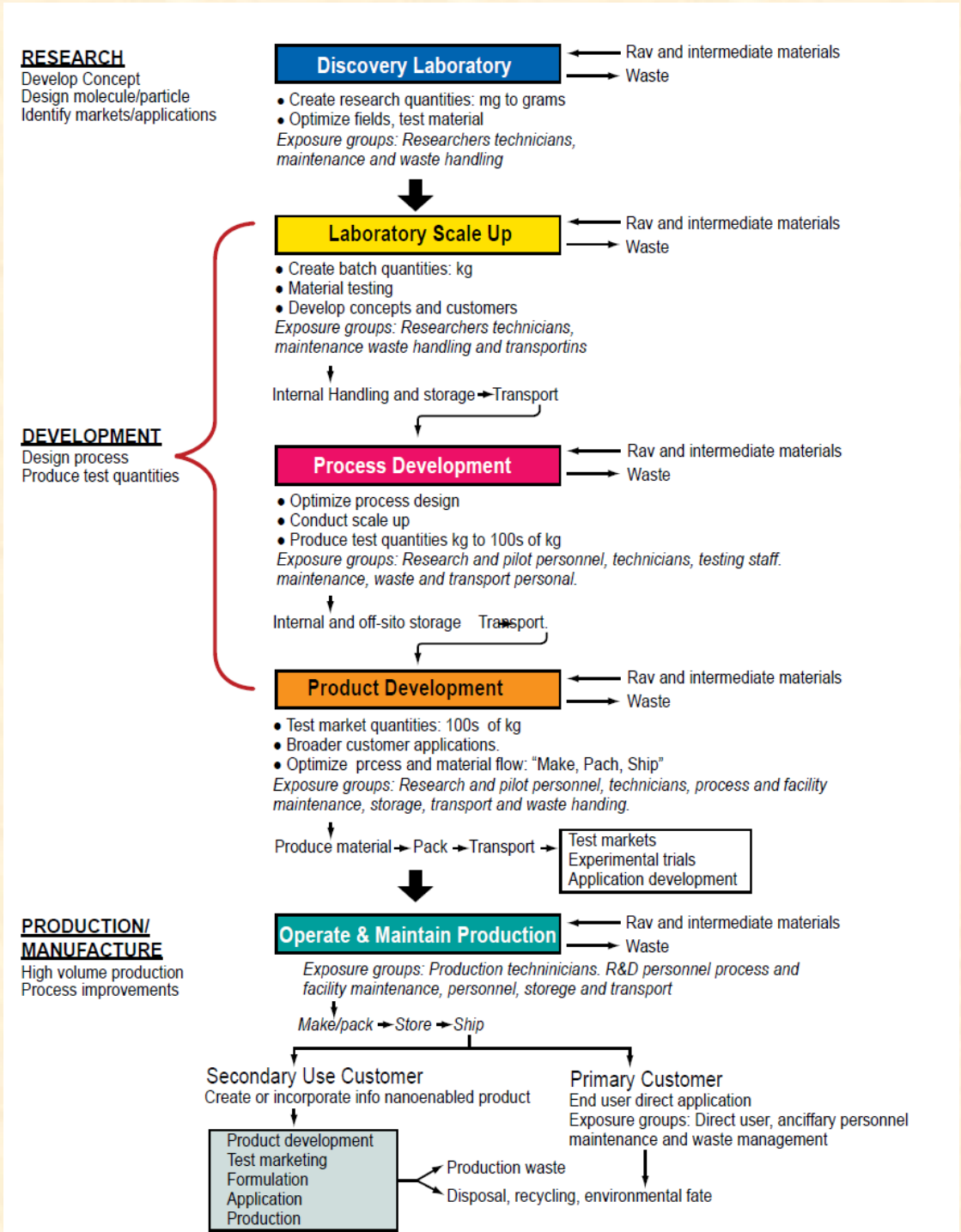
Type of NPs	Toxicity Assay	Cell Line/Species	Assessment Outcome	References
Zinc oxide	ELISA and flow cytometry	Human colon carcinoma cells	1. Reduced cell viability 2. Induced oxidative stress 3. Presence of inflammatory biomarkers	[13]
Zinc oxide	MTT and comet micronucleus test	Human hepatocytes cell line (HEK 293)	1. Reduced cell viability 2. Elevated oxidative stress 3. DNA and mitochondrial damage	[14]
Iron oxide	MTT	Human hepatocytes carcinoma cells	Reduced cell viability	[15]
Copper oxide	MTT and lactate dehydrogenase	Human lung epithelial cells	1. Elevated lactate dehydrogenase 2. Reduced cell viability 3. Enhanced lipid peroxidation	[16]
Aluminum oxide	MTT	Human mesenchymal stem cells (HMSC)	Reduced cell viability	[17]
Aluminum oxide	MTT and DHE	Human brain micro vascular endothelial cells (HBMVECs)	1. Reduced cell viability 2. Elevated oxidative stress 3. Mitochondrial dysfunction 4. Altered proteins expression of blood-brain barrier	[18]
Silver	Lactate dehydrogenase and WST-1	Human leukemia cells	1. Elevated lactate dehydrogenase 2. Reduced cell viability	[19]
Silver	MTT and DCFH-DA	Human alveolar cells	1. Elevated reactive oxidative stress 2. Reduced cell viability	[20]
Single-walled carbon nanotube	Commercial kits	In vivo	Elevated lactate dehydrogenase, aspartate transaminase, and alanine transaminase	[21]

Table 5.1 Various Toxicity Assessments Conducted on Different Types of NPs *(Cont.)*

Type of NPs	Toxicity Assay	Cell Line/Species	Assessment Outcome	References
Single-walled carbon nanotube	Clonogenic	Human alveolar carcinoma epithelial cells (HACECs) and normal human bronchial epithelial cells (NHBECs)	Cell death	[22]
Silica	DCFH-DA and commercial kit	Human bronchoalveolar carcinoma cells	1. Elevated reactive oxidative stress 2. Increased lactate dehydrogenase 3. Elevated malondialdehyde	[23]

DCFH-DA, *Dichloro-dihydro-flourescein diacetate;* DHE, *dihydroethidium;* ELISA, *enzyme-linked immunosorbent assay;* MTT, *3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide;* WST-1, *water soluble tetrazolium salt-1.*

Tan, K. X., Barhoum, A., Pan, S., & Danquah, M. K. (2018). Risks and toxicity of nanoparticles and nanostructured materials. In A. S. H. Makhlouf & A. Barhoum (Eds.), *Emerging applications of nanoparticles and architectural nanostructures: Current prospects and future trends* (pp. 121–139). Elsevier. Pag. 125



Al phases of workplaces with potential for occupational exposure to NP

Schulte, P., Geraci, C., Zumwalde, R., Hoover, M., & Kuempel, E. (2008). Occupational risk management of engineered nanoparticles. *Journal of Occupational and Environmental Hygiene*, *5*(4), 239–249. https://doi.org/10.1080/15459620801907840

Nanoparticles & the Environment

1. Impact of nanoparticles **in the environment**
   - How do they change?
   - Where do they go?

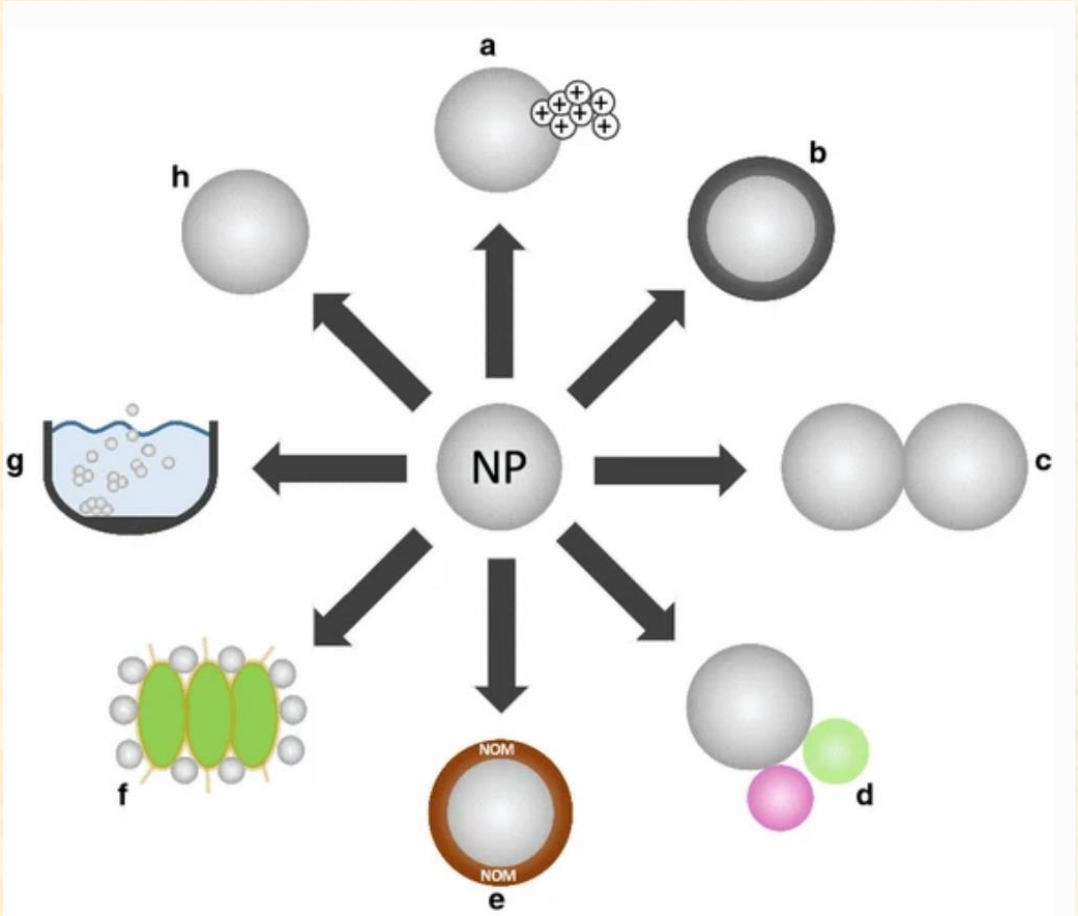
2. Impact of nanoparticles **in the environment & human interface**
   - How do changes in nanoparticles within the environment end up affecting human health?

1. Impact of nanoparticles in the environment

Alterations in ***chemical speciation***, ***dissolution***, ***degradation***, as well as ***alteration of the surface properties by precipitation and ad- or desorption*** are important chemical transformation processes of NP, which have frequently been investigated both in **aquatic and soil ecosystems**

Bundschuh, M., Filser, J., Lüderwald, S., McKee, M. S., Metreveli, G., Schaumann, G. E., Schulz, R., & Wagner, S. (2018). Nanoparticles in the environment: Where do we come from, where do we go to? *Environmental Sciences Europe*, *30*(1), 6. https://doi.org/10.1186/s12302-018-0132-6

Chemical changes in NP in the environment



Bundschuh, M., Filser, J., Lüderwald, S., McKee, M. S., Metreveli, G., Schaumann, G. E., Schulz, R., & Wagner, S. (2018). Nanoparticles in the environment: Where do we come from, where do we go to? *Environmental Sciences Europe*, *30*(1), 6. https://doi.org/10.1186/s12302-018-0132-6

Interactions and fate of NP in the environment considering
(a) dissolution,
(b) sulfidation,
(c) homo-aggregation,
(d) hetero-aggregation,
(e) coating with NOM,
(f) NP adsorption on bio. surfaces,
(g) sedimentation/deposition,
(h) persistence

2. Impact of NP in the environment & human interface: Example of nanosilver

"There is a significant difference between how cells react when exposed to nanosilver alone and when they are exposed to a cocktail of nanosilver and cadmium ions. Cadmium ions are naturally found everywhere on Earth.

The study was conducted on human liver cancer cells. In the study, 72 percent of the cells died when exposed to both nanosilver and cadmium ions. When exposed to nanosilver only, 25 percent died. When exposed to cadmium ions only, 12 percent died".

Miranda, R. R., Gorshkov, V., Korzeniowska, B., Kempf, S. J., Neto, F. F., & Kjeldsen, F. (2018). Co-exposure to silver nanoparticles and cadmium induce metabolic adaptation in HepG2 cells. *Nanotoxicology*, *12*(7), 781–795. https://doi.org/10.1080/17435390.2018.1489987

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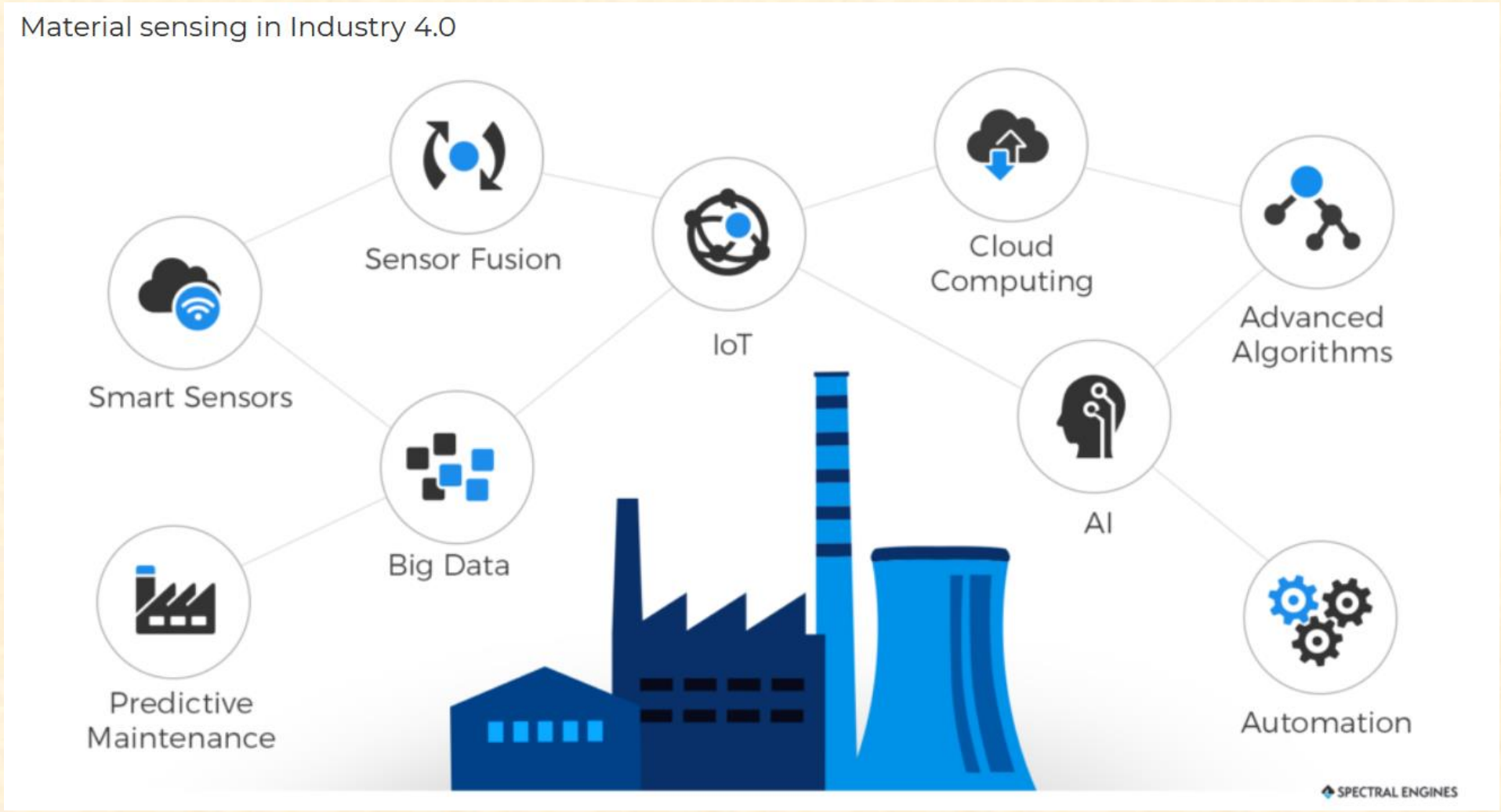
Nano in all Industry 4.0 process (e.g. nano sensors, Nems)



Spectral. (2018, February 26). *Industry 4.0 and how smart sensors make the difference*. https://www.spectralengines.com/articles/industry-4-0-and-how-smart-sensors-make-the-difference

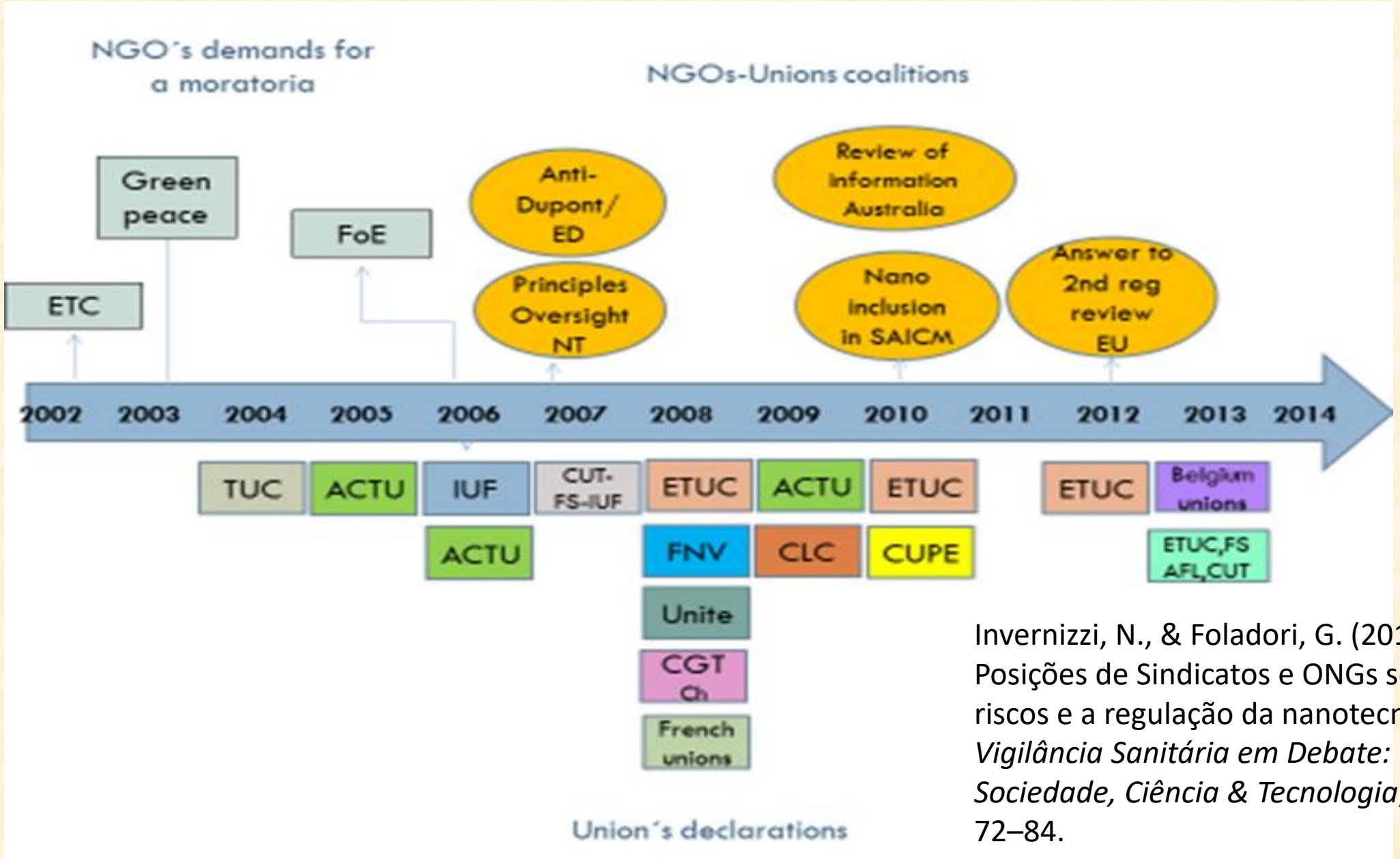
Consequences of nano in all economic sectors

- Demand for new qualifications and skillsets for labour resources
- Increse in unemployment
- Increase in underemployment and precarious jobs
- Loose of labor power bargaining and legal protection due to non-standard working forms

¡Although this always happens with new tech.; policy measures should reduce damages, and scientists must alert!

GÖRMÜŞ, A. (2020). Future of work in Industry 4.0. In *International Congress on Social Sciences (INCSOS 2019) Proceeding Book* (pp. 317–323). Sageya Yayincilik.

ONGs and Trade Unions demands for regulation



Invernizzi, N., & Foladori, G. (2013). Posições de Sindicatos e ONGs sobre os riscos e a regulação da nanotecnologia. *Vigilância Sanitária em Debate: Sociedade, Ciência & Tecnologia*, *1*(4), 72–84.

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Governance in nanotechnologies

- The concept of ***governance*** includes 2 different type of standards and regulations

  - Juridic regulation -mandatory (hard law)

  - Non binding standards -voluntary (soft law)

Mandatory Regulation in Nanotechnologies

- Europe
- USA
- Others ...

EU Binding regulation

- Cosmetics. 2009 Regulation (EC) No 1223/2009
  - Registration 6 months in advance of marketing
  - List of ingredients and toxicological and exposition characteristics
  - Labelling (NANO + list of ingredients)
- Food. 2011 Regulation (EU) No 1169/2011
  - Idem cosmetics
- Biocides 2012. Regulation (EU)
  - Previous autorization
  - Major details of ingredients and toxic issues
  - Labelling

Some European Countries with mandatory registration of companies

Regulation

National reporting schemes

International activities

ECHA's activities on nanomaterials under REACH and CLP

The Biocidal Products Regulation (BPR) and nanomaterials

Food

National reporting schemes

Several Member States have taken national initiatives to request more information on nanomaterials from industry. These national regulations vary in scope, but also in terms of what information is actually requested from companies.

National initiative	Registrants	Main exceptions	Information requirements	Reporting
France: Notification Scheme - National Decree for Mandatory Reporting of Nanomaterials	Manufacturers or importers of nanomaterials (on their own or included in a mixture or another material) in quantities of 100 g/year or above.	The amount manufactured, imported or distributed is less than 100 g/year;	Identity of the company, of the nanomaterial (including physico-chemical data) and available info on (eco)toxicological properties.	1 May (from 2013 onwards)

Belgium: Registry - Royal Decree on the placing on the market of substances manufactured in the nanoparticle form	Manufacturer, importers and distributors that put nanomaterials on the Belgian market in quantities of > 100 g/year. It will be expanded to also include mixtures at a later state.	Volume trigger of 100 g/year. Nanomaterials used as pigments are exempted.	Company's identity; Physico-chemical properties; Quantity; Uses; Identity of professional purchasers and users.	1 January (from 2015 onwards)
Denmark: Product Registry - Order on the Register of Mixtures and Products Containing Nanomaterials	Manufacturers or importers of mixtures and articles containing nanomaterials intended to be put on the Danish market. The EU Recommendation for a	Food and food contacting materials, feed, medicines, cosmetic products, pesticides, waste, pigments and inks,	Company's identity; Product information (including name, quantity; professional uses, applications); Information on	30 August (from 2015 onwards)

Norway: Product Registry – Order on mandatory declaration of chemicals to the national product registry	General requirement to report on chemicals that are manufactured/imported which has introduced specific obligation for nanomaterials. The EU Recommendation for a nanomaterial is used.	Nanomaterials manufactured for export, welding powders, food, feed and pharma.	Information that is already known by the producer/manufacturer should be reported. In addition, the function fulfilled by the nanomaterial should be reported.	Obligatory from March 2013 onwards
Sweden: Product Registry	Manufacturers or importers of mixtures containing nanomaterials intended to be put on the Swedish market.			Entry into force on 1 January 2018. Ref: Kemikalieinspektionens foreskrifter (KIFS) 2017:7

Germany, on the way …

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NEWS

Print Version

German minister backs register for nano-products

ENDS Europe

Thursday 3 February 2011

An advisory body to the German government has issued preliminary guidelines for assessing nano-products' risks and benefits. It is divided on the need for a register of such products but Norbert Roettgen backed the idea.

The environment minister was referring to the need for a registry at EU level, an idea championed by Belgium during its presidency of the union in the second half of 2010. Germany-based Oeko Institute welcomed Mr Roettgen's support for an EU register.

Related Content

German retailers oppose tax on drinks packaging 10 Feb 2011

Access to biomaterials still an issue – CEFIC 10 Feb 2011

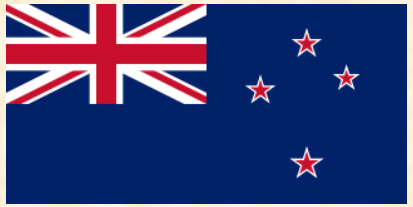
EU states to adopt ecolabel criteria for detergents 8 Feb 2011

EU chemicals agency facing challenges ahead 7 Feb 2011

EU advised to keep limit for cadmium in food 4 Feb 2011

Environment ministers meet in Luxembourg

The ministers discussed the draft EU ship recycling regulation on 25 October



New Zealand

Labelling of Cosmetics

Environmental Protection Authority Application to Amend the Cosmetic Products Group Standard 2006. , ERMA200782 (2012). Retrieved from http://www.epa.govt.nz/search-databases/HSNO%20Application%20Register%20Documents/ERMA200782_ERMA200782%20Decision%20(28.06.2012).pdf

Regulation U.S.

- **Environmnet Protection Agency (2 laws regarding nano)**
  - **TSCA** Toxic Substance Control Act
    - Nano is "New Substance"
    - SNUR Significant new use rules. 90 days/pre-market registry
    - Only includes production/use of more than 10 tons/year
  - **FIFRA** Federal Insecticide Fungicide and Rodenticide Act. Pre-market registration
- **FDA**. [Voluntary guides for industry]
- **Department of Commerce** [Voluntary guides for international agreements]
- **Department of Labor.** Occupational Safety and Health Administration. [Volutary guides]

Voluntary standards and guides

- U.N. Organizations
- ISO
- SAICM (Strategic Approach to International Chemicals Management)
- …

Governance in nanotechnology in Latin America

NO mandatory regulation in any Latin American country

Some attempts in Brazil, Argentina ...

- *PL 880/2019—Senado Federal*. (n.d.). Retrieved November 2, 2020, from https://www25.senado.leg.br/web/atividade/materias/-/materia/135353

ISO (voluntary guides) Nanotechnology in Latin America

- Brasil, ABNT (Associação Brasileira de Normas Técnicas)
- Argentina, IRAM (Instiuto Argentino de Normalización y Certificación
- Colombia, ICONTEC (Instituto Colombiano de Normas Técnicas y Certificación)
- México, CENAM (Centro Nacional de Metrología)
- Peru, INACAL (Instituto Nacional de Calidad)

Foladori, G. (2017). Occupational and environmental safety standards in nanotechnology: International Organization for Standardization, Latin America and beyond. *The Economic and Labour Relations Review*, *28*(4), 538–554. https://doi.org/10.1177/1035304617719802

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Principles for the Oversight of Nanotechnologies and Nanomaterials

1. A Precautionary Foundation
2. Mandatory Nano-specifi c Regulations
3. Health and Safety of the Public and Workers
4. Environmental Protection
5. Transparency
6. Public Participation
7. Inclusion of Broader Impacts
8. Manufacturer Liability

NanoAction. (2007). *Principles for the Oversight of Nanotechnologies and Nanomaterials*. International Center for Technology Assessment. www.icta.org/files/2012/04/080112_ICTA_rev1.pdf

¡Thank you for your attention!

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ReLANS

Red Latinoamericana de Nanotecnología y Sociedad

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