

Contra Costa County – Hazardous Materials Commission

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Gabriele Windgasse, Dr.PH

Chief, Site Assessment Section
Environmental Health Investigations Branch
California Department of Public Health

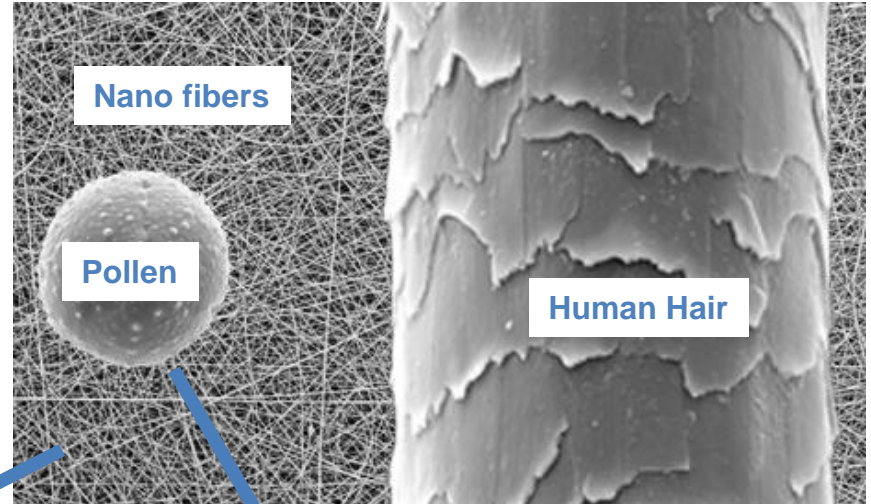
Engineered Nanomaterials and Public Health

- The Nano Scale
- ENM in the US and CCC
- Product Lifecycle
- Biological Effects/Toxicity
- Regulatory landscape
- Data Gaps and Uncertainties
- Summary and Opportunities

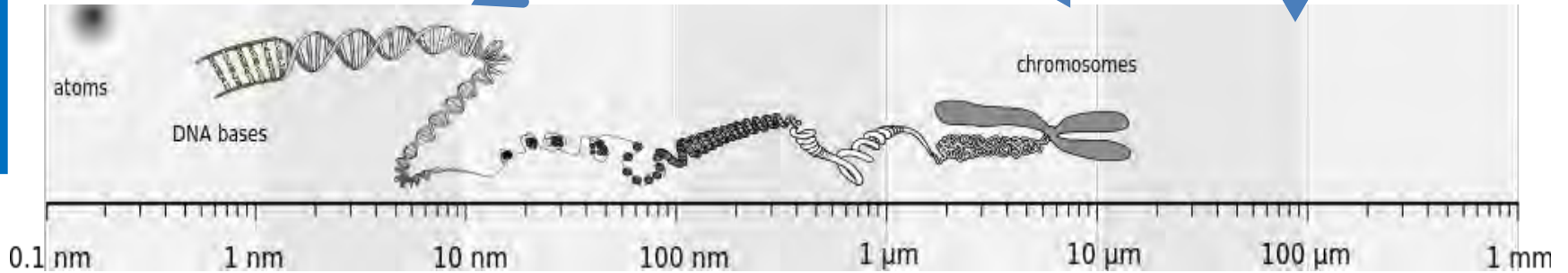


The Nano Scale

Nano Materials (Ultrafine PM: < 100 nm)		
Naturally occurring	Incidental	Engineered
ocean spray friction erosion	combustion laser printers welding fumes	designed properties/ functions



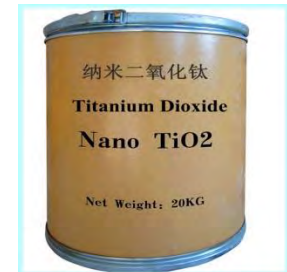
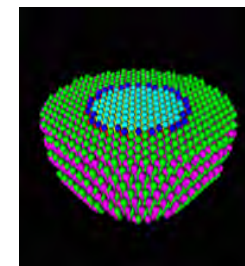
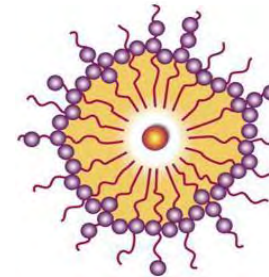
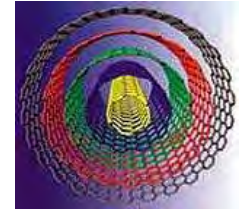
www.elmarco.com



← nano range →

ENM: Unique Properties...due to Quantum Effects

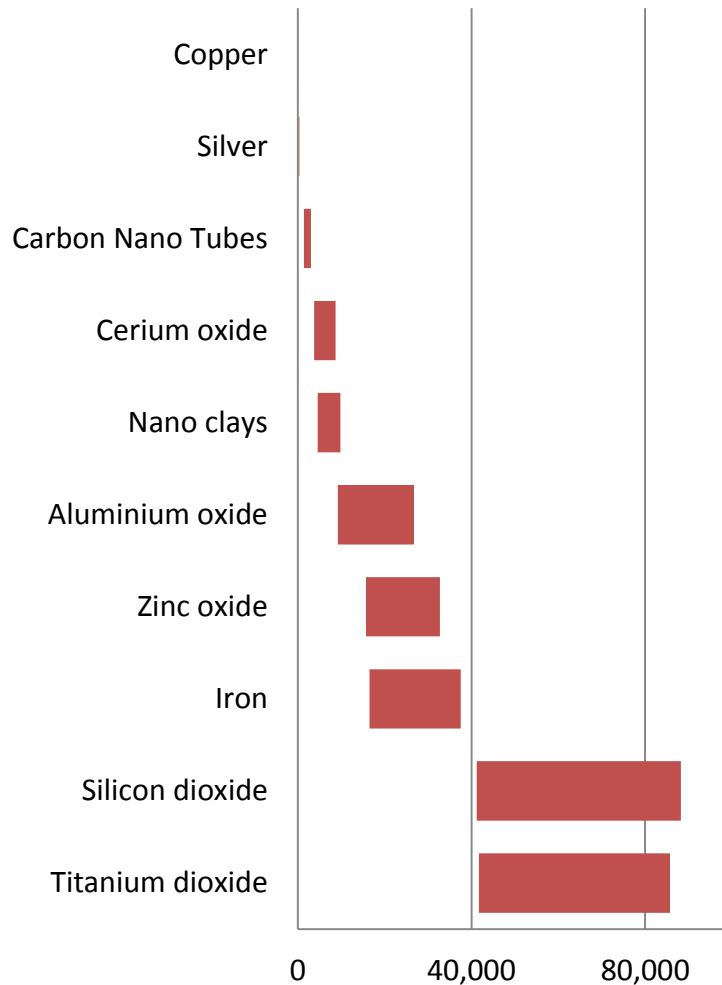
- **Nano properties \neq macro properties**
- **Surface area / gram**
(VERY large!)
- **Size, size distribution**
- **Shape**
(tubes, rods, wires, spheres, sheets,...)
- **Composition**
(organic, metal, hybrid)
- **Surface modification**
(charge, hydrophilic, lipophilic, magnetic,...)
- **Agglomeration**
- **Protein corona**



... leading to amazing applications of ENMs, including public health applications!
We all want the benefits of this technology..... but not the unintended consequences.

Engineered Nano Materials in the US (estimates!)

Nano materials produced in US
(metric tons/yr, 2010, low and high estimates)



US: 50% of world-wide production US
Total production is in US:
134,000 – 158,000 tons/yr

Major uses

> **1600 consumer products**
> **487 construction products**

- Coatings, paints, pigments (textiles)
- Personal care products
- Electronics, optics
- Energy, environment
- Catalysts
- Automotive
- Medical

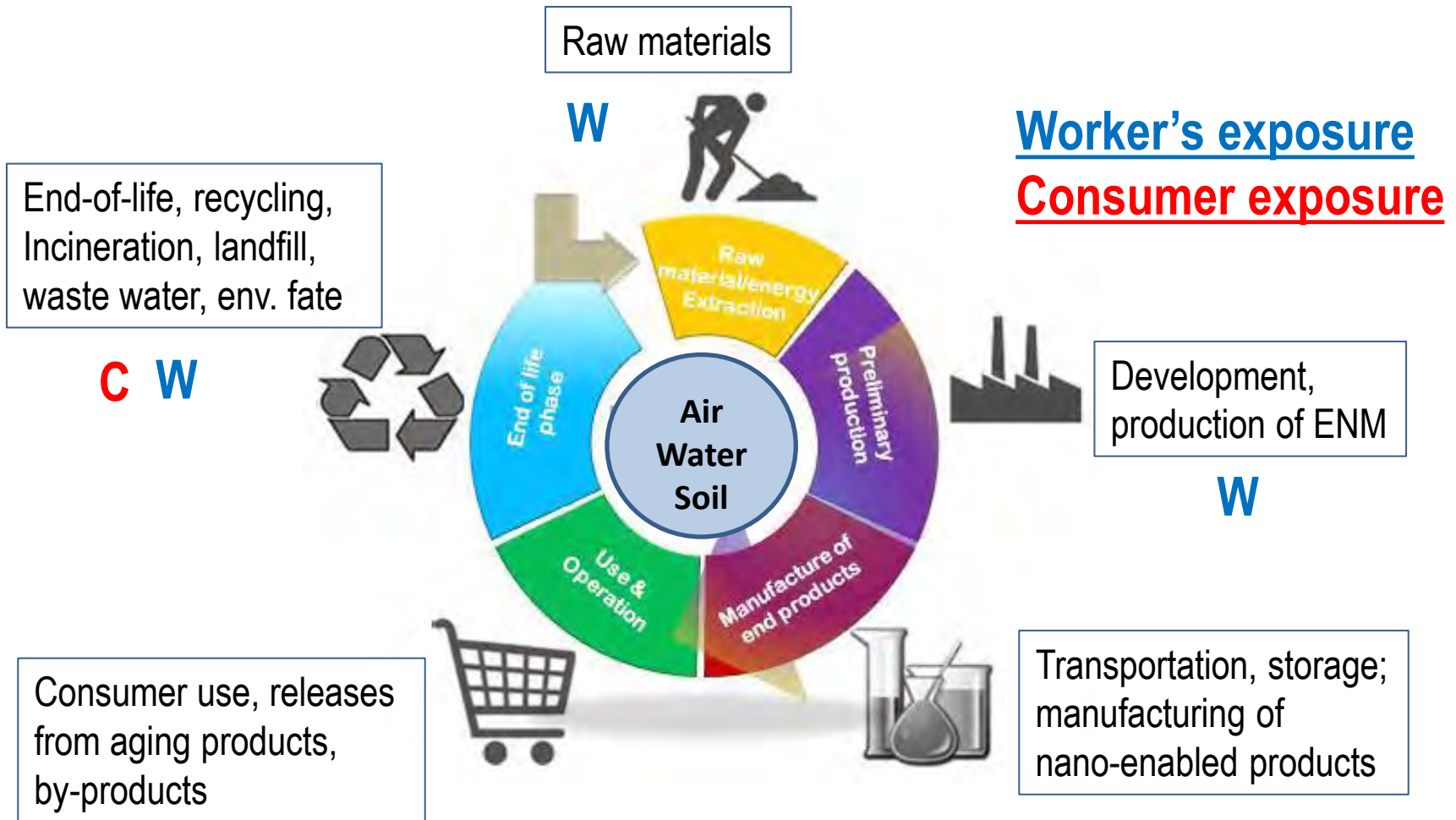
Sources:

A Keller, A. Lazareva, ES&T Lett, 2014, 1, 65-70

<http://www.nanotechproject.org/>

<http://www.nano.elcosh.org>

Product Lifecycle



C Exposures to humans & releases into the environment:
UNKNOWN!

Accidental Release

Source: Nowack et al, Env. Sciences Europe, 2014, 26:2

Nano TiO₂ spill, France, 2011
Each bag 1500 lb of nano TiO₂



ENM: Observed Biological Effects

- **Local**

Absorption through membranes, accumulation in lung

- **Systemic**

Translocation, blood-brain barrier, placenta, reproductive effects

- **Acute**

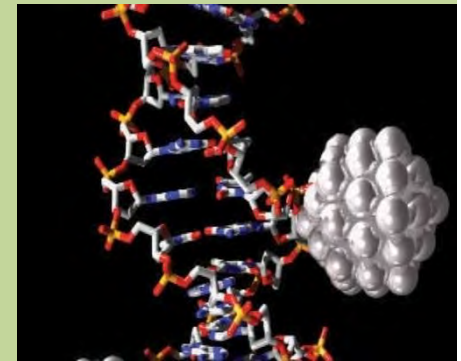
Reactive Oxygen Species, inflammation, mutations

- **Chronic**

Animal studies: fibrosis (CNT); asbestos-like effects, possibly carcinogenic to humans (IARC – 2B); lung tumors (TiO₂); in vitro: transformation of lung cells

ENM: Difficulties in Assessing Toxicity

- Nano toxicity \neq macro toxicity
- Few standard methods
- Dose metrics (NOT mg/kg bodyweight):
reactivity, surface area, particle number, ...?
- Appropriate toxic endpoints?
- Impurities, endotoxins in commercial ENM
- Poor reproducibility of published research
- Lack of published negative data
- ID worker cohorts?
- ID Sensitive Subpopulations?



Regulatory Landscape

No legal framework specific to nano-scale materials

- Feds **regulate by product**: chemicals, consumer products, pesticides, foods, drugs, medical devices, cosmetics, hazardous waste, etc.
- **Definitions** do not differentiate between nano- and “regular” chemicals.
- Example of federal law: **Toxic Substances Control Act**
Update on Reporting Rules (5/12/2017)?
- Local level? Worker’s RtK? Community RtK?

Berkeley’s “Manufactured
Nanoscale Materials Health
and Safety Disclosure
Ordinance” (BNO)
2006

NIOSH Guidance:

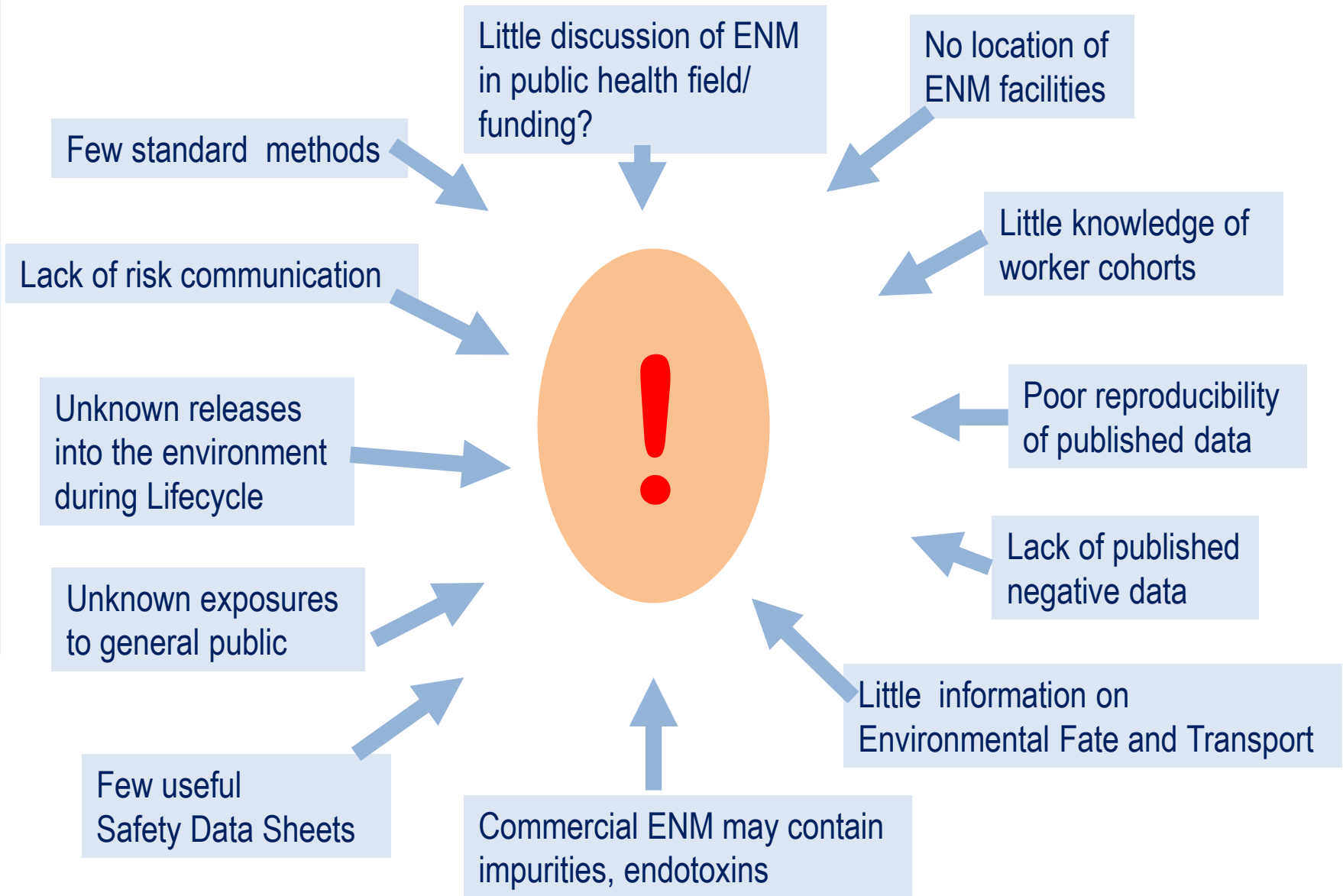
REL nano TiO₂: 300 µg/m³ (potential occ. carcinogen)

REL CNT/CNF: 1 µg/m³ (effects similar to asbestos)

(REL: Recommended Exposure Limit)

DoE: Registry for nano workers (DoE O 456.1)

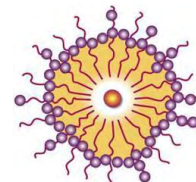
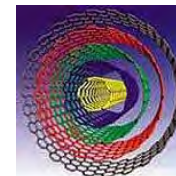
ENM: Data gaps and uncertainties !



Summary and Opportunities

- Great potential for beneficial uses!
- Large gaps in data, knowledge, infrastructure, especially toxicology, environmental fate
- Increasing number of products
- Unknown exposures to consumers and workers
- Unknown releases into the environment

Unknown consequences for Public Health



Opportunities for local activities:

- Identify local facilities and exposed populations
- Prepare locally (emergency response, Workers RtK, Community RtK)
- Communicate with public

Thank you!

Contact: Gabriele.Windgasse@cdph.ca.gov



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ENM Resources

- Nano EHS: Communities of Research : www.us-eu.org
- National Nanotechnology Initiative: www.nano.gov
- NIOSH: <http://www.cdc.gov/niosh/topics/nanotech/>
- NIOSH - eLCOSH nano (Construction Materials): <http://nano.elcosh.org/>
- NIOSH: Good NanoGuide: <https://nanohub.org/groups/gng>
- USEPA: <http://www.epa.gov/chemical-research/research-evaluating-nanomaterials-chemical-safety>
- USEPA Exposure Assessment Tool:
<http://www.epa.gov/expobox/exposure-assessment-tools-chemical-classes-nanomaterials>
- NIH: <http://www.nih.gov/research-training/nanotechnology-nih>
- Woodrow Wilson Center: www.nanotechproject.org/
- Nanomaterial Registry: <https://www.nanomaterialregistry.org/>
- Denmark: <http://nanodb.dk/en/>
- France: <https://www.r-nano.fr/?locale=en>
- EU: <http://www.nanosafetycluster.eu/> and <http://www.nanopartikel.info/en/>
- Literature Checklist: <http://www.nanopartikel.info/en/nanoinfo/methods/991-literature-criteria-checklist>

