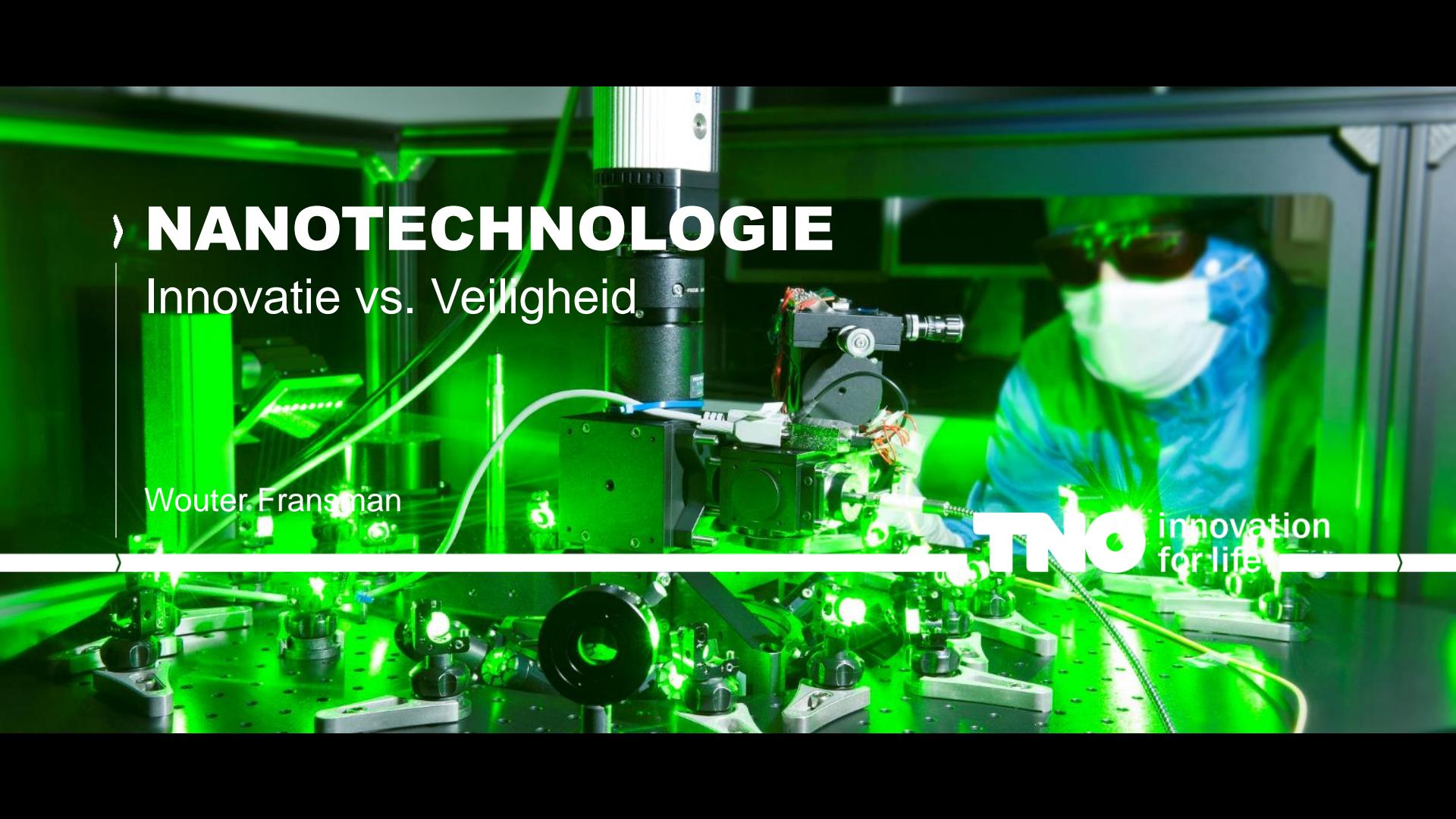


NANOTECHNOLOGIE

Innovatie vs. Veiligheid

Wouter Fransman

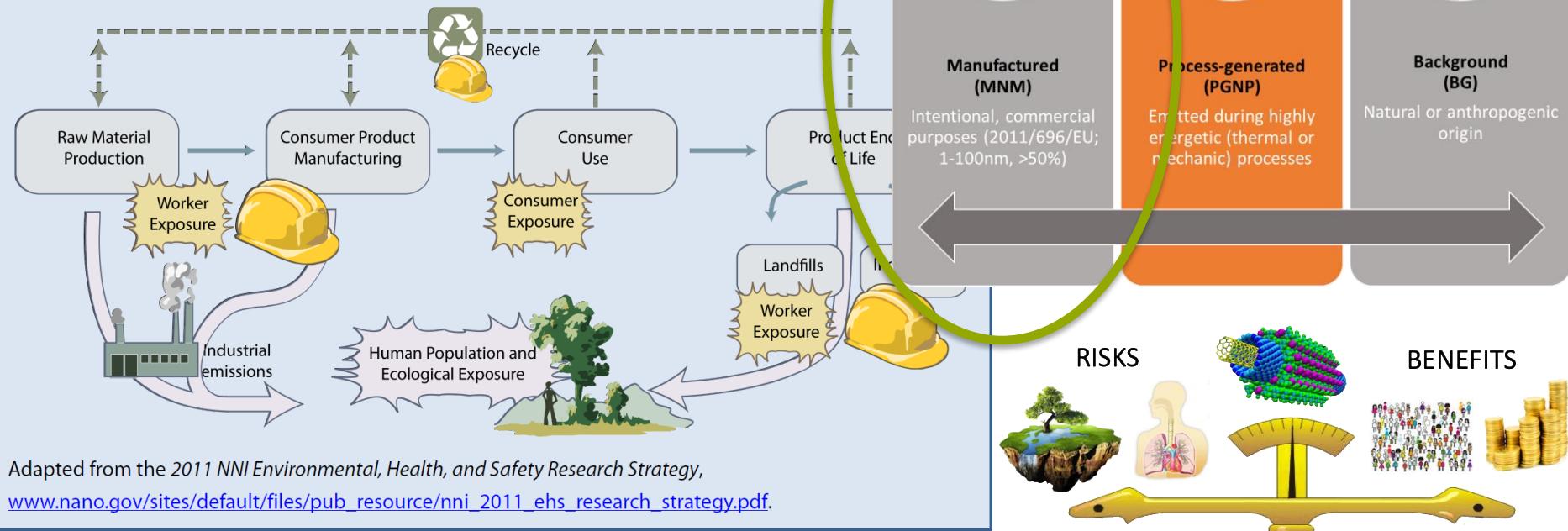
TNO innovation
for life



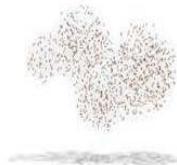
INLEIDING

Engineered Nanomaterial and Nanotechnology-Enabled Product Life Cycle Considerations

Human and environmental exposures to ENMs can occur at all life cycle stages of an NEP.



INLEIDING



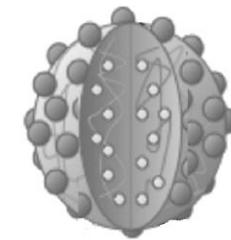
Synthesis of
material



Handling
powders



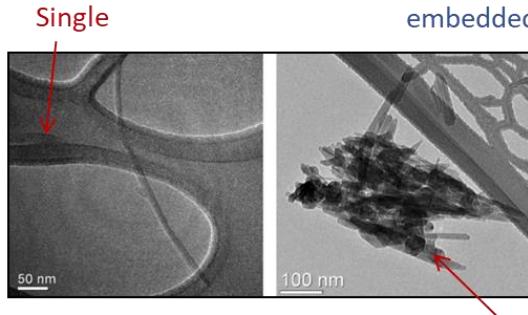
Application of
dispersions



End of life of enabled
products

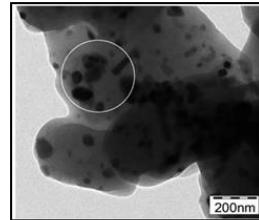
INLEIDING

Released ENM
≠
Pristine ENM

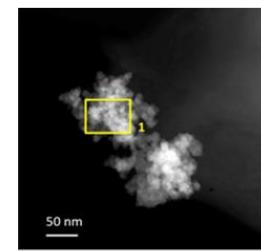


CNTs from an epoxy-based
nanocomposite⁴

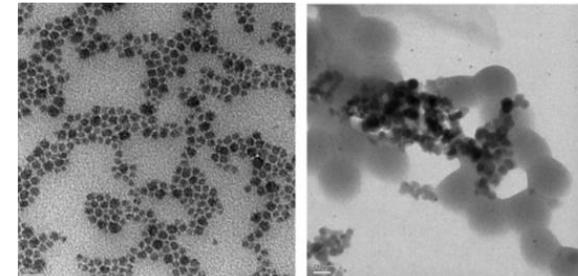
Aggregated within the
polymer



Wear from a **steel panel** with
embedded ZnO NPs¹

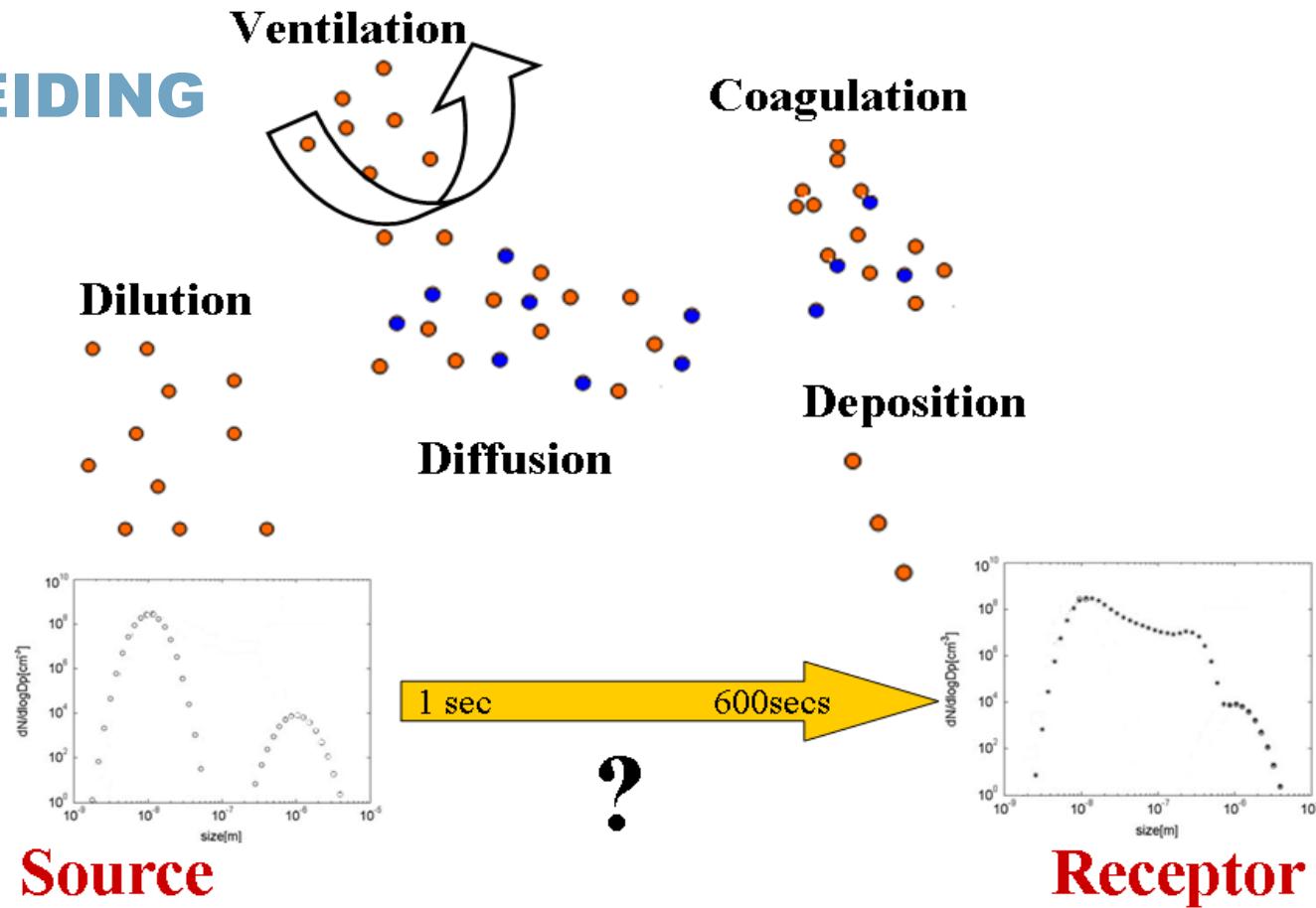


SiO₂ NPs in leaching
liquids from **paints**³



Washing solution (**textiles**)
containing Ag NPs²

INLEIDING



MODEL ONTWIKKELING

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The collage illustrates the development of models for nanomaterials across different sectors:

- Stoffenmanager Nano module 1.0:** A screenshot of a web-based tool for assessing occupational health risks from inhalation exposure.
- NanoSafer Control Banding Report Airborne Occupational Exposure Assessment:** A screenshot of a report template for exposure assessment.
- GUIDE nano:** A conceptual diagram showing the relationship between (Nano)materials, Exposure, and Populations.
- SUNDs:** A screenshot of a platform for environmental assessments, featuring a sun icon and EU flags.
- www.consexponano.nl:** A screenshot of a website for nanosafety, including a bar chart titled "Update 2016".
- LiCARA nanoSCAN:** A logo for a scanning electron microscopy service.
- Benefits:** A central concept represented by three green boxes: Environmental, Economic, and Societal.
- Risks:** A central concept represented by three red boxes: Public health & environmental, Occupational health, and Consumer health.
- Public health & environmental:** A screenshot of a software interface for environmental risk assessment.
- Occupational health:** A screenshot of a software interface for occupational health risk assessment.
- Consumer health:** A screenshot of a software interface for consumer health risk assessment.
- FUTURE NANO NEEDS:** A screenshot of a platform for nanosafety, featuring a sun icon and a complex network diagram.
- BBN Shredding Model:** A screenshot of a computational model for predicting nanoparticle release during shredding.

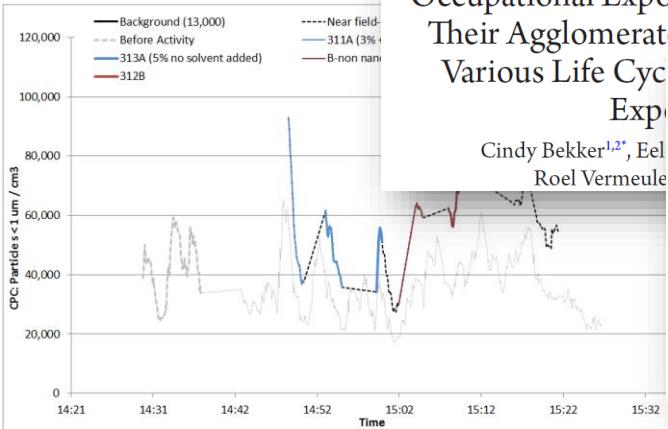
BLOOTSTELLING METEN



Ann. Occup. Hyg., 2015, Vol. 59, No. 6, 681–704
doi:10.1093/annhyg/mew023
Advance Access publication 6 April 2015

Occupational Exposure to Nano-Objects at Their Agglomerates and Aggregates Across Various Life Cycles

Cindy Bekker^{1,2*}, Eel
Roel Vermeulen



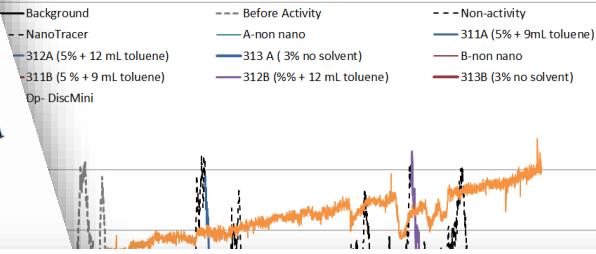
Ann. Occup. Hyg., 2016, Vol. 60, No. 9, 1039–1048
doi:10.1093/annhyg/mew448
Advance Access publication 16 September 2016

The Validity and Applicability of Using a Generic Exposure Assessment Model for Occupational Exposure to Nano-Objects and Their Agglomerates and Aggregates

BOHS
The Chartered Society for Worker Health Protection

JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE
2017, VOL. 14, NO. 5, 349–359
<http://dx.doi.org/10.1080/10545962.2016.1252843>

Taylor & Francis
Taylor & Francis Group



Understanding workers' exposure: Systematic review and data-analysis of emission potential for NOOA

E. Kuijpers^a, C. Bekker^{a,b}, D. Brouwer^{a,c}, M. le Feber^a, and W. Fransman^a
TNO Toxix, The Netherlands; Institute for Risk Assessment Sciences (IRAS), Molecular Epidemiology and Risk Assessment Utrecht, Utrecht, The Netherlands; University of the Witwatersrand Johannesburg, RSA, Johannesburg, South Africa

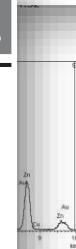
Annals of Work Exposures and Health, 2017, Vol. 61, No. 1, 98–109
doi: 10.1093/aweh/wwx013
Original Article

BOHS
The Chartered Society for Worker Health Protection
OXFORD

Original Article

Assessment of Determinants of Emission Potentially Affecting the Concentration of Airborne Nano-Objects and Their Agglomerates and Aggregates

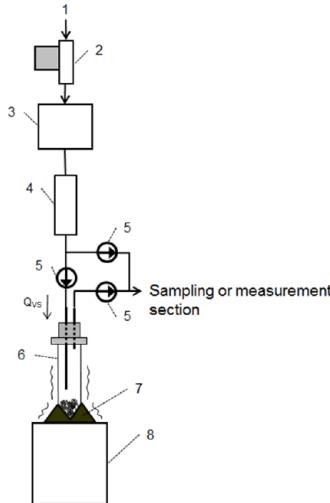
Cindy Bekker^{1,2*}, Wouter Fransman², Ruud Boessen², Arné Oerlemans³, Ilse B. Ottenbos¹ and Roel Vermeulen¹



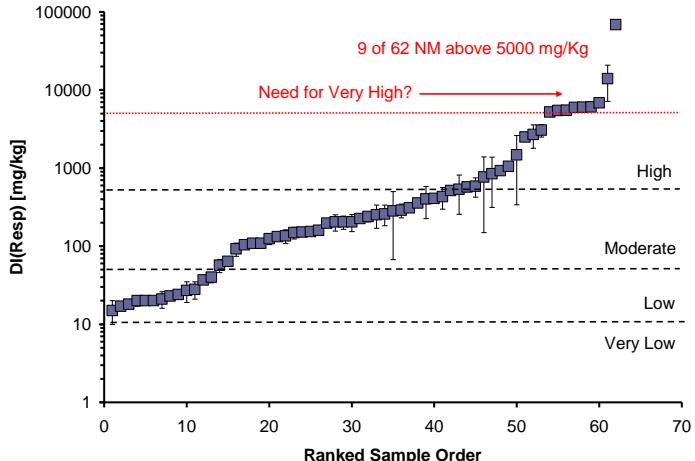
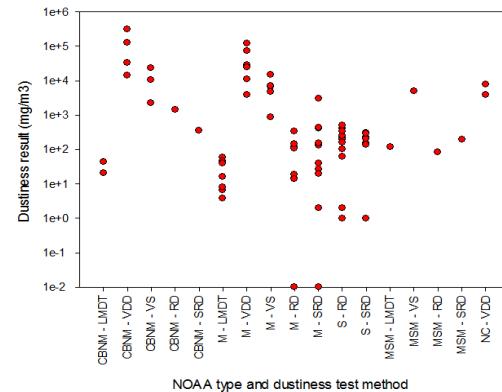
EMISSION METRICATION



Stoffigheidstesten
➤ 5 CEN standards



Overview dustiness results



DATABASE ONTWIKKELING EN HARMONISATIE

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Nano
Exposure &
Contextual
Information
Database

Sample information

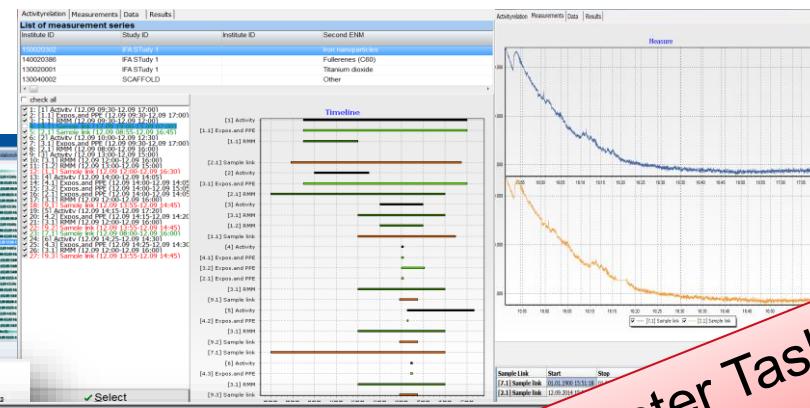
Measurement

Protocol (PDF)

Timeline

Data Exchange

Export (Excel)



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IN OCCUPATIONAL SAFETY AND HEALTH
www.necid.eu

MARINA

GUIDE^{nano}

Please select search criteria from the available options below

Select Scenario Type: Occupational

Engineered Manufacture NM: Titanium dioxide

Contributing Exposure Scenario: Transfer of powders

Lifecycle Stage: Transfer of powders

Source Domain:

Search Clear

Your search returned 1 results:

Packing Of TiO2

Contributing Exposure Scenario: Transfer of powders

NIOSH Used: Titanium dioxide

Life Cycle Stage: Manufacture or processing

Abstract: Summary of contributing exposure scenarios of bulk manufactured nanomaterial powders

Contributing Exposure Scenario ID: 355

Download Contributing Exposure Scenario PDF | Download Overall Exposure Scenario PDF

IOM Research Institute for Occupational Medicine

GUIDE^{nano} (Project funded by the European Union's Seventh Framework Programme)
Grant Agreement No: 604367

IOM | Research Avenue North, Riccarton, Edinburgh, EH14 4AP, United Kingdom

EU NanoSafetyCluster Task Force
Publicly Accessible Exposure Database

Section 2: Contributing Exposure Scenarios for Uses of Substances By Workers

Time: Packing Of TiO2

Name of the contributing scenario: Transfer of powders

Activity Class: Movement and agitation of powders or granules

Task Description: 1. Weigh the TiO2 nanoparticle powder; 2. Dispense and package the TiO2 nanoparticle powder into plastic bags.

Chemical composition: Titanium dioxide

Type of Product: Not apply (free NOAAs)

Weight Fraction:

Quality of the exposure scenario data:

Confidential information: High

Measurement data: Medium

NOAA and substance characteristics: NOAA1

Type of substance:

Name of the NOAA used:

EAS Registration number:

Physical state of the NOAA:

Primary particle size (mean diameter) (nm):

Mean particle size (90% particle size) (nm):

Shape of the NOAA:

Surface area of the NOAA (m² g⁻¹):

Density of the NOAA (kg m⁻³):

Type of density:

Surface emission potential of the NOAA:

Concentration of NOAA:

Activity emission potential:

Describe the activity in terms of the energy applied:

Very high

High

Not apply (free NOAAs)

Very high

100 kJ

**NanoSafety
Cluster**

GUIDE^{nano}

› CEN TC137 WG3 Workplace exposure Particulate matter

› Ontwikkeling van 8 European standards

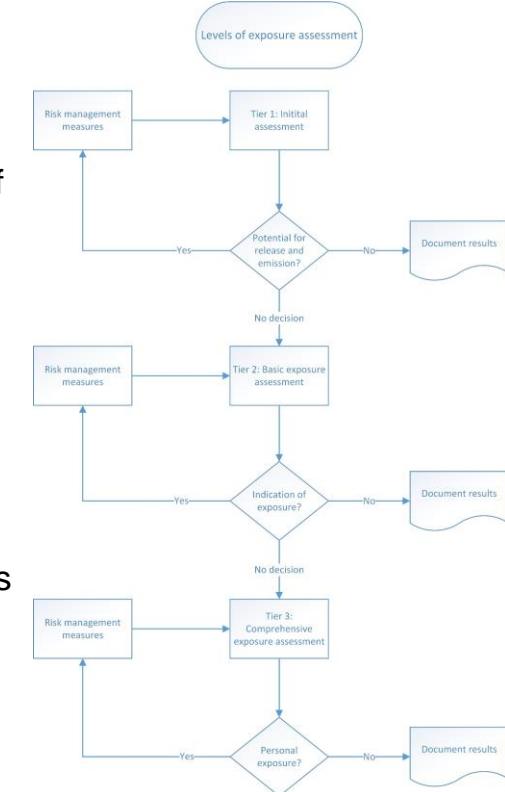
- › Characterization of ultrafine aerosols/nanoaerosols – Determination of number concentration using condensation particle counters
- › Assessment of exposure by inhalation of nano-objects and their agglomerates and aggregates
- › Metrics to be used for the measurement of exposure by inhalation of nano-objects and their agglomerates and aggregates such as number concentration, surface area concentration and mass concentration
- › 5 dustiness standards

› WG 6 Dermal exposure

- › Development of 1 TS: Assessment of dermal exposure to nano-objects and their aggregates and agglomerates (NOAA)

› CEN TC352 Nanotechnology

› Collaboration with ISO TC229, OECD



RISICO-BEHEERSING



You are signed in as wouter.tramman@tno.nl
Sign out Change password

TNO innovation for life

DATABASE BACKGROUND FORUM

Exposure Control Efficacy Library

Industry	risk management strategy	task	substance	route	study	efficacy
RMM	Not specified; personal enclosure / separation	Spraying	Cation	Inhalation Cross-sectional (a-posterior design)		0.29
RMM group		Mopping	Benzene	Inhalation Experimental study		0.49
RMM sub-group		Mopping	Total organic matter	Inhalation Experimental study		0.52
Optimization		Handling of solvents	Total particulate	Inhalation Experimental study		0.04
Combined RMM		Stabilization by changing product properties	Inhalable particulate	Inhalation Experimental study		1
			Benzene	Inhalation Intervention		0.10
			Respirable particulate	Inhalation Intervention		0.08
			Respirable particulate	Inhalation Intervention		0.17
			Silica crystalline - quartz (in respirable particulates)	Inhalation Intervention		0.14
			Respirable particulate	Inhalation Experimental study		0.77
			Not specified; local ventilation systems	Milling	Inhalation Experimental study	0.03
			Kneaded suppression	Milling	Inhalation Intervention	0.05
			Kneaded suppression	Milling	Inhalation Intervention	0.88
			Complete personal enclosure without air supply ventilation / filtered recirculated air	Grinding	Inhalation Cross-sectional (a-posterior design)	0.95
			Not specified; local ventilation systems	Grinding	Inhalation Cross-sectional (a-posterior design)	0.70
			Not specified; local ventilation systems	Grinding	Inhalation Cross-sectional (a-posterior design)	0.70

Laboratory	Pilot Plants	Laboratory fume cupboards	Local exhaust enclosures	Reaching in	Process/other	Movable LEV	Walk-in cabinet	HEPA filter down flow booth	Ventilated cabinet exhaust in	HEPA filter down flow booth	Carbo-fabric	Continuous vent. on fume hood	Infrared	
Material Unpacking (Dry Powder)	HEPA filtered down flow booth													
Material Unpacking (Liquid dispersions)														
Material Unpacking (Dry Powder)														
Weighing (Dry Powder)														
Weighing (Liquid dispersions)														
Transferring														
Sonicating														
Mixing (Dry Powder)														
Mixing (Liquid dispersions)														
Production (physical and chemical synthesis)														
Packing / bag filling														
Spraying														
Machining (sawing + grinding, etc.)														
Compounding / injection molding														



Welcome to the NanoRISK Risk Measures Library

Guidance



Open / Refine Study

Start New Study

Library of Individual Measures

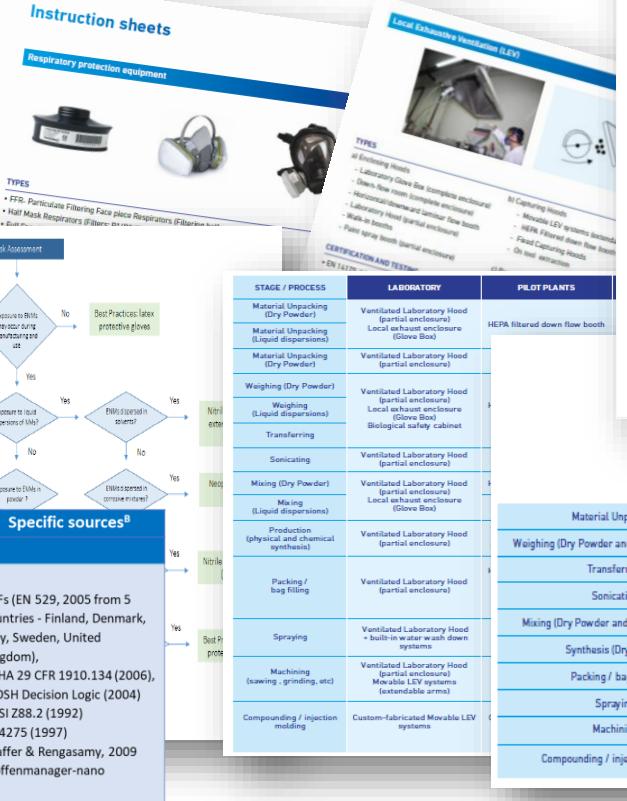
Sector / Process related RMMs

References

GUIDANCE ON RECOMMENDED MEASURES AND CONTROLS FOR MITIGATING RISK FOR ENGINEERED NANOMATERIALS

LIFE NanoRISK

Best practices effectiveness protection measures for control by engineered nanomaterials

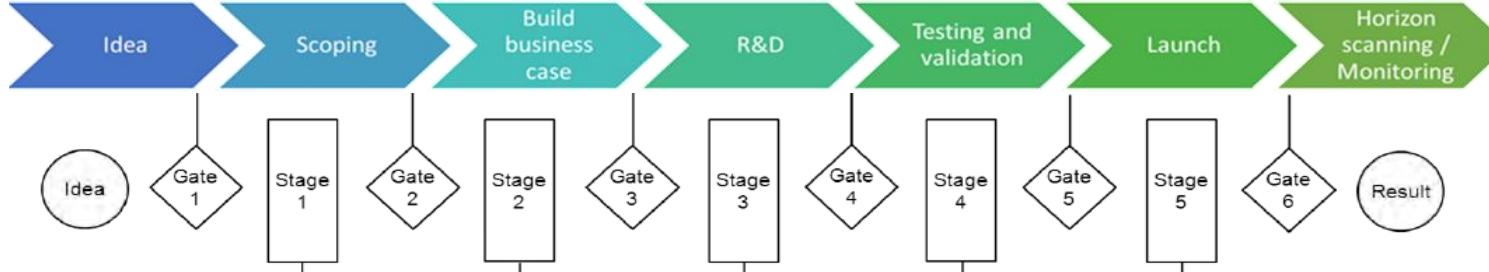


SAFE-BY-DESIGN

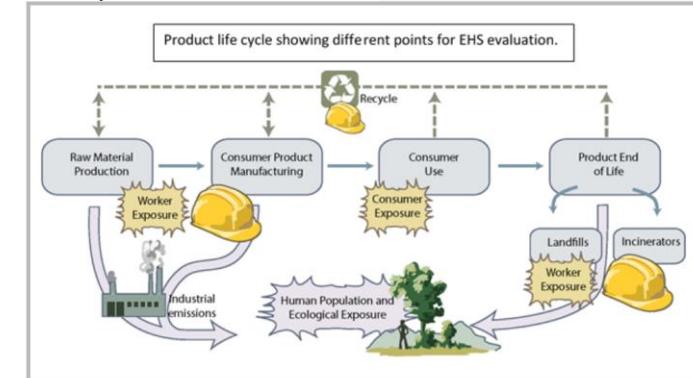
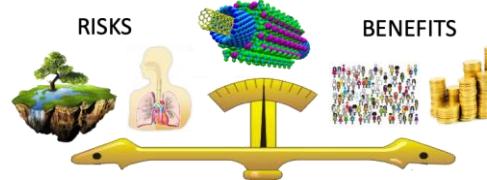
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NanoReg²

 caLIBRAte
nano risk governance

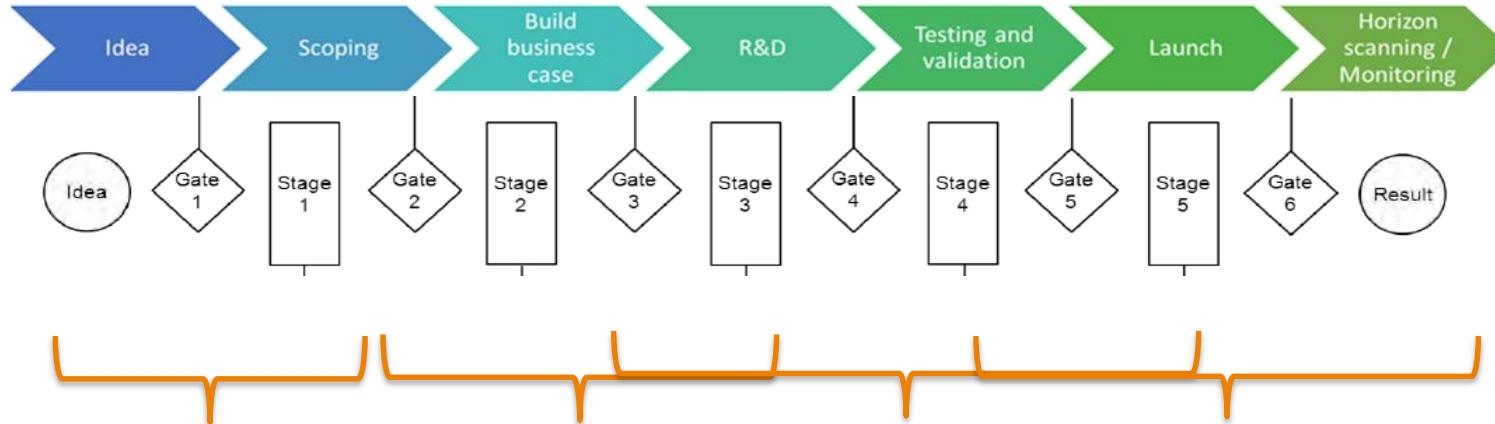


- Verandering is makkelijkst in beginstadium
- Investering neemt toe gedurende de innovatie keten



OECD WPMN project

Moving Towards a 'Safe Innovation Approach' for Sustainable NMs and Nano-enabled Products:
Overview of existing risk assessment tools and frameworks, and their applicability in industrial innovations

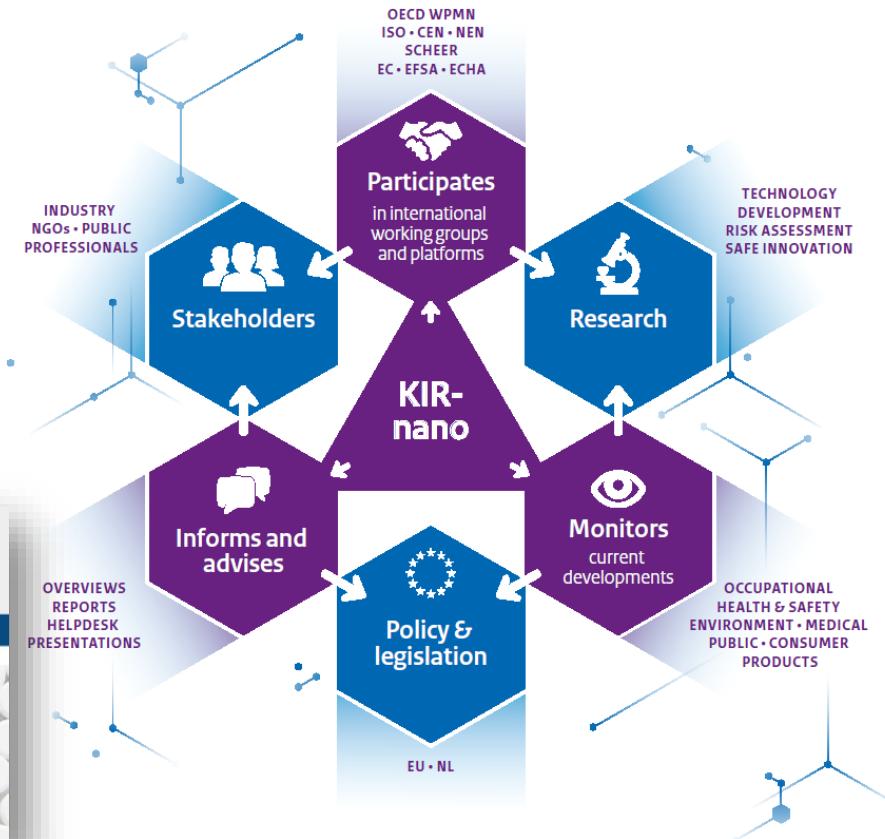


- No need at all
 - Little information available
 - Cheap
 - Widely applicable
 - No expertise available
 - Risk output required
 - Indicative/banding
 - Qualitative output
 - Most phys-chem available
 - Tox only core material
 - Classification available
 - Cheap
 - Widely applicable
 - No expertise available
 - Banding or quantitative output
 - Scientifically sound risk output
 - All phys-chem available
 - Tox only in vitro available
 - Still Cheap
 - Widely applicable
 - Low to medium expertise available
 - Quantitative risk output required
 - Regulatory accepted risk output
 - All tox endpoints addressed

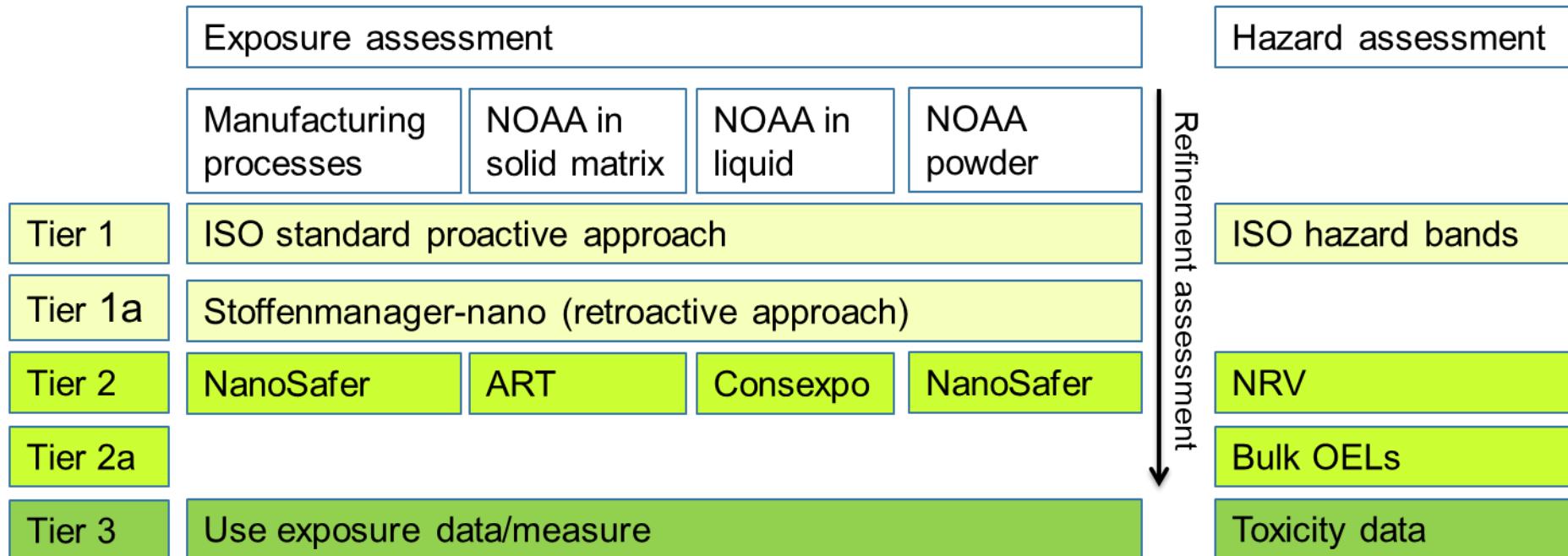
COMMUNICATIE MET STAKEHOLDERS

The screenshot shows two parts of a website:

- Nanocentre:** A green-themed page with a header "VEILIG INNOVEREN MET NANOMATERIALEN". It features a large image of a molecular structure, navigation links (HOME, OVER NANO, VEEL GESTELDE Vragen, AGENDA), and sections like "Wat is Nanocentre?", "Doe de quick scan", "Heeft u vragen?", and "Word ik blootgesteld aan nanomaterialen?".
- EC4SafeNano:** A blue-themed page with a header "EC for SafeNano". It features a large image of a molecular structure, navigation links (Home, Project, Network, Events, News), and sections like "Is mijn nanomateriaal gevaarlijk?", "OVERVIEWS REPORTS HELPDESK PRESENTATIONS", and "EU • NL".



INDUSTRIE-SPECifieKE AANPAK

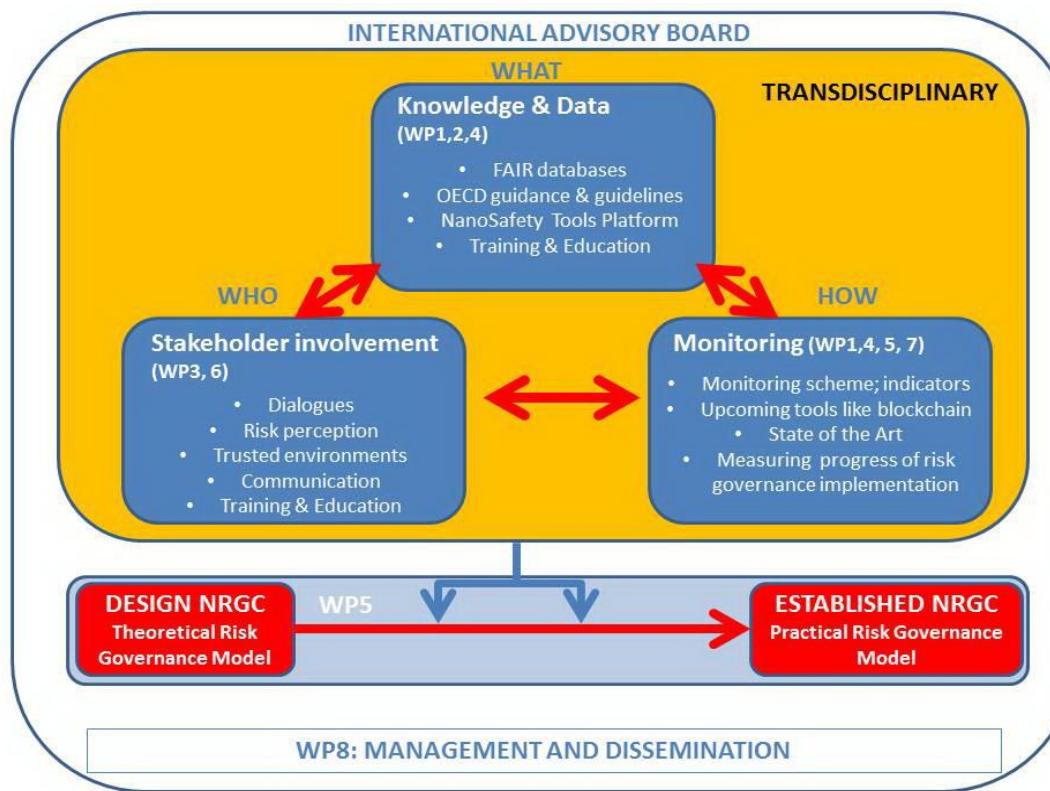


NANO RISK GOVERNANCE

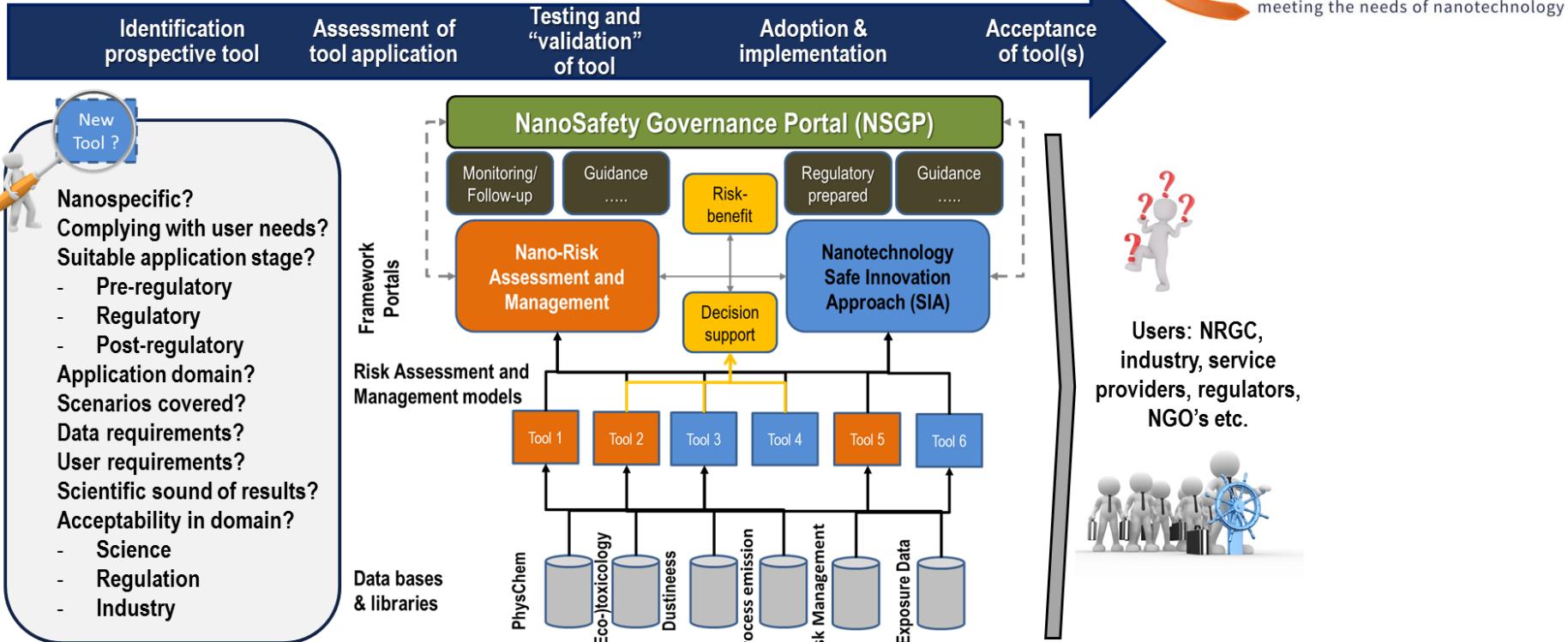


- › Nanotechnologie heeft een enorme vaart genomen in een breed scala van toepassingen en industrieën
- › Uitdaging om deze technologische ontwikkeling te stimuleren, maar wel **duurzaam** en binnen de gestelde **wetgeving**
- › Wetenschappelijk onderzoek is nog in ontwikkeling, terwijl producten al op de markt verschijnen
- › Oplossing: Ontwikkel een effectief risk governance proces voor nanotechnologie met verschillende stakeholders

NANO RISK GOVERNANCE



NANO RISK GOVERNANCE



NANO RISK GOVERNANCE

Website: <https://www.gov4nano.eu/>



The screenshot shows the Gov4Nano website homepage. At the top, there is a navigation bar with links for 'PROJECT', 'BENEFICIARIES', 'EVENTS', 'SCIENTIFIC RESULTS', and 'OUTREACH ACTIVITIES'. The main header features the 'Gov4Nano' logo and the tagline 'meeting the needs of nanotechnology'. Below the header is a large banner image showing a close-up of blue spherical particles on a surface. The bottom section contains the project title 'Gov4Nano' in large orange letters, followed by the tagline 'meeting the needs of nanotechnology' in a smaller white font. A funding acknowledgment at the bottom states: 'Gov4Nano has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement 814401.' A cookie consent banner is visible at the very bottom.

CONCLUSIES

- › Blootstelling aan nanomaterialen nog steeds een probleem
- › Balans tussen innovatie en veiligheid van nanotechnologie
- › Gehele levenscyclus van nanomaterialen
- › Veel hulpmiddelen, instrumenten, modellen zijn ontwikkeld
 - › Meetdata nog steeds nodig (harmonisatie en databases)
- › Van risico-beheersing naar Safe-by-Design
- › Communicatie met stakeholders
- › Sector-specifieke aanpak
- › Nano Risk Governance



BEDANKT VOOR UW AANDACHT

Voor meer inspiratie:
TNO.NL/TNO-INSIGHTS

WOUTER.FRANSMAN@TNO.NL

TNO

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