DELEGACIÓN BRASILEÑA

IBN
Iniciativa Brasileira de Nanotecnologia

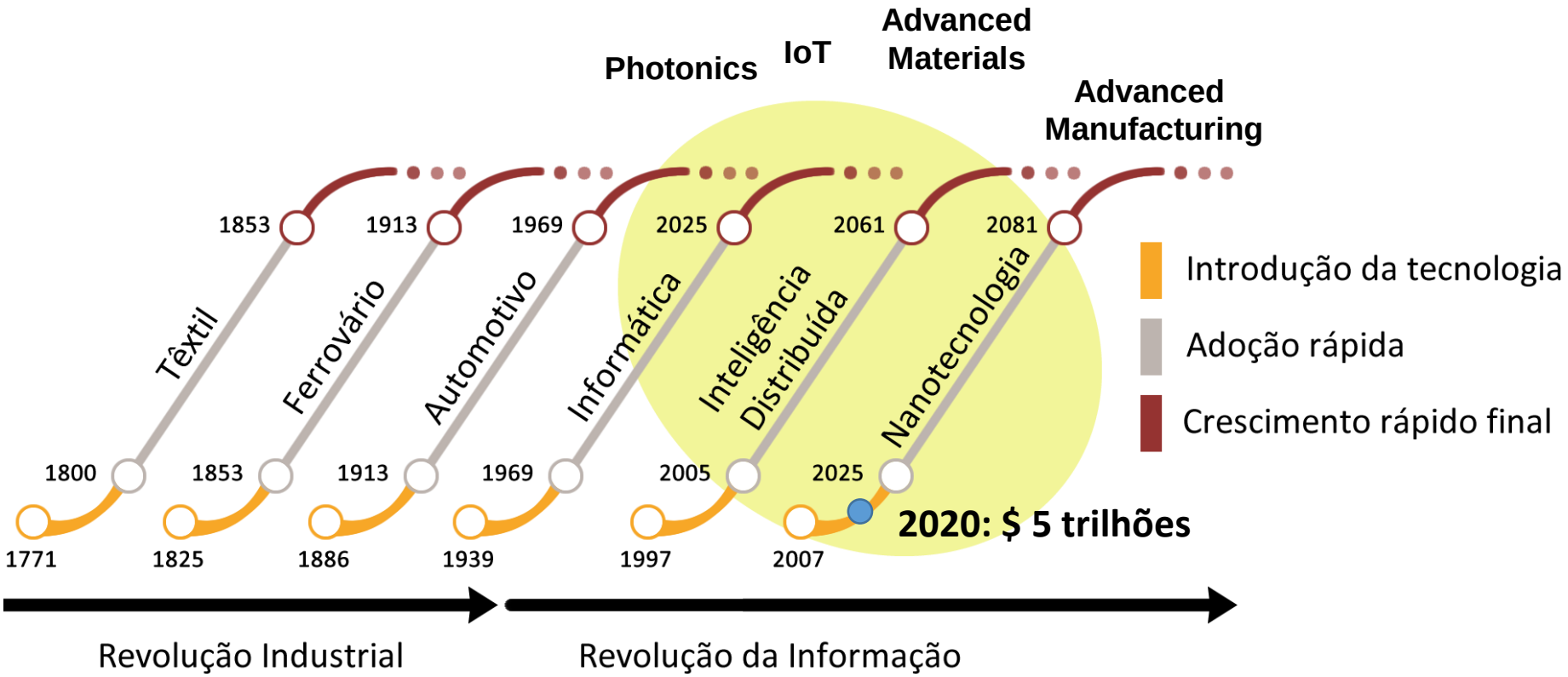
Nanotechnology in Brazil

nano MERCOSUR

Dr. Leandro Antunes Berti (leandro.berti@mctic.gov.br)

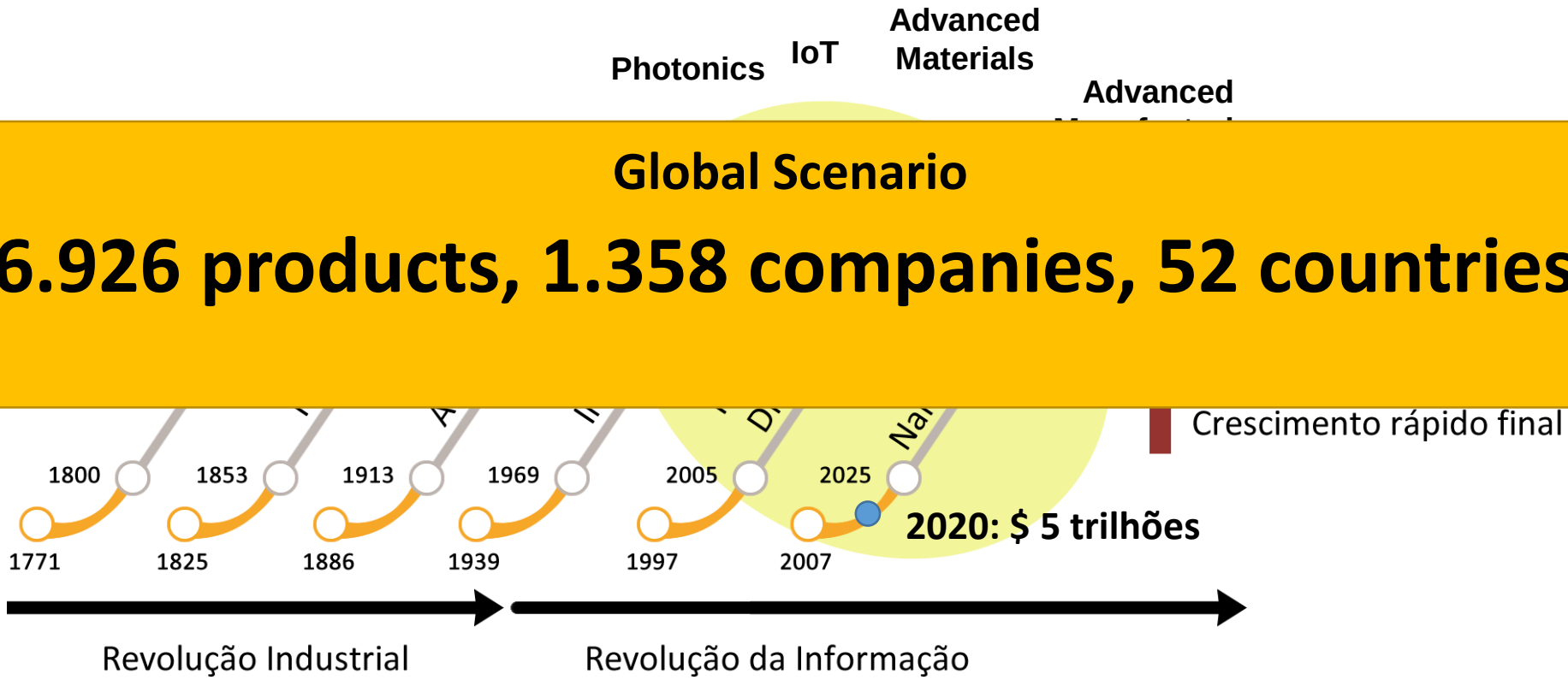
National Coordinator of Converging & Enabling Technologies

Motivation



Fonte: Norma Poire, Merrill Lynch, LuxResarch, Adapted by: Leandro Antunes Berti

Motivation



Global Scenario

6.926 products, 1.358 companies, 52 countries

Fonte: Norma Poire, Merrill Lynch, LuxResarch, Adapted by: Leandro Antunes Berti

Motivation

Photonics

IoT

Advanced Materials

Advanced

Global Scenario

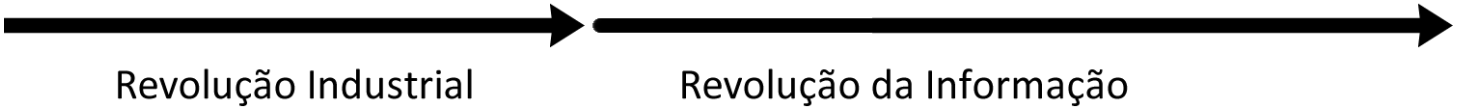
6.926 products, 1.358 companies, 52 countries

Graphene

1 kg = US$ 15k

Quantum Dots

2022: US$ 14,2 trillion



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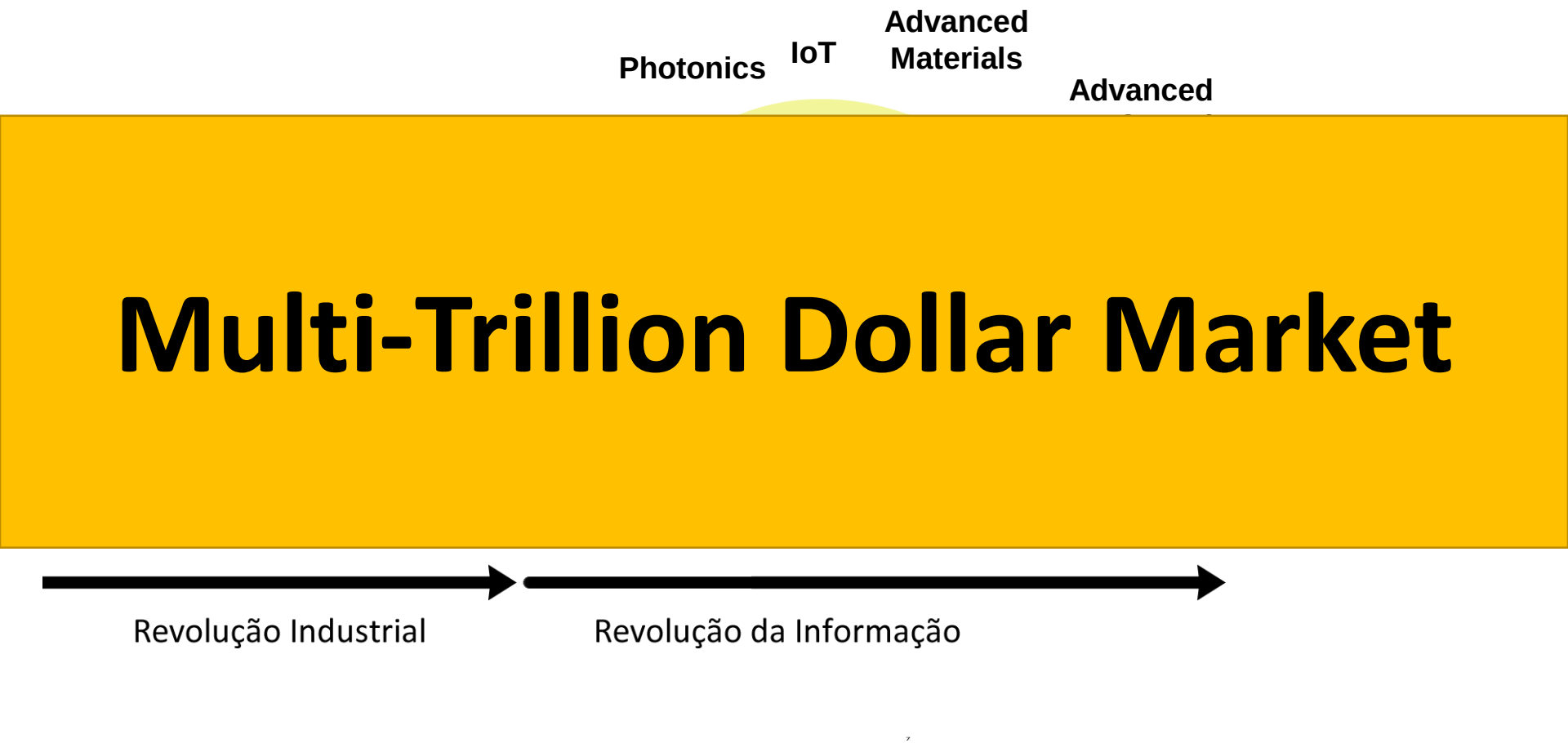
Motivation



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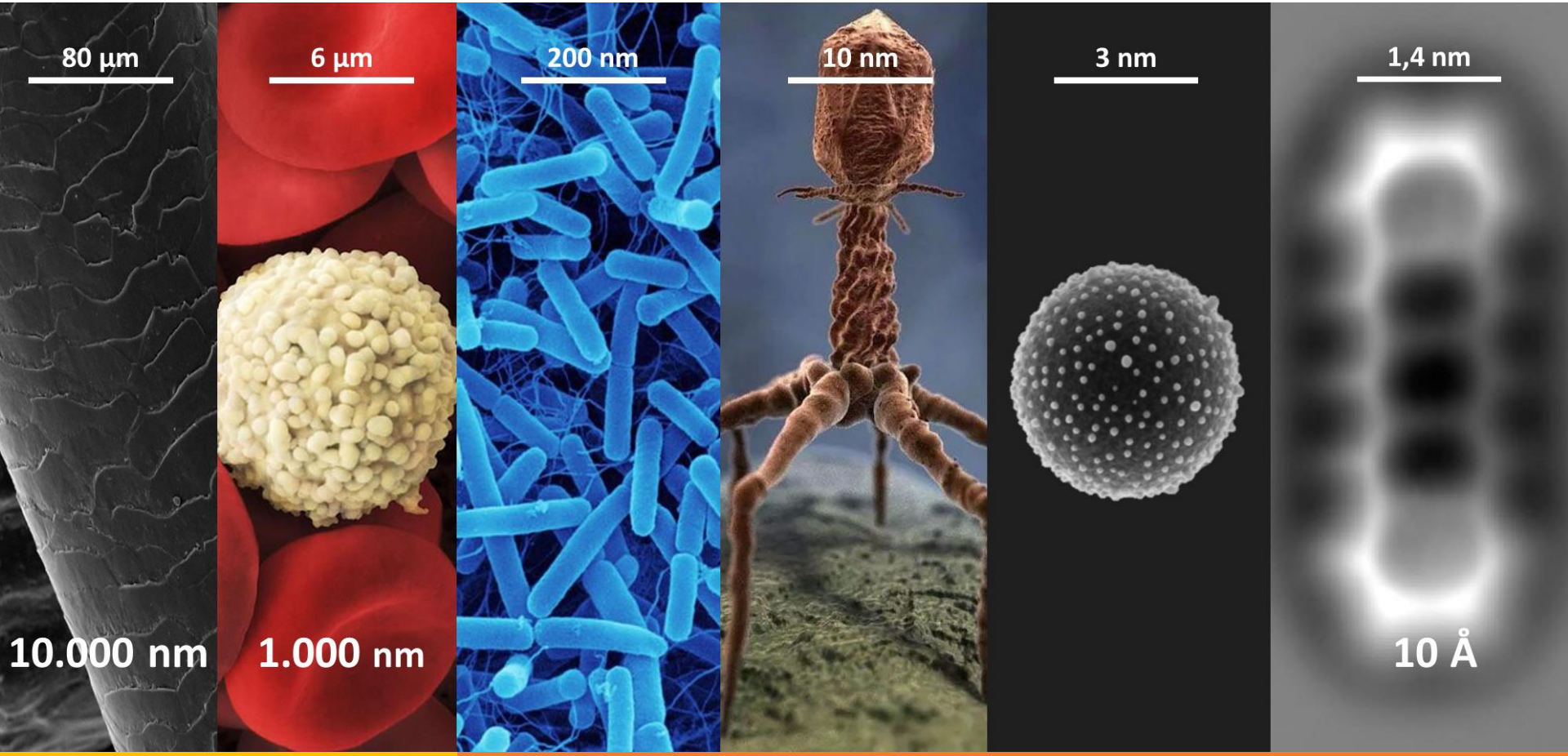
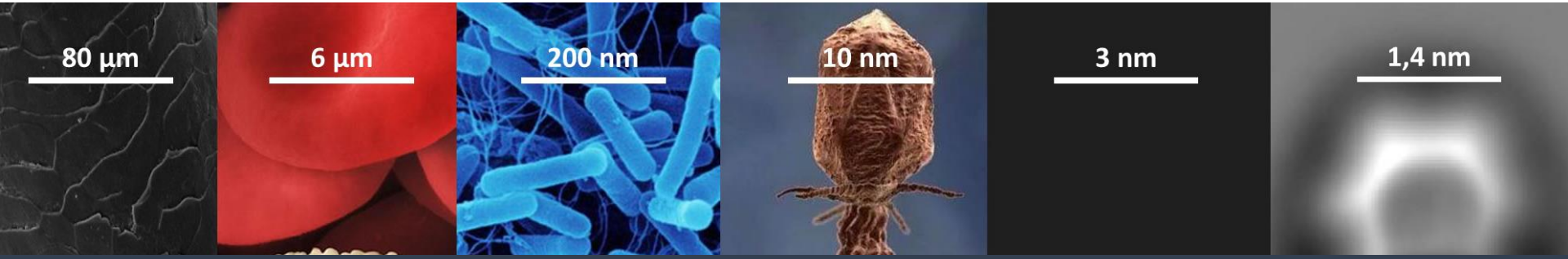


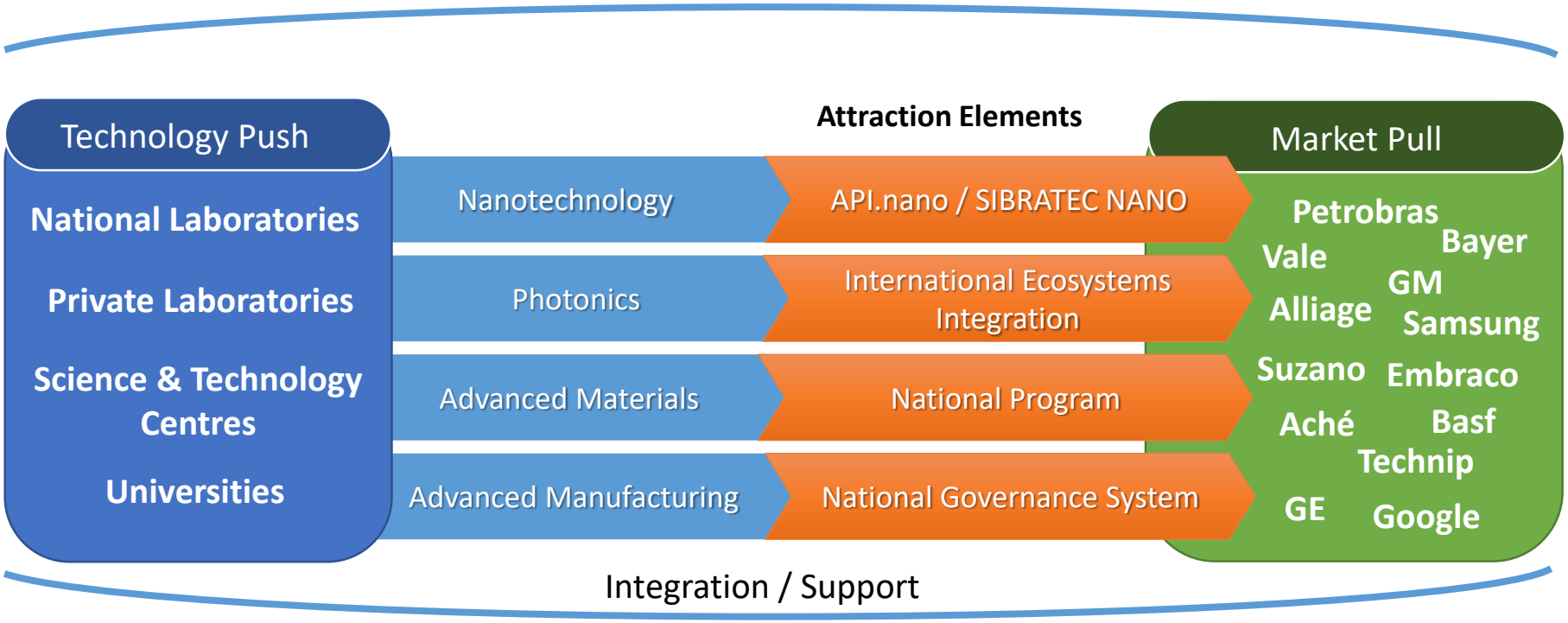
Microscale **Nanoscale**



Life's Engineering

Microscale **Nanoscale**

Brazilian Integrated Nanotechnology View



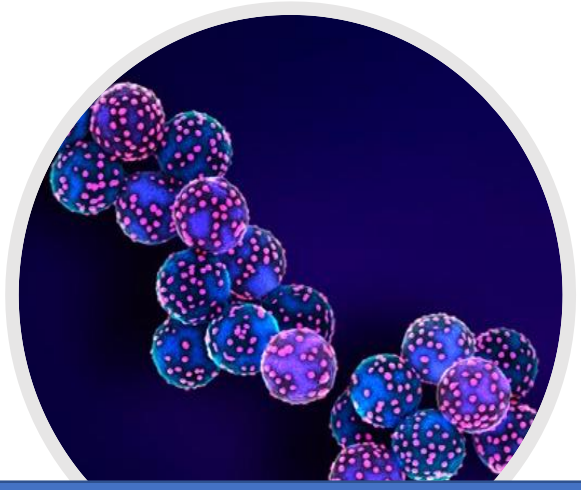
Ministério da Ciência, Tecnologia e Inovação
SisNANO
Sistema Nacional de Laboratórios em Nanotecnologias

IBN
Iniciativa Brasileira de Nanotecnologia

NANOREG

Sibratec NANO

Nanotech Clusters



Consultive Commitee

Interministerial Commitee

Nanotechnology

National Nanotechnology Laboratory System – SisNANO

Ministério da Ciência, Tecnologia e Inovação
SisNANO
Sistema Nacional de Laboratórios em Nanotecnologias

Portaria nº 245, de 5 de abril de 2012

PRINCIPAL OBJETIVO: "Universalization and access to state-of-the-art infrastructure and scientific technical support for Nanotechnology"

26

8 Strategic Laboratories
- Aligned to the National ST&I policies
- **National Laboratories**
- Give ≥ 50% of labor time to the community

18 Associated Laboratories
- **Local State/University Laboratories**
- Give ≥ 15% of labor time to the community

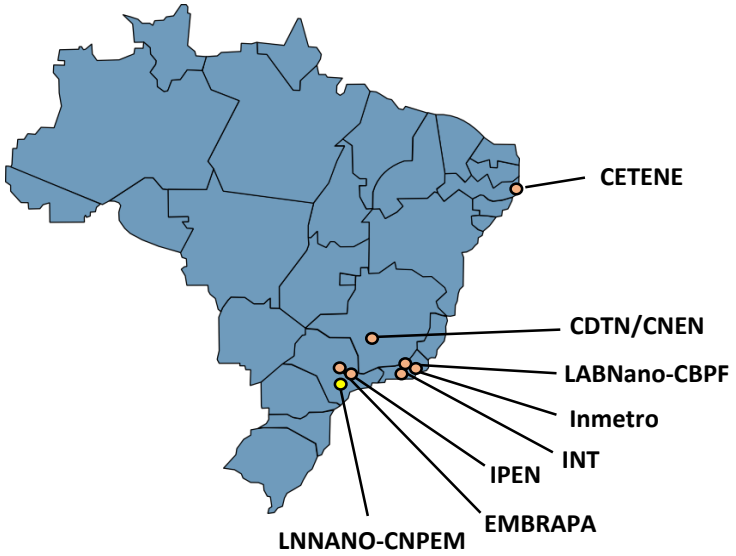
National Nanotechnology Laboratory System – SisNANO

Ministério da Ciência, Tecnologia e Inovação
SisNANO
Sistema Nacional de Laboratórios em Nanotecnologias

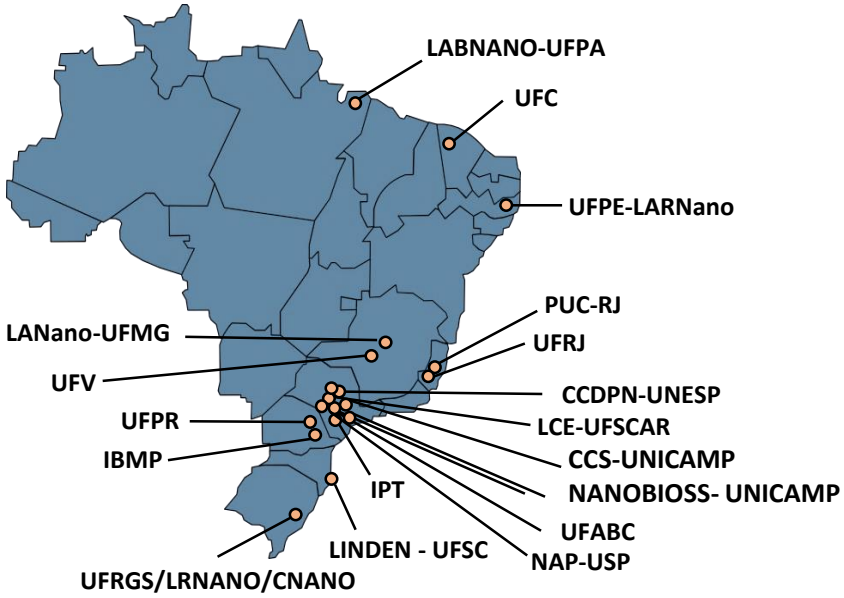
Portaria nº 245, de 5 de abril de 2012

Main Goal: "Universalization and access to state-of-the-art infrastructure and scientific technical support for Nanotechnology"

Strategic Labs (8)



Associated Labs (18)




Sibratec NANO
Projetos
O SibratecNANO
Como participar
Laboratórios
Publicações
Contato
Tem um projeto inovador?
Edital aberto. Submissão de projeto até 26 de maio. Selecione uma das redes abaixo e confira
Nanodispositivos & Nanosensores
SAIBA COMO PARTICIPAR
Nanomateriais & Nanocompositos
SAIBA COMO PARTICIPAR
Aplicação da nanotecnologia em produtos e processos.

Industrial Development Nanotechnology Cluster

Founded in 2013, with 30 members
General Manager: Dr. Leandro Antunes Berti
Steering Comitee: Prof. Dr. Antônio Rogério de Souza

TECNÓPOLIS
API. nanotecnologia

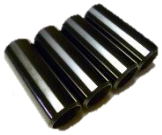
127
Members

Researcher Leader (60)
Supplier (14)
User (16)
Institutional (10)
Strategic Partners (28)

Setores:
Textile, Cosmetics, Health (biomedical, physical therapy), Pharmaceuticals, Food, Automotive, Metal-mechanics, Paints, Resins and Plastics, Toxicology, Transportation, Energy, Environmental, Construction, Legal & Social

Some Members of API.nano

API.nano: Member's Products



Examples: Nanovetores

nanovetores
INOVANDO NATURALMENTE

Developer of encapsulated raw materials for high-tech industry.

http://www.nanovetores.com.br/

14 – Internacional Distributors

Exports to more than 22 countries

ARGENTINA
RLC Representaciones Quimicas SAC
+511 719 2170
+511 719 2171

CHINA
Bermtag Asia Pacific
+65 6511 7830
www.bermtag-asiapacific.com

COLOMBIA
Ricardo Molina SA
+57 1 675 3066
www.ricardomolina.com

SPAIN
Ricardo Molina SA
+57 34 93 295 4960
www.ricardomolina.com

INDIA
Chemco Health & Beuty Solution
+91 022 2569 2622
www.chemcogroup.com

INDONESIA
Bermtag Asia Pacific
+62 21 8379 0755
www.bermtag-asiapacific.com

ITALY
Carlo Sessa
+39 3902 240 2051

MALAYSIA
Chemco Health & Beuty Solution
+603 8959 8232
www.chemcogroup.com

MEXICO
HB Quimica Internacional SA de CV
+52 55 5819 8230

PERU
RLC Representaciones Quimicas SAC
+51 1 719 2170
+51 1 719 2171

PORTUGAL
Ricardo Molina SA
+34 93 295 4960
www.ricardomolina.com

THAILAND
Chemco Health & Beuty Solution
+66 2 731 5575
www.chemcogroup.com

TURKEY
Per Egitim Danismanlik
+90 0 212 322 5100
www.pinegitim.com

VIETNAM
Bermtag Asia Pacific
+84 8 3997 5050
www.bermtag-asiapacific.com

The Washington Post

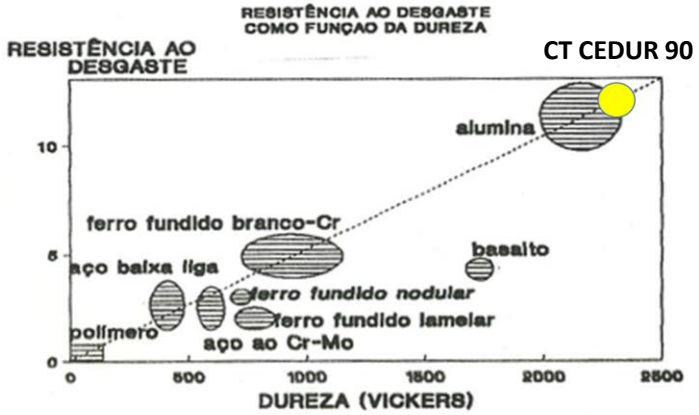
As Zika fear spreads, Brazilian mothers opt for mosquito-resistant baby clothing

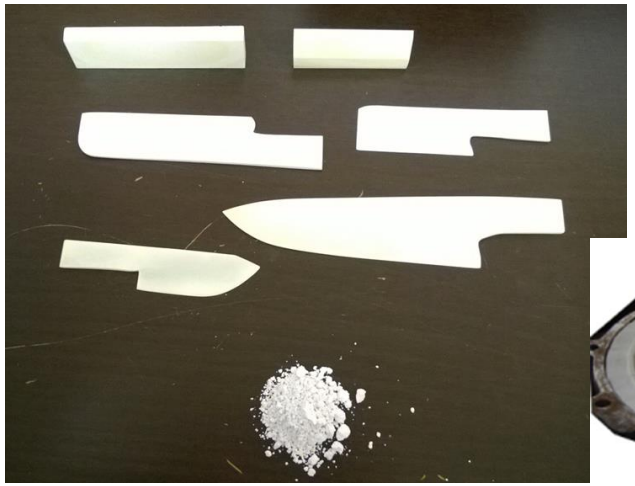
CETARCH Nanoceramics

CETARCH
CERÂMICA TÉCNICA E ARCHITETURAL LTDA

Special Ceramics (CT CEDUR 90)

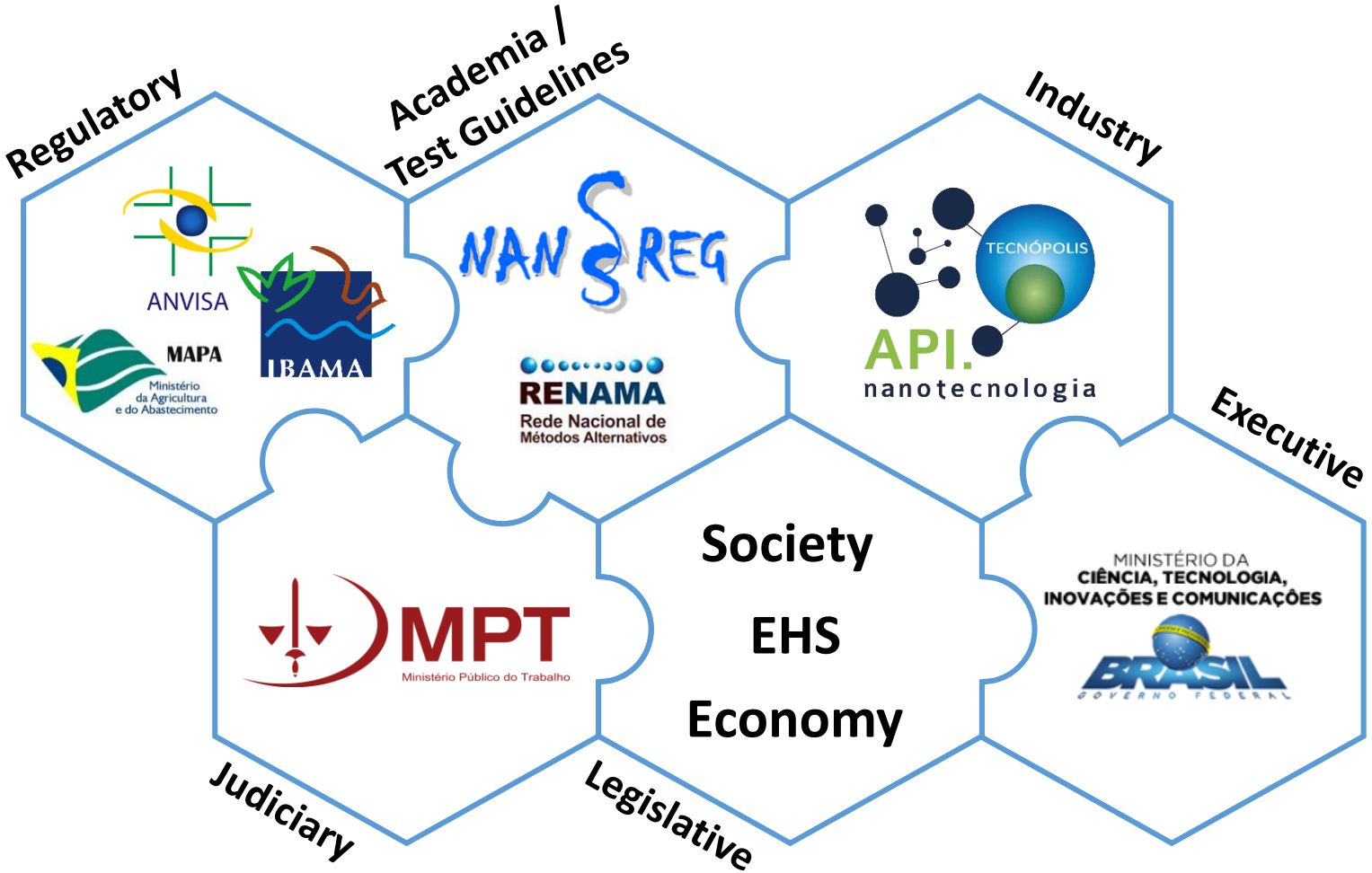
- Increases the internal forces of resistance to impacts and micro impacts
- Hinders the spread of intergranular cracks
- Increases the durability of the final material





- Alumina Al_2O_3 > 93%
- Water Absorption < 0,005%
- Bulk density: 3,6 g/cm³
- Flexural strength: 380 MPa
- K1c: 4.5 MPa $m^{1/2}$
- Vickers Hardness (10 kgf)> 1300
- Color: White

Nanosafety Brazilian Strategy



Nanomaterials Definition

A. $0 < d \leq 100$ nm → Natural Nanomaterials (NN) / Engineered Nanomaterials (ENM)

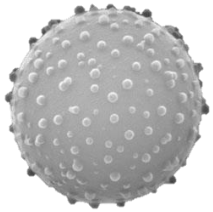
B. $100 < d \leq 500$ nm → NN e ENM / NOAA

C. $500 < d < 1000$ nm → NOAA

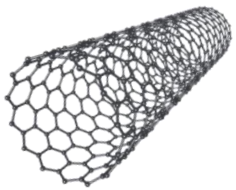
D. $d > 1000$ → Microstructures

Nanomateriais

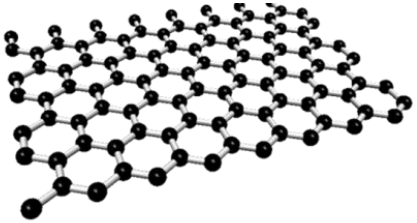
Dimension + Function + Control



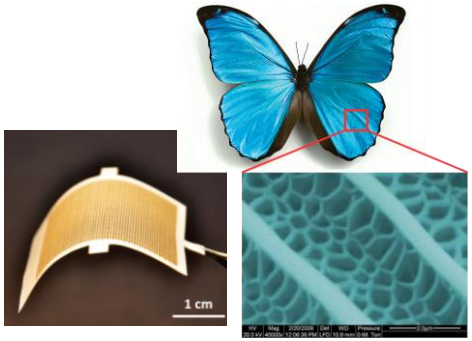
Nanoparticle **0D**



Nanotube **1D**



Nanofilm **2D**



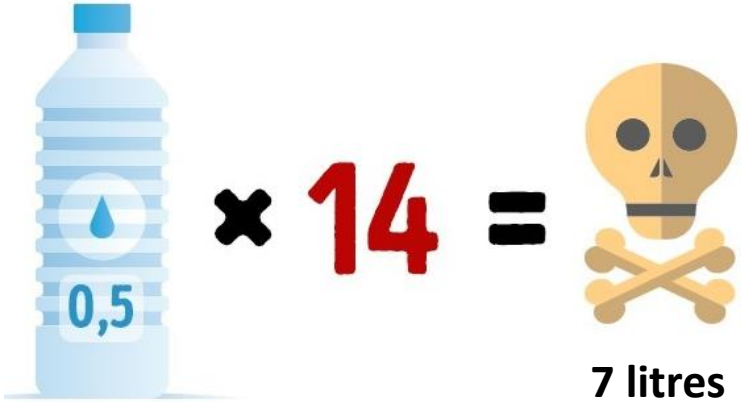
Nanocomposites **3D**

Materials Toxicity

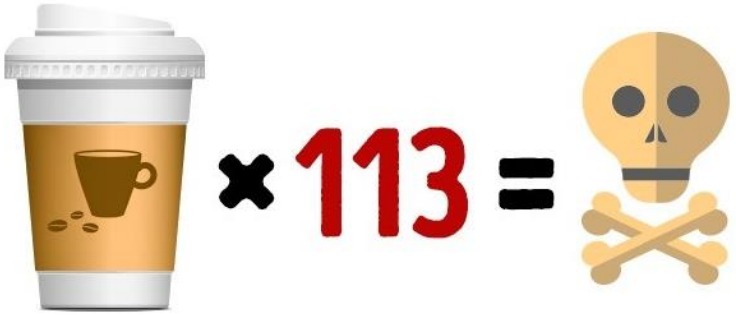
Substance	LD50 / LC50 (mg/kg)	Classification
Sugar	29.700	Relatively harmless
Vitamin C	11.900	Practically non-toxic
Table Salt	3.000	Practically non-toxic
Paracetamol	1.944	Slightly toxic
Aspirin	200	Moderately toxic
Cafein	192	Moderately toxic
Nicotin	13	Highly toxic
Strychnine	1	Extremely toxic
Viper Venon	0,025 {ou 25 µg/kg}	Extremely toxic
Polonium - 210	0. 00001 {ou 10 ng/kg}	Extremely toxic
Botulinum toxin (Botox)	0. 000001 {ou 1 ng/kg}	Extremely toxic

Hodge and Sterner's Toxicity Rating Scale

Materials Toxicity



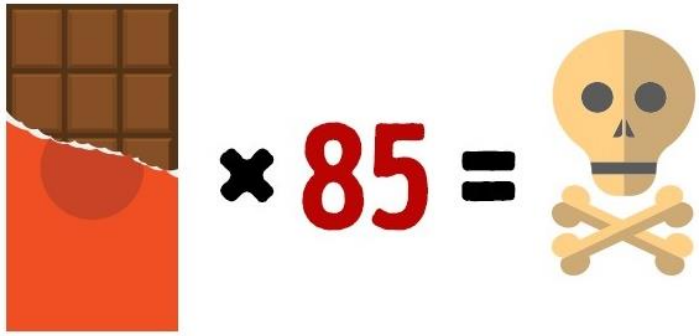
7 litres



250 ml

1,25 litre / 40% alcohol

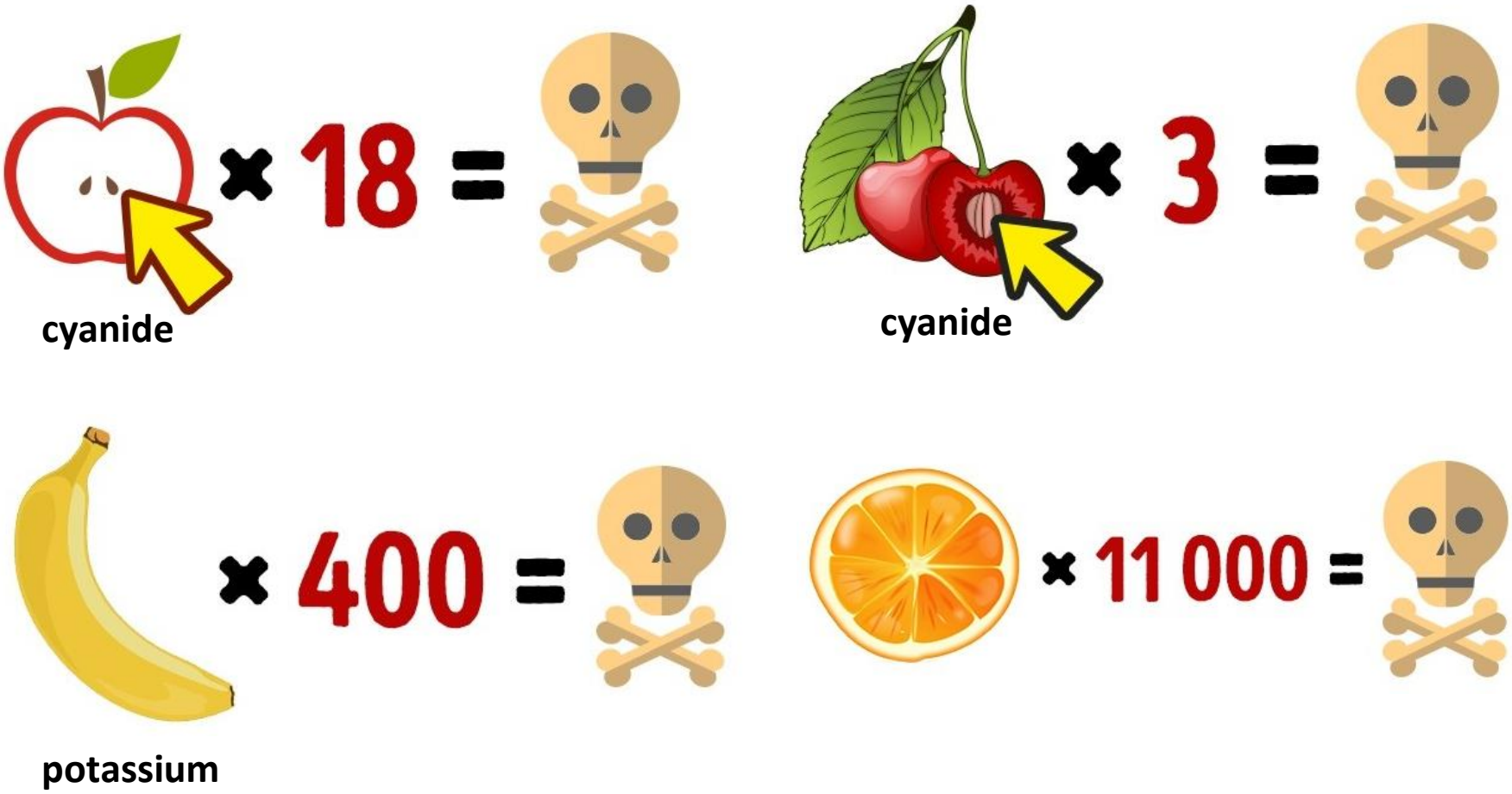
27 shots / 45 ml



10 kg

Source: https://brightside.me/inspiration-health/how-much-of-these-15-popular-foods-and-items-can-kill-you-375410/

Materials Toxicity



Source: https://brightside.me/inspiration-health/how-much-of-these-15-popular-foods-and-items-can-kill-you-375410/

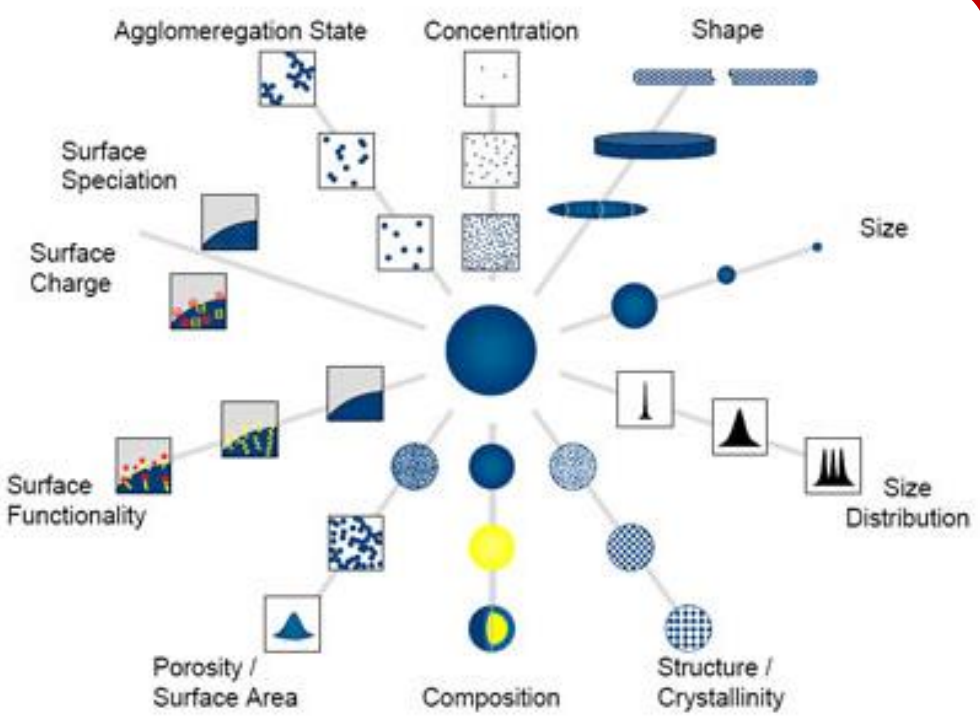
Materials Toxicity

Substance	LD50 / LC50 (mg/kg)	Classification
Sugar	29.700	Relatively harmless
Vitamin C	11.900	Practically non-toxic
Strychnine	1	Extremely toxic
Viper Venon	0,025 {ou 25 µg/kg}	Extremely toxic
Polonium - 210	0. 00001 {ou 10 ng/kg}	Extremely toxic
Botulinum toxin (Botox)	0. 000001 {ou 1 ng/kg}	Extremely toxic

Any material or nanomaterial can be toxic (it depends on the Reference Dose)

Hodge and Sterner's Toxicity Rating Scale

Physicochemical and Biological Nanomaterials Properties



56	**Toxicity endpoints**
18	**Physicochemical properties**
9	**Biological efects and properties**
21	**Environmetnal properties**
3	**Material Safety properties**

Source: Hassellöv & Kaegi, 2009

Review of achievements of the OECD Working Party on Manufactured Nanomaterials' Testing and Assessment Programme. From exploratory testing to test guidelines, 2016

Physicochemical and Biological Nanomaterials Properties

56 **Toxicity endpoints**

∞ **possibilities and combinations**

3 **Material Safety properties**

Source: Hassellöv & Kaegi, 2009

Review of achievements of the OECD Working Party on Manufactured Nanomaterials' Testing and Assessment Programme. From exploratory testing to test guidelines, 2016

How to assess nanomaterials / nanoproducts?

How to do?

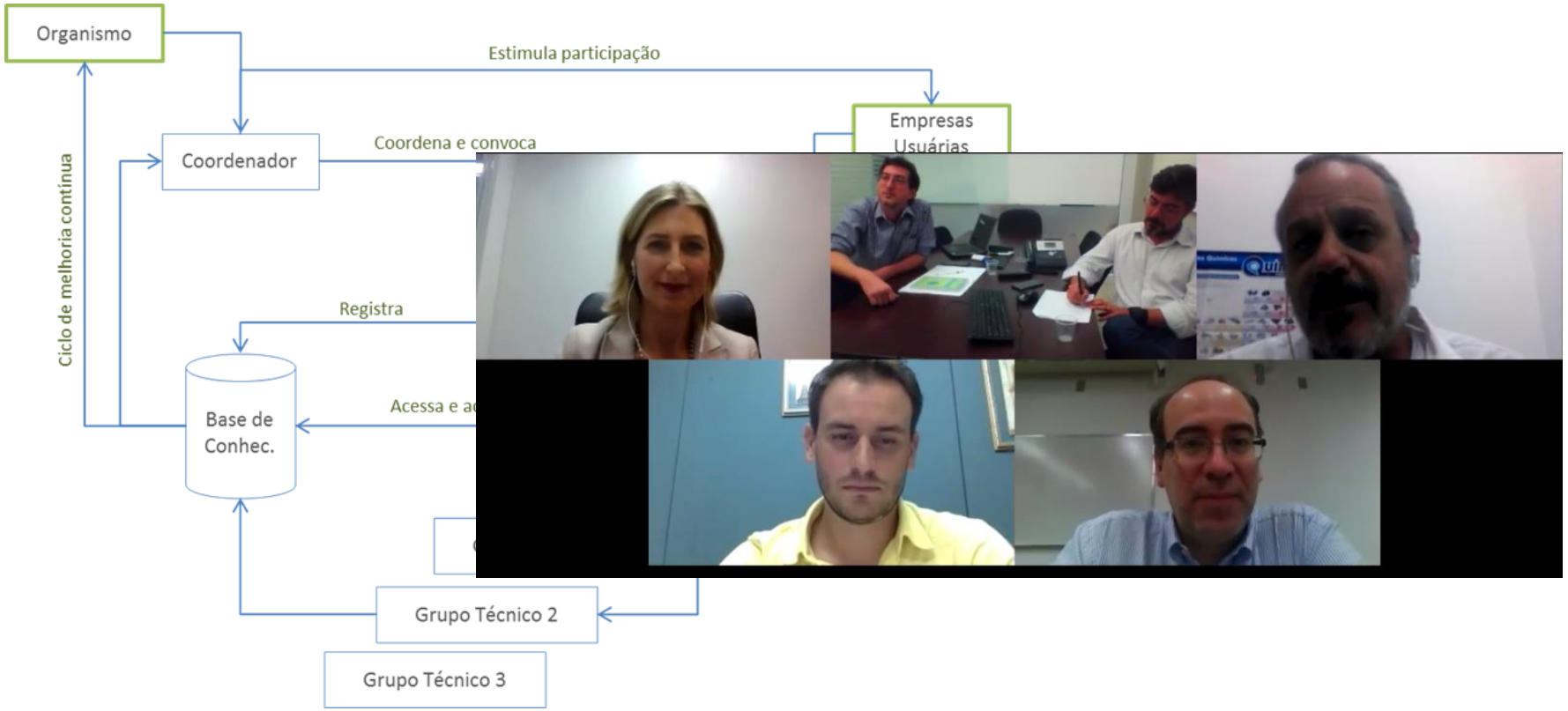
Which methods?

Standard Procedures?

Which tools?

What to do?

Nanosafety Standardization Committee



Conformity Assessment Model

How to do?

RAC

(Conformity Assessment Regulation)

Model Assessment

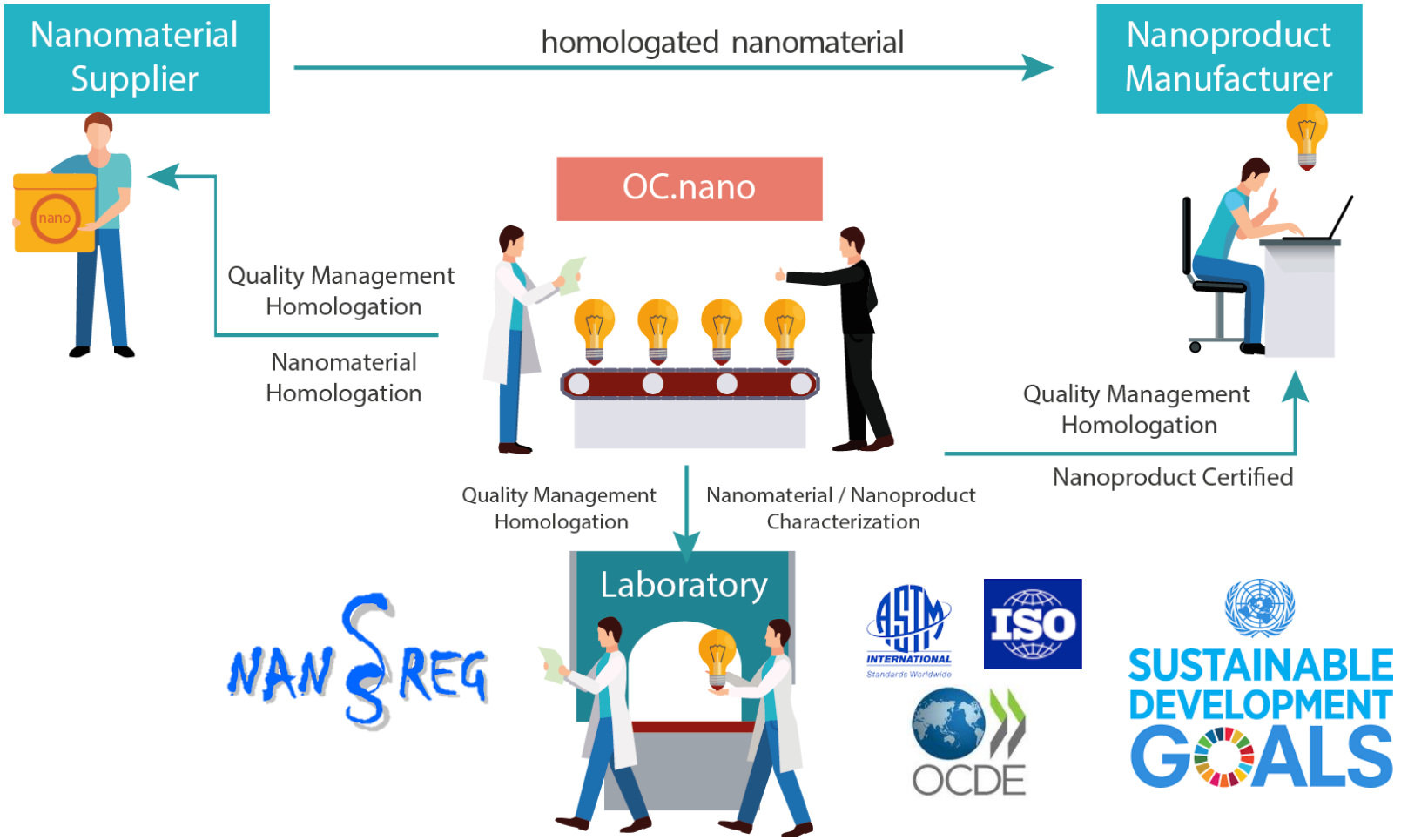
What to do?

RTQ

(Technical Quality Regulation)

Assessment by by Product Type
(Case by Case approach)

Nanosafety Value Chain Assessment



Certification Bureau

INMETRO

ASTM INTERNATIONAL
Standards Worldwide

ISO

ANVISA

OCDE

BPF
BOAS PRÁTICAS DE FABRICAÇÃO

MAPA
Ministério da Agricultura e do Abastecimento

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT
IAF

SUSTAINABLE DEVELOPMENT GOALS

Nanosafety Assessment Method

1st Step

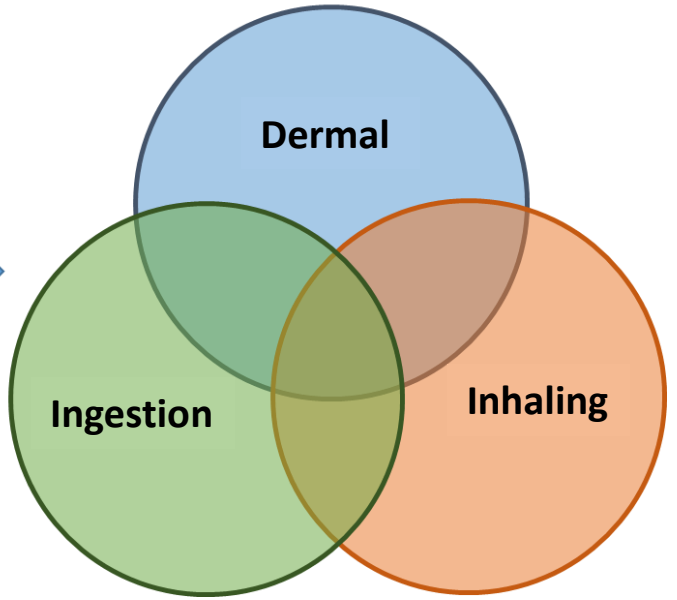
Control Banding

Níveis		Exposição			
		1	2	3	4
Perigo	A	Baixo	Baixo	Baixo	Médio
	B	Baixo	Baixo	Médio	Alto
	C	Baixo	Médio	Médio	Alto
	D	Médio	Médio	Alto	Alto
	E	Médio	Alto	Alto	Alto

ISO/TS 12901-2

2nd Step

MoE (Mode of Exposure)



OECD Guides and Test Guidelines

Alternative Methods To Animal Experimentation

Risk Analisys Assessment

Basic information

Auditable Values:

- Name / Nanomaterial Description: NanoRepllent (Gliceril behenate, Melaleuca Oil)
- CAS Number: 77538-19-3 or 30233-64-8, 8647-73-4
- Activity classification: nanomaterials during liquid blending operations
- Current Safety Control: Containment

Parent Material

Auditable Values:

- Lowest OEL: 1900 mg/kg
- Carcinogenic? No
- Reproductive Hazard? No
- Mutagenic? No
- Dermal Hazard? No
- Asthmagen? No

Ocupational Assessment

Auditable Values:

- Estimated maximum amount of chemical used in one day (mg): 1.000.000 mg
- Number of Employees with Similar Exposure: 6 - 10
- Dustiness: Low
- Frequency of Operation: Daily
- Operation Duration (per shift): 1h - 4h

Nanomaterial

Fixed Values:

- Solubility: Soluble

Auditable Values:

- Surface reactivity: Low
- Surface Chemistry: Low
- Particle shape: Spherical
- Particle Diameter: (180 ± 30) nm
- Carcinogênic? No
- Reproductive Hazard? No
- Mutagenic? No
- Dermal Hazard? No
- Asthmagen? No

Risk Analisys Assessment

- Suppliers of nanomaterials and manufacturers of nanoproducts.
- Application of Control Banding (ISO / TS 12901-2).
- Checking the effectiveness of countermeasures according to the risk level.

Worker/Environmental Hazard	Release/Exposure Probability			
	Unlikely (1)	Low (2)	Likely(3)	Probable (4)
Very High or Unknown (D)	Control Level III	Control Level III	Control Level IV	Control Level IV
High (C)	Control Level II	Control Level II	Control Level III	Control Level IV
Medium (B)	Control Level I	Control Level I	Control Level II	Control Level III
Low (A)	Control Level I	Control Level I	Control Level I	Control Level II

Scoring Levels	Risk Levels	Countermeasures
≤ 125	RL1	General or natural ventilation
Very High + Extremely Unlikely (125)	RL1	General mechanical or natural ventilation
$125 - 150$	RL2	Closed Ventilation: ventilated cabin, fume hood, closed reactor with normal opening
High + Extremely Unlikely (100)	RL3	Containment
$150 - 175$	RL3	Containment
$175 - 200$	RL4	Find an Expert

Mode of Exposure (MoE)

Exposure Time

Dermal **Ingestion** **Inhaling**

Exposure Time

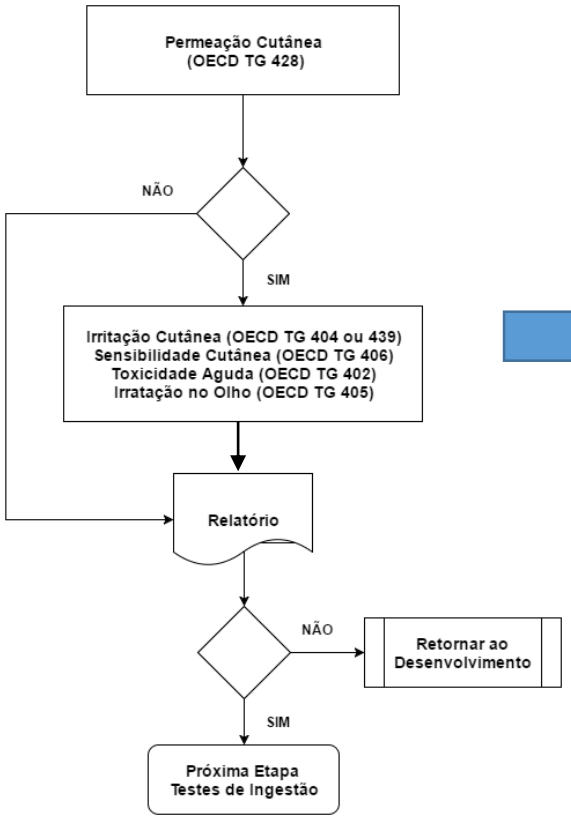
1x **até 4x** **< 5x**

Risk Group

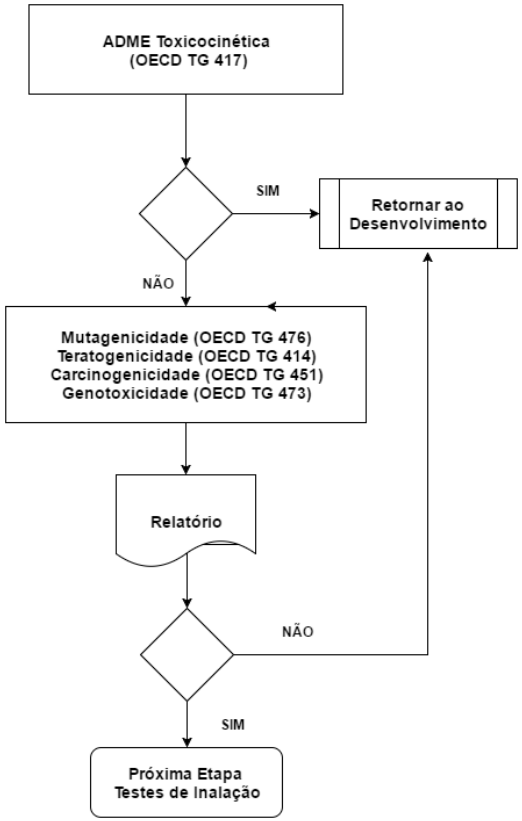
Adult > Child > Elderly > Pregnant

Mode of Exposure (MoE)

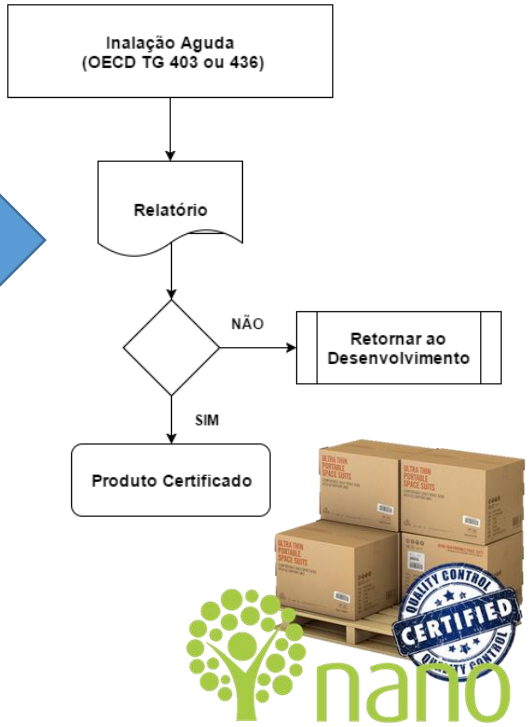
1st Dermal



2nd Ingestion



3rd Inhaling



Mode of Exposure (MoE)

Adulto

Exposição	Frequência (dia)		
Dérmica	1 vez	até 4 vezes	acima de 5 vezes
Aplicado diretamente na pele	-	OECD TG 428 OECD TG 404	OECD TG 428 OECD TG 404 OECD TG 406
Aplicado nos ólhos / mucosas	-	OECD TG 405	OECD TG 405
Via líquida	-	OECD TG 428 OECD TG 404	OECD TG 428 OECD TG 404 OECD TG 406
Encapsulado / carreado via líquida	-	OECD TG 428 OECD TG 404 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406 OECD TG 402
Ingestão			
Ingerido	OECD TG 417	OECD TG 417 OECD TG 451	OECD TG 417 OECD TG 476 OECD TG 451
Via líquida	OECD TG 417	OECD TG 417 OECD TG 451	OECD TG 417 OECD TG 476 OECD TG 451
Encapsulado / carreado via líquida	OECD TG 417	OECD TG 417 OECD TG 451 OECD TG 473*	OECD TG 417 OECD TG 476 OECD TG 451 OECD TG 473†
Encapsulado / carreado via sólida	OECD TG 417	OECD TG 417	OECD TG 417 OECD TG 451 OECD TG 473*
Via sólida / pó	OECD TG 417	OECD TG 417	OECD TG 417 OECD TG 451
Inalação			
Inalado Encapsulado / carreado via sólida Via sólida / pó Via aérea / aerossol	OECD TG 403 ou OECD TG 436	OECD TG 403 ou OECD TG 437	OECD TG 403 ou OECD TG 438

* se carreamento menor que 100 nm
† depende do tipo de substância ingerida (ex: corantes, químicos controlados)

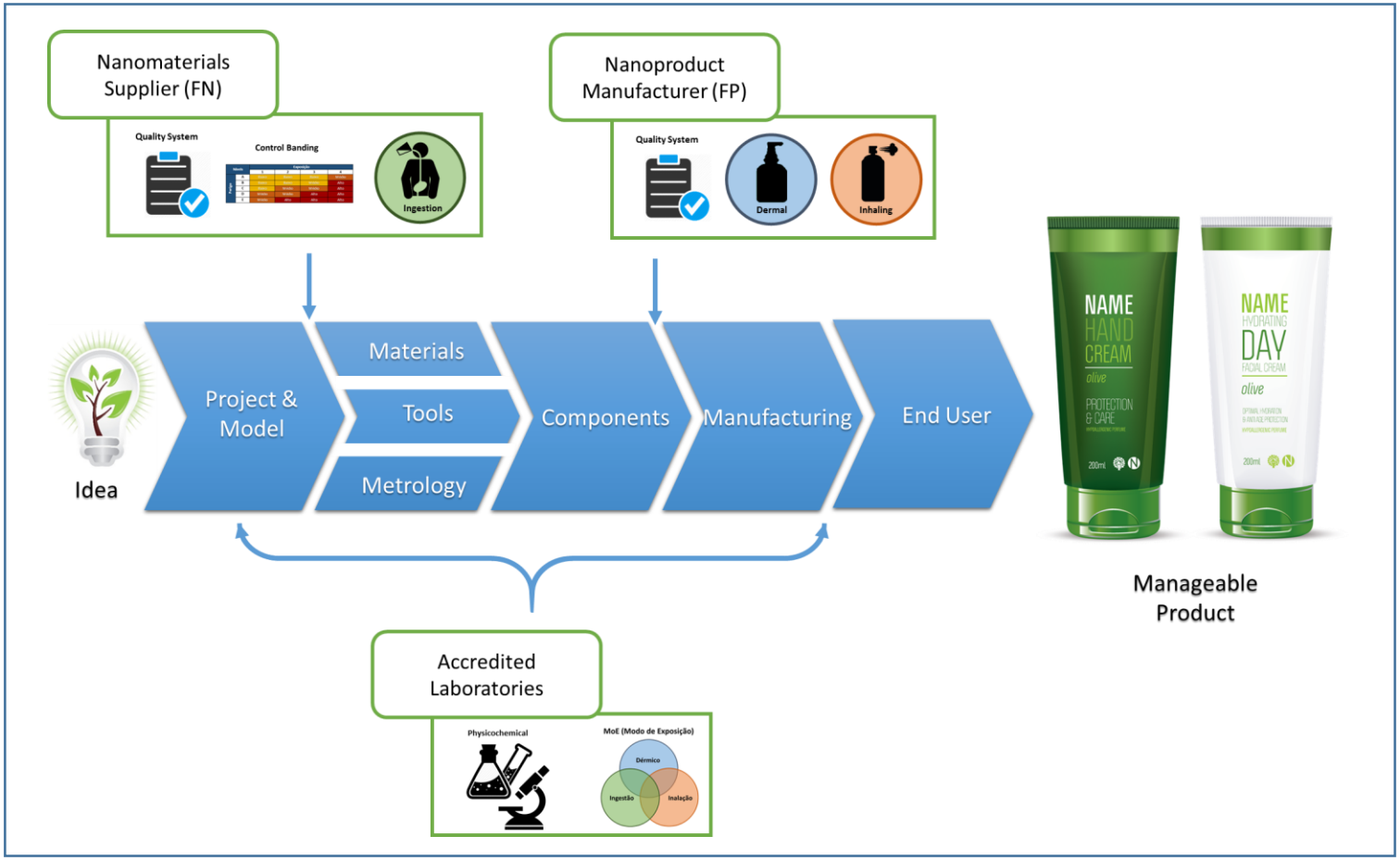
Gestante

Exposição	Frequência (dia)		
Dérmica	1 vez	até 4 vezes	acima de 5 vezes
Aplicado diretamente na pele	OECD TG 428 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406 OECD TG 402
Aplicado nos ólhos / mucosas	OECD TG 405	OECD TG 405	OECD TG 405
Via líquida	OECD TG 428 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406 OECD TG 402
Encapsulado / carreado via líquida	OECD TG 428 OECD TG 406	OECD TG 428 OECD TG 404 OECD TG 406 OECD TG 402	OECD TG 428 OECD TG 404 OECD TG 406 OECD TG 402
Ingestão			
Ingerido	OECD TG 417 OECD TG 451†	OECD TG 417 OECD TG 476 OECD TG 451†	OECD TG 417 OECD TG 476 OECD TG 451 OECD TG 473†
Via líquida	OECD TG 417 OECD TG 451†	OECD TG 417 OECD TG 451† OECD TG 414	OECD TG 417 OECD TG 476 OECD TG 451 OECD TG 414
Encapsulado / carreado via líquida	OECD TG 417 OECD TG 451†	OECD TG 417 OECD TG 451 OECD TG 476 OECD TG 414	OECD TG 417 OECD TG 476 OECD TG 451 OECD TG 473* OECD TG 414
Encapsulado / carreado via sólida	OECD TG 417 OECD TG 451	OECD TG 417 OECD TG 451 OECD TG 414	OECD TG 417 OECD TG 451 OECD TG 476 OECD TG 473*
Via sólida / pó	OECD TG 417 OECD TG 451†	OECD TG 417 OECD TG 451† OECD TG 414	OECD TG 417 OECD TG 451 OECD TG 476 OECD TG 473*
Inalação			
Inalado Encapsulado / carreado via sólida Via sólida / pó Via aérea / aerossol	OECD TG 403 ou OECD TG 436	OECD TG 403 ou OECD TG 437	OECD TG 403 ou OECD TG 438

* se carreamento menor que 100 nm

Example: Cosmetic Nanosafety Assessment

Safe by Design



Public Engagement

Public Engagement

New!

Thank you!

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National Coordinator of Converging & Enabling Technologies