Estimated Risk Profiles of Titanium Dioxide and Carbon Nanotubes Engineered Nanomaterials (ENMs) in the Gauteng Province environment

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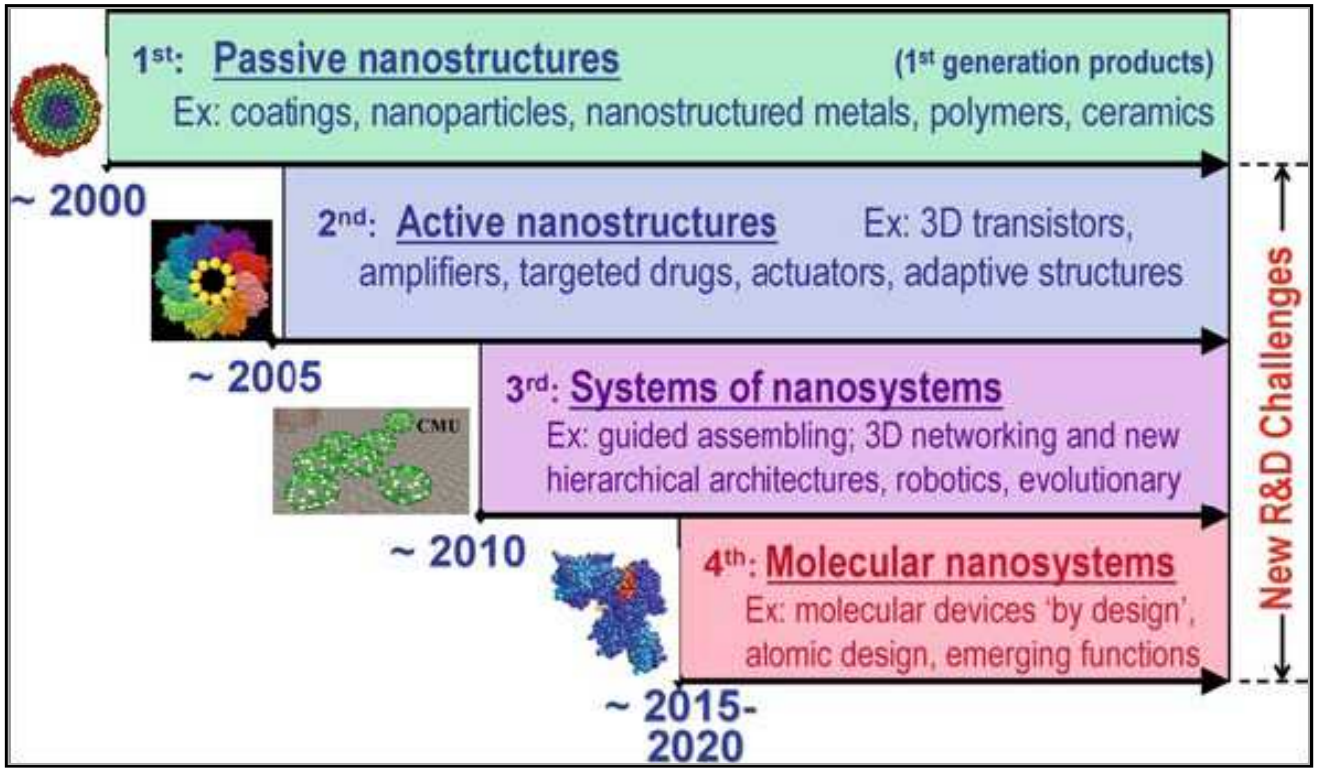
Overview of presentation

- Study background
- Objectives
- Methods
- Results and discussion
- Conclusions and recommendations

Study background



Four generations of nanotechnology development (Roco, 2004)

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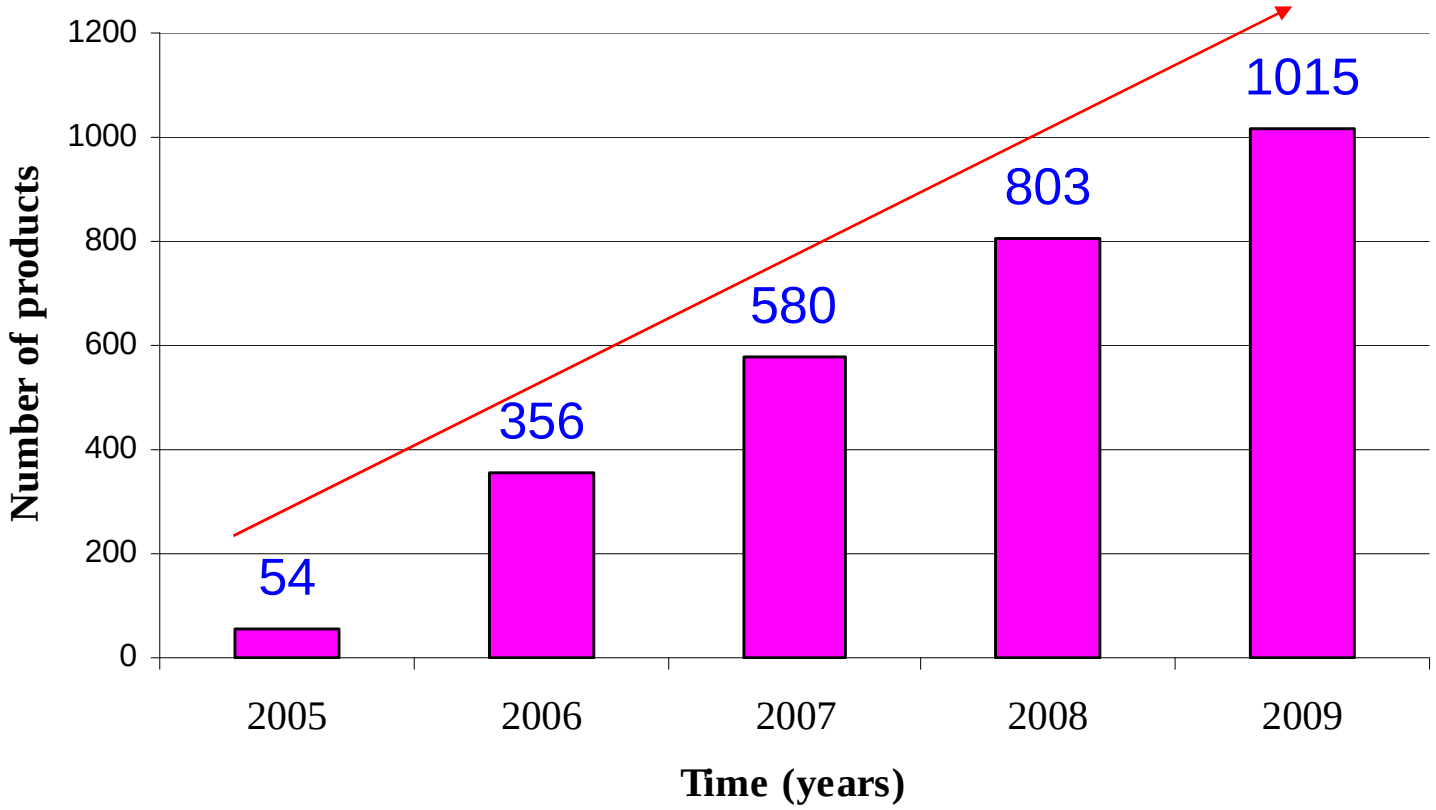
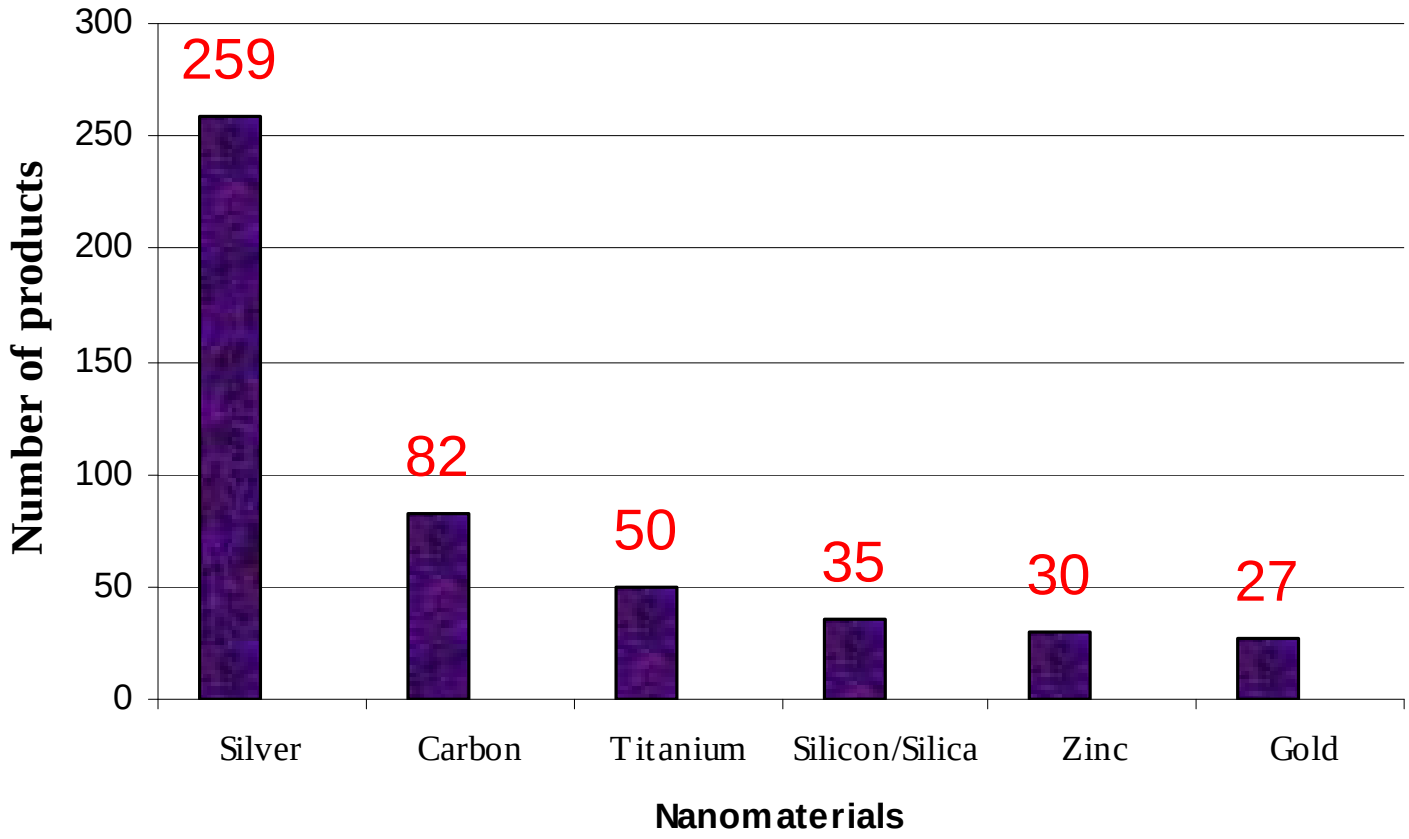
Nanoproducts inventory



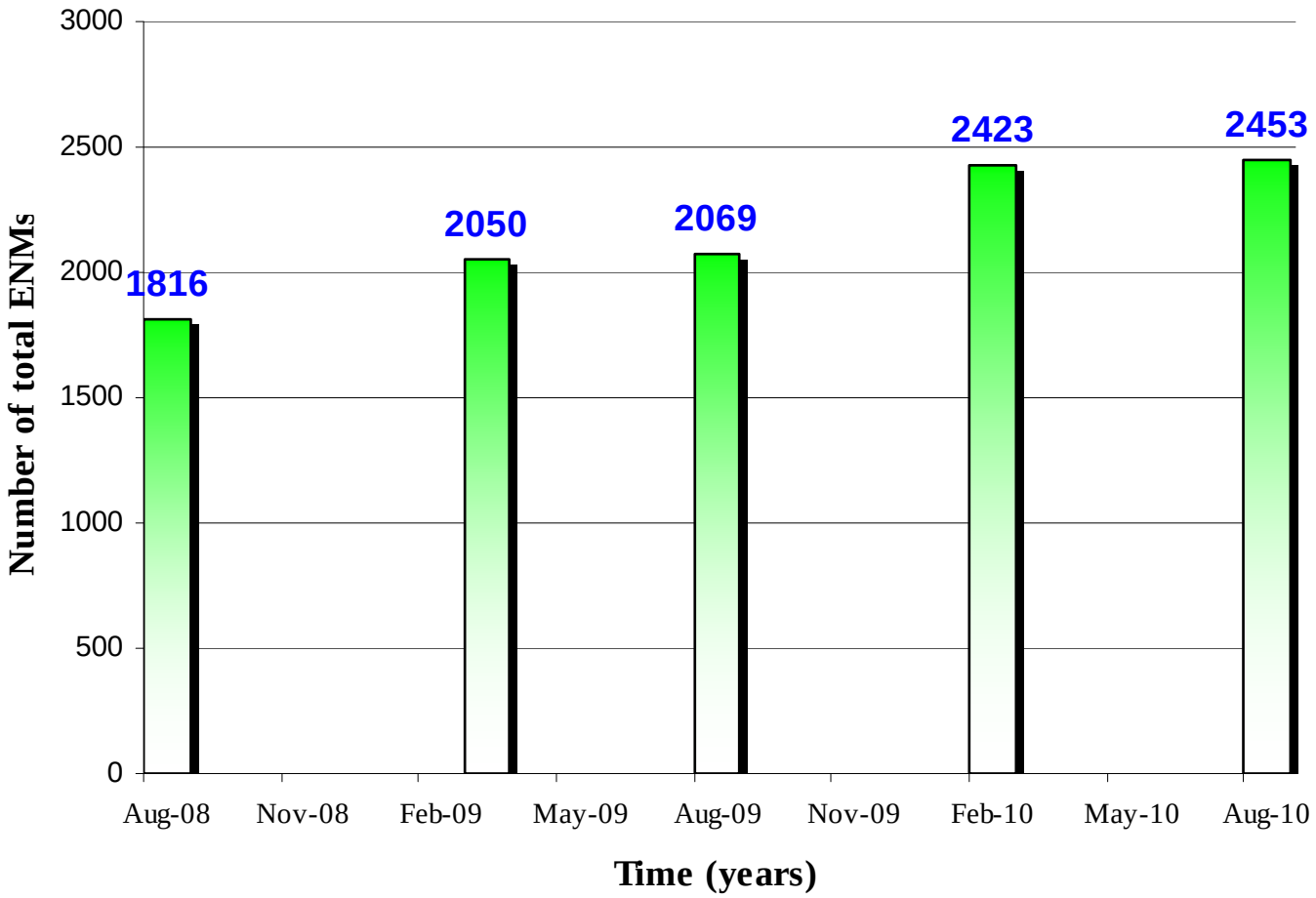
Company declared consumer products (Project on Emerging Nanotechnologies - PEN, 2010)

Major nanomaterials in products



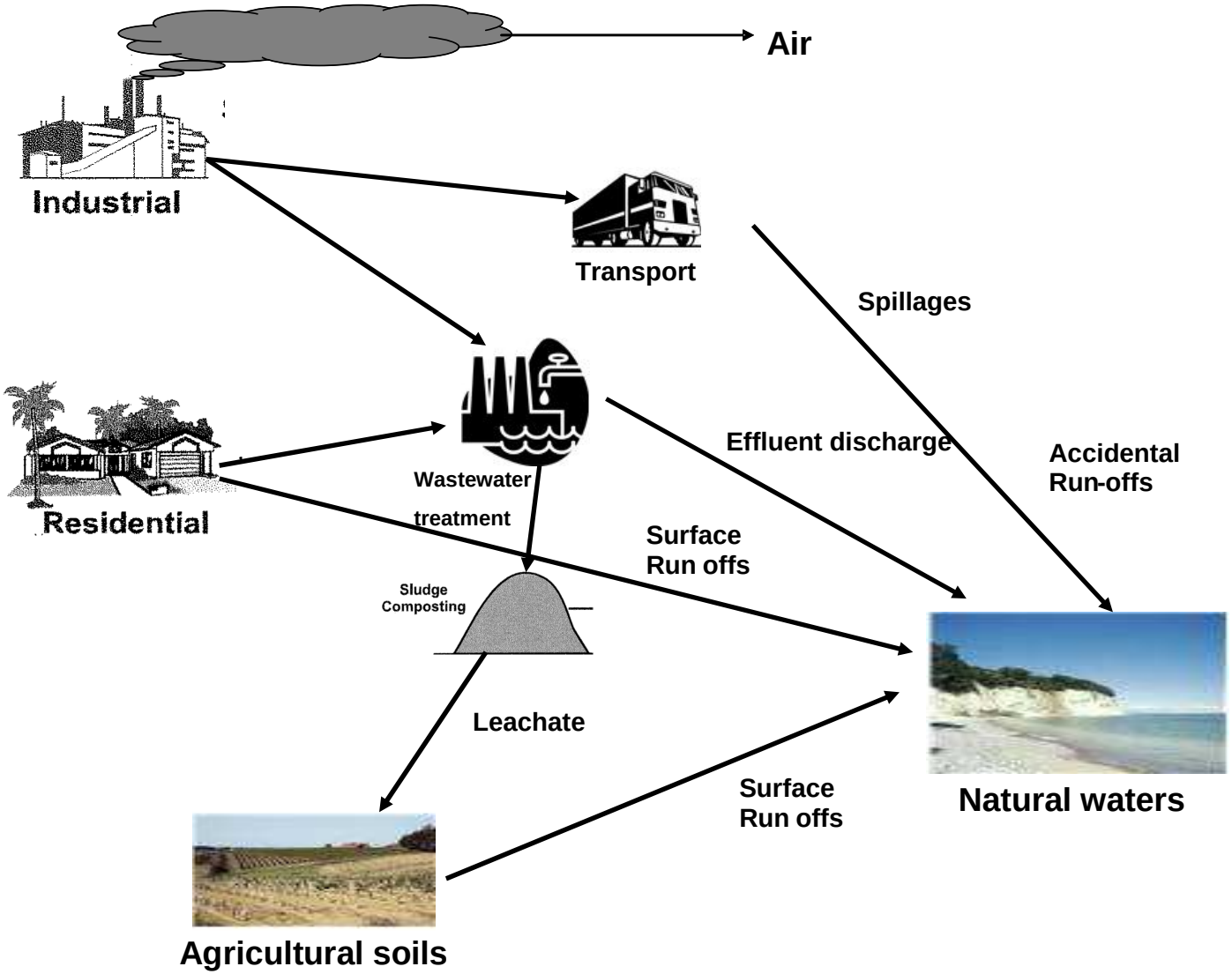
Most dominant nanomaterials in listed nanoproducts (PEN, 2010)

Engineered nanomaterials (ENMs) inventory



Engineered nanomaterials growth trend (Nanowerk database, 2010)

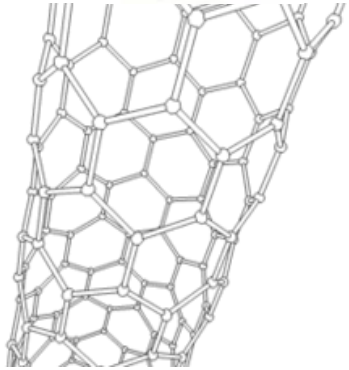
Potential pathways of ENMs to the environment



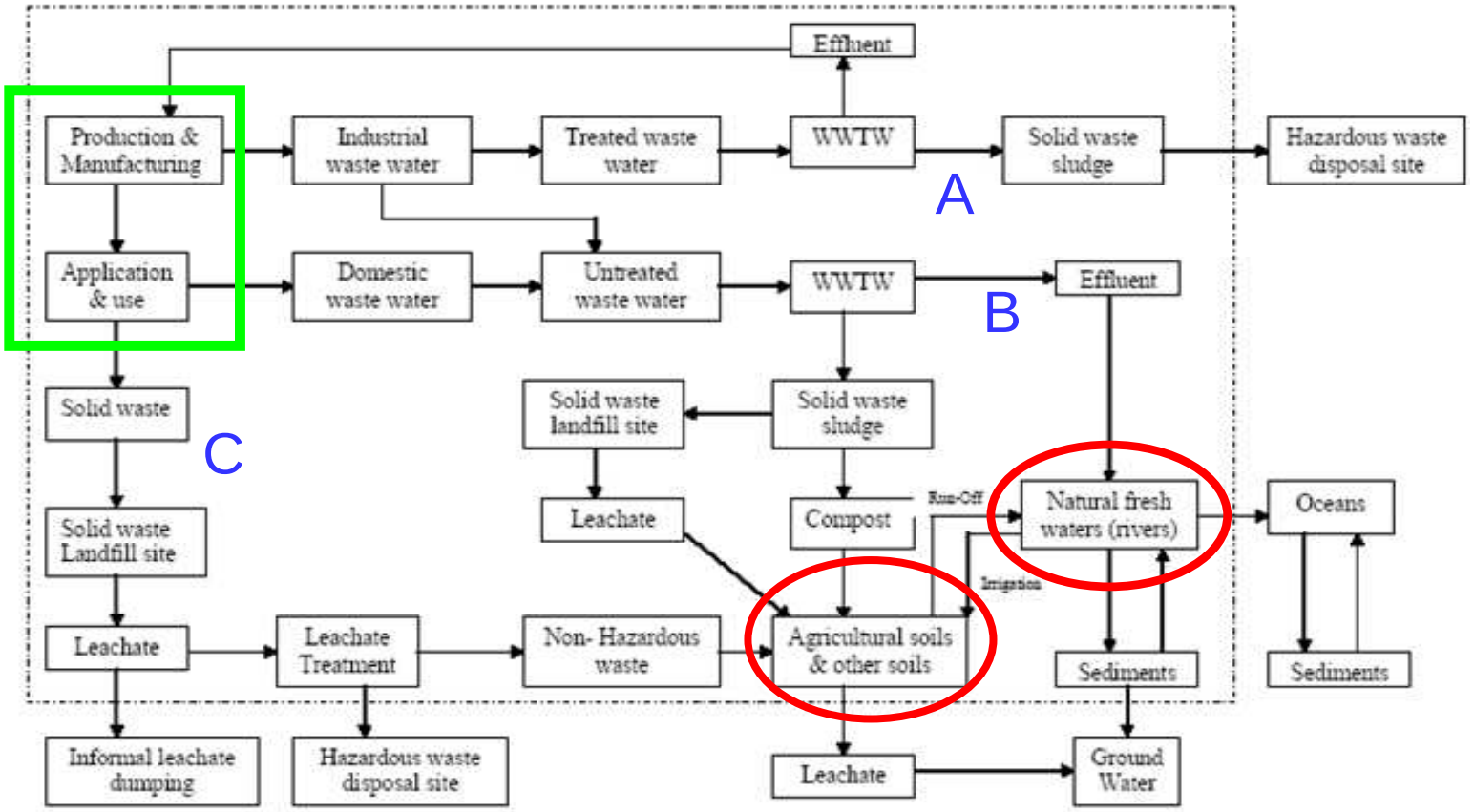
Objectives

- Estimate concentrations of $nTiO_2$ and CNT in aquatic and terrestrial environments of the Gauteng Province (GP), South Africa

- Estimate the potential risks of nTiO2 and CNT in aquatic and terrestrial environments



Methods: Probable environmental ENMs flows



Process boundary

WWTW – waste water treatment works

A – release to the hazardous waste sites

B – release to the aquatic environment

C – release to the terrestrial environment

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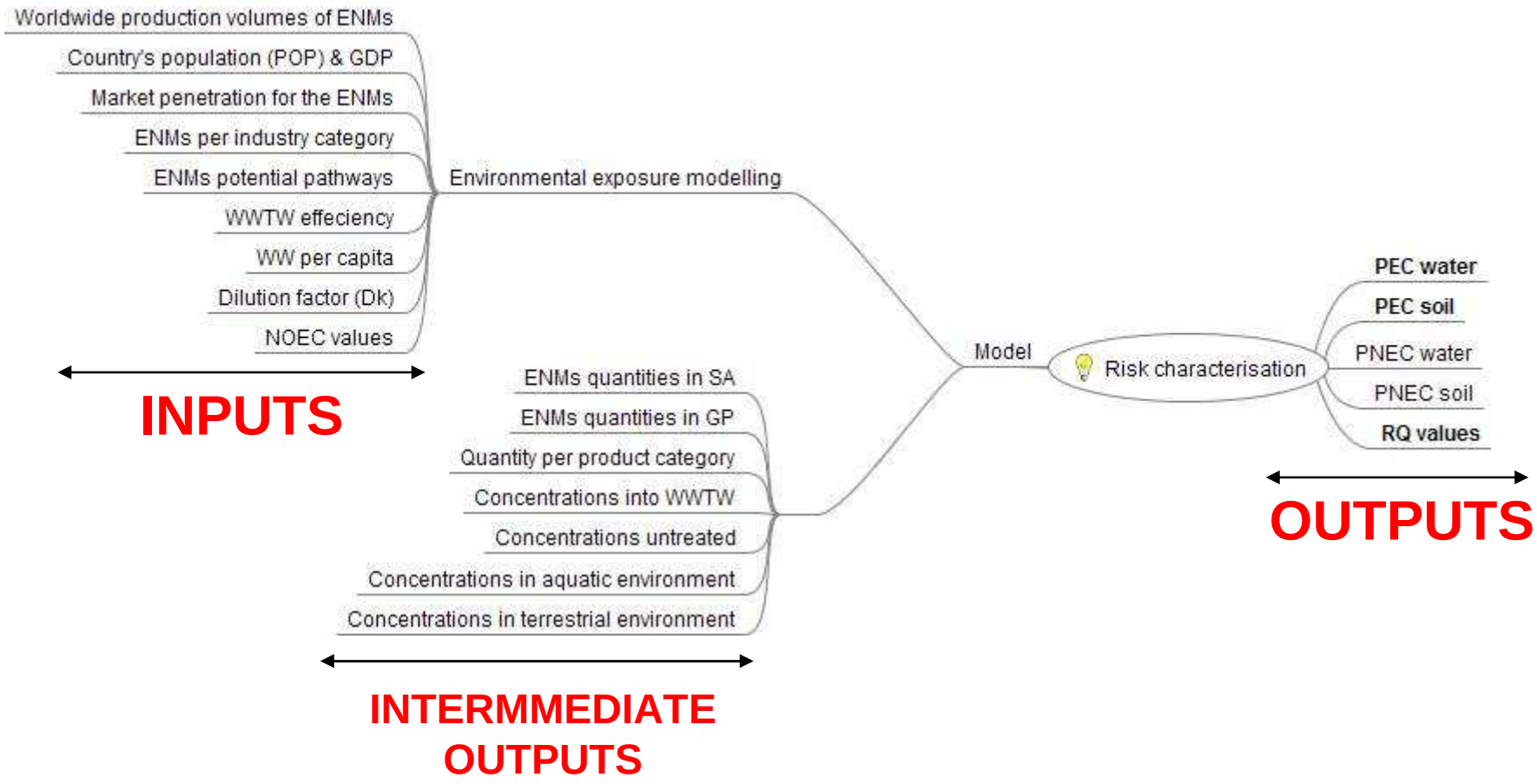
Model input and output variables



Model Equations: Aquatic Environment

$$NM_{Water,inputi} = NM_{WW,Totali} \bullet (1 - f_{STPi} \bullet f_{\mathrm{Re}movali})$$

$$C_{WW} = C_{STP} = \frac{NM_{i,WW,STP} \times 10^{12}}{WW_{percapita} \bullet f_{STP} \bullet POP}$$

$$PEC_i = \frac{NM_{i,Water} \bullet 10^{12}}{POP \bullet WW_{percapita} \bullet D_k} = C_{STP} \bullet \frac{NM_{i,Water}}{NM_{i,WW,STP}} \bullet \frac{f_{STP}}{D_k}$$

$$RQ = \frac{PEC_{NMi}}{PNEC_{NMi}}$$

Model equations: Terrestrial environment

$$NM_{soil,\ input(i)} = NM_{WW,Total(i)}\{1 - f_{STP(i)} * (1 - f_{removal(i)})\}$$

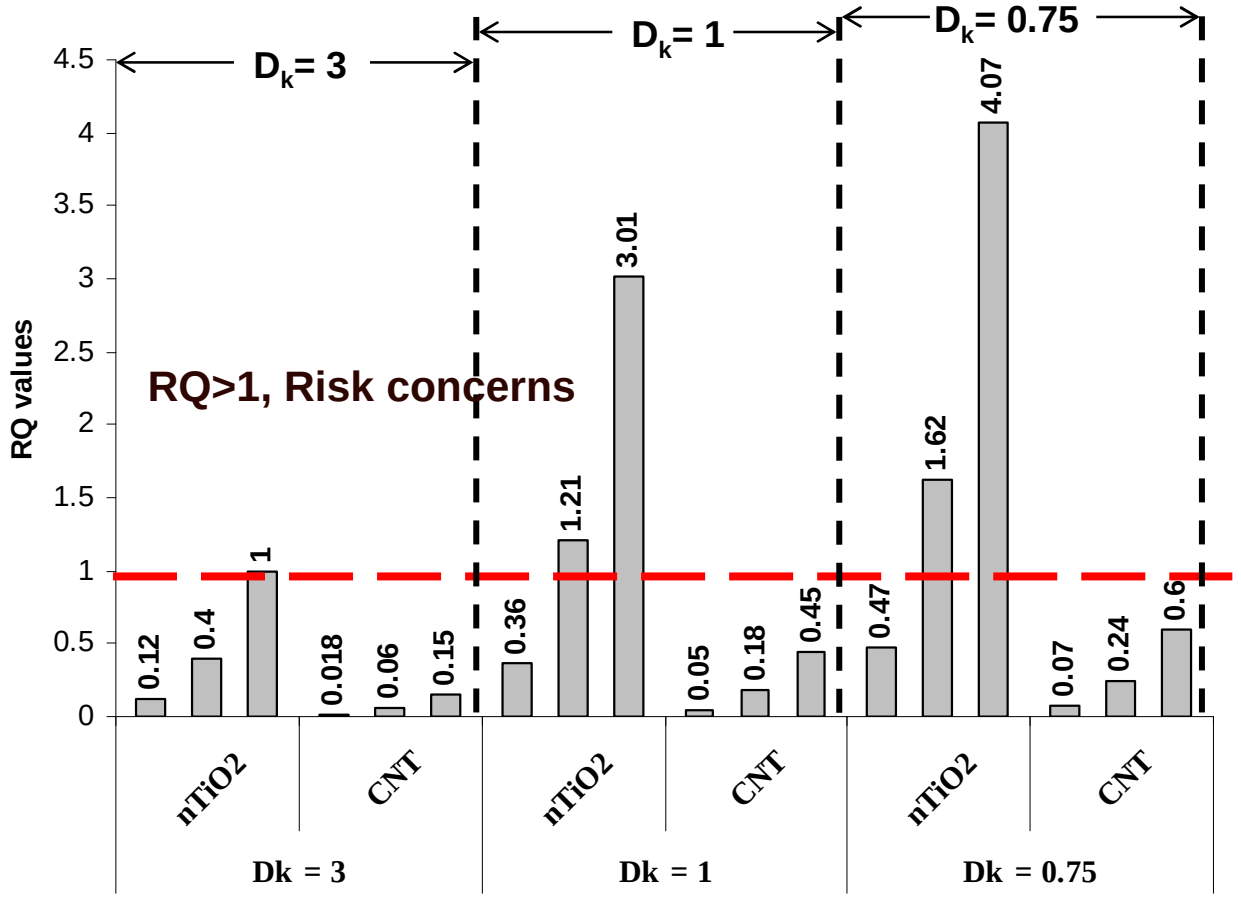
$$PEC_{soil} = \frac{A \bullet 10^{9}}{RHO_{soil} \bullet D_{soil}}$$

$$RQ = \frac{PEC_{NMi}}{PNEC_{NMi}}$$

Results and discussion (1)

	Modelled scenarios	Variables			
	$D_k = 1$	PEC_{water} (µg/L)	RQ_{water}	PEC_{soil} (µg/L)	RQ_{soil}
$nTiO_2$	Min	0.035591	0.355905	0.457127	0.000457
	Prob	0.121298	1.212985	1.879172	0.001879
	Max	0.30059	3.005905	3.348632	0.003349
CNT	Min	0.005301	0.053006	0.068081	0.006808
	Prob	0.018065	0.180653	0.27987	0.027987
	Max	0.044768	0.447676	0.49872	0.049872

Results and discussion (2)



Conclusions and recommendations

- $nTiO_2$ – poses higher risk concern in the GP aquatic environment (RQ>1)
- CNT did not show any risk concerns at present (RQ<1)
- Risk was minimal in the terrestrial environment (RQ<<<1)
- Urgent risk assessment measures to be prioritised for $nTiO_2$
- Hence, there is a need for parallel research on risk assessment to the synthesis, characterisation and applications of ENMs in the country

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THANK YOU

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