What will drive the EU nanoremediation market till 2025? Assessment of factors determining opportunities and challenges for the take-up of nanoremediation

AquaConSoil 2015 –
Special session 1C.24S

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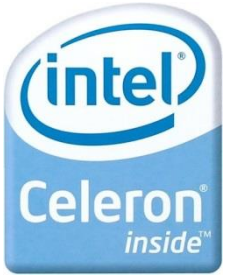
Nano-technology – market examples



Source: http://www.nanotechproject.org/cpi/

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A “normal” product life cycle

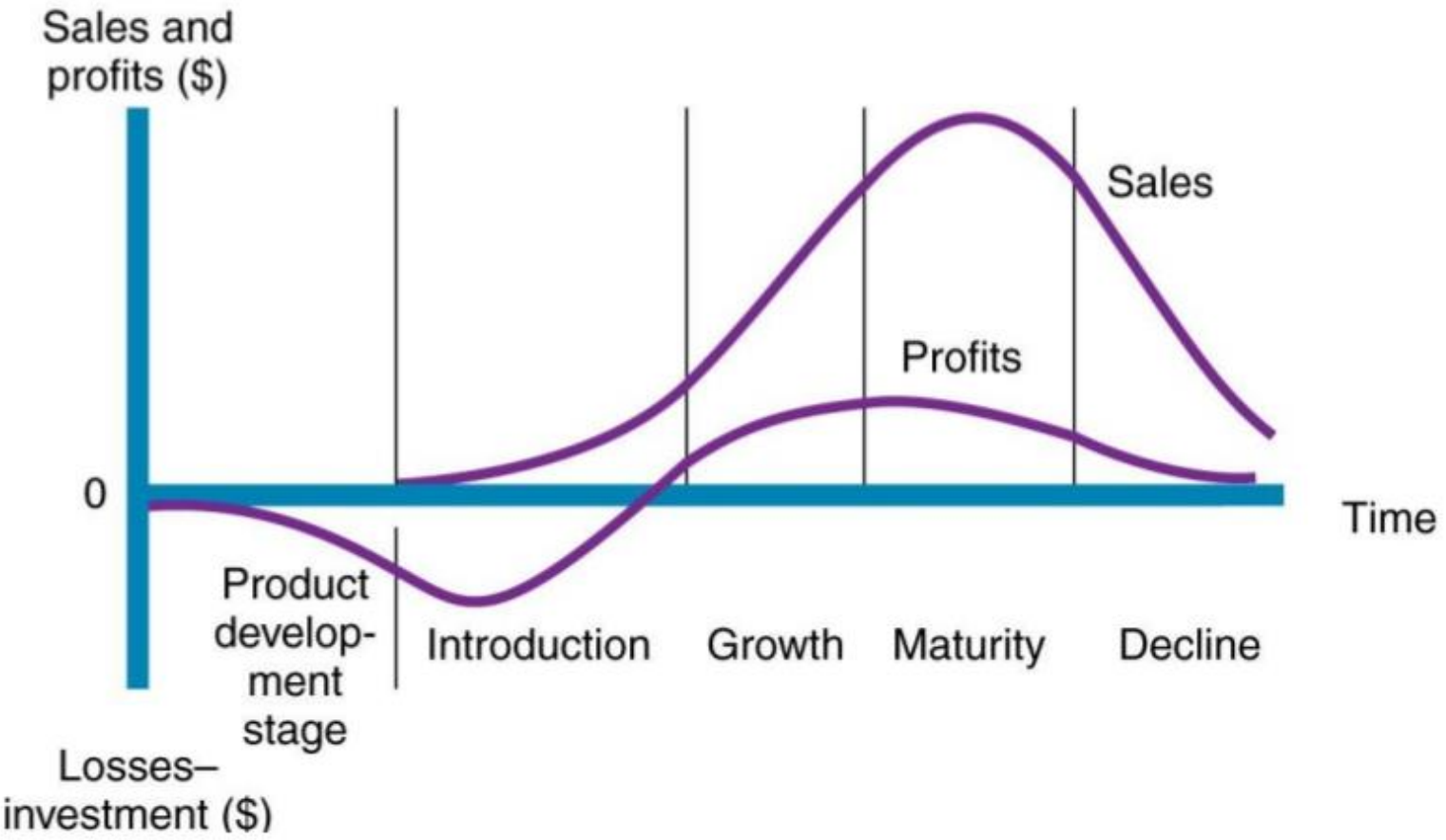

Image-Source: Moghimi 2013: http://image.slidesharecdn.com/kotler-10new-productdevelopmentandproductlife-cyclestrategiesmoghimi-130424085545-phpapp02/95/kotler-10-newproduct-development-and-product-lifecycle-strategies-moghimi-32-638.jpg?cb=1366811839

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Nanoremediation technology: Is it a “normal” product?

- People do not buy technology; they buy products – Robust product development is critical to realize the potential
- Venture community (research, entrepreneurs, …) behavior will determine the fate
- Early and periodic wins needed to keep investor confidence high
- Still uncertainties on application potential

Nano-remediation potentials

- Improving the speed of contaminant destruction
- Improving the extent of contaminant destruction
- Extending the treatable range of contaminants
- Limited longevity of action
- Compatibility with other treatments

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Scenario approach

- Advantages, risks and further development of the nanoremediation market are uncertain
- Scenario approach helps to uncover market drivers
- Projections of future states (2025) to derive recommendations

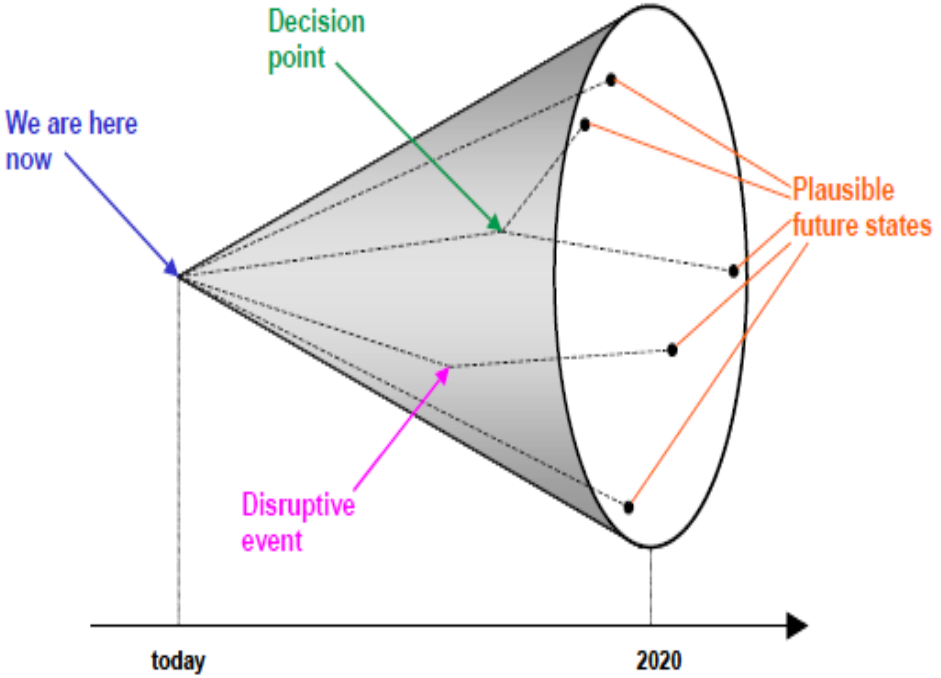

Figure 3.1 *The scenario funnel*

Source: Timpe and Scheepers (2003)

Understand drivers and inhibitors

- Collection of factors driving/inhibiting the market in expert interviews and from literature

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- Selection of most important factors based on expert engagement

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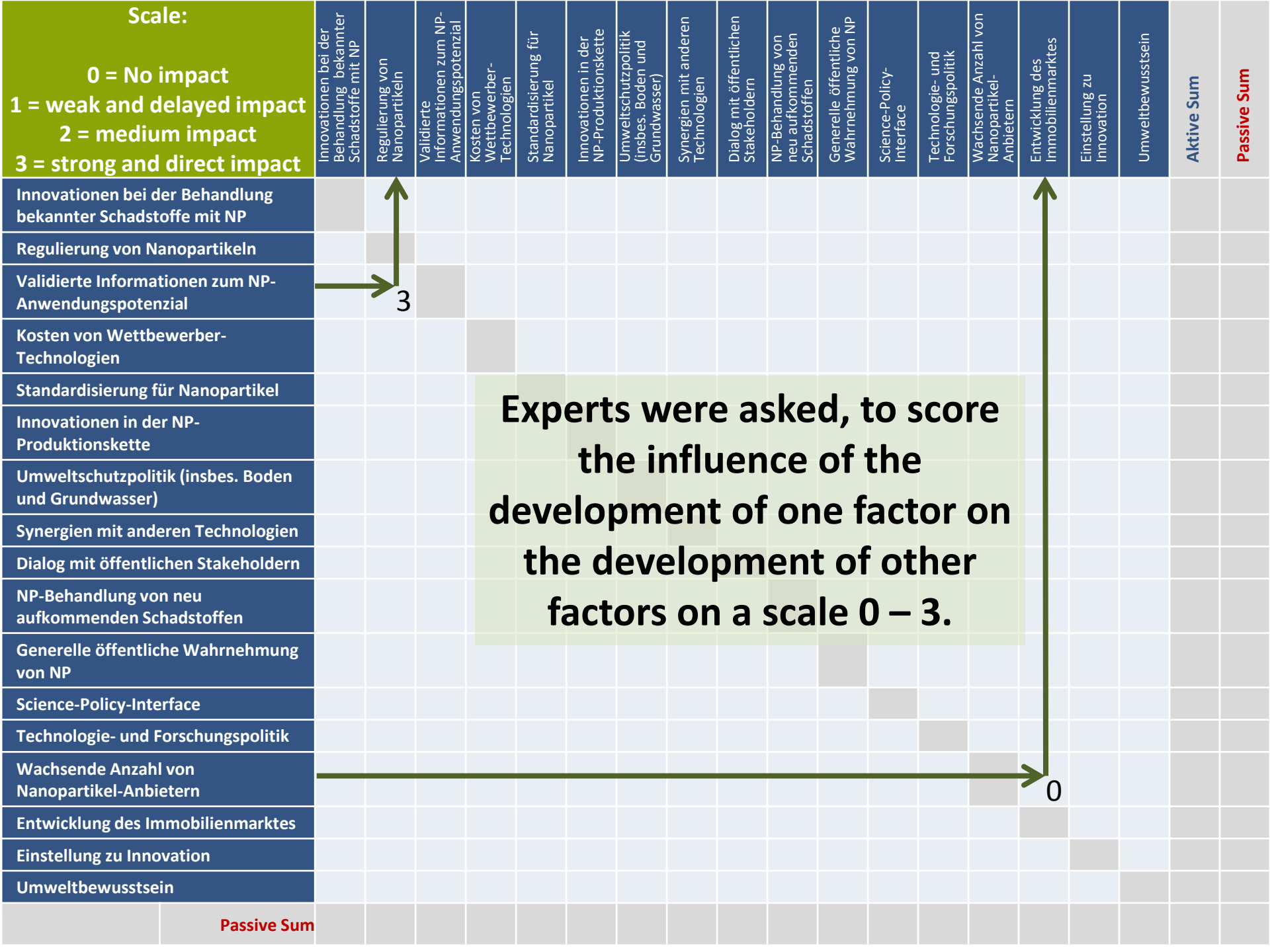
- Systemization of linkages and impact of 16 key factors


Scale:
0 = No impact
1 = weak and delayed impact
2 = medium impact
3 = strong and direct impact
Innovationen bei der Behandlung bekannter Schadstoffe mit NP
Regulierung von Nanopartikeln
Validierte Informationen zum NP-Anwendungspotenzial
Kosten von Wettbewerber-Technologien
Standardisierung für Nanopartikel
Innovationen in der NP-Produktionskette
Umweltschutzpolitik (insbes. Boden und Grundwasser)
Synergien mit anderen Technologien
Dialog mit öffentlichen Stakeholdern
NP-Behandlung von neu aufkommenden Schadstoffen
Generelle öffentliche Wahrnehmung von NP
Science-Policy-Interface
Technologie- und Forschungspolitik
Wachsende Anzahl von Nanopartikel-Anbietern
Entwicklung des Immobilienmarktes
Einstellung zu Innovation
Umweltbewusstsein
Aktive Sum
Passive Sum
3
0
Experts were asked, to score the influence of the development of one factor on the development of other factors on a scale 0 – 3.

Scale: 0 = No impact 1 = weak and delayed impact 2 = medium impact 3 = strong and direct impact	Innovationen bei der Behandlung bekannter Schadstoffe mit NP	Regulierung von Nanopartikeln	Validierte Informationen zum NP-Anwendungspotenzial	Kosten von Wettbewerber-Technologien	Standardisierung für Nanopartikel	Innovationen in der NP-Produktionskette	Umweltschutzpolitik (insbes. Boden und Grundwasser)	Synergien mit anderen Technologien	Dialog mit öffentlichen Stakeholdern	NP-Behandlung von neu aufkommenden Schadstoffen	Generelle öffentliche Wahrnehmung von NP	Science-Policy-Interface	Technologie- und Forschungspolitik	Wachsende Anzahl von Nanopartikel-Anbietern	Entwicklung des Immobilienmarktes	Einstellung zu Innovation	Umweltbewusstsein	Aktive Sum	Passive Sum
Innovationen bei der Behandlung bekannter Schadstoffe mit NP		0	0	3	2	2	0	2	1	1	1	0	2	3	1	3	1	22	29,5
Regulierung von Nanopartikeln	3		3	0		0	3	0	2	3	1	3	3	2	0	0	0	23	19
Validierte Informationen zum NP-Anwendungspotenzial	3	3		2	2	2	3	3	3	2	3	3	1	1	1	1	3	36	21
Kosten von Wettbewerber-Technologien	3	2	2		2	3	0	3	0	1	0	2	1	3	0	2	0	24	24
Standardisierung für Nanopartikel																		0	19
Innovationen in der NP-Produktionskette	2	0	0	3	3		0	2	0	3	0	0	2	3	1	3	2	24	21
Umweltschutzpolitik (insbes. Boden und Grundwasser)	3	3	3	0		0		0	3	3	1	3	3	2	0	0	1	25	17
Synergien mit anderen Technologien	3	0	0	3	2	2	0		1	2	1	0	2	3	1	3	1	24	20
Dialog mit öffentlichen Stakeholdern	1	3	3	1	1	0	3	0		0	3	3	2	1	1	0	3	25	20
NP-Behandlung von neu aufkommenden Schadstoffen	0	0	0	2	1	2	0	1	0		2	0	3	3	1	3	1	19	26
Generelle öffentliche Wahrnehmung von NP	0	1	0,5	0	0,5	0	1	0	3	0		2	1	2	0	2	1	14	21
Science-Policy-Interface	3	3	3	2	2	1	3	2	3	3	3		2	2	1	2	3	38	26
Technologie- und Forschungspolitik	3	0	2	1		2	2	1	1	3	1	3		1	0	2	1	23	27,5
Wachsende Anzahl von Nanopartikel-Anbietern	2	2	2	3	2	3	0	2	1	2	1	1	1		0	1	1	24	28
Entwicklung des Immobilienmarktes	1	0	1	3	1	0	0	1	2	0	0	1	0,5	1,5		0	1	11,5	8
Einstellung zu Innovation	1,5	0	0	1	0	2	0	2	0	2	2	2	2	2	0		0	16,5	24
Umweltbewusstsein	1	2	1,5	0	0,5	2	2	1	1,5	1	2	3	2	0	1	2		21	19
Passive Sum	29,5	19	21	24	19	21	17	20	20	26	21	26	27,5	28	8	24	19		

Interrelatedness of factors determining the market development

- 16 key factors identified to determine the market
- Below listed are the five most influential factors from those recorded in order of their activity

Factor	Active sum*	Passive sum*
Science-Policy-Interface	38	26
Validated information on NP application potential	36	21
Environment (especially soil) protection policies	25	17
Public stakeholder dialogue	25	20
Synergies with technologies	24	20

*Active and Passive sums had a maximum potential value of 48. The closer the active sum for a factor is to 48, the more influential that factor is.

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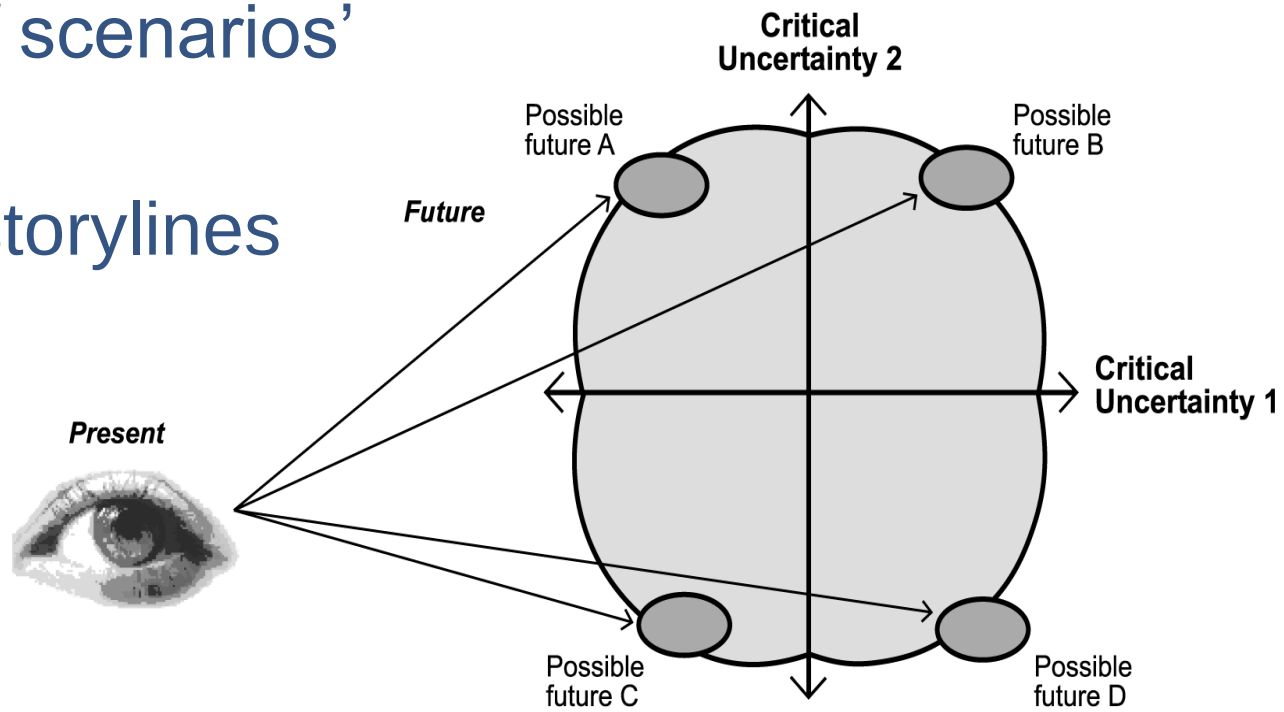
Envisioning future market state

- Compiling projections of plausible drivers' developments into plausible futures (scenarios)
- Evaluation of scenarios' consistency
- Elaborating storylines



The scenarios' development process based on critical uncertainties. Source: Kelly et al. (2007: 87).

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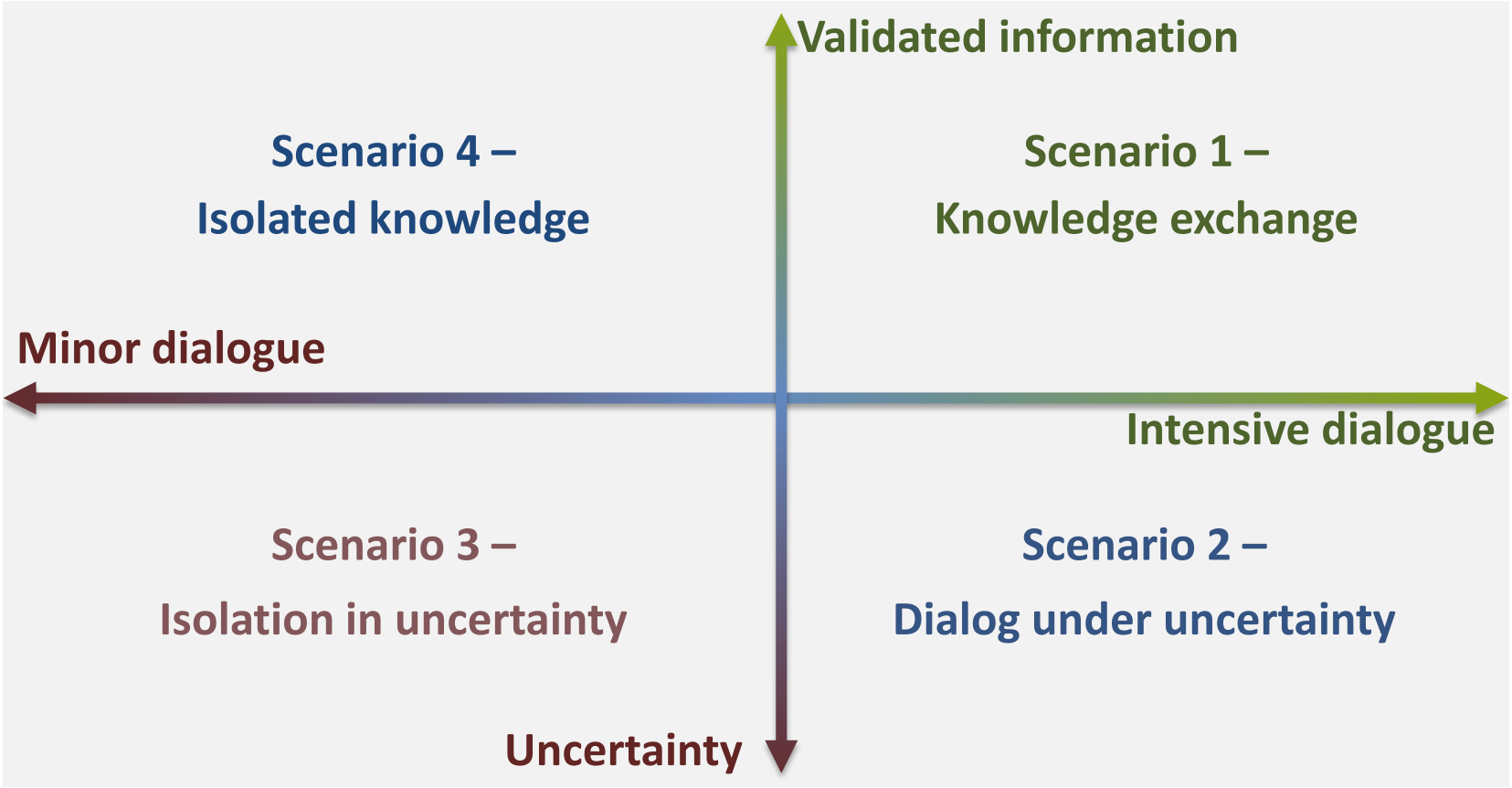
Future nanoremediation market states



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We would like to have your view:

1. How is the nanoremediation market changing / likely to change by 2025?

2. What is the most critical information needed to achieve a positive shift in the uptake of nanoremediation?

3. How are the factors identified likely to influence you or your organisation?

This project received funding from the European Union Seventh Framework Programme (FP7 / 2007-2013) under Grant Agreement No. 309517.

Scenario framing elements	
Validated information on NP application potential	'Information' dimension describing the quality of available information for decision-making. Information quality can range from a level with great uncertainty with regards to the potential developments of the market and the set of factors driving the market, to a situation where information about nanoremediation is readily available, well tested, and broadly accepted (i.e. "validated").
Science-Policy-Interface - Communication with others	Broadly understood as 'Dialogue' process by which stakeholder groups (in particular those from science, policy and regulation) have informal/formal discussions, consultations and other forms of engagement in order to ascertain the potential application of nanoremediation (in general or in specific cases).
Market determining factors as known now	
Innovation on treatment of known contaminants with NP	NPs are effective in treating a range of contaminants. They may be superior to existing remediation approaches (being quicker or cheaper to apply or offering another added value) on a site specific basis.
Regulation of nanoparticles	While moratoria against use of NPs for remediation still exist in a few instances, the emerging trend is that NPs can be deployed using existing regulatory regimes. Uncertainties are those experienced in general for the injection of "new" types of material into the subsurface.
Costs of competitive technologies	There are already competitive nanoremediation technology solutions, but their international market penetration is low and they face strong competition from more established in situ technologies. Cost effectiveness is highly site specific.
Innovations along NPs production chain	The production of NPs could be boosted by improved efficiency based on increasing knowledge and economies of scale, making NPs cheaper.
Environment (especially soil and groundwater) protection policies	There is policy uncertainty at a European level for remediation drivers in general (e.g., withdrawing of Soil Framework Directive versus increasing concerns over 'emerging contaminants'). Specific to nanoremediation 'moratoria' against use exist in some countries/regions but these may be reconsidered, particularly as a result of current research work
Synergies with technologies	NPs can be applied in remediation integrated with other approaches, e.g. bioremediation.
Public stakeholder dialogue	Refers to communication with general public. Risks, uncertainties and benefits should be communicated in targeted formats. (Dialogue work currently being conducted in the UK may indicate increasing acceptability of nanotechnology use in remediation.)
NP treatment of emerging contaminants	NPs are may be effective in remediating various emerging contamination problems, but research and practical experience are fairly limited at present.
Public perception of NPs in general - What people think of nano	Public perception of NPs is patchy with low consumer knowledge and ambiguity in risk perception. The increasing use of 'nano-products' implies increasing levels of public acceptance for the technology in general, although concerns over some specific potential pollutants such as nano-silver remain.
Technology and research policies	European and national policies fund R&D into innovative technologies, generating new knowledge, including a range of nanoremediation R&D and demonstration work (such as NanoRem).
Growing number of nanoparticles suppliers - supplier having available more produces	More producers are entering the market. Suppliers are typically remediation service providers, such as consultancies. More suppliers are considering nanoremediation, although the number investing in expertise, capacities and credibility to provide nanoremediation remains relatively small at present
Real estate market development	The property market has begun to recover since the financial crash increasing the demand for suitable areas for development – which in turn influences the demand for the remediation of contaminated land.
Innovation attitude – People like new technology	There is an increasing openness in the remediation sector towards innovation paired with willingness to invest in inventions and knowledge creation along with greater readiness to apply innovative technologies.
Environmental awareness and sustainability	There is increasing support for ensuring a more sustainable approach to contaminated land management, and this will increasingly affect remediation decision-making. This is a highly site specific consideration.