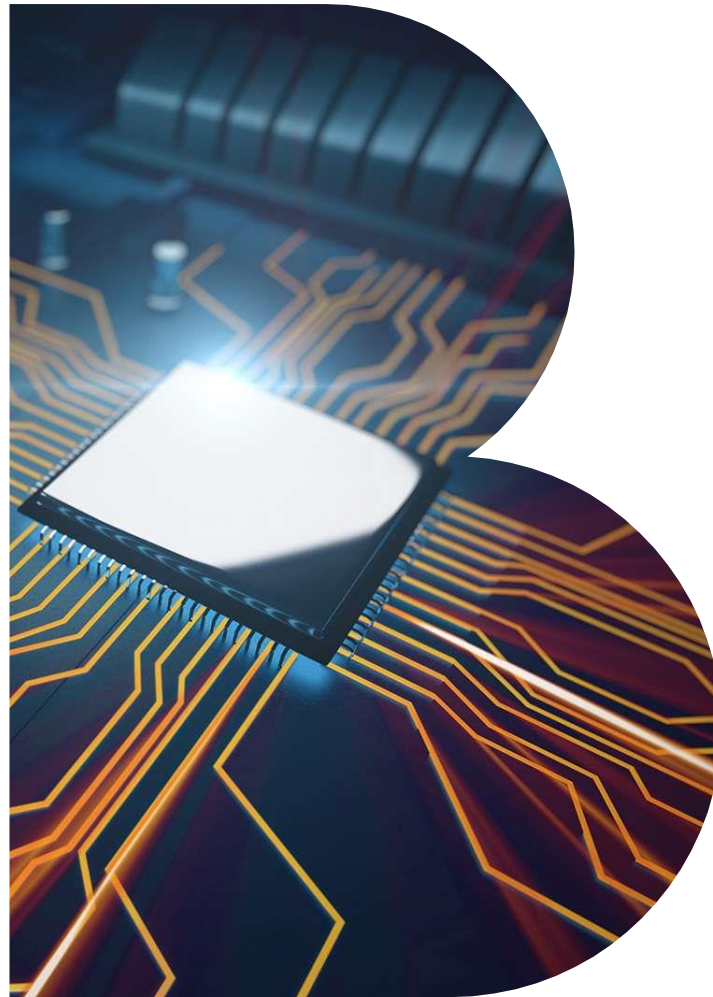


# Next steps for NanoNextNL

Report for Executive Board



# This document presents guidance for NNNL's continuation discussion based on interviews and case examples

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**Next steps** – Sustain NanoNextNL results by enabling new Public-Private-Partnerships (PPP) and initiating specific differentiating community functions

— Collected information —

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**A Company interviews** – Input from interviews with companies

**B Interviews with academia/board** – Selected input from interviews with academic participants

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**D FES predecessors** – Learnings from other FES initiatives that have preceded NanoNextNL

**E NanoNextNL overview** – Large impulse to Dutch nanotechnology community

# REFLECTIONS: Interviews reflected general interest for themes; need to be focused to applications and made economically relevant

## Key learnings from interviews

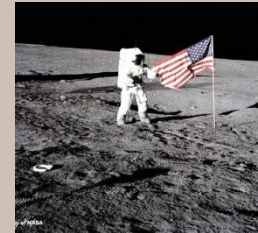
<b>Moonshot</b>	Future PPPs join <b>scientific, industrial</b> and <b>societal</b> relevance in one moonshot, collaborating on associated <b>roadmap</b> with <b>intermediate spin-off</b> and <b>critical mass</b> along the full <b>innovation chain</b> and clustered on <b>one physical location</b>
<b>Tailored financing</b>	'FES'-like funding does not seem to be(come) available anymore soon – this requires to find <b>tailored financing</b> for every individual continuation theme in line with its theme-specific dynamics
<b>Companies' view</b>	Companies are <b>interested</b> in <b>continuation themes</b> , but also see a lot of room for adapting, shaping and/or broadening the themes and wish to be involved in a <b>(co-)leading role</b>
<b>Cross-overs</b>	Interest for a <b>broad networking</b> community without resources/financing available for research <b>appears to be low</b> , while networks with <b>embedded cross-overs to other sectors</b> are marked as highly interesting to establish <b>new relations</b>
<b>Education</b>	<b>Educational programs</b> , other than the PhD research projects stimulating <b>expertise</b> and <b>multidisciplinary team work</b> skills, were <b>not marked as value adding</b> activity for a future community
<b>NWA</b>	For the future, being present in one of the routes of the <b>'NWA'</b> is seen as <b>necessary qualifier</b> for public parties to obtain public funding in PPPs
<b>SME facilities</b>	<b>SMEs</b> see <b>subsidies</b> as important instrument to sponsor their specific <b>own R&amp;D activities</b> , rather than outsourcing their research to academia, and to <b>facilitate in scaling up</b> (capital intensive) high-tech production
<b>RATA</b>	<b>RATA research</b> seen as interesting and <b>value adding</b> , but <b>no consensus</b> found as to <b>where to embed</b> RATA research in future programs
<b>Valorization</b>	<b>Valorization</b> (education) is done by many parties – although <b>well received</b> , there seems to be <b>no need for additional valorization programs</b> apart from making grants available

# PPP MODEL: Several roles should be fulfilled to organize multilateral R&D Public-Private-Partnerships (PPP)

## Key roles to organize in multilateral PPPs

### Exceeding *nanotechnology program*

- **Moonshots** a few appealing perspectives for society, industry and academia and associated roadmaps, around which excellent public and private parties/people cooperate and in which nanotechnology plays an important role (together with other fields)



### Differentiating *for nanotechnology program*

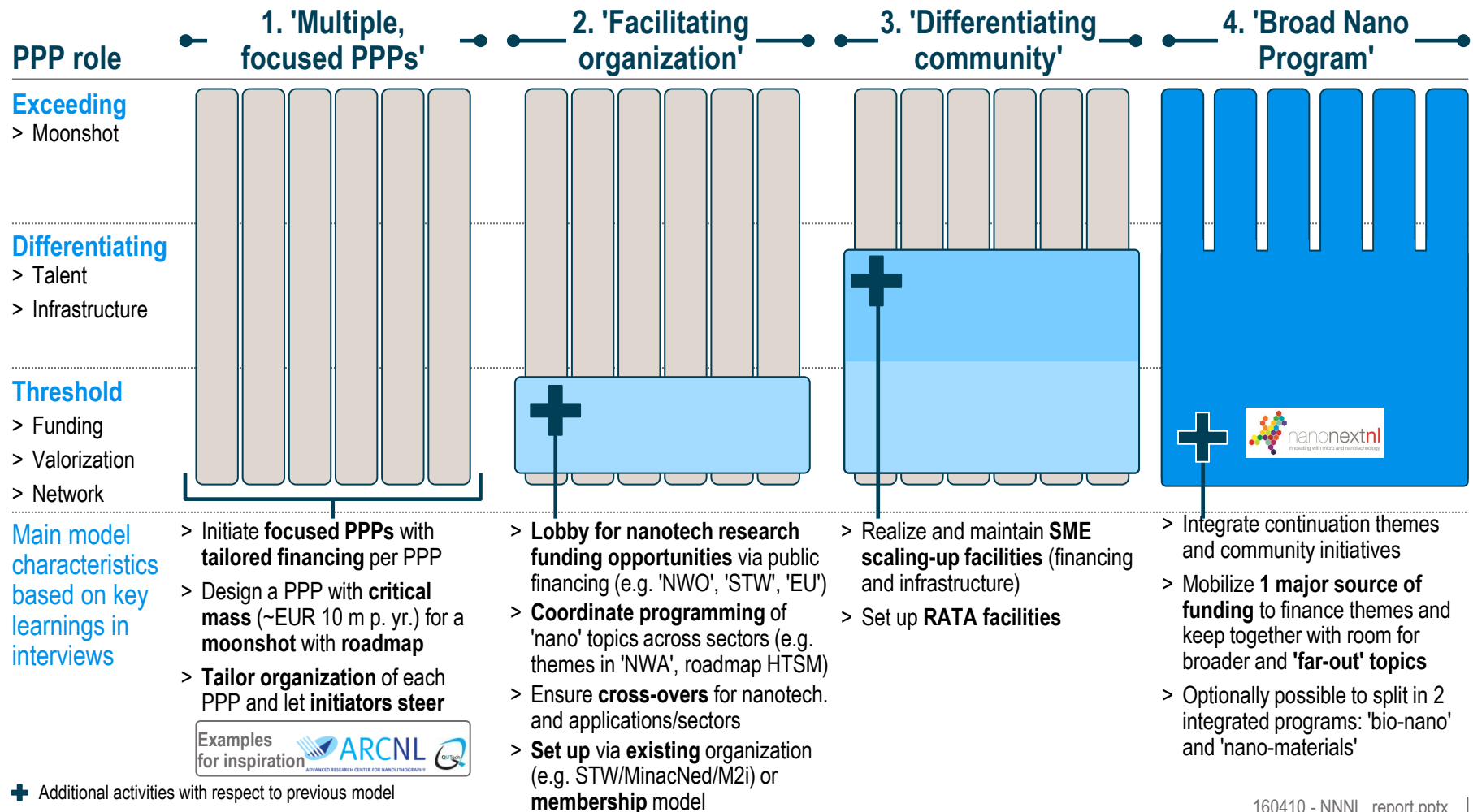
- **Talent** talented people in nanotechnology
- **Infrastructure** unique shared physical infrastructure in nanotechnology, not easily accessible for a single party and that also acts as a meeting place for the community

### Threshold *for nanotechnology program*

- **Funding** organizing financing (opportunities) for nanotechnology
- **Valorization** routes from idea to market
- **Network** good connections between parties/people in the sector

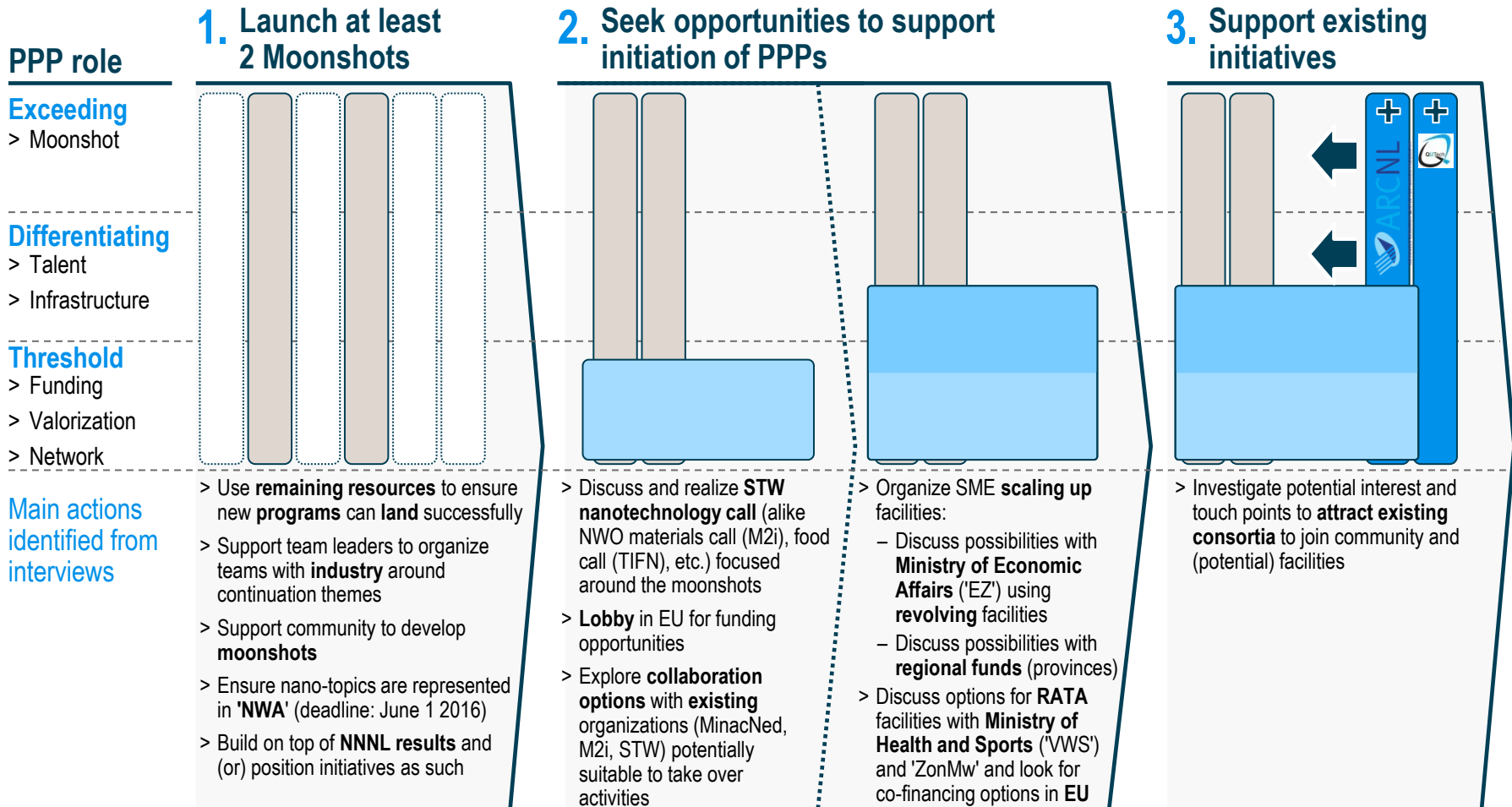
# OPTIONS: Based on the interview feedback, four models were found to be value adding continuation options for NanoNextNL

Potential NanoNextNL continuation models based on interviews



# NNNL STRATEGY: Realize at least two focused PPPs around moonshots and seek opportunities to support PPPs in nanotech

## Strategy for NanoNextNL



# ROLES: Executive Board will lead the search for nanotech broad opportunities – continuation theme leaders lead realization of PPPs

## Roles in executing strategy

	1. Launch at least 2 Moonshots	2. Seek opportunities to support initiation of PPPs	3. Support existing initiatives
<b>NanoNextNL Executive Board and office</b>	<p><b>SUPPORTIVE</b></p> <ul style="list-style-type: none"> <li>&gt; Transfers <b>lessons learned</b> from PPP cases</li> <li>&gt; Supports <b>financially</b> from NanoNextNL budget</li> <li>&gt; Stimulates where possible – e.g. <b>connecting</b> with industry and NWA</li> </ul>	<p><b>LEADING</b></p> <ul style="list-style-type: none"> <li>&gt; Seeks <b>funding</b> and <b>partners</b></li> <li>&gt; Inventories <b>needs</b> of community</li> <li>&gt; Mobilizes stakeholders for definition and realization of <b>facilities</b></li> </ul>	
<b>Continuation theme leaders</b>	<p><b>LEADING</b></p> <ul style="list-style-type: none"> <li>&gt; Drive definition, formation and <b>realization of PPP</b></li> <li>&gt; Seek connections with <b>industry</b> and drives development of roadmap towards <b>moonshot</b></li> </ul>		<p><b>SUPPORTIVE</b></p> <ul style="list-style-type: none"> <li>&gt; Give <b>input</b> on themes and facility requirements</li> </ul>

## A. Company interviews

*Input from interviews with companies*





# In the company interviews we reflected on NNNL, the selected continuation themes and guidelines for future PPPs

## Conclusions company interviews

- |                                  |  |
|----------------------------------|--|
| 1. <b>NanoNextNL reflections</b> | Industrial partners appreciated the R&D <b>multiplier</b> (enabling to look beyond their core) and the stimulation of <b>new relations</b> , where <b>cross-overs</b> could have been stronger   |
| 2. <b>PPP criteria</b>           | Industry values <b>cross-domain application</b> driven programs with involvement of all relevant <b>partners along the chain</b> and with <b>critical mass</b> organized                         |
| 3. <b>Continuation Themes</b>    | Industry is <b>interested</b> in themes, but also sees ample room for <b>adapting, shaping</b> and/or <b>broadening</b> the <b>themes</b> and wishes to be involved in (co-) <b>leading role</b> |
| 4. <b>Community needs</b>        | In the <b>community</b> , industry mostly interested in linking <b>cross-overs</b> between sectors – additionally, <b>SMEs</b> look for <b>scale up</b> facilities                               |
| 5. <b>PPP financing</b>          | Ministry of Economic Affairs ('EZ') refers to <b>existing financing instruments</b> , as well as the <b>anticipated importance of the NWA</b> for future financing of PPPs                       |

# Looking back, industrial partners appreciated R&D multiplier and new relations, which could have been stronger and more cross-domain

## NanoNextNL results – Feedback from industry



– *What was good?*

*Results*

*What was not so good?*



- > New (positively enforced) academia-industry **relations**
- > Providing **cross-sector view** on technology
- > Major effort to **integrate full program** and maintain it as a whole

### 1 Technology Network

- > After projects, partners separated for own course, **no strong sustaining new connections** outside natural 'clubs'
- > **Cross-domain collaborations** could have been stronger, not strongly embedded or enforced from start
- > **Governance** does not reflect volume-mix of participating partners

- > Attractive R&D investment **multiplier**
- > Enabled to explore **new areas**
- > Matching principle for industry greatly stimulated **rise of SMEs**
- > Some form of **focus of innovation** (after research) on key areas
- > Good examples of developed **working concepts**

### 2 Science

- > Many **relative small projects**, less room to develop sustaining assets in larger group
- > Results **not anchored in broader perspective on applications** or societal challenges
- > Free format projects, also led to **less intimate collaborations**

- > **Valorization program** (and **grants**) to bring prototypes to sample level where good

### 3 Business

- > Could enhance involvement of all players along value chain
- > Could have had more start-ups?
- > **Valorization program overlaps** with existing programs, grants are good incentive

- > Educated **new generation of PhDs**
- > **Entrepreneurship courses** interesting

### 4 Talent

- > Entrepreneurship courses **not necessary task for program** (is abundant at universities)

- > **RATA program** good and important

### 5 Societal value

- > **Negative connotation** of 'nano' for food applications

# Industry values cross-domain application driven programs with involvement of all relevant partners along the chain

## Success factors for multilateral R&D PPP programs (based on interviews)

<b>Design for new business</b>	Program should be designed with clear goal to establish or expand business and economical activity in The Netherlands
<b>Focus on applications jointly defined with industry</b>	One common objective with integral plan to work towards envisioned application as defined with, and partially controlled by, industry
<b>Involve full chain</b>	Involve partners along full supply chain until target application and involve R&D partners such that all TRL competences are represented
<b>Ensure critical mass, uniqueness &amp; excellence</b>	Program needs to have international impact in global niche, which requires critical mass of ca. EUR 10 m per year, to be unique and therefore appealing and internationally unparalleled academia
<b>R&amp;D multiplier</b>	Multilateral program needs to have R&D multiplier (i.e. via cash, facilities, shared research resources, ...)
<b>Organize physical location</b>	Physical location needed to stimulate multidisciplinary work, have visible appealing place to attract people and enable flexible and easy exchange of ideas
<b>Embed cross-overs</b>	Innovation happens at the intersection of disciplines – Programs should bring together different disciplines and different markets/industries
<b>Flexible program</b>	Set up flexible program to allow pivoting based on lessons learned
<b>SME as 'knowledge carrier'</b>	Many High-Tech SMEs with enabling technology want to be seen as 'knowledge' partner and treated alike academia in terms of subsidies, to let them do R&D themselves in their niche

# As a basis for the next phase, NanoNextNL is considering several focal themes

Potential themes for future 'NanoNextNL' – preliminary, work in progress

## 1. Organs-on-Chips

*Albert van den Berg (UT), Vinod Subramaniam (AMOLF), Andries Vermeer (UT)*

- > Ever increasing healthcare costs and rise of chronic diseases demand improved therapy efficiency
- > The aim is to develop organs-on-chips: realistic laboratory models of human tissues that improve outcome and efficiency of new drug development

## 4. Green ICT

*Paul Koenraad (TU/e), Guus Rijnders (UT)*

- > Computer systems need ever increasing levels of data exchange, which requires increasing energy consumption
- > Limits of current photonic, electronic and magnetic ICT components are reached
- > The aim is to develop new hybrid opto-electronic-magnetic materials to build new energy efficient ICT devices

## 2. 3D Nanostructuring and metrology

*Pieter Kruit (TU Delft), Ardi Dortmans (TNO)*

- > Next generations of e.g. nano-electronics, catalysis and solar panels ask more complex nano structures in high volume/high precision manufacturing
- > The aim is to provide knowledge and tools for 3D nano manufacturing

## 5. Synthetic Biological NanoDevices

*Menno Prins (TU/e), Jan van Hest (RU)*

- > Ever increasing healthcare costs demand improved therapy efficiency – trends are moving towards automated/self-management and early diagnosis
- > The aim to develop synthetic biosensors and bioactuators for continuous monitoring and control of drug delivery based on nano-bio-chemical advances

## 3. Nanomaterials for Solar Energy

*Wilson Smith (TUD), Erwin Kessels (TU/e)*

- > Solar energy has potential to take major share in global sustainable energy supply – for that, efficiency of panels needs to increase and storage to improve
- > The aim is to develop nanomaterials and prod. equipment for ultra efficient solar panels and for storage in solar fuels

## 6. Food body interactions



*Maarten Jongtsma (WUR), Krassimir Velikov (Unilever), Karin Schroën (WUR)*

- > The Netherlands has an internationally renowned food industry that is of major importance to our economy
- > That industry needs tools to test its products and ingredients
- > The aim is to develop devices that model a.o. human taste and digestions for high-throughput testing of food/ingredients

# Themes perceived as 'far-out' topics – Industry is interested to collaborate and shape the continuation themes towards applications

## Industry interest in 'continuation themes' from interviews

Companies	Organs-on-Chips	Food body interactions	Synthetic Bio Nano Dev.	3D Nanostr. & metrology	Nanomater. for Solar Energy	Green ICT
Company 1	✓	✓	✓	x	~	✓
Company 2	✓	✓	x	x	x	x
Company 3	✓	✓	x	x	x	x
Company 4	x	✓	x	x	x	x
Company 5	x	x	✓	x	x	x
Company 6	~	x	~	~	x	x
Company 7	x	✓	x	x	✓	x
Company 8	x	~	✓	✓	✓	✓
Company 9	x	x	x	x	✓	✓
Company 10	x	x	x	✓	✓	x
Company 11	x	x	x	~	~	x
Company 12	~	x	x	~	x	x
Company 13	x	x	x	x	x	x
Company 14	x	x	x	✓	✓	x

 Company showed interest to join and shape topic
  Company showed marginal interest; keep informed
  Company did not show interest

There are other (public-private) partnerships around the continuation themes – Suggested to investigate where to join efforts

Suggested touch points for continuation themes (based on interviews) – Non exhaustive

**Organs-on-Chips**

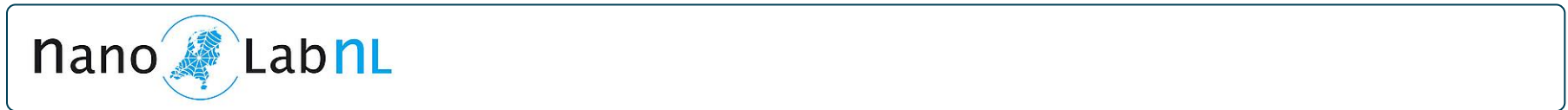
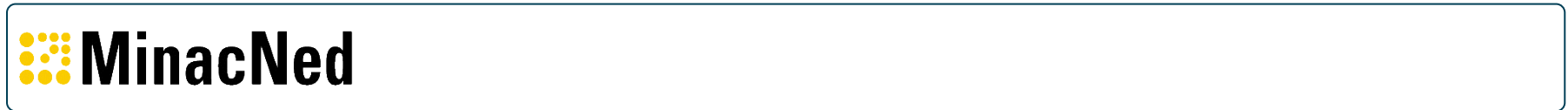
**Food body interactions**

**Synthetic Biological Nanodevices**

**3D Nanostruct. & metrology**

**Nanomaterials for Solar Energy**

**Green ICT**



# Regarding community, industry mostly interested in linking cross-overs between sector; additionally, SMEs look for scale up facilities

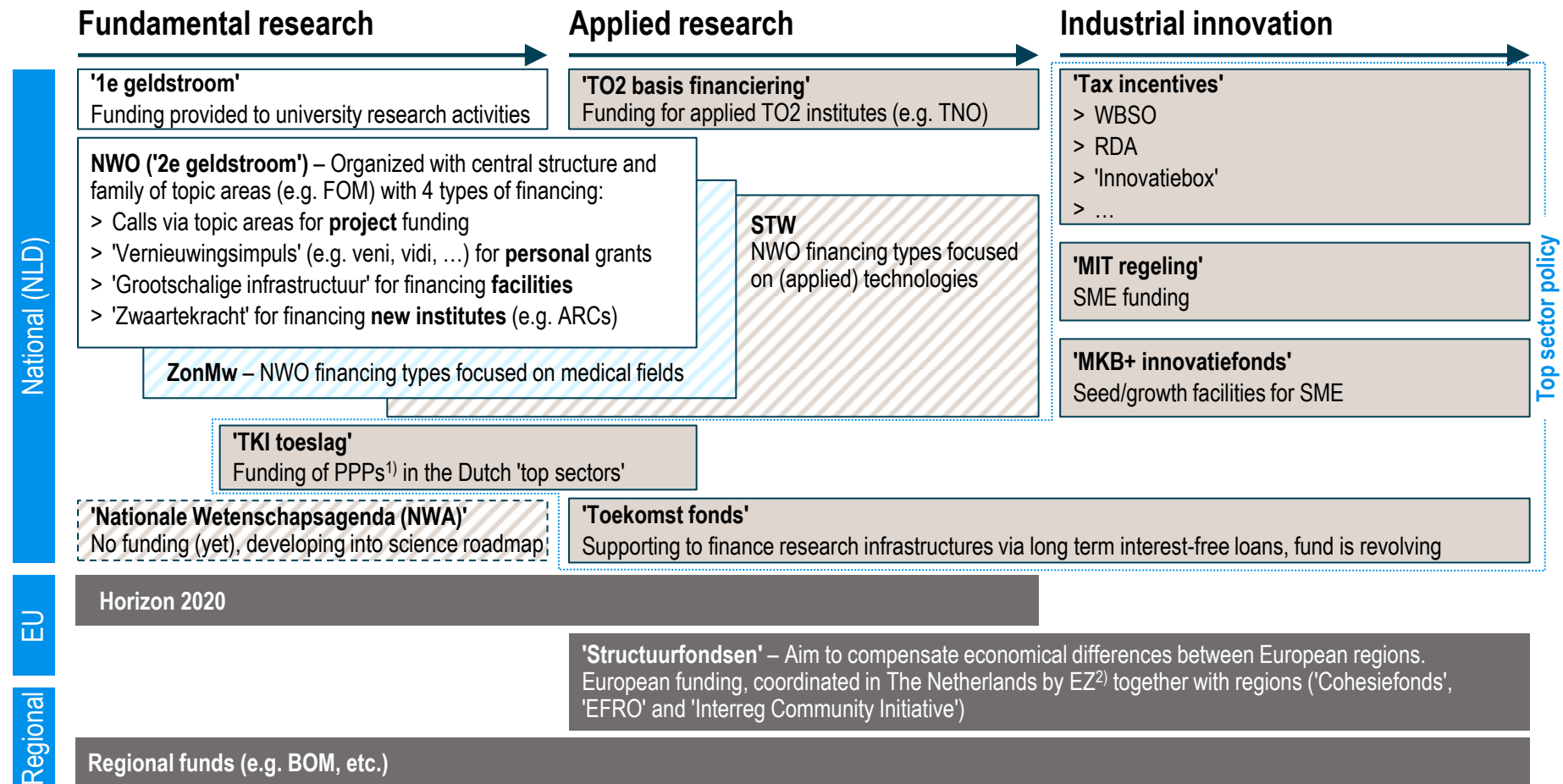
## Industry interest in nanotechnology community building

Companies	Network & PR	Talent & Education	Infra & Facilities	Lobby & Legislation
Company A	> Connect tech. with app. in broad sense > Drive societal education	> n/a	> n/a	> Collaborate to standardize regulatory approval
Company B	> n/a	> Consolidate metrology knowledge > Organize selected post-master courses	> n/a	> Discuss environmental impact
Company C	> No separate broad network needed, should be build via content programs	> n/a	> n/a	> n/a
Company D	> Single discipline comm. exist, multi-disc. requires effort, not per se needed	> n/a	> Pilot foundry facility to scale up production capacity	> n/a
Company E	> Sustain broad multidisciplinary cross-over network indep. of science program	> n/a	> n/a	> n/a
Company F	> Offer yearly full-width conference would be good (enough)	> n/a	> Pilot foundry facility to scale up production capacity	> n/a
Company G	> n/a	> Platform for education: (1) expert knowledge, (2) soft team skills	> n/a	> n/a
Company H	> International PR to advertise sector	> Link university education to each other and to industry needs and std. quality	> Build High-Tech specific incubators: lab + office together	> n/a
Company I	> Connect nanotechnology and cell biology fields (cross-overs)	> n/a	> Looking for facilities to scale up with lab-on-a-chip suppliers	> n/a
Company J	> International PR to advertise sector > Formal network as 'go-to' place for nano	> Ensure skilled clean-room technicians	> n/a	> Install European lobby (service fee + commission)
Company K	> n/a	> Academic research certainly useful and applicable for company's topics	> n/a	> n/a
Company L	> Would be good to be connected, but there are already many 'clubs/groups'	> Talent development via 1-on-1 PhD assignments with selected groups	> n/a	> n/a
Company M	> Focused collaborations – broad network not needed (unless it provides subsidies)	> Not interested in education platform	> Shared pilot foundry could support in tackling scale up challenge	> Not particularly interested in joint lobby
Company N	> tbd	> tbd	> tbd	> tbd

<ul style="list-style-type: none"> <li>&gt; Cross-overs in disciplines (via programs)</li> <li>&gt; No broad networking interest expressed – potential interest for recognizable community with network and PR function</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Talent development via PhD tracks suffices – no additional programs needed</li> </ul>	<ul style="list-style-type: none"> <li>&gt; SMEs look for support in facilities (infra, financing) to scale up – could be (partially) shared via community</li> </ul>	<ul style="list-style-type: none"> <li>&gt; RATA topics could fit in broader community</li> <li>&gt; Minimum (explicit) interest for joint lobby</li> </ul>
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EZ refers to existing financing instruments, as well as the anticipated importance of the NWA for future financing of PPPs

Public financing landscape



1) PPP = Public-Private-Partnership; 2) EZ = Ministry of Economic Affairs

□ OC&W (Ministry of Education, Culture and Science) □ WVS (Ministry of Health and Sports) □ EZ<sup>2)</sup>



# Input has been obtained through 39 interviews

## Interview overview

### Continuation Topic Leaders

Albert van den Berg (Organs-on-Chips)  
 Pieter Kruit (3D Nanostructuring and metrology)  
 Erwin Kessels (Nanomaterials for Solar Energy)  
 Guus Rijnders (Green ICT)  
 Menno Prins (Synthetic Biological NanoDevices)  
 Maarten Jongsma (Food body interactions)

### NNNL Leadership

Dave Blank  
 Jaap Lombaers  
 Albert Polman  
 Reinder Coehoorn  
 Martin Schuurmans  
 Leon Gielgens  
 Frank de Jong (FEI)

### PPP cases

Marco Waas (Akzo Nobel, ARC CBBC)  
 Mario van Wingerde (M2i)  
 Cees Slingerland (AMS)  
 Bert Kip (Brightlands Chem. Campus)  
 Anouschka Versleijen (QuTech)  
 Jorg Janssen (Lygature)  
 Colje Laane (NGI)  
 Ruben Kok (DTL)

### Company interviews

Marcel Wubbolts & Germ Visser (DSM)  
 Jos Keurentjes (TNO, ex AKZONobel)  
 Hans Hofstraat (Philips)  
 Henk Leeuwis (Lionix)  
 Jasper Wesseling & Richard Roemers (EZ)  
 Ger Willems (FrieslandCampina)  
 Wybren Jouwsma & Joost Lötters (Bronkhorst)  
 Marcel Slot (Océ)  
 Arjen Janssens (Solmates)  
 Frank Schuurmans (ASML/ARCNL)  
 Richard Janssen (Galapagos/hDMT)  
 Eugene Reuvekamp (PANalytical)  
 Hans Rijns (ex. CTO NXP)  
 Romano Hoofman (NXP)  
 Janneke Hoedemaekers (NanoLab)  
 Ronny van 't Oever (MinacNed/Micronit)  
 Egbert-Jan Sol (TNO ind./Smart ind.)  
 Roel Bosch (Meyer Burger)

## B. Interviews with academia/board

*Selected input from interviews with academic participants*



# Generally recognized that an ecosystem was created and major steps forward in science, while truly collaborating has proven difficult

## NanoNextNL results – First feedback from academia and board interviews



– *What was good?*

**Results**

– *What was not so good?*



<ul style="list-style-type: none"> <li>&gt; <b>New connections</b> between <b>industry</b> and <b>academia</b> in nanotechnology</li> <li>&gt; <b>Broad ecosystem</b> in and <b>across</b> programs/themes</li> </ul>	<p><b>1 Technology Network</b></p>	<ul style="list-style-type: none"> <li>&gt; <b>Larger companies</b> rather <b>closed</b> and <b>difficult to steer</b></li> <li>&gt; Large collection of topics/programs with <b>limited focus</b> and <b>synergy</b> (together for the funding)</li> </ul>
<ul style="list-style-type: none"> <li>&gt; <b>Major investment</b> in <b>science</b></li> <li>&gt; <b>Good scientific output</b> with several spikes</li> <li>&gt; <b>Simple procedures</b>, pragmatic reviews</li> </ul>	<p><b>2 Science</b></p>	<ul style="list-style-type: none"> <li>&gt; Companies <b>net receivers</b>, leading to <b>limited 'pressure'</b> on <b>academia to deliver</b> on promise</li> <li>&gt; Room to <b>enhance steering</b> with more <b>content reviews</b></li> <li>&gt; <b>Fixed program</b> at the start tampered <b>accountability and steering on results</b></li> <li>&gt; Difficult to <b>re-align collaborations</b> when projects <b>changed</b></li> </ul>
<ul style="list-style-type: none"> <li>&gt; <b>Structured and objective valorization</b> program with fair amount of start-ups seeded</li> <li>&gt; Good <b>involvement of SMEs</b> and good results for SMEs</li> </ul>	<p><b>3 Business</b></p>	<ul style="list-style-type: none"> <li>&gt; <b>True involvement</b> of companies and <b>true collaboration</b> between <b>academia</b> and companies was limited</li> </ul>
<ul style="list-style-type: none"> <li>&gt; <b>Good entrepreneurship program</b> familiarized PhDs with commercialization</li> <li>&gt; Large <b>amount of PhD students</b> educated in nano</li> </ul>	<p><b>4 Talent</b></p>	<ul style="list-style-type: none"> <li>&gt; <b>Recruiting</b> talent was <b>difficult to synchronize</b>, which delays projects and hampers collaborations</li> </ul>
<ul style="list-style-type: none"> <li>&gt; <b>RATA research positioned as pro-active</b> topic and connecting element</li> </ul>	<p><b>5 Societal value</b></p>	<ul style="list-style-type: none"> <li>&gt; Program <b>overhead budget</b> could be reduced</li> <li>&gt; <b>Size</b> of RATA program was perceived as <b>out of proportion</b></li> </ul>

# Theme leaders for selective continuation expressed expectations and ideas for the potential future role of NanoNextNL

Expectations/ideas on potential roles for NanoNextNL in the near future from interviews

## Acquire funding (or open funding opportunities)

How can I get my projects funded?

- > Acquire **funding for research** – e.g. from national government
- > Set **agendas and influence other funders** – e.g. NWO nanotechnology call, connect to Europe and European roadmaps
- > Provide **transition budget**, to continue the results until new funding found
- > Facilitate **Match-making** of projects/research with funders

## Stimulate academia-industry collaborations

How can we seduce industry to invest and truly collaborate?

- > **Facilitate definition of joint programs** that are appealing to industry, e.g. based on 'Moonshots'
- > Facilitate **Match-making** of academia and industry
- > Introduce academic **scientists to decision makers** in companies

## Maintain common grounds

How can we continue sustaining common grounds?

- > **Maintain the established network** of Dutch public and private nanotech-related organizations
- > Establish **joint education** initiatives, e.g. national nanotech research school for (PhD) education
- > Maintain nanotech **valorization** and start-up expertise and program
- > Stimulate attention for the topic of **risk assessment**

## C. Post-FES environment

*PPP environment has changed after FES*

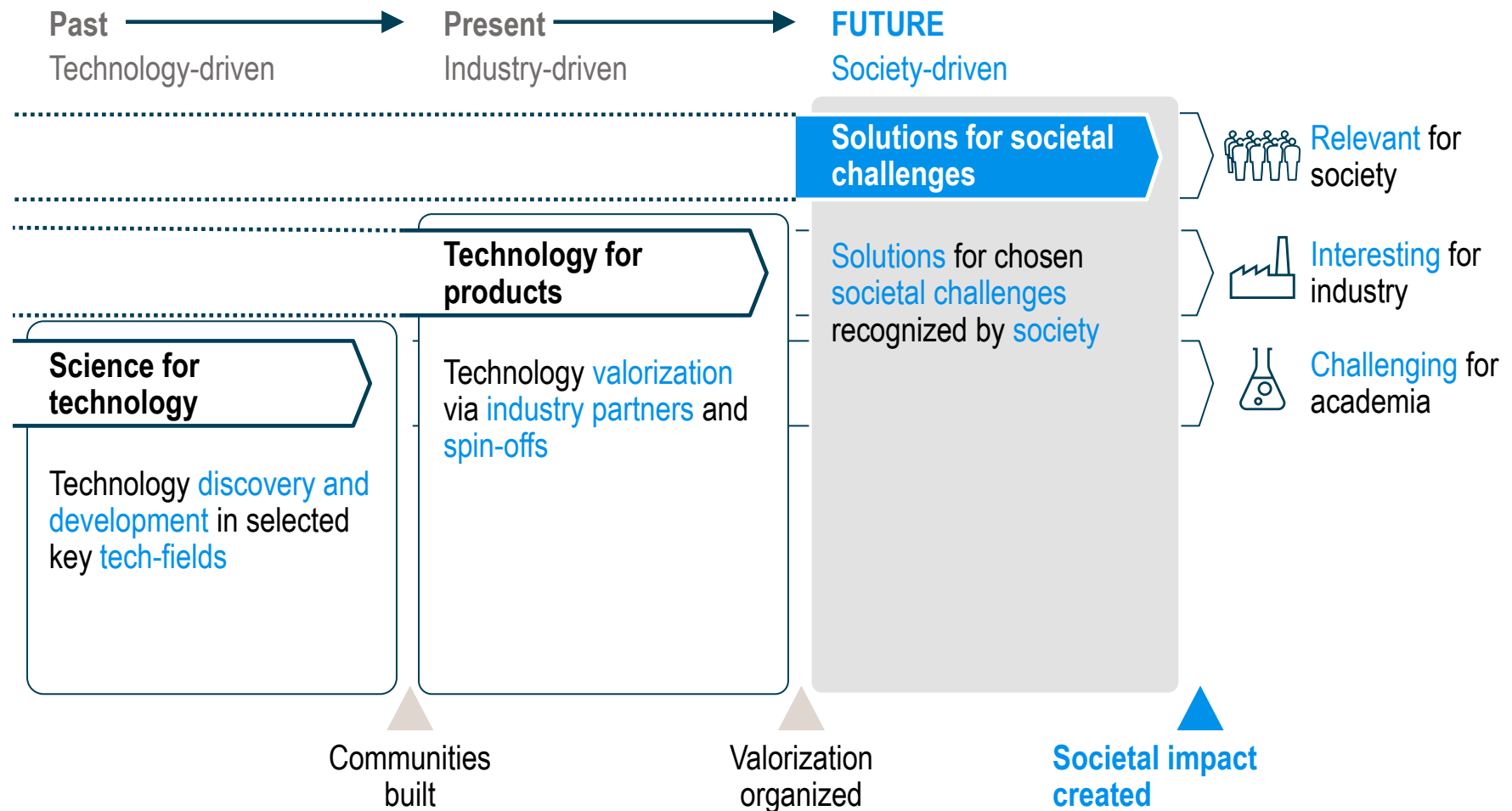


# The funding landscape has changed since NanoNextNL was established

## Funding landscape changes

FES episode	Top Sector regime and beyond	Implications for NanoNextNL
<p><b>Large</b> pocket <b>central</b> governmental funding to finance <b>whole</b> initiative</p>	<p><b>Scattered</b> decentralized funding pockets (regional, national, EU) to finance <b>parts</b> of initiatives</p>	<ul style="list-style-type: none"> <li>&gt; Chances of obtaining a single, large fund for (selective) continuation of NanoNextNL are slim</li> </ul>
<p><b>Central theme</b> mostly around <b>technology</b> or <b>economic sector</b></p>	<p>Push central theme away from technology towards <b>economic sectors</b> (topsectors) or <b>social challenges</b> (especially EU)</p>	<ul style="list-style-type: none"> <li>&gt; NanoNextNL should consider whether nanotech is an appealing theme towards financiers, and connect to economic and social themes</li> </ul>
<p>Large, <b>broad programs</b> (e.g. nanotech as a whole)</p>	<p>More <b>focused initiatives</b> (e.g. specific topic in nanotech)</p>	<ul style="list-style-type: none"> <li>&gt; NanoNextNL should consider the value of having a multitude of different topics/programs in a single initiative</li> </ul>
<p><b>Private</b> parties are <b>net receivers</b> with large multiplier on investment</p>	<p><b>Private</b> parties are <b>net payers</b> with limited multiplier on investment</p>	<ul style="list-style-type: none"> <li>&gt; NanoNextNL was financially very attractive to companies – in a next phase the conditions for companies may be very different</li> <li>&gt; Poses challenge on how to attract them and collaborate with them</li> </ul>

# Future public-private partnerships need to be relevant for society, interesting for industry and challenging for academia





# Post-FES PPPs show a variety of funding models and propositions to companies

Examples of 'post-FES' PPPs (for details see next slides)

	PPP	Funding model	Proposition to companies (key elements)
Regional subsidies	<b>AMS</b>	<ul style="list-style-type: none"> <li>&gt; EUR 50 m subsidy from the <b>city of Amsterdam</b> for a 10 year period</li> <li>&gt; To be matched with EUR 200 m by <b>academia and companies</b>, project <b>subsidies</b> (e.g. NWO, EU, regions) and <b>revenue models</b></li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Infrastructure:</b> use of the City of Amsterdam as a living lab</li> <li>&gt; <b>Co-financing:</b> some co-funding from the subsidy of the city</li> <li>&gt; <b>Excellence:</b> cooperation with internationally leading researchers</li> </ul>
	<b>BMC, InSciTe and AMI-BM</b>	<ul style="list-style-type: none"> <li>&gt; Three PPPs all obtaining large institute funding from the <b>Province of Limburg</b>, co-invested by a few public and private <b>founding fathers</b></li> <li>&gt; Seek <b>other subsidies and partner contributions</b> on project level</li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Co-financing:</b> from the Province of Limburg</li> <li>&gt; <b>Infrastructure:</b> shared facilities at the Brightlands Chemelot Campus</li> <li>&gt; <b>Talent, entrepreneurship, expertise:</b> different programs</li> </ul>
	<b>QuTech</b>	<ul style="list-style-type: none"> <li>&gt; Two public-private programs (<b>Intel and Microsoft programs</b>) funded by <b>companies, STW, FOM, TKI toeslag</b> and the <b>TU Delft</b></li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Excellence:</b> expertise of world class</li> <li>&gt; <b>Relevance:</b> roadmap to application by connecting quantum science with computational and electrical engineering</li> </ul>
National subsidies	<b>ARC CBBC</b>	<ul style="list-style-type: none"> <li>&gt; Institute subsidy from <b>NWO</b> and use of <b>TKI Toeslag</b></li> <li>&gt; EUR 1 m cash by each of the <b>three private founding fathers</b></li> <li>&gt; (In kind) contributions by three participating <b>universities</b></li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Co-financing:</b> attractive co-financing scheme for founding fathers</li> <li>&gt; <b>Excellence:</b> cooperation with excellent scientists – evolves from two 'Zwaartekracht' projects</li> <li>&gt; <b>Ownership:</b> results of bilateral projects can be made exclusively</li> </ul>
	<b>Onco XL (in development)</b>	<ul style="list-style-type: none"> <li>&gt; <b>KWF, VWS, OC&amp;W</b> and <b>EZ</b> (Toekomstfonds and TKI Toeslag) and <b>universities</b> are looked at for institute financing</li> <li>&gt; On project level other subsidies and company/institute contributions</li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Excellence:</b> access to world-leading oncology researchers</li> <li>&gt; <b>Thematic TTO:</b> support and make easy licensing IP and cooperation with scientists by having dedicated technology transfer experts</li> </ul>
EU	<b>European Lead Factory</b>	<ul style="list-style-type: none"> <li>&gt; EUR 80 m subsidy from EU (IMI), EUR 91 m in kind contribution from large companies and EUR 25 m from other parties (academia and SMEs)</li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Equipment:</b> access to unique <b>facilities</b> with ultra-high throughput screening and compound library</li> <li>&gt; <b>Services:</b> different services around facilities</li> </ul>
Community	<b>TI COAST</b>	<ul style="list-style-type: none"> <li>&gt; <b>Membership model</b> with ~80 paying members (EUR 1-25 k per year depending on size), obtaining ~EUR 350 k per year</li> <li>&gt; It works to <b>improve access to and mobilize different types of subsidies</b> for the analytical chemistry community</li> </ul>	<ul style="list-style-type: none"> <li>&gt; <b>Talent:</b> provide access to talent in analytical chemistry through a talent program/ internship-scholarship program</li> <li>&gt; <b>Infrastructure:</b> provide access to its partners to high-end analytical equipment at other partners (e.g. uNMR facilities UU)</li> </ul>



# Some learnings from post-FES PPPs

Examples (for details see next slides)

- |   |  |
|---|--|
| <b>1 Focus, relevance &amp; excellence</b>  | A lot of traction can be made by defining an <b>appealing 'Moonshot'</b> based on <b>excellent</b> science – this also helps to define relevant content and a <b>clear proposition</b> and keep <b>focus</b> |
| <b>2 Infra &amp; physical meeting point</b> | Shared, <b>unique facilities</b> are part of many new initiatives – such <b>infrastructure</b> provides a <b>physical nucleus</b> for a PPP, attract partners, and open up a route to regional funding       |
| <b>3 Few founding fathers</b>               | Starting with a <b>few</b> , committed <b>founding</b> fathers mobilized leadership and makes it possible to act fast and create focus   |
| <b>4 Entrepreneurship</b>                   | It requires an <b>entrepreneurial spirit</b> , drive and stamina to <b>mobilize</b> (and combine different sorts of) <b>funding</b> and <b>private partners</b> to new PPPs                                  |
| <b>5 Tailor</b>                             | There is <b>no one-size-fits-all</b> – all PPPs need to be <b>tailored</b> to the goals, partners and financiers   |
| <b>6 Membership</b>                         | A <b>membership model</b> can support a public-private community in performing basic activities – those can be the <b>foundations for subsidy models</b>   |

## D. FES predecessors

*Learnings from other FES initiatives that have preceded NanoNextNL*



# Former FES (-like) initiatives roll out various sustainability strategies

Examples (for details see next slides)

PPP	Sustainability strategy
BMM	<ul style="list-style-type: none"> <li>&gt; Initiated a <b>new PPP with regional subsidy</b> in which they continued: part of its scientific program, the results and its back office (Chemelot InSciTe)</li> <li>&gt; Leveraged <b>FES-built network, scientific program</b> and back office expertise</li> </ul>
NGI	<ul style="list-style-type: none"> <li>&gt; <b>Stopped</b> the overall program/umbrella</li> <li>&gt; Strived for <b>continuation of its individual research centers (16) and activities</b> (e.g. valorization), or the embedding of those centers/activities in the Dutch knowledge/innovation infrastructure (e.g. in topsector, NWO) – tailored per center/activity</li> </ul>
TIFN	<ul style="list-style-type: none"> <li>&gt; Becomes <b>embedded in the topsector as part of the TKI Agro-food</b>, sharing back offices and becoming an independent TIFN program line in the TKI</li> <li>&gt; Makes use of the <b>financing opportunities for PPPs in the topsector policy: NWO and TKI Toeslag</b> – a NWO-TIFN call is being executed</li> <li>&gt; Leveraged <b>FES-built network and scientific program</b></li> </ul>
DTL	<ul style="list-style-type: none"> <li>&gt; Established <b>network of research groups</b> around enabling life sciences technology</li> <li>&gt; Builds (with NWO, ESFRI) and makes available <b>technology and infrastructure</b> in the network and establishes shared <b>education</b></li> <li>&gt; Supports community in opening funding opportunities for enabling technologies, e.g. establish and enabling technology call at ZonMw</li> <li>&gt; Business model is a membership structure through which its basic operations are financed</li> <li>&gt; Leveraged <b>FES-built network, technologies and infrastructure, and courses</b></li> </ul>
DDMoRe	<ul style="list-style-type: none"> <li>&gt; Develops (in progress) a <b>private foundation that makes available the infrastructure/products</b> that DDMoRe developed in its program</li> <li>&gt; Business model is that users of the infrastructure/products pay a <b>'membership fee'</b> to the foundation</li> <li>&gt; Leveraged <b>IMI-built network</b> (to acquire members/customers) and <b>developed infrastructure/products</b></li> </ul>
TI Pharma, CTMM (Lygature)	<ul style="list-style-type: none"> <li>&gt; Had strong scientific connection to the <b>Innovative Medicine Initiative</b> (EU program)</li> <li>&gt; Turned back office into a <b>program management organization</b> for PPPs, helping realize and manage consortia (often IMI funded)</li> <li>&gt; Business model is to be <b>financed by the consortium</b> it is working for (fee-for-service)</li> <li>&gt; Leveraged its <b>FES-built network</b> (for connecting to IMI and acquire customers) and consortium management <b>capabilities and tools</b></li> </ul>
M2i	<ul style="list-style-type: none"> <li>&gt; Founded as NIMR with independent back-office and researchers on pay-roll, renamed into M2i to expand R&amp;D portfolio in functional materials</li> <li>&gt; M2i sustainability strategy is to turn into a <b>'consultancy' organization</b> for (1) research and (2) human capital <b>services</b> via <b>transition funding</b></li> <li>&gt; Business model is <b>fee-for-service; success</b> based on strong <b>link to HTM calls, broad network</b> and <b>commercial mindset</b></li> </ul>

Acquire large subsidy  
 'Stop' and embed activities  
 Maintain platform for common grounds

# Some key success factors for sustainability strategies of former FES initiatives

Examples (for details see next slides)

- |                     |  |
|---------------------|--|
| <b>1 Timing</b>     | Start preparations long before end of funding – it takes time to develop and implement the strategy and with FES funding this may be financed                        |
| <b>2 People</b>     | Need people with drive, energy and believe for sustainability to make it into a success  |
| <b>3 Connect</b>    | It is key to connect with funds/initiatives in the 'new world' (e.g. topsector policy, regions, EU, NWA, etc.) from the start  |
| <b>4 Tailor</b>     | Design strategy around assets developed, defined goals for the future and the common grounds of the partners   |
| <b>5 Network</b>    | The established network is at the basis of the next step, but the network needs to be offered value to stick together while implementing the sustainability strategy |
| <b>6 Leadership</b> | Requires several parties to step up  |

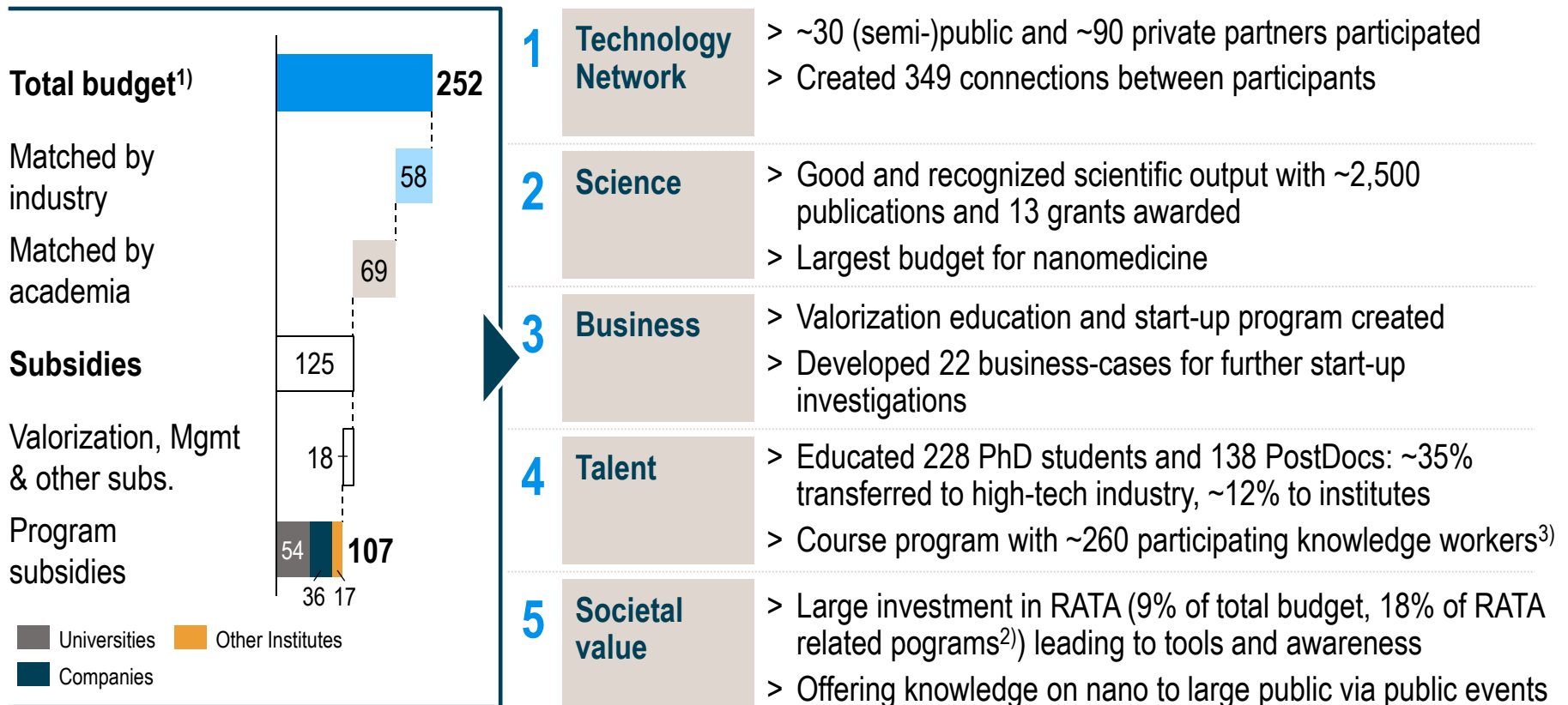
## E. NanoNextNL overview

*Large impulse to Dutch nanotechnology community*



# NanoNextNL is a EUR 252 m Public-Private-Partnership that gave a large impulse to the Dutch nanotechnology community

NanoNextNL summary: Budget and results<sup>2)</sup> [EUR m]



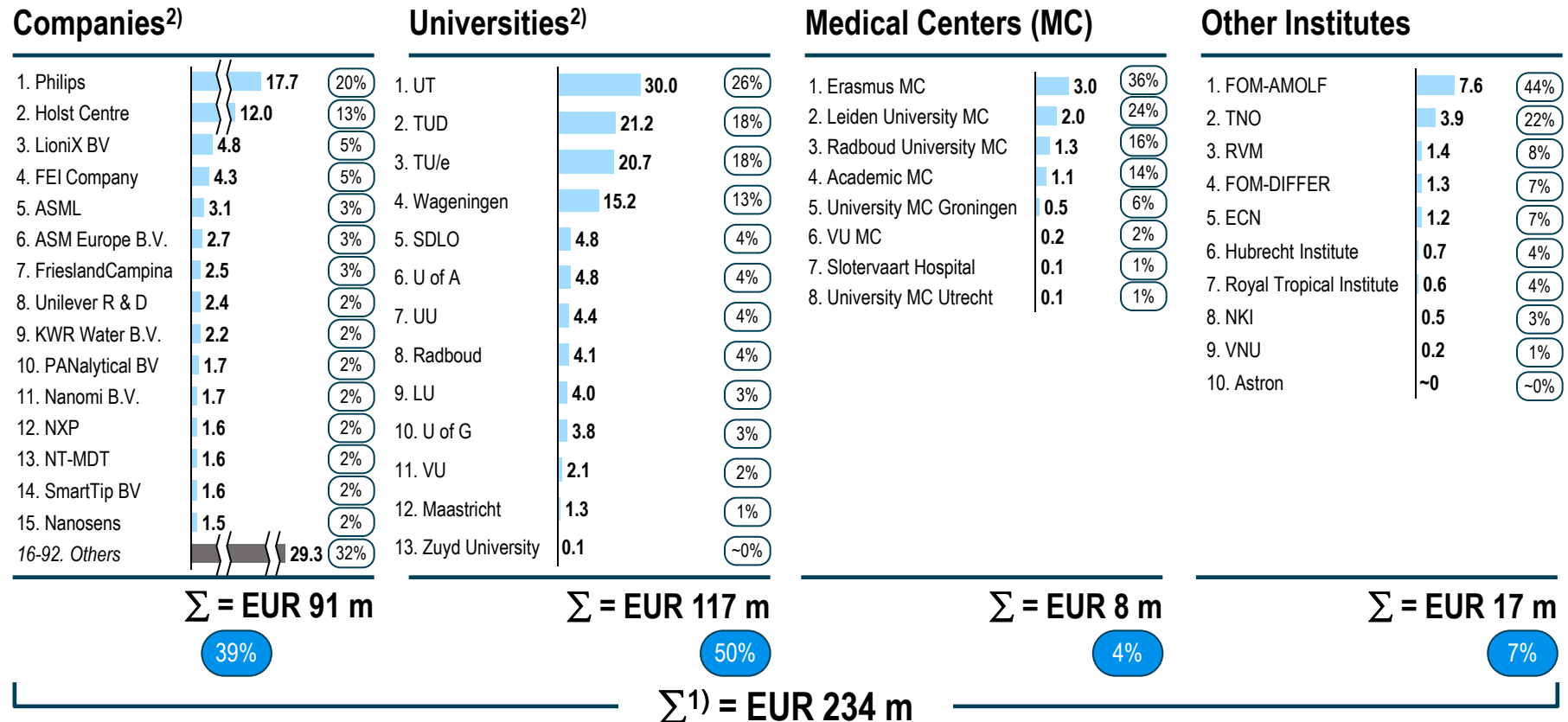
1) For completeness, but not significant: Number for program subsidy budget taken from 'Grootboekposten', which is EUR 272,737 more than reflected in 'NNNL-2015 10 08-06 - Financien'

2) RATA = Risk Analysis and Technology Assessment – RATA related programs have been 'earmarked' during definition phase as to where PhD theses are required to give attention to potential risk for human beings

Source: NNNL – Grootboekposten: 25-1-2016; NNNL-2015 10 08-06 – Financien; MTR NNNL; KPI overview; NanoNextNL cursussen – update; Endterm report - Draft 160410 - NNNL\_report.pptx | 30

# NanoNextNL united 13 universities, 92 private companies, 8 medical centers and 11 institutes in a joint program

Project budget for different partner types<sup>1)</sup> [EUR m]

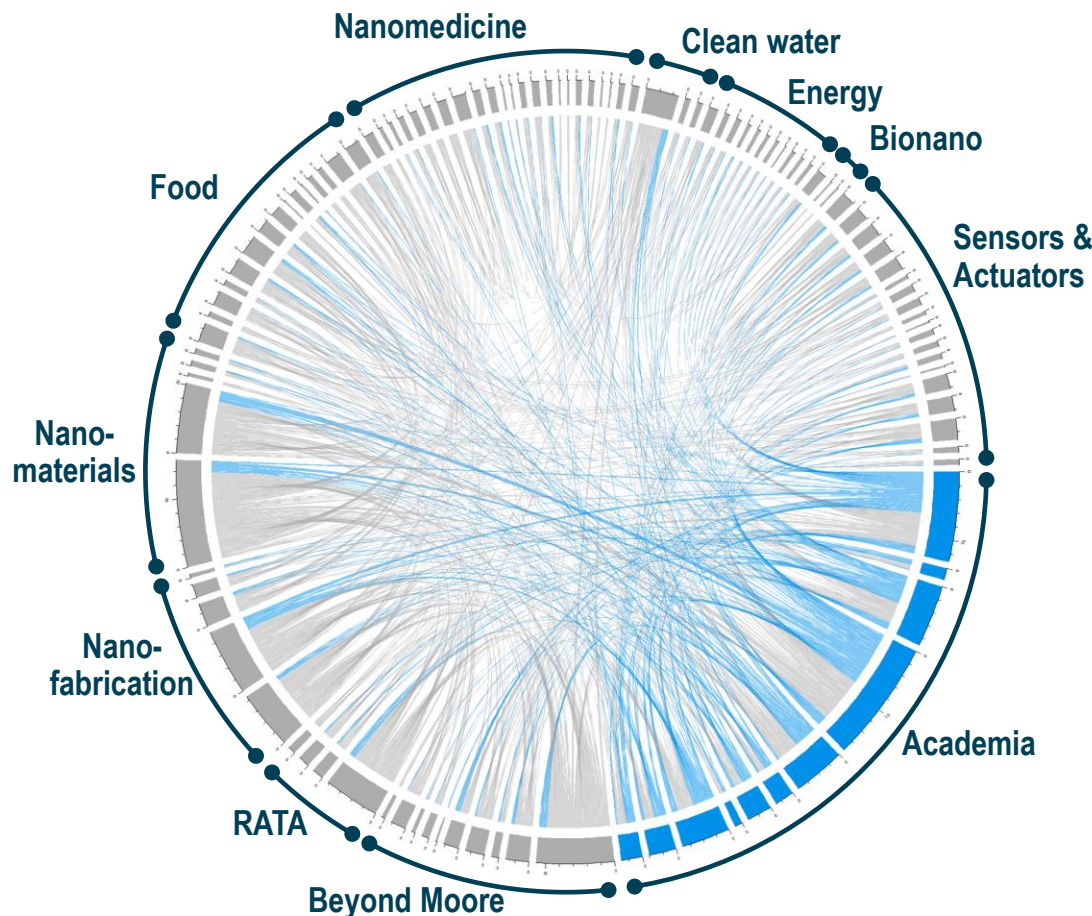


1) Projects with no parties assigned ('Gereserveerd') represent EUR 1 m, and are included in grand total (EUR 234 m), while excluded in separate columns  
 2) EUR 7.5 m of university subsidies is matched by '3<sup>rd</sup>' party companies, ca. 20 additional companies



# NanoNextNL established 349 connections between the consortium partners, where academia established a broad network with industry

Network connectivity [connection strength defined by number of projects]



## Connections established via different ways

- > In total, ~120 partners collaborated in the 244 NanoNextNL projects
- > Out of total of **349** established partner **connections<sup>1)</sup>**, **academia** established **161** connections **with industry**
- > During the course of the program, **3 events** (NanoCity) were held for the **whole community** with over 450 visitors
- > Within themes, the theme coordinator and program directors meet annually in **theme meetings** (e.g. ~3 times a year within RATA)
- > **Theme days** are organized bringing together programs in workshops
- > Annual **cross-theme program** meetings are held for projects from different themes
- > Various **conferences** and **symposia** were organized with contributions from different themes
- > **RATA sessions** enhanced the connections between partners
- > Interviewed participants indicate that indeed **new connections were established**, mainly between industry and academia

1) Unique connections, established in 435 project connections



# NanoNextNL ran 241 scientific projects in 28 programs across 10 themes, resulting in ~2,500 publications of which 850 journal papers

## NanoNextNL – Program overview (2011-2015<sup>2)</sup>)

Theme	Programs	Budget [EUR m]	Projects [#]	Publications [#] (PhD theses <sup>1)</sup> ) [#]	IF <sup>2)</sup> Journal Publ. ('10-'14)
1 Risk analysis & Tech. Assessment (RATA)	Human health risks   Environmental risks   Technology Assessment	10   10   21	17	260 (35)	1.8
2 Energy	Efficient generation of sustainable energy   Efficient energy utilization by secondary conversion of energy and separation	3   5   7   ~15	15	258 (18)	4.7
3 Nanomedicine	Nanoscale biomolecular interactions in disease   Nanofluidics for lab-on-a-chip   Molecular imaging   Drug delivery   Integrated Microsystems for Biosensing	10   12   19   41	47	395 (33)	1.4
4 Clean Water	Nanotechnology in water applications	2   7	4	63 (12)	4)
5 Food	Food process monitoring and product quality assessment   Molecular structure of food   Food products and processes   Microdevices for structuring and isolation	2   3   8   7   ~12   27	14	158 (25)	1.0
6 Beyond Moore	Advanced NanoElectronics Devices   Functional nanophotonics   Nano-bio interfaces & devices   Active nanophotonic devices	9   9   15   33	50	539 (39)	2.0
7 Nanomaterials	Supramolecular and bio-inspired materials   Multilayered and artificial materials	5   7   10   22	26	255 (32)	2.2
8 Bio-nano	Nanomolecular machines in cellular force-transduction   Bionano interactions for biosensing	7   15	21	68 (8)	1.0
9 Nanofabrication	Nano-inspection and characterization   Nano patterning	4   4   8   6   12   26	31	383 (9)	1.9
10 Sensors and actuators	Systems and Packaging   Micro nozzles   Microdevices for chemical processing	8   7   12   27	16	188 (24)	1.0

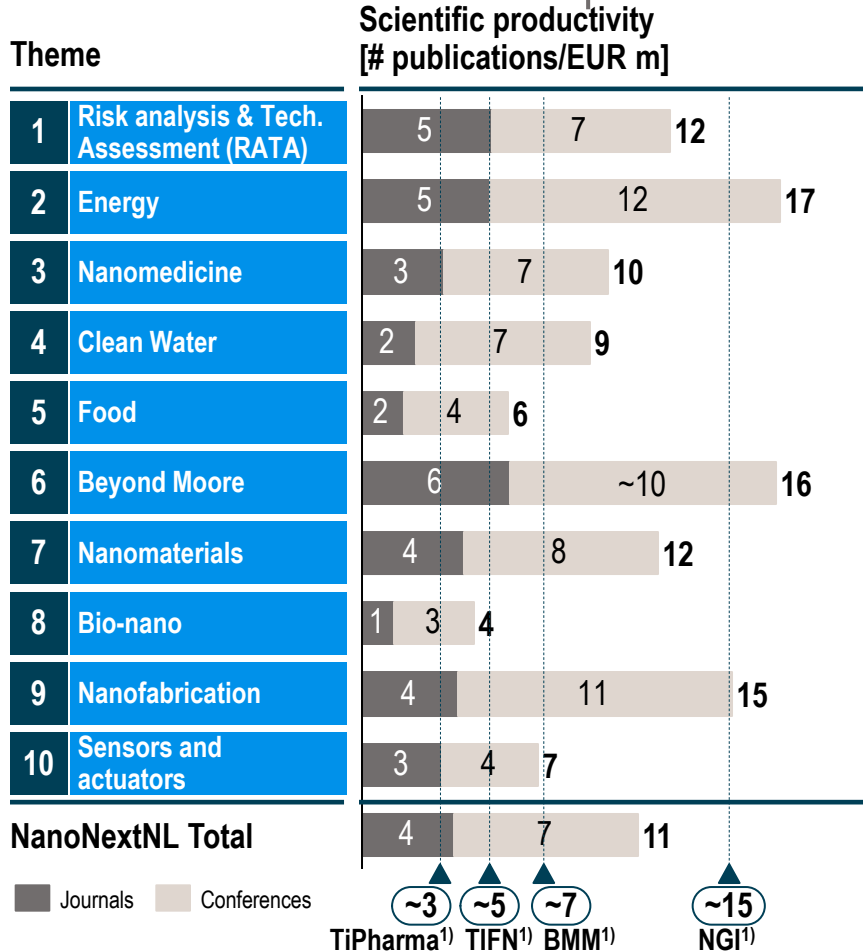
1) 7 PhD students in multiple programs, 228 is unique no. of PhD students; Assuming every PhD student publishes a Thesis; 2) Impact factor (IF) as MNCS (mean normalized citation score) of journal publications normalized by field and year 2010-2014 relative to world average(2015 and conference publ. excluded); 3) As reported in CWTS analysis; 4) No significant data

■ Matched by Industry   
 ■ Matched by Academia   
 ■ FES subsidies

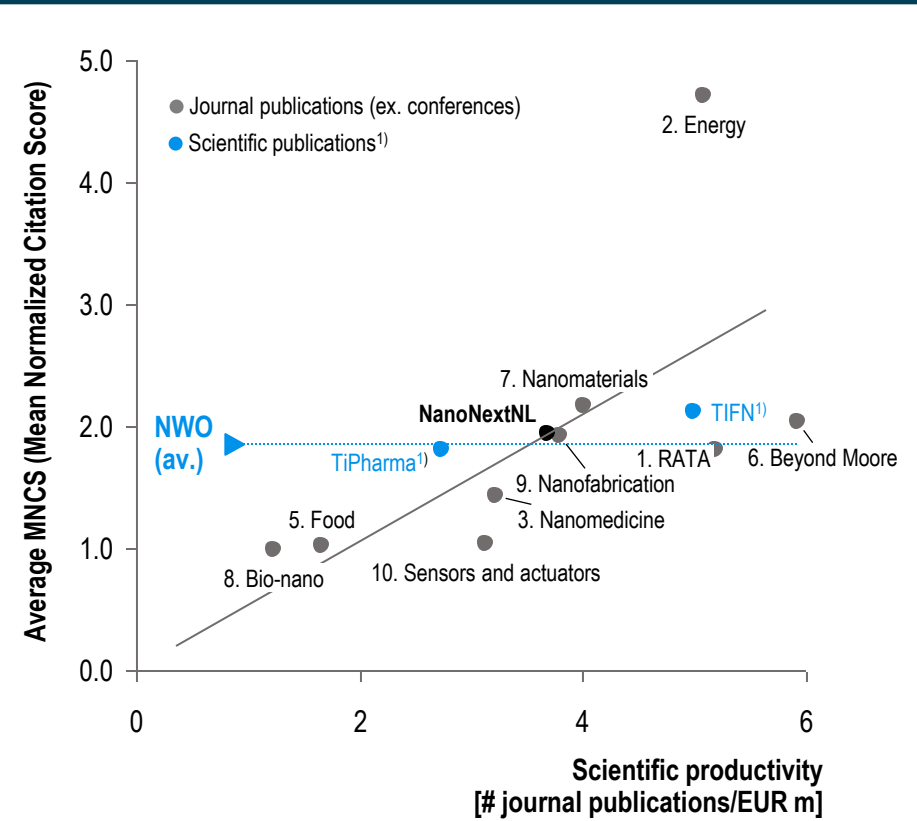
**Σ = 234 m**     
 **Σ = 241**     
 **Σ = 2,567 (228<sup>1)</sup>)**     
 **(~1.8) Ø<sup>3)</sup> = 1.9**  
 NWO

In terms of scientific productivity, NanoNextNL performed at lower side of spectrum of FES programs, while scientific impact is on par

NanoNextNL – Scientific output



Scientific quality and impact – Normalized benchmark<sup>1,2)</sup>

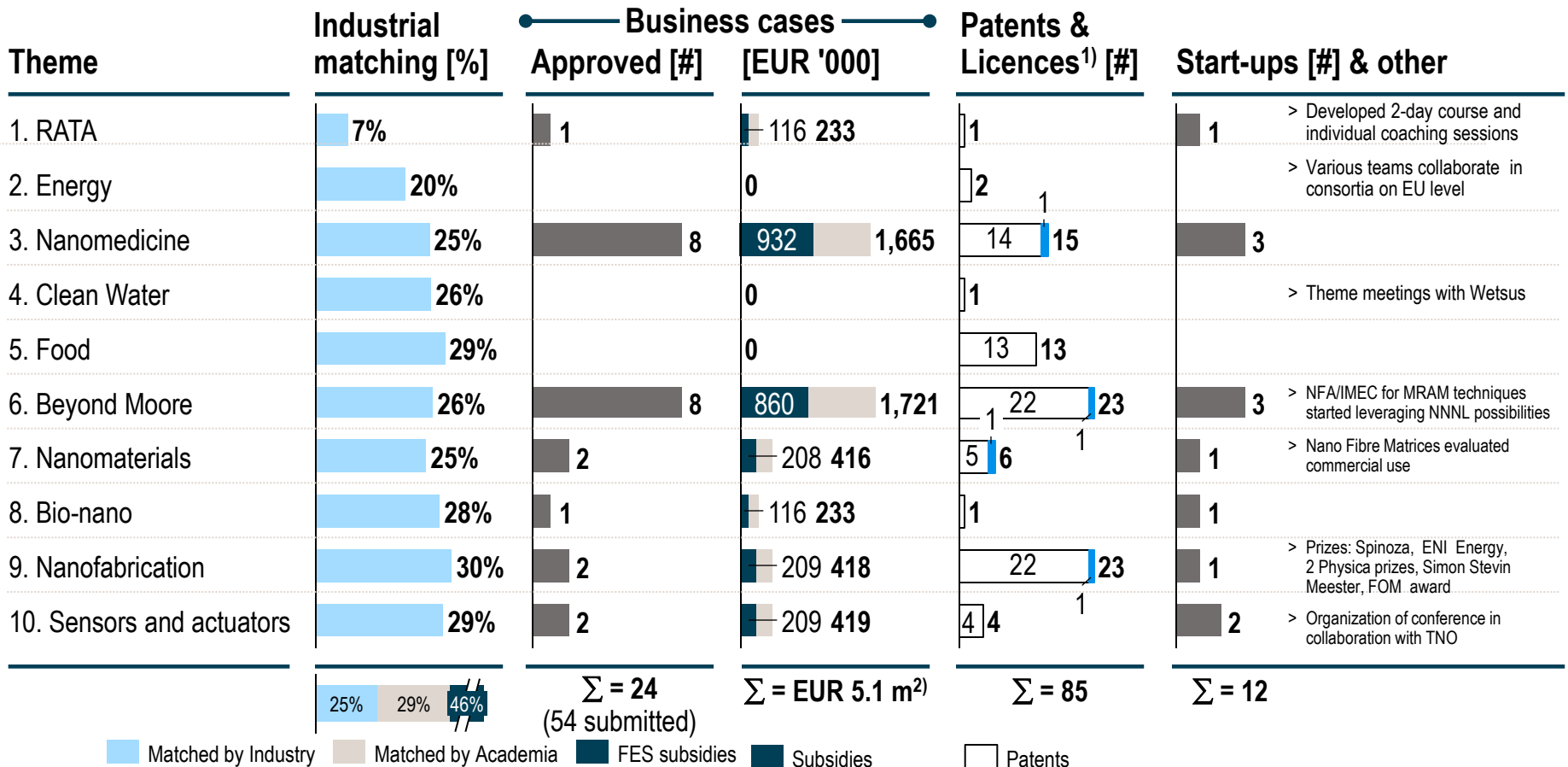


1) Total of reported scientific publications in the program – Assumed (but not confirmed that conference publications are excluded); Theme 'Clean water' left out due to no significant data

Source: CWTS Bibliometric report from NNLL 02-2016; TIFN website (impact factor & # publications) (10-3-2016); Annual report BMM '13; TiPharma report – new ways to medicine; NGI final report ('02-'13); 'Partners in the Polder'

# NanoNextNL valorized knowledge through its industrial partners and by supporting new business development

## Business potential and valorization activities and results

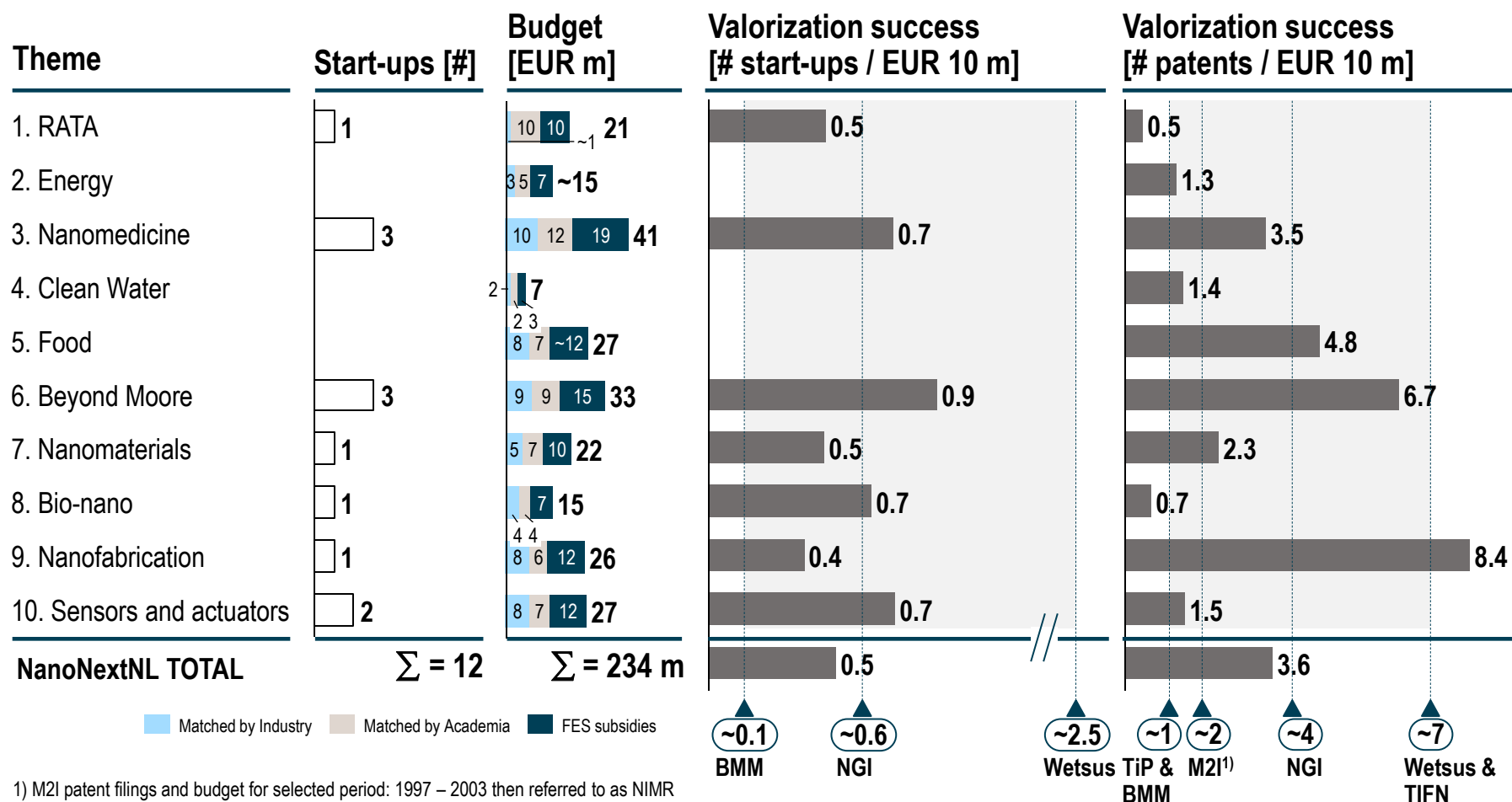


1) Only reported patents – Actual number expected to be higher (due to confidentiality)

2) Net budget for business cases, Gross financing is EUR 5.5 m (incl. 7% office cost)

# In terms of valorization success, NanoNextNL performed in the midst of the wide bandwidth of FES program results

## Valorization success NNNL



1) M2I patent filings and budget for selected period: 1997 – 2003 then referred to as NIMR

# NanoNextNL developed an education program and trained ~200 PhD students and postdocs

## Education program and results NNNL

### Program

- > 4 courses of 2-3 days have been developed by NNNL
- > Creating knowledge and opportunity to form networks

- > **NNNL developed courses** (327 participants attended the courses, of which 260 were PhDs and postdocs)
  - IP and Valorization Awareness
  - Risk Analysis and Technology Assessment
  - Entrepreneurship
  - Analytic storytelling
- > **Co-developed courses**
  - Insight in Nanotechnology (with Euroforum)
- > The courses are accessible to researchers and entrepreneurs, both junior and senior – NNNL participants attend at lower price

### People

- > NanoNextNL boosted talent development by creating additional PhD and PostDoc positions

- > 366 PhDs and postdocs trained within NNNL
- > Excellent talent brought forward as recognized in awards:
  - European Research Council (ERC) Adv. Grant: 1 researcher
  - ERC Starting Grant: 3 researchers
  - ERC Proof-of-Concept Grant: 3 researchers
  - 'Zwaartekracht' program awards: 6 research teams with participation in NNNL

# NNNL delivered tools and awareness for RATA to contribute to solutions on societal issues

## NanoNextNL highlights on societal value creation

### Public relations

- > Annual national 2-day event **NanoCity** open to anyone interested in nanotech with >450 visitors with RTL Z broadcasting live in 2016
- > Organizing the informative event **Science café** with speakers from nanotechnology sector in collaboration with RTL Toekomstmakers
- > Sponsoring **Llowlab** on the Lowlands festival to develop public awareness on developments in micro- and nanotech
- > Annual **NanoNextNL magazine** reporting on highlights, NNNL results, new scientific publications, emerging start-ups, events and in-depth information on projects
- > Supporting **Eureka Cup** financially, a national technological and scientific design competition for secondary school
- > **Miniconference** Nanogeneeskunde

### Risk analysis & Technology assessment

- > Safety issues come along with new innovations, therefore **risk analyses** of effects to health, safety and environment are necessary
- > RATA gives **insight into potential human health risks**, environmental risks and societal embedding of nanotechnology (including broader economic aspects)
- > Gathering information which leads to development of **efficient assessment strategy and tools** for applying this in various research themes (e.g. nanomedicine, clean water)
- > Courses are developed to make researchers aware of RATA

### Solutions on societal issues

- > **Spray on plaster**, a gel which is non-toxic, elastic, permeable to water and air, but impermeable to bacteria
- > Flexible **sensor measuring urine loss** with a personalized training program providing women information of which muscles need to be trained (Carin)
- > Measuring the composition of gas quickly & cheap by developing **miniature gas chromatograph** (Qmicro)
- > Production of **clean identical nanoparticles** for miniature electronics
- > Production of **biological molecules to kill cancer cells** without harming surrounding healthy tissue (Tagworks Pharmaceuticals)
- > **Quick detection of a pneumonia** from exhaled air with a simple device
- > **Microscope** showing DNA and proteins response in **real-time**

Roland  
Berger

