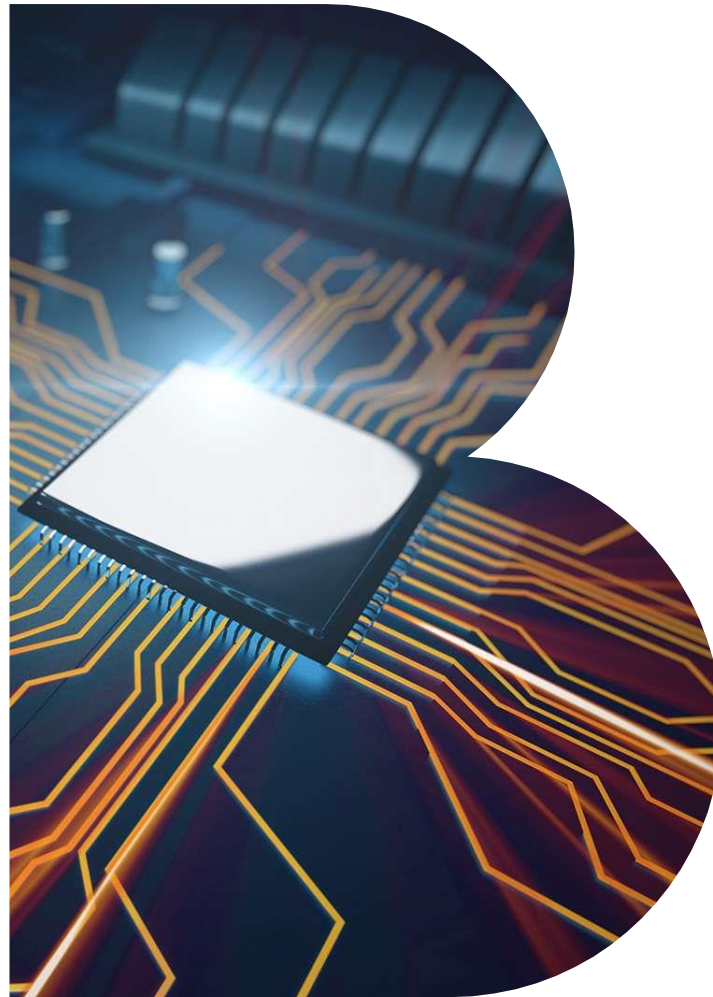


Next steps for NanoNextNL

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 —

A Company interviews – Input from interviews with companies

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

C Post-FES environment – PPP environment has changed after FES

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

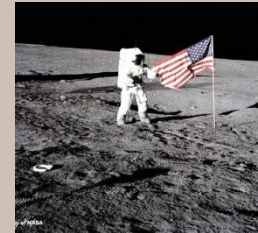
Moonshot	Future PPPs join scientific, industrial and societal relevance in one moonshot, collaborating on associated roadmap with intermediate spin-off and critical mass along the full innovation chain and clustered on one physical location
Tailored financing	'FES'-like funding does not seem to be(come)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

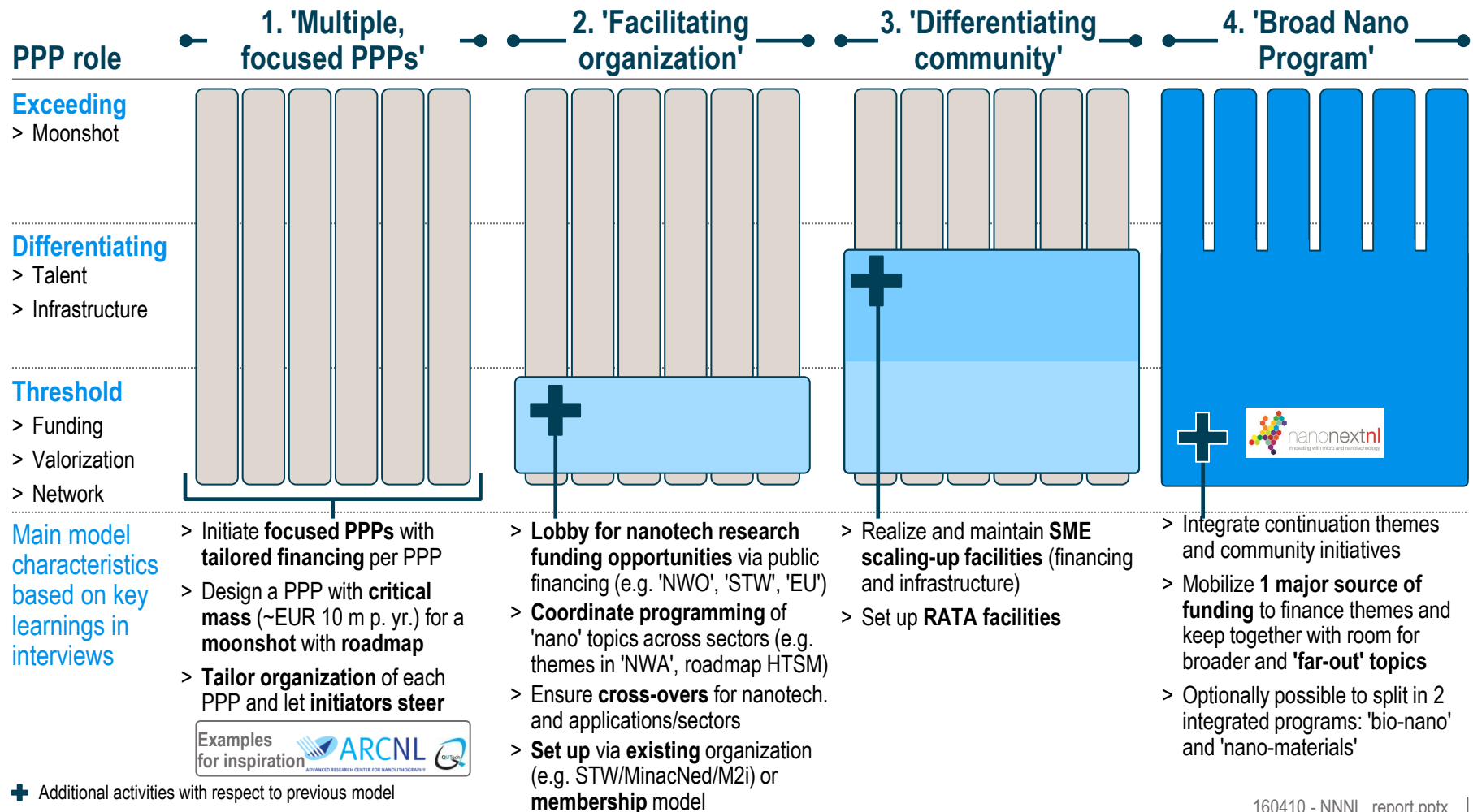
- **Talent** talented people in nanotechnology
- **Infrastructure** unique shared physical infrastructure in nanotechnology, not easily accessible for a single party and that also acts as a meeting place for the community

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

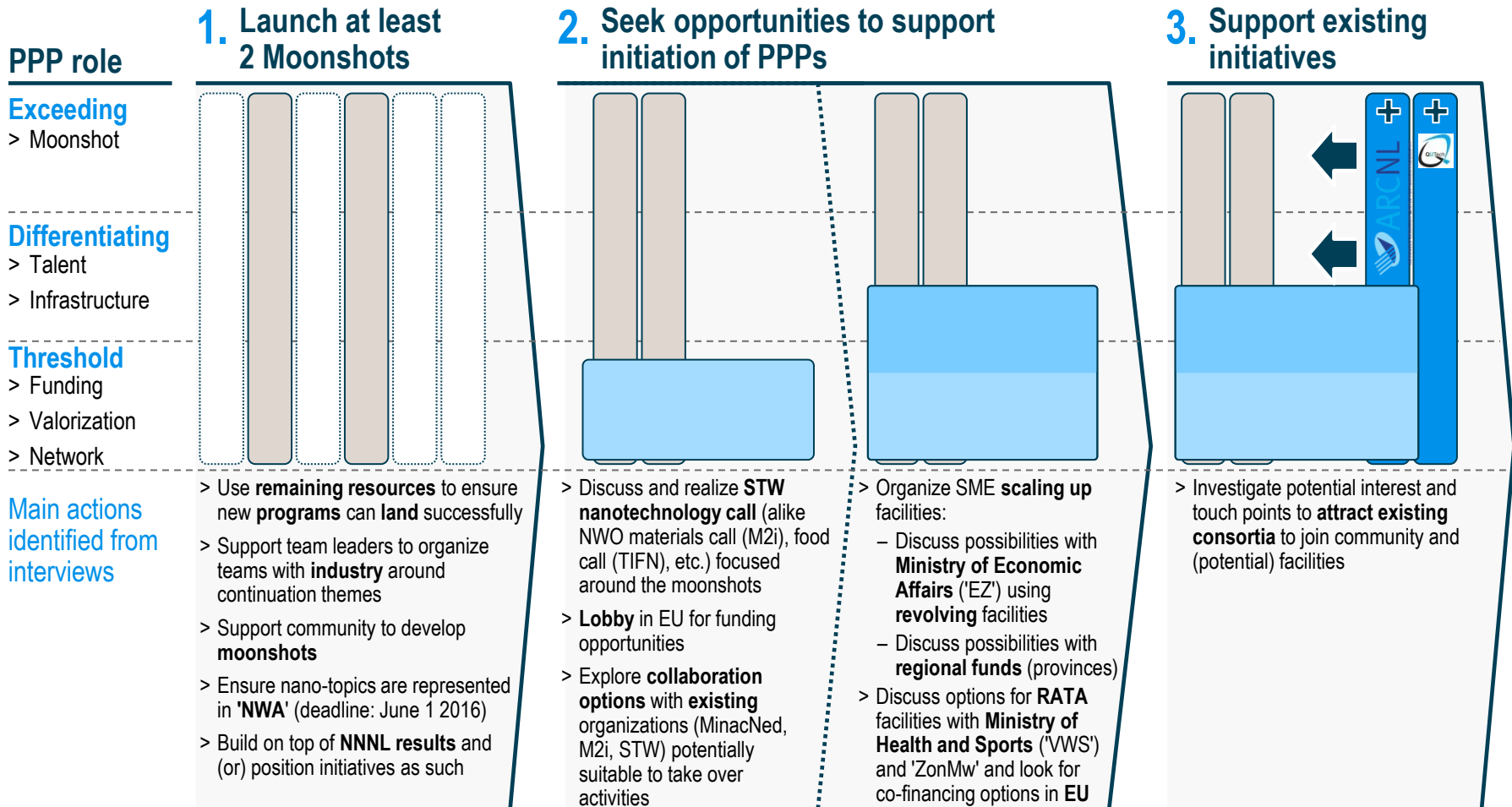
Potential NanoNextNL continuation models based on interviews



+ Additional activities with respect to previous model

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
NanoNextNL Executive Board and office	<p>SUPPORTIVE</p> <ul style="list-style-type: none"> > Transfers lessons learned from PPP cases > Supports financially from NanoNextNL budget > Stimulates where possible – e.g. connecting with industry and NWA 	<p>LEADING</p> <ul style="list-style-type: none"> > Seeks funding and partners > Inventories needs of community > Mobilizes stakeholders for definition and realization of facilities 	
Continuation theme leaders	<p>LEADING</p> <ul style="list-style-type: none"> > Drive definition, formation and realization of PPP > Seek connections with industry and drives development of roadmap towards moonshot 	<p>SUPPORTIVE</p> <ul style="list-style-type: none"> > Give input on themes and facility requirements 	

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

Design for new business	Program should be designed with clear goal to establish or expand business and economical activity in The Netherlands
Focus on applications jointly defined with industry	One common objective with integral plan to work towards envisioned application as defined with, and partially controlled by, industry
Involve full chain	Involve partners along full supply chain until target application and involve R&D partners such that all TRL competences are represented
Ensure critical mass, uniqueness & excellence	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
R&D multiplier	Multilateral program needs to have R&D multiplier (i.e. via cash, facilities, shared research resources, ...)
Organize physical location	Physical location needed to stimulate multidisciplinary work, have visible appealing place to attract people and enable flexible and easy exchange of ideas
Embed cross-overs	Innovation happens at the intersection of disciplines – Programs should bring together different disciplines and different markets/industries
Flexible program	Set up flexible program to allow pivoting based on lessons learned
SME as 'knowledge carrier'	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 Jongsma (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

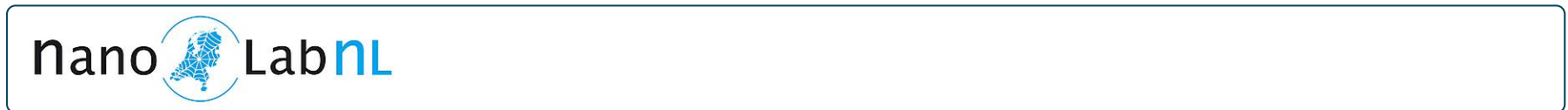
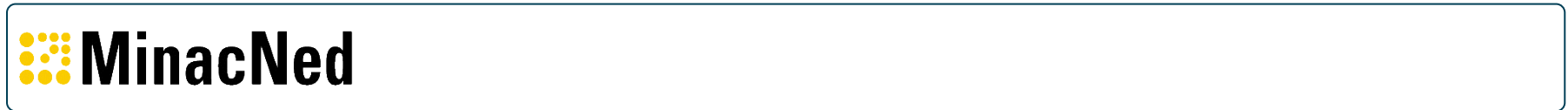
Food body interactions

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

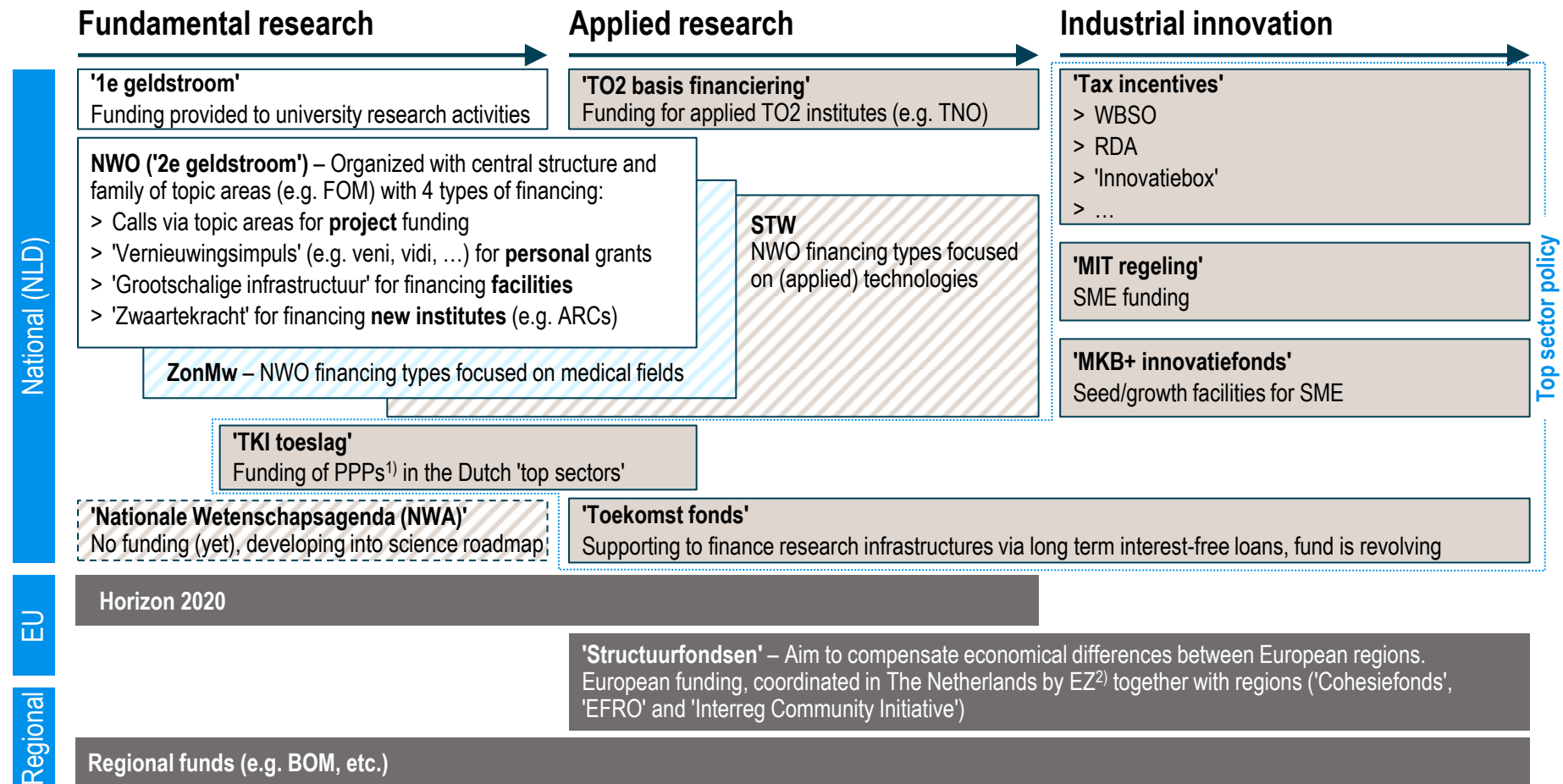
Industry interest in nanotechnology community building

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"> > Cross-overs in disciplines (via programs) > No broad networking interest expressed – potential interest for recognizable community with network and PR function 	<ul style="list-style-type: none"> > Talent development via PhD tracks suffices – no additional programs needed 	<ul style="list-style-type: none"> > SMEs look for support in facilities (infra, financing) to scale up – could be (partially) shared via community 	<ul style="list-style-type: none"> > RATA topics could fit in broader community > Minimum (explicit) interest for joint lobby
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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)
 VWS (Ministry of Health and Sports)
 EZ²⁾

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?*



<i>What was good?</i>	Results	<i>What was not so good?</i>
<ul style="list-style-type: none"> > New connections between industry and academia in nanotechnology > Broad ecosystem in and across programs/themes 	1 Technology Network	<ul style="list-style-type: none"> > Larger companies rather closed and difficult to steer > Large collection of topics/programs with limited focus and synergy (together for the funding)
<ul style="list-style-type: none"> > Major investment in science > Good scientific output with several spikes > Simple procedures, pragmatic reviews 	2 Science	<ul style="list-style-type: none"> > Companies net receivers, leading to limited 'pressure' on academia to deliver on promise > Room to enhance steering with more content reviews > Fixed program at the start tampered accountability and steering on results > Difficult to re-align collaborations when projects changed
<ul style="list-style-type: none"> > Structured and objective valorization program with fair amount of start-ups seeded > Good involvement of SMEs and good results for SMEs 	3 Business	<ul style="list-style-type: none"> > True involvement of companies and true collaboration between academia and companies was limited
<ul style="list-style-type: none"> > Good entrepreneurship program familiarized PhDs with commercialization > Large amount of PhD students educated in nano 	4 Talent	<ul style="list-style-type: none"> > Recruiting talent was difficult to synchronize, which delays projects and hampers collaborations
<ul style="list-style-type: none"> > RATA research positioned as pro-active topic and connecting element 	5 Societal value	<ul style="list-style-type: none"> > Program overhead budget could be reduced > Size of RATA program was perceived as out of proportion

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

Large pocket **central** governmental funding to finance **whole** initiative

Central theme mostly around **technology** or **economic sector**

Large, **broad programs** (e.g. nanotech as a whole)

Private parties are **net receivers** with large multiplier on investment

Top Sector regime and beyond

Scattered decentralized funding pockets (regional, national, EU) to finance **parts** of initiatives

Push central theme away from technology towards **economic sectors** (topsectors) or **social challenges** (especially EU)

More **focused initiatives** (e.g. specific topic in nanotech)

Private parties are **net payers** with limited multiplier on investment

Implications for NanoNextNL

> Chances of obtaining a single, large fund for (selective) continuation of NanoNextNL are slim

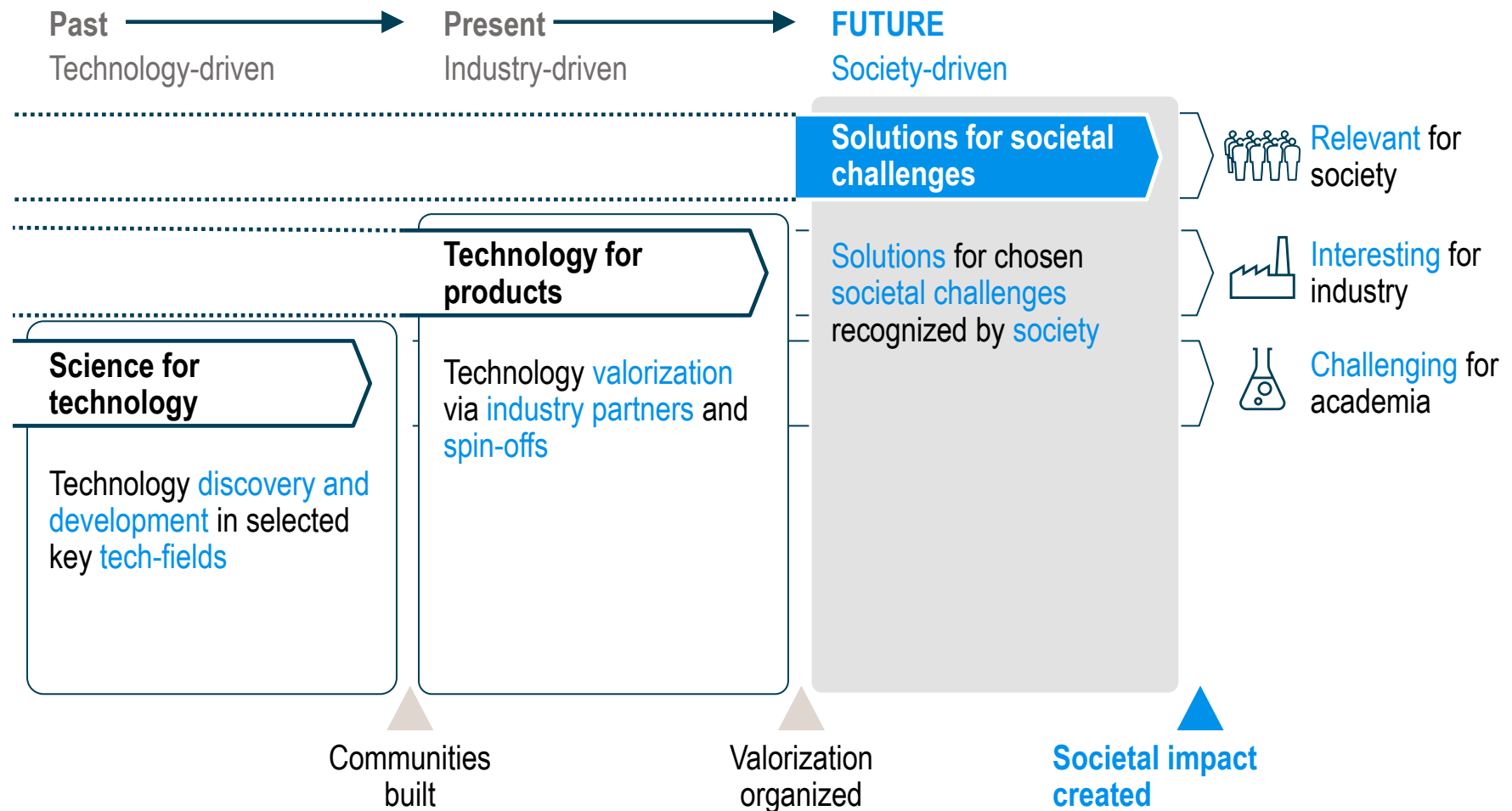
> NanoNextNL should consider whether nanotech is an appealing theme towards financiers, and connect to economic and social themes

> NanoNextNL should consider the value of having a multitude of different topics/programs in a single initiative

> NanoNextNL was financially very attractive to companies – in a next phase the conditions for companies may be very different

> Poses challenge on how to attract them and collaborate with them

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

Some learnings from post-FES PPPs

Examples (for details see next slides)

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

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

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)

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

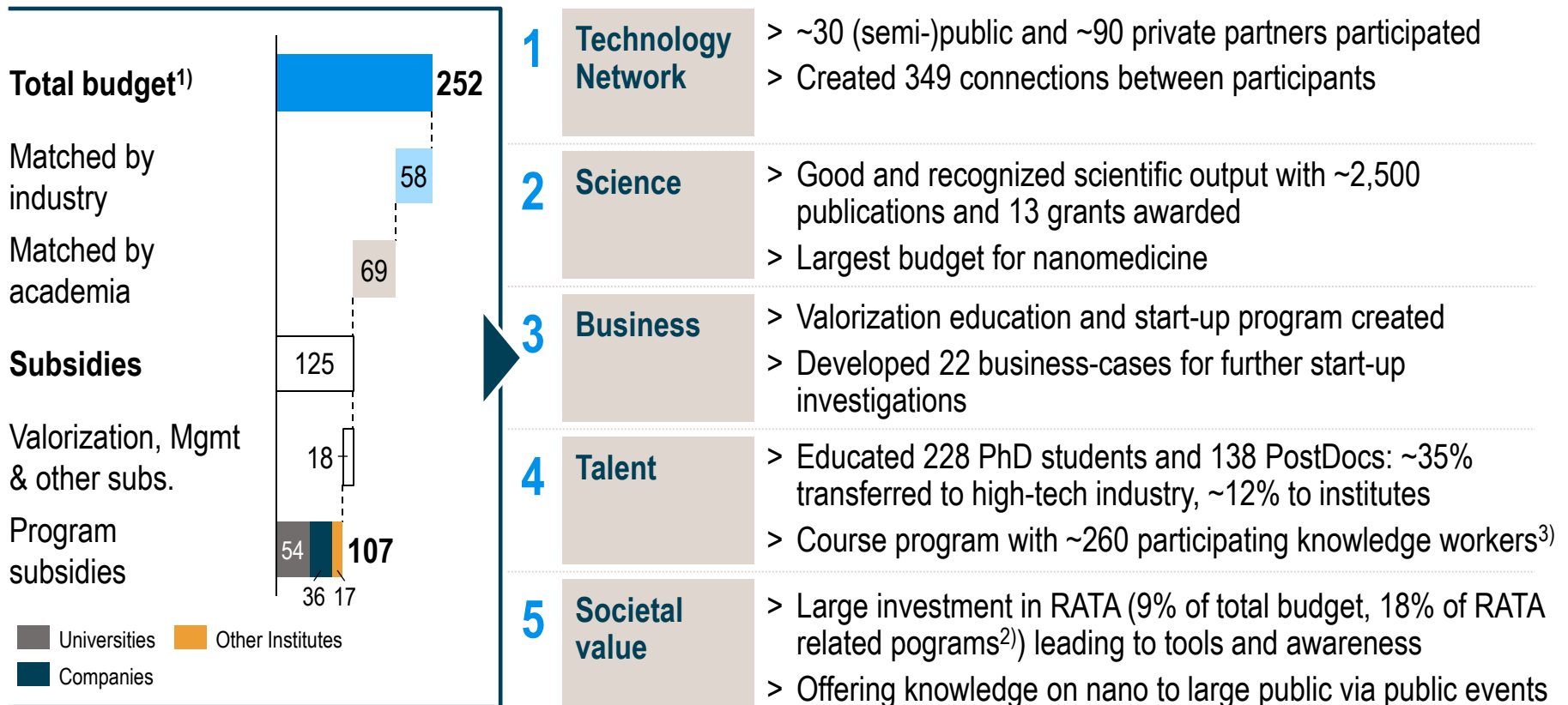
E. NanoNextNL overview

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 results²⁾ [EUR m]



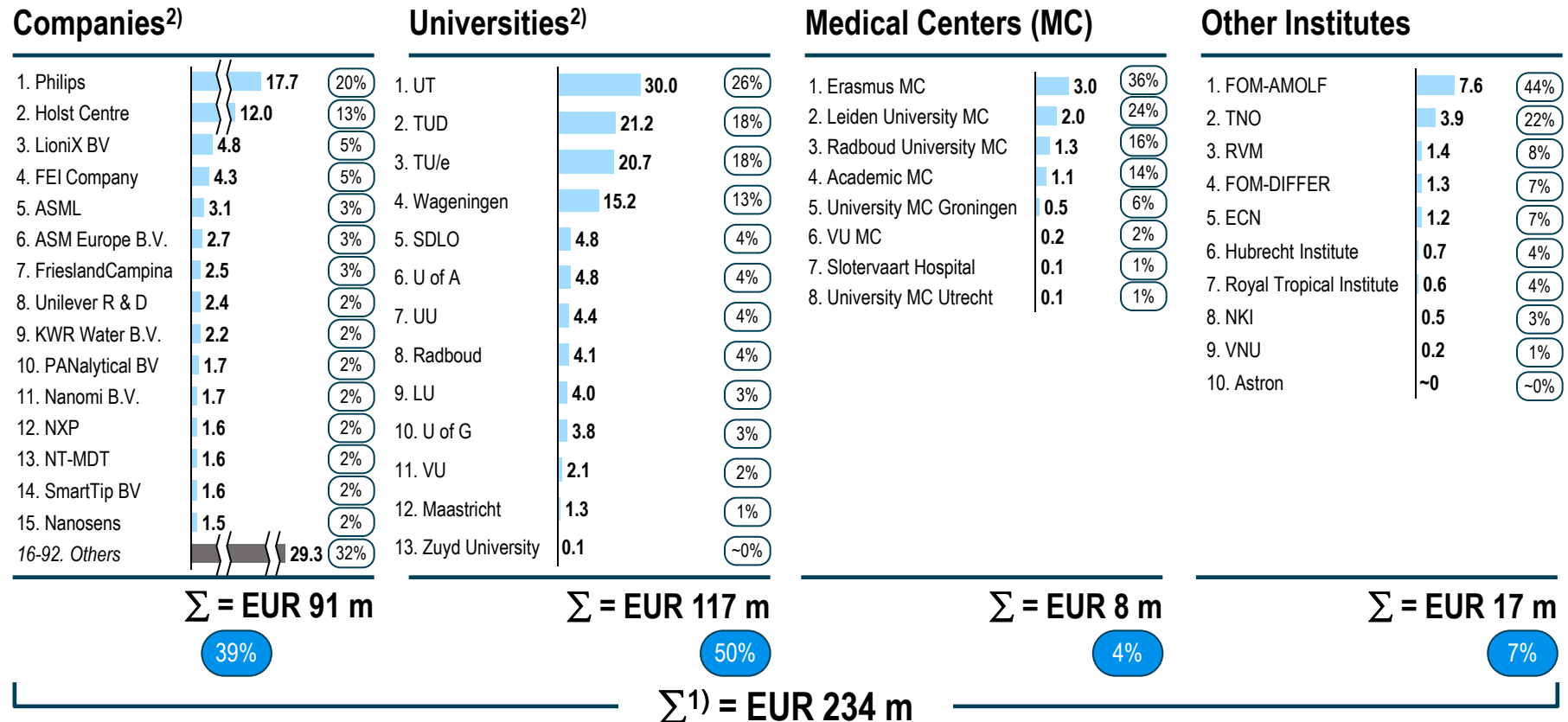
1) For completeness, but not significant: Number for program subsidy budget taken from 'Grootboekposten', which is EUR 272,737 more than reflected in 'NNNL-2015 10 08-06 - Financien'

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 types¹⁾ [EUR m]

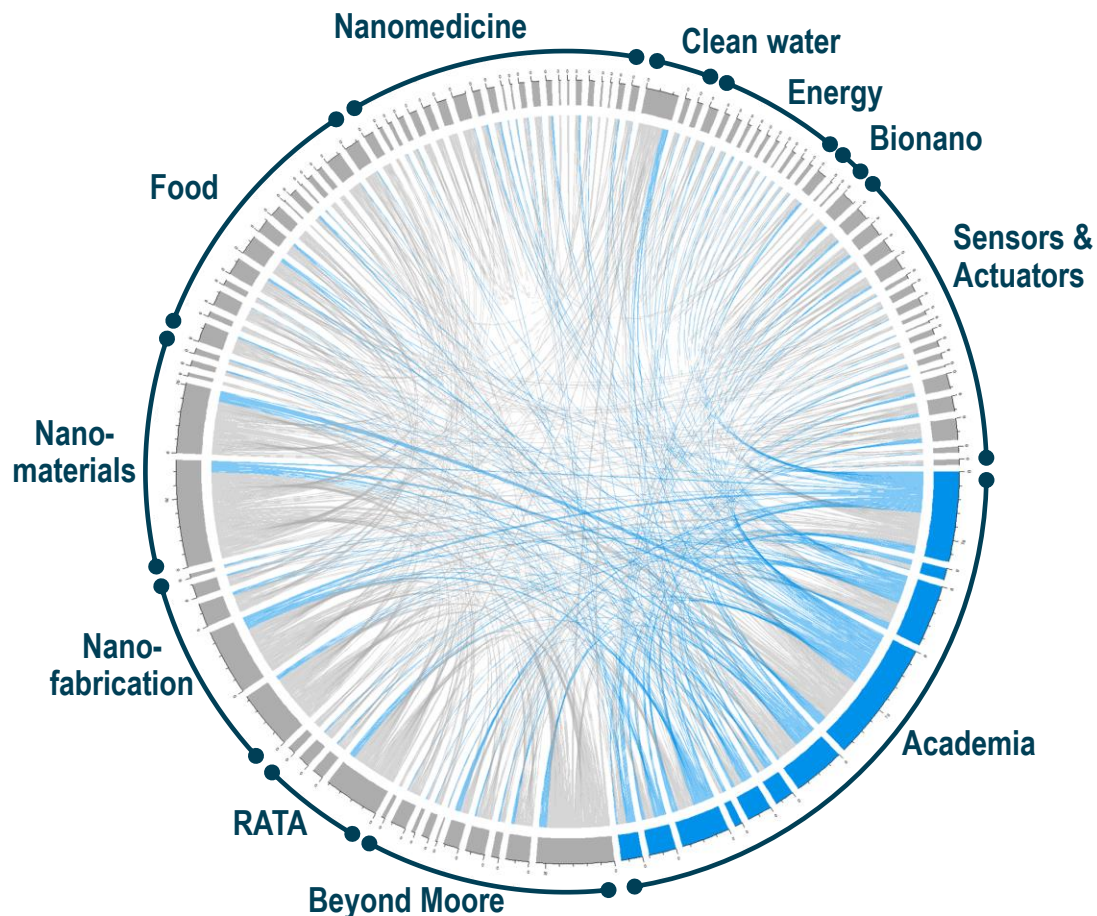


1) Projects with no parties assigned ('Gereserveerd') represent EUR 1 m, and are included in grand total (EUR 234 m), while excluded in separate columns

2) EUR 7.5 m of university subsidies is matched by '3rd' 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 connections¹⁾, 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 (2011-2015²⁾)

Theme	Programs	Budget [EUR m]	Projects [#]	Publications [#] (PhD theses ¹⁾) [#]	IF ²⁾ 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

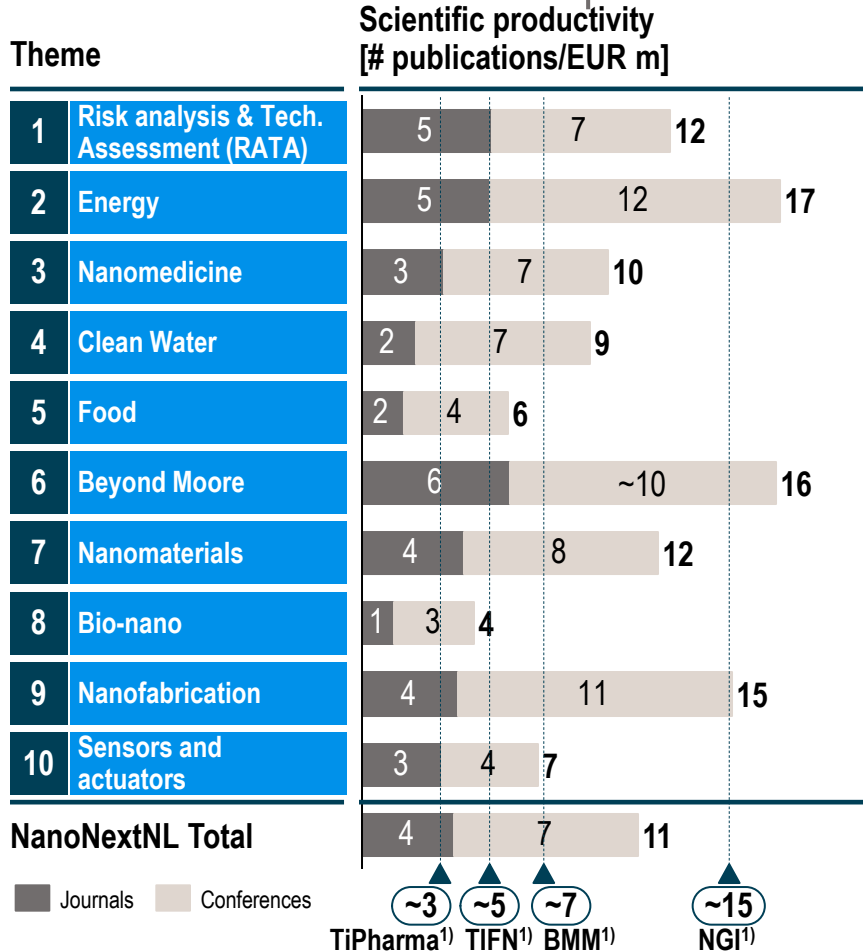
1) 7 PhD students in multiple programs, 228 is unique no. of PhD students; Assuming every PhD student publishes a Thesis; 2) Impact factor (IF) as MNCS (mean normalized citation score) of journal publications normalized by field and year 2010-2014 relative to world average(2015 and conference publ. excluded);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

■ Matched by Industry
 ■ Matched by Academia
 ■ FES subsidies

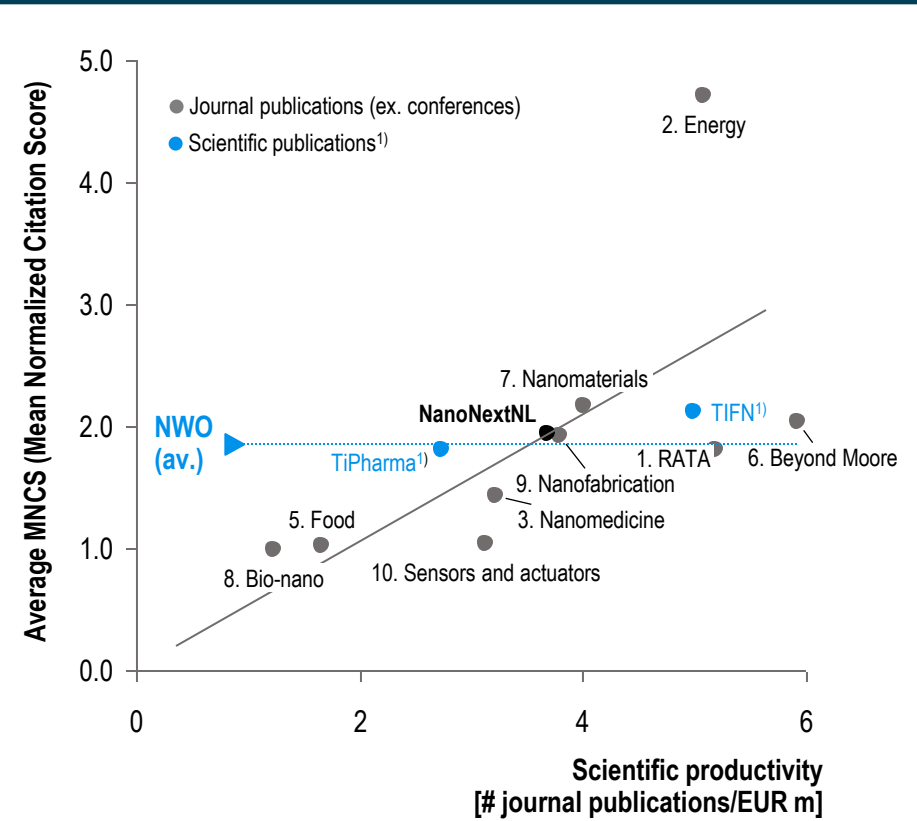
Σ = 234 m
 Σ = 241
 Σ = 2,567 (228¹⁾)
 (~1.8) Ø³⁾ = 1.9
 NWO

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^{1,2)}

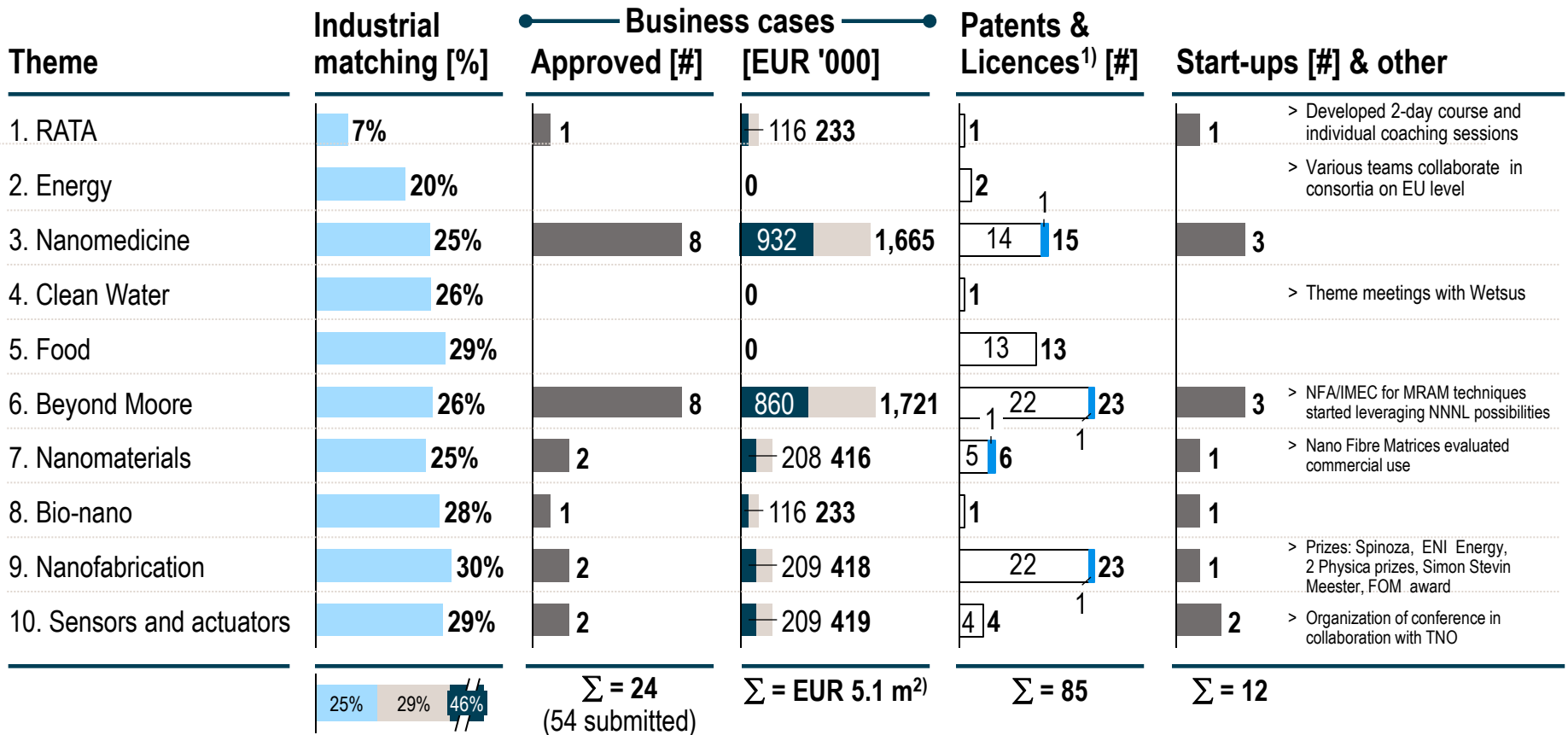


1) Total of reported scientific publications in the program – Assumed (but not confirmed that conference publications are excluded); Theme 'Clean water' left out due to no significant data

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

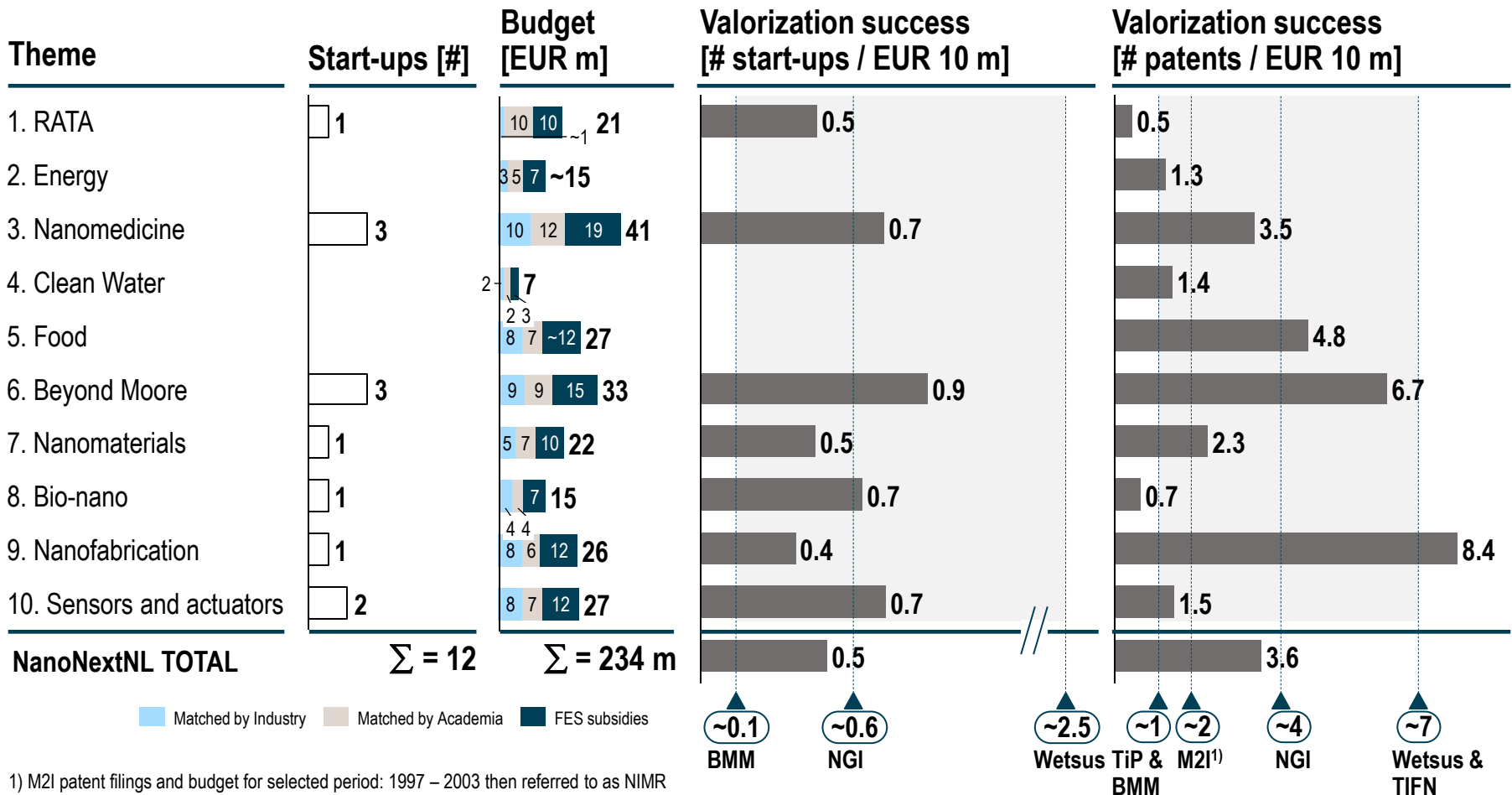


■ Matched by Industry
 ■ Matched by Academia
 ■ FES subsidies
 ■ Subsidies
 ■ Matched
 Patents
 ■ Licenses

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

