



Nanosciences, Nanotechnologies, Materials and New Production Technologies Deployment in Latin American Countries

Addressing societal challenges:



Water | Energy | Health

www.nmp-dela.eu

Policy Brief, August 2015

Frontier Science for Healthy & Sustainable Latin American Societies A Policy Brief on Euro-Latin American Cooperation in Nanotechnologies

This year offers a unique opportunity to connect at least two emerging international strategies: Nano- and emerging science and technology can be integrated into the Post-2015 Sustainable Development Goals (SDG) while contributing to the EU policy fostering Responsible Research and Innovation.



Figure 1: NMP-DeLA visits the European Commission in Brussels, October 2015

The Sustainable Development Goals should be adopted by the UN General Assembly in September 2015, and will direct global cooperation until 2030.

Inspired by the Capability Approach proposed by the political philosopher Martha Nussbaum (2006), the NMP-DeLA roadmap is designed to foster international cooperation for enabling all citizens of Latin America to develop themselves simultaneously in six dimensions. (1) **Public engagement** is stimulated through a web-based “community of interest” including not only research, government and industry from Europe and Latin America, but also civil society. This is also linked up with public dialogue about the nanotechnologies, materials and production technologies to be deployed in Latin America.

(2) **National sovereignty** of the participating Latin American countries is respected by engaging their relevant government departments in developing and implementing the roadmap. (3) **European and other foreign and private investment** in the deployment of the technologies should be attracted during the execution phase of the roadmap in the period 2015-2025. The roadmap covers plans to stimulate (4) **international cooperation in higher education, research and production**. The leading force in the development of the roadmap is its focus on (5) **poverty and health-related problems** and (6) **environmental sustainability**.



Figure 2: project coordinator Liceth Rebolledo opens the workshop on nanotechnology for industry in Chile, 4 December 2014



General trends

Bibliometric study, literature review and stakeholder engagement during workshops, summerschools and interviews carried out in the NMP-DeLA project reveal many weaknesses in the current higher education, research, development and innovation system in Latin America.

In general, most of the research in Science, Technology, Engineering and Mathematics (STEM) in Latin America is still in the basic research stage. In particular, there is a lack of educated nanoscientists and nanoengineers and of research equipment, infrastructure and chemicals and materials for the experiments. An important element of the roadmap therefore focuses on building capacity for research in nanoscience and nanotechnology in Latin America, to create the conditions for innovation in nanotechnology, materials and production technologies in the long term. The existing collaborations involving Latin American and European partners should preferably be consolidated and strengthened in the wider NMP-DeLA community of interest.

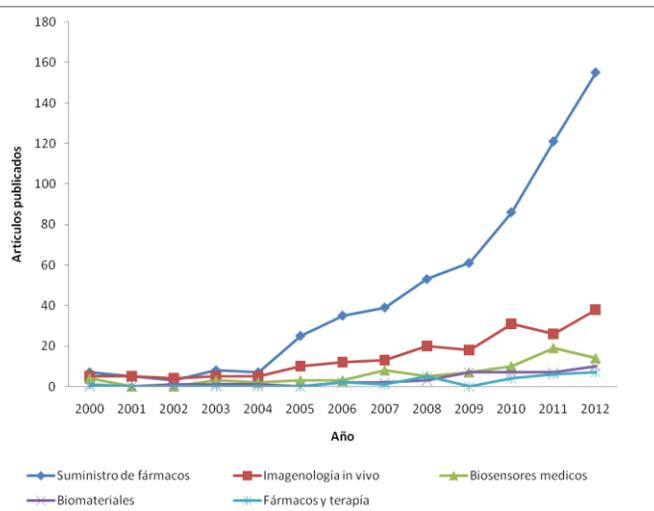


Figure 3: Evolution of the publications in the different areas in the field of nanomedicine in Latin America and the Caribbean during the period 2000-2012 (source: Invernizzi et al, 2015). Drug delivery is the most important, followed by in vivo imaging, medical biosensors, biomaterials, and pharmaceuticals and therapy.

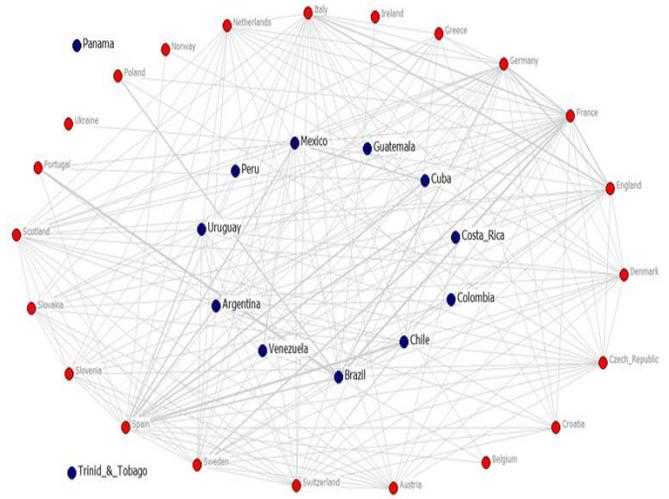


Figure 4: Scientific collaboration networks in the field of nanomedicine between Latin America and the Caribbean and Europe up to year 2012. Source: Invernizzi et al, 2015

Health

Although differences in resources and capabilities are notorious among countries, there is a considerable amount of research on nanomedicine in Latin America as illustrated in figure 3. Drugs and therapies, drug delivery and materials for different applications are the most developed areas of research. Research groups in most countries have some degree of cooperation with international research networks, within and outside the region (see figure 4). Enhancing cooperation between the European Union and Latin American countries will require further discussion on priority areas for cooperation.

Several Latin American countries have crossed the “epidemiological transition” and present a very similar pattern of diseases and causes of deaths to most developed countries. While some tropical diseases are still of importance, most research seems to be directed to a more global landscape of medical issues.

Nanosafety

In Latin America, research groups in several countries are already engaged in research on Environment, Health and Safety aspects of nanomaterials, much of which is of good quality. A key problem is its lack of coordination.

Water

Water applications are considerably less investigated than health or energy applications in Latin America and in Euro-Latin American cooperation (compare figures 3, 5 and 6). Co-authored publications and collaboration exist involving Latin American and European partners in research and education and training. Several large European headquartered engineering companies are already active in the water sector in Latin America. A number of large and small companies are interested in nanotechnology for water applications, mostly in Brazil. Nanotechnology is not a priority in international funding for water solutions, nor is water a priority in research funding for nanotechnology. Some projects have been funded on water applications in nanotechnology programmes in Latin American countries.

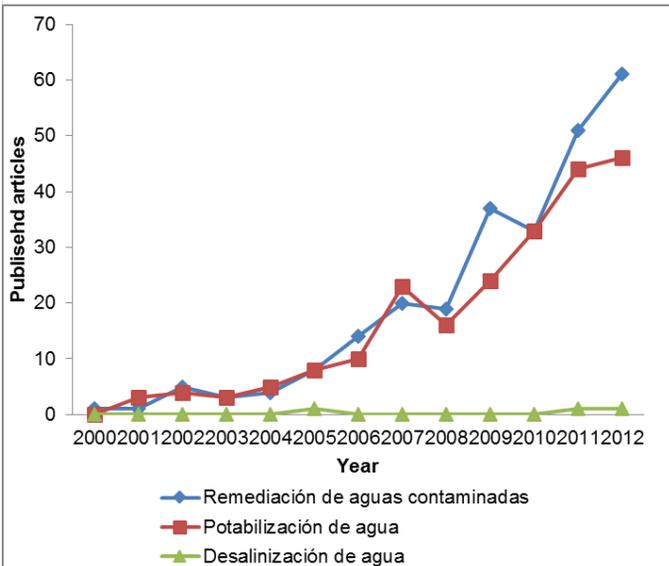


Figure 5: Evolution of publications across the various areas in the field of nanotechnology and the water problematic in Latin America and the Caribbean (2000–2012). Source: Invernizzi et al, 2015). Remediation of contaminated water is the most important, followed by water purification. Desalination is investigated in very few publications.

Energy

There is considerable activity in research on nanotechnology for energy applications in 13 Latin American countries. Many Latin American researchers have co-authored publications with European partners in the period 2003-2012. Most research targets solar PhotoVoltaics (PV), followed by fossil energy, energy storage and energy transport. Since 2004, Brazil has targeted nanotechnology for energy research in its national funding strategy, focusing on fuel cells, storage and PV.

Some companies are already active in nanotechnology for energy applications in Brazil, Mexico and Chile, often in cooperation with academia. Applications include solar PV for energy production but also for powering mobile devices. In 2014, Brazil announced plans for investing in solar PV for energy production, including 10 GW in the coming five years. This will open opportunities for European research organisations and industry in cooperation with Brazilian partners.

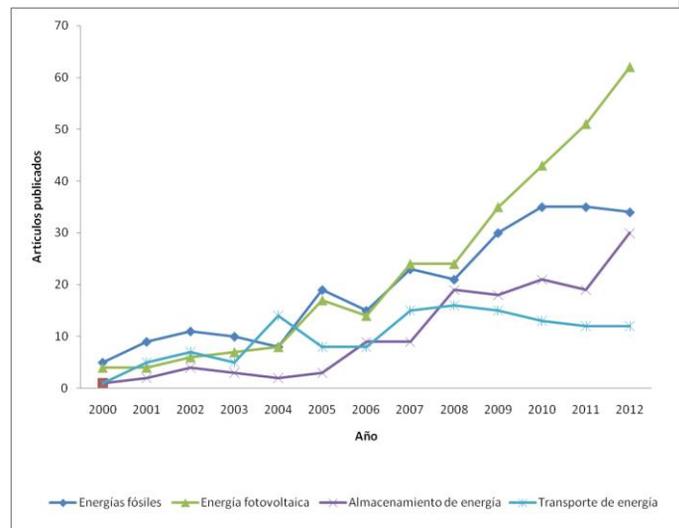


Figure 6: Evolution of publications in a variety of areas within the nanotechnology field and the energy sector in Latin America and the Caribbean for the period 2000-2012 (Source Invernizzi et al, 2015). Photovoltaic Solar Energy is the fastest riser, followed by fossil energy, energy storage and energy transportation.

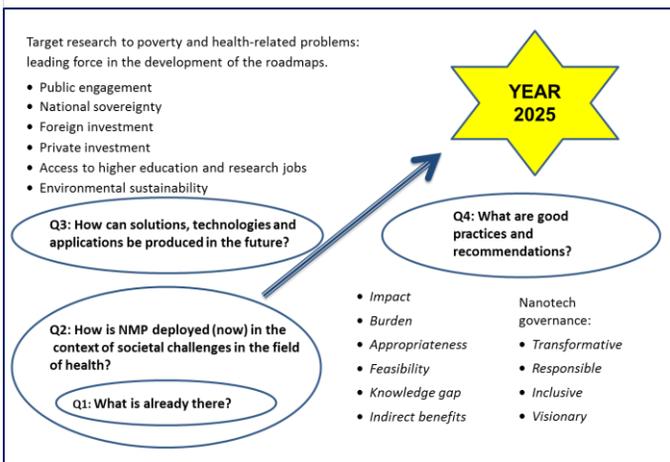


Figure 7: The NMP-DeLA roadmap methodology for deployment of NMP to health, water and energy by 2025

Options for policy makers

Policy makers from Europe and Latin America could **strengthen the local capacities for innovation** in nanoscience and nanotechnology by agreeing a common long term strategy and by pooling resources for common research and innovation priorities as part of the EU-CELAC policy dialogue.

One key issue is a lack of reliable long term **funding**. The European Horizon 2020 programme offers a good starting point with its 7 year budget horizon, but it is important that Latin American national funding is also coordinated in the region as well as with European, North American and other funding (e.g. World Bank, International Monetary Fund, and preferably also venture capital).

The participating ministries in NMP-DeLA (the Ministries for Science, Technology and Productive Innovation from Argentina and for Education and Culture, and Industry, Energy and Mining from Uruguay) and the European Commission could take an initiative for such coordinated funding.

Because Brazilian and Mexican researchers cannot be funded from the EU Horizon 2020 budget, it is a *conditio sine qua non* that the Brazilian and Mexican funding agencies at both Federal and State levels are engaged in such funding strategy coordination from the beginning at the same level as other countries.

In the short term, the Sector Dialogues could offer funding for cooperative projects in cooperation with Brazil: <http://sectordialogues.org/>

A balanced funding strategy is needed including research, infrastructure, education, environment, health and safety, and ethical, legal and social aspects.

The United Nations Institute for Training and Research (UNITAR) focuses on training and capacity building of governments in developing countries and has published a pilot “Guidance for Developing a **National Nanotechnology Policy and Programme**” (UNITAR, 2011). This could form the basis also for such regional coordination in Latin America as well as EU-Latin American cooperation.

Responsible Research and Innovation

The current work of the Argentinean Ethics Board CECTE <http://www.cecte.gov.ar/> on a code of conduct for nanotechnology research could offer a starting point for introducing Latin American perspectives in the EU-Latin American dialogue on Responsible Research and Innovation. On the European side, the materials and methodologies collected in the RRI-tools project can also foster the discussion on a common approach: <http://www.rri-tools.eu/>.

Nanosafety

In the short to medium term there are opportunities for international cooperation in the WHO healthy workplaces programme: http://www.who.int/occupational_health/healthy_workplaces/en/. Brazil has already joined the European NanoREG project, a common European approach to the regulatory testing of Manufactured Nanomaterials www.nanoreg.eu. It may be worthwhile to explore opportunities for other Latin American countries to follow suit. In addition, synergies between NanoREG and RRI-tools could be explored.

Options for policy makers – continued

Health

Government departments for health should participate in common policy making on nanomedicine, along with departments responsible for research and economic affairs and the interested stakeholders. These stakeholders include research, industry (nanomedicine, pharma, medical devices), investors, healthcare professionals, patients associations and non-governmental organisations.

Water

Regional and local policy makers are recommended to articulate demand for nano-enabled **water technologies**. Such demand articulation could be supported by the City Blueprint tool (<http://www.watershare.eu/>). National policy makers should review environmental laws governing the water sector and where necessary introduce a billing system for potable water. This should help create a business case for innovative water purification systems in Latin America.

Energy

At international level, nanotechnology could be included as a key enabling technology in funding and investments in sustainable energy solutions. The Energy mix of Latin American countries varies considerably making it difficult to design a common strategy to nanotechnology for energy applications. In terms of more bioenergy and energy for local use like in remote areas in agribusiness, there is a need for self-sustaining local energy supply. There are opportunities for joint ventures between foreign companies and for instance Brazilian companies. One way to stimulate local development is to establish projects with local facilities or local research council funding.

Options for research and industry

Health

The NMP-DeLA roadmap priority Health targets the proposed UN SDG sub-goal 3.3: *“by 2030 end the epidemics of ... tuberculosis, ... and neglected tropical diseases ...”*.

The emerging Latin American **Nanomedicine** platform is already associated to the International Society for Nanomedicine. It may benefit from cooperation with the European Technology Platform Nanomedicine <http://www.etp-nanomedicine.eu/public/>, including stakeholders and experts in Ethical, Legal and Social as well as technological and economic aspects. (Latin American) research and development targeting tropical diseases including Chagas and Leishmaniasis could be strengthened by learning from (European) experience in “translational nanomedicine”, transferring academic research to the market.

Nanosafety

The European Nanosafety Cluster www.nanosafetycluster.eu coordinates EU funded research on Environment, Health and Safety aspects of Nanomaterials. It has developed a strategic research agenda until 2025. Latin Americans can also participate.

Water

By 2030, the NMP-DeLA roadmap priority water targets the following proposed UN SDG sub-goals: *“...achieve universal and equitable access to safe and affordable drinking water for all ... improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse by x% globally ... by 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies...”*

Industry and researchers should cooperate in scaling up nano-enabled water technologies from lab scale to pilot or full scale.

Researchers should set up international networks and conferences specifically targeting nanotechnology for water applications. This could be related to the nanotechnology working group of the International Water Association (IWA) or the OECD Working Party on Nanotechnology, that published a report on nanotechnology for water in 2011.

Responsible Research and Innovation in nanotechnology for water could be stimulated by targeting the following societal needs of large groups in the Latin American populations:

- Arsenic and Fluor removal from ground water
- Remediation of effluents from mineral mining activities in several countries
- Desalination of sea water in (remote) coastal regions in point of use / small scale units

Energy

By 2030, the NMP-DeLA roadmap priority Energy targets the following proposed UN SDG sub-goals: *"...increase substantially the share of renewable energy in the global energy mix ... double the global rate of improvement in energy efficiency ... enhance international cooperation to facilitate access to clean energy research and technologies, including renewable energy, energy efficiency, and advanced and cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean energy technologies..."*

Public and private partners should cooperate in an integral EU-Latin American R&D&I programme from TRL 1 until TRL 9, where nanotechnologies for solar PV should gradually move from academia via public research centres to industrial partners. The industrial partners should be existing solar energy companies active in Latin America. In Europe, the EU PV clusters and PV platform offer good starting points: <http://www.eupvclusters.eu/> and <http://www.eupvplatform.org/>. It is important to look for niches like lifecycle and stability testing of materials developed by others or specialize in a particular application for Latin America. Niche markets for nanotechnology for energy include batteries, solar and energy harvesting modules for mobile devices, and stand-alone solar energy for agricultural uses in remote regions.

EU-Latin American cooperation should be embedded in broader global networking including North-South as well as South-South cooperation. As a spin-off from the NMP-DeLA project, the conference on Bridging Africa, Latin America and Europe on Water and Renewable Energies Applications (BALEWARE 2016) will facilitate the start of this global initiative: www.baleware.org.

Education and outreach

Education, awareness raising and communication to policy makers and the general public can build upon existing initiatives including the South and Meso-American Research Centres for Fundamental Research: <http://www.ictp-saifr.org/> and <http://mctp.mx/index.html>, NanoAndes: www.nanoandes.org, NanoDYF: www.nanodyf.org, ReLANS: www.relans.org and RENANOSOMA: <http://www.nanotecnologiadoavesso.org/>.

Further reading

All NMP-DeLA deliverables can be downloaded from www.nmp-dela.eu

Invernizzi, N., Foladori, G., Lindorfer, M. (2015) Mapping of Advanced Materials Deployment for Social Challenges: Health, Energy, Water, NMP-DeLA deliverable D2.1

Malsch, I (2014) 1st Ethics and Gender Report, NMP-DeLA D1.4

Malsch, I (2015) 2nd Ethics and Gender Report, NMP-DeLA D1.7

Malsch, I., Lindorfer, M., Lima Toivanen, M., (2015) Final roadmap and recommendations for nano-health, nano-water & nano-energy deployment for societal challenges in Latin American Countries, NMP-DeLA D2.4

Lima Toivanen, M. et al. (2015) Roadmap and recommendations for deployment – Focus on nanotechnologies for health, NMP-DeLA D2.2

Arnold, M. et al. (2015) Roadmap and recommendations for deployment – Focus on nanotechnologies for water, NMP-DeLA D2.7

Pérez Martínez, L.C. et al. (2015) Roadmap and recommendations for deployment: Focus on nanotechnologies for energy, NMP-DeLA D2.6

Nussbaum, M.C. *Frontiers of Justice: Disability, Nationality, Species Membership*; The Tanner Lectures on Human Values, Harvard University Press, Cambridge, MA, 2006

OECD (2011) *Fostering Nanotechnology to Address Global Challenges: Water*, OECD, Paris <http://www.oecd.org/sti/nano/47601818.pdf>

UNITAR, 2011. "Guidance for Developing a National Nanotechnology Policy and Programme"

<http://www2.unitar.org/cwm/publications/Nano.aspx>