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Working Party on Nanotechnology

RESPONSIBLE DEVELOPMENT OF NANOTECHNOLOGY

Summary Results from a Survey Activity

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FOREWORD

Over 2012-2013, the Working Party on Nanotechnology (WPN) developed a questionnaire to collect information on overarching national or regional government policy and/or national and regional research programmes supporting the responsible development of nanotechnology.

Twenty five delegations participated in this survey activity: Argentina, Australia, Canada, China, the Czech Republic, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, South Africa, Spain, Sweden, Turkey, the United Kingdom, the United States and the European Union.

This paper presents the findings of that survey activity in the form of a snapshot of current national or regional policy in this area and examples of research programmes related to the responsible development of nanotechnology.

Note: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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EXECUTIVE SUMMARY

In 2012, the Organisation for Economic Co-operation and Development (OECD) Working Party on Nanotechnology (WPN) developed a questionnaire to collect information on overarching national or regional governmental policy and/or national or regional research programmes supporting the responsible development of nanotechnology. Twenty five delegations participated in this survey activity: Argentina, Australia, Canada, China, the Czech Republic, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, South Africa, Spain, Sweden, Turkey, the United Kingdom, the United States and the European Union. The survey sought to provide a snapshot of current national or regional policy in this area and examples of research programmes related to the responsible development of nanotechnology. For the purpose of the questionnaire, the responsible development of nanotechnology was described as actions to stimulate the growth of nanotechnology applications in diverse sectors of the economy, while addressing the potential risks and the ethical and social challenges the technology might raise.

The results provided information on the way in which nanotechnology is addressed in policy and research programmes. However, the survey did not aim to gather information on policies or programmes administered by government agencies or departments relating to the application of nanotechnology in specific product sectors and, therefore, the results of the survey may not cover any such sector-specific policies or programmes.

The responses indicated that participating delegations share areas of interest in addressing the responsible development of nanotechnology, thereby providing an insight into current thinking. For example, similar research and strategic directions for nanotechnology could be identified from responses to the questionnaire as follows:

- The majority of responses from delegations indicated that national or regional policy and research programmes include investment to support the responsible research, development and commercialisation of nanotechnology by increasing the understanding of environmental, health and safety (EHS) implications of nanotechnology as well as its ethical, legal and social implications (ELSI).

- Many delegations indicated that nanotechnology is seen as having a role to play in addressing major economic and social challenges such as health, sustainable energy, the environment, food security, as well as competitiveness and development challenges such as industrial upgrading, job creation, education and research.

- Delegations, in general, perceived nanotechnology as one of the technologies key to the development of a knowledge-based economy.[1]

- Delegations unanimously reported a particular interest in the potential of nanotechnology to address social and economic challenges when used and/or developed in convergence with other emerging technologies.

Responses to the questionnaire showed a common objective among delegations of achieving socio-economic benefits from the responsible development of nanotechnology, though indicating different approaches to the integration of this objective into national policy and research programmes (see Table 1).

- Some delegations indicated that a specific national or regional policy for the responsible development of nanotechnology was in place (eleven delegations out of 25). For some of these delegations nanotechnology was also part of other national or regional policies.

- Some delegations indicated that there was no dedicated national or regional policy for the responsible development of nanotechnology, but that nanotechnology was included within other policies (nine delegations out of 25).

- In some cases, there was neither a dedicated policy for the responsible development of nanotechnology nor a policy of which nanotechnology was a part (two delegations out of 25). However, the delegations that reported this either had a dedicated research programme for nanotechnology or had recognised nanotechnology as a strategic research area.

- Some delegations reported that a national or regional policy for the responsible development of nanotechnology was under development (three delegations out of 25, namely Sweden, Turkey and the United Kingdom) with publication planned in 2013-2014. For those countries, nanotechnology was included under the general umbrella of science and technology policy.

Table 1: Summary of responses to the questionnaire by delegation[(1)]

	Does your country have a policy for the responsible development of nanotechnology?	Is nanotechnology part of other policies?	Does your country have a national research programme on nanotechnology?	Is nanotechnoloy part of another research programme?
Argentina	•	•	•	•
Australia	•			•
Canada		•	•	•
China	•		•	
Czech Republic		•		•
Denmark		•	•	
European Union	•	•	•	•
Finland		•		
France		•	•	
Germany	•	•		•
Israel		•	•	
Italy	•			•
Japan		•	•	
Korea	•		•	
Mexico				
Netherlands	•	•	•	•
New Zealand			•	
Norway	•		•	
Poland		•	•	•
South Africa		•	•	
Spain	•			•
Sweden	Under development	•		•
Turkey	Under development	•		•
United Kingdom	Under development			•
United States	•	•	•	•

Note: 1-In the case of the European Union, where "country" is referred to in the table, the response covers the countries as a whole, not individual countries.

The survey activity also identified challenges faced by policy makers when developing and implementing policy for the responsible development of nanotechnology. In particular, delegations reported on the challenge posed by the cross-sectoral nature of nanotechnology. Many government departments and agencies, with different mandates and varying levels of expertise, are affected by nanotechnology developments. Already, in a majority of delegations, strategies for the responsible development of nanotechnology are based on cross-ministry/cross-departmental involvement. Strengthening collaboration and co-operation among the different parties involved has proved to be an essential factor in assuring the responsible development of nanotechnology, according to the survey.

RESPONSIBLE DEVELOPMENT OF NANOTECHNOLOGY

Introduction

Nanotechnology policy worldwide aims to ensure that nanotechnology is developed in a responsible way. This means that the opportunities offered by nanotechnology research and business activities, and in addressing grand societal challenges, should be enabled, while at the same time possible negative effects and/or negative perceptions of this new technology should be appropriately managed.

In 2012, the OECD Working Party on Nanotechnology (WPN) began a project, the objective of which was to provide a snapshot across OECD WPN delegations of current overarching national or regional policy and examples of research programmes supporting the responsible development of nanotechnology. A survey activity was carried out during 2012 (see Annex 3 for the questionnaire used).[2] Twenty five WPN delegations participated: Argentina, Australia, Canada, China, the Czech Republic, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, South Africa, Spain, Sweden, Turkey, the United Kingdom, the United States and the European Union.

The current report examines results from the survey responses. It first focuses on the approaches used to the responsible development of nanotechnology that were reported by participating delegations. In view of the responses, the report then considers the role that nanotechnology plays in the development of a knowledge economy and the main investment priorities that link to the responsible development of nanotechnology.

For the purpose of this activity the responsible development of nanotechnology was described as actions to stimulate the growth of nanotechnology applications in diverse sectors of the economy, while addressing the potential risks and the ethical and societal challenges the technology might raise. Policy and initiatives for the responsible development of nanotechnology aim both at supporting research (and/or business activities) and implementing effective legal and regulatory frameworks in order to assure that risk and safety standards are met. They also aim at supporting and stimulating the debate on the place of science and technology in society by engaging with the public on social and ethical issues. As nanotechnology develops, countries and regions have begun to develop, refine and/or articulate regulatory approaches to support the responsible development of nanotechnology.[3]

Approaches to the responsible development of nanotechnology

All participating delegations responded to the questions on whether a dedicated policy for the responsible development of nanotechnology was in place or if nanotechnology was addressed as part of other policies; and whether a dedicated research programme for nanotechnology was in place or if nanotechnology formed a part of other research programmes.

Many delegations reported a specific policy for the responsible development of nanotechnology, with 11 delegations, out of the 25 participating, indicating the development of a policy brief, a regulatory framework, a legislative framework and/or an overall strategy for the responsible development of nanotechnology. All of these delegations reported that the policy had already been implemented. Some of

the delegations that indicated a dedicated policy for the responsible development of nanotechnology also indicated that nanotechnology was included within other policies.

Where there was a dedicated policy for nanotechnology, the policy operated at the national level in all cases with the exception of Spain, which indicated that there was a nanotechnology policy in some of its regions, in parallel with the national dedicated nanotechnology policy for R&D and innovation.

Nine delegations indicated there was no dedicated policy for the responsible development of nanotechnology, but those delegations indicated that nanotechnology was included as part of other policies.

Two delegations indicated there was neither a dedicated policy for the responsible development of nanotechnology nor a policy of which nanotechnology was a part. However, these delegations either reported a dedicated research programme on nanotechnology, or that nanotechnology had been recognised as a strategic research area.

Finally, three delegations, out of the 25 participating, indicated that a policy for the responsible development of nanotechnology was under development (Sweden, Turkey, and the United Kingdom) with publication planned for 2013-2014. For those countries, nanotechnology is currently included under the general umbrella of science and technology policy.

The majority of delegations highlighted the importance of collaboration and co-operation across-ministries, departments and agencies to ensure responsible and efficient development of the technology. Indeed, nanotechnology was expected to impact on a variety of industrial and economic sectors; this cross-sectoral nature appears to be a challenge for policy makers who require the involvement of all governmental stakeholders likely to be impacted by nanotechnology development. The majority of delegations involved a number of relevant ministries and departments in the development of their strategies for the responsible development of nanotechnology. This broad involvement was noted as a clear requirement in order to succeed in the development of nanotechnology.

Delegations also used organisation websites to provide information on their policy approach to the responsible development of nanotechnology and research programmes for nanotechnology. Annexes 1 and 2 give a snapshot of the type of approaches reported. Annex 1 specifies whether or not a country has a policy in place and the type and name of the policy and provides links to relevant websites. Annex 2 tabulates national and regional research programmes that are specific to, or otherwise include, nanotechnology.

For delegations that reported a national or regional policy or a policy of which nanotechnology is a part, some different modes of implementation were identified, as exemplified in the following seven country examples:

Argentina

Since 2007, Argentinean policies for nanotechnology are established through the Ministry of Science, Technology and Productive Innovation and under the support of the Argentinean Nanotechnology Foundation. The "Argentine Innovative 2020" master plan seeks to encourage the formation of local innovative networks around key targeted projects, in a set of activities, for the technological development of the "new general purpose technologies", mainly nanotechnology, but also biotechnology and ICT.

The Ministry, through the National Directorate of International Relations, together with the European Union, is managing the NanoPymes programme to promote the implementation of industrial micro and nano-technology in small and medium-sized companies across the country incorporating technologies boosting its productivity, job creation and the strengthening of competitiveness. The Argentinean

Nanotechnology Foundation supports workshop series on "Nanotechnology and Sustainability" that aim to establish an agenda of work on regulatory matters, notably approaches to environmental aspects of these new technologies. To contribute to the development of norms and standards, communication between governmental, investigating dependencies and industry has been promoted.

The Government's approach to the responsible development of nanotechnology is implemented through the recommendations and reports made by the National Ethics Committee on Science and technology (CECTE). It covers all areas of scientific and technological research and gives guidelines for responsible conduct in research in nanoscience and nanotechnology. Based on these recommendations, for example, spaces for dialogue between researchers from various disciplines and citizens have been promoted. These contribute to the formulation of proposals for a "Code of Scientific Conduct" for progress to be made in science and the welfare of society.

Australia

The government's Approach to the Responsible Development of Nanotechnology provides high level guidance, which covers the following three objectives:

- protect the health and safety of humans and the environment;
- foster informed community debate;
- achieve economic and social benefits from the responsible adoption of nanotechnology.

The responsible development of nanotechnology is also addressed in various regulatory frameworks, policy positions and approaches to risk management.

Canada

While Canada does not have a distinct policy for nanotechnology, the Government of Canada is engaged in a number of activities which specifically address the responsible development of nanotechnology:

- **Policy principles for regulation and oversight**: Federal departments are working together under the Canada-United States Regulatory Cooperation Council Nanotechnology Initiative to strengthen current policy principles to guide government decision-making concerning the responsible development of nanotechnology. These principles address the need to protect human health, safety, and the environment, while not unnecessarily hampering innovation and the exploitation of potential benefits from nanotechnology use.
- **Research and international collaboration**: In collaboration with domestic and international partners, the Government of Canada is actively involved in research and other activities to assess the environmental, health, and safety aspects of nanomaterials and to develop appropriate and internationally compatible approaches for their responsible development and application (e.g. through safety assessment work at the OECD, ISO/IEC nanotechnology standards development, bilateral regulatory co-ordination, and government research and government-funded extramural research).
- **Development of new policy tools**: In October 2011, Health Canada introduced a Working Definition of Nanomaterials to provide a tool to assist the Government to gather safety information about nanomaterials in support of Health Canada's mandate. The Working Definition is not an

additional source of authority, but applies within existing regulatory frameworks that allow for obtaining information (www.hc-sc.gc.ca/sr-sr/pubs/nano/pol-eng.php).

- **Federal science and technology (S&T) strategies**: Federal strategies for S&T research recognise the interconnection between responsible innovation, regulation, and socioeconomic development. Through its 2007 strategy, Mobilising Science and Technology to Canada's Advantage, for example, the Government of Canada is committed to ensuring the responsible development of nanotechnology. Federal strategies set out the general priority areas for government S&T research support (www.science.gc.ca/S&T_Reports-WS5F25C99B-1_En.htm).
- **Interdepartmental collaboration and coordination**: Federal science-based departments and agencies (SBDAs) are engaged in an initiative to foster interdepartmental collaboration and coordination of activities for the responsible governance of nanotechnology. The results of this initiative will inform SBDA work and activities concerning innovation, regulation, public engagement and research.
- **External collaboration and coordination***:* Federal departments and agencies collaborate with external partners, such as provincial nanotechnology associations, on issues related to the responsible development of nanotechnology.

The Netherlands

The nanotechnology policy of the Netherlands consists of three strands that are all being implemented:

- **Opportunities: Research agenda and Top Sector policy**: in 2011, a new national research programme on nanotechnology was started: NanoNextNL which is based on the Strategic Research Agenda that was asked for by the government in both the cabinet and the action plan. Risks and Technology Assessment form part of this research programme. 15% of the budget is dedicated to risk related research, as was demanded by government in the action plan. Since 2011, the research agenda for nanotechnology is also part of the top sector policy of the Netherlands, which aims at enhancing the knowledge economy by stimulating nine top sectors (leading economic sectors).

  The top sector policy is implemented via innovation contracts, in which agreements are laid down between business leaders, researchers and government, jointly focusing the available resources for knowledge and innovation towards the leading economic sectors. As an "enabling technology" nanotechnology can give new impetus to innovation within the High Tech Systems and Materials (HTSM) sector and other top sectors, and in future can also drive technological breakthroughs and solutions to social issues such as the ageing population, climate change, food for a growing population and clean water. Nanotechnology has its own roadmap (which is an update of the Strategic Research Agenda Nanotechnology published in 2008) and is part of the research and technology development taking place within the other roadmaps of the HTSM sector, such as "Semicon Equipment", "Photonics", "Printing" and "High Tech Materials", "Lighting", "Solar", "Healthcare" and in the top sectors Water, Energy, Life Sciences & Health, Chemicals and Agro-food. The research and technology development that are laid down in the abovementioned top sector roadmaps are the backbone of these innovation contracts.

- **Safety and risk policy:**

  – To enable all stakeholders in the Netherlands to assume responsibility and co-operate if necessary, the sharing of data, points of view and best-practices are part of the national policy.

To facilitate this, a group of stakeholders meets regularly as a sounding board facilitated by the government.

- Also, the government finances RIVM/KIRnano: the Risks of Nanotechnology Knowledge and Information centre. KIR nano aims to observe and monitor the potential risks of nanotechnology, gathering relevant scientific literature, generating overviews of relevant legislation, and advising and informing governmental bodies and professionals. Its signalling function is put into practice by participating in national and international networks and bringing experts together into national expert panels on different topics (environment, food, consumer products, medical applications, and workers). In addition, KIR nano is involved in the EU Seventh Framework (FP7) projects EU-ObservatoryNano and NanoImpactNet. In this way, KIR nano acts as an information exchange platform without performing research itself. KIR nano regularly publishes newsletters in Dutch, directed at professionals and regulators but also publicly available.

- The Social and Economic Council of the Netherlands (SER) has recommended the use of provisional nano reference values as alternative for health-based recommended occupational exposure limits or derived no-effect levels. The advice of the SER includes a description on how these provisional reference values should be derived and used, according to the Dutch Trade Unions and the Confederation of Netherlands Industry and Employers.

- The Netherlands, with the support of several other member states, urged the European Commission (by letter in July 2012) to provide for adaptations to existing legislation (e.g. on chemicals, biocides, cosmetics, additives and labeling), to propose legislation on registration or market surveillance of nanomaterials or products containing nanomaterials, and to amend or supplement REACH.

- The Netherlands initiated the European NANoREG project. This project involves 60 partners from 14 European Union member states which brings together regulators, toxicologists, researchers and industry. NANoREG will provide a tool box of relevant instruments for risk assessment, characterisation, toxicity testing and exposure measurements of manufactured nanomaterials, and will develop, in the long term, new testing strategies adapted to innovation requirements.

- **Societal dialogue and ethical aspects**: this strand was implemented via the Committee on the Societal Dialogue on nanotechnology that organised a Public Engagement process in 2010-2011. Its main conclusion was that citizens from the Netherlands want a responsible continuation with nanotechnology, just as the government.

Norway

The Norwegian Government's R&D Strategy for Nanotechnology 2012-2021 is being implemented through priorities in relevant public support schemes stimulating research and innovation, and through relevant national and international legislation and guidelines, etc. The R&D-programme on nanotechnology in the Research Council of Norway, NANO2021, will have a particularly important role in implementing the priorities laid down in the National Strategy in this area, but also other R&D-programmes in the Research Council will be central. Other Governmental Bodies like Innovation Norway (which provide aid to research and innovation activities), the Norwegian Climate and Pollution Agency (which regulates and supervises environmental issues) and the Norwegian Labour Inspection Authority (which regulates and supervises the labour market), will also play important roles. Agents like the Norwegian Board of Technology (which has an independent advisory role to the Government and the

Parliament in technology development issues), will be important in promoting a responsible development of nanotechnology as well. The R&D agents themselves, in the public higher education and research institutions, in the hospitals and in industry, are also expected to contribute to achieving national goals in this policy area.

Spain

The national policy for nanotechnology is being implemented by public support instruments that stimulate research and innovation by:

- **Instrumental strands of action:** Within the new Spanish State Plan for Scientific and Technical Research and Innovation 2013-2016, endorsed in February 2013, different funding support instruments will be available for the Key Enabling Technologies development and dissemination, including nanotechnology, (e.g R+I+i projects, innovation and technology modernisation projects).
- **Development of relevant infrastructures:** Co-operation has been established specially for the creation and use of the needed infrastructures in support of innovation in nanotechnology.
  - **National level:** Spain has established several agreements with different countries in order to promote international technological co-operation among entities from the participating countries, including nanotechnology development, e.g. INL – International Iberian Nanotechnology Laboratory, is the first international intergovernmental organisation in Europe focused on nanosciences and nanotechnology and it relies on Spain and Portugal as member states. Moreover, Spanish Government has formed agreements with all the regions for the design and implementation of R&D policies in nanotechnology in order to avoid fragmentation.
  - **Regional level:**
    - In Andalucia, setting up of the Andalusian nanomedicine and nanotechnology centre (BIONAND) by the Andalusian Government.
    - In the region of Aragon, the Regional Government has centralised research activities on nano within the Institute of Nanoscience of Aragon (http://ina.unizar.es/index.php) created in 2003. In this sense, different frameworks were created to provide this centre with state of the art infrastructure and high level scientists.
    - In the Basque country, CIC Nanogune a centre in permanent pursuit of scientific excellence, with the mission and commitment of contributing to the competitive growth of the Basque country, through the development of nanoscience and nanotechnology (www.nanogune.eu)
    - In Cataluña, creation of the centre for research in nanoscience and nanotecnologies (CIN2) (www.cin2.es/) and the Institute of Photonics Science (ICFO) (www.icfo.es).
- **Dedicated agencies/competence centre creation:**
  - **Regional level**: The Basque government set up the nanoBasque Agency as a tool for the deployment of its policy in this area, supporting the industry in the incorporation of nanomaterials in their processes (more info: http://nanobasque.eu/aNBW/web/en/strategy/index.jsp). Its strategy is an open and integrative proposal that covers three main action areas: business development, knowledge generation, and sector stimulation.

Aware of the international efforts to define a regulatory framework and a common working area and the difficulty for the industry to follow them, the Basque government also aims to align the Basque scientific and technological knowledge and infrastructures for the provision of assessment and services to the industry in this matter with the creation of a *Competence Centre for Environment, Health and Safety issues on nanotechnology.*

- **Private/public national partnerships**: Spain supports different public/private collaborations framed within national technology platforms that aim to bring together the main Spanish players in research, industry and administration in order to promote a common strategy.
- **European dimension**: Among other activities, Spanish entities and governmental institutions are present within European key initiatives related to nanotechnology policies.

The United States

The White House Emerging Technologies Interagency Policy Coordination Committee (ETIPC) has developed a set of principles specific to the regulation and oversight of applications of nanotechnology, to guide the development and implementation of policies at the agency level. (www.whitehouse.gov/blog/2011/06/09/responsible-realization-nanotechnologys-full-potential).

The National Nanotechnology Initiative (NNI) is managed within the framework of the National Science and Technology Council (NSTC), the Cabinet-level council by which the President of the United States co-ordinates science and technology policy across the Federal Government. The Nanoscale Science, Engineering, and Technology (NSET) Subcommittee of the NSTC's Committee on Technology co-ordinates planning, budgeting, programme implementation, and review of progress for the initiative. The NSET Subcommittee is composed of representatives from participating agencies and the Executive Office of the President. The National Nanotechnology Coordination Office (NNCO) acts as the primary point of contact for information on the NNI; provides technical and administrative support to the NSET Subcommittee, including the preparation of multiagency planning, budget, and assessment documents; develops, updates, and maintains the NNI website http://nano.gov; and provides public outreach on behalf of the NNI.

The NSET's Nanotechnology Environmental and Health Implications (NEHI) working group is charged with supporting Federal activities to protect public health and the environment, and was responsible for the development of the NNI 2011 Environmental Health and Safety (EHS) Research Strategy. This document provides guidance to the Federal agencies that produce the scientific information for risk management, regulatory decision-making, product use, research planning, and public outreach of nanotechnology. The core research areas providing this critical information are: 1) nanomaterial measurement infrastructure; 2) human exposure assessment; 3) human health; 4) environment; 5) risk assessment and risk management methods; and 6) informatics and modelling. Considerations of Ethical, Legal, and Societal implications (ELSI) of nanotechnology were also woven into the strategy (see: www.nano.gov/node/681).

Nanotechnology and the knowledge-based economy

When indicating specific approaches toward the responsible development of nanotechnology, delegations provided information on key areas of investment for nanotechnology. Independently of the way in which nanotechnology is being addressed in national strategies, responses to the questionnaire highlighted that nanotechnology is seen as having an essential role to play in the creation of a knowledge based economy. Although priority areas for nanotechnology varied depending on the country's scientific and economic specialisation, development and competitiveness goals and social objectives, there was a common trend towards achieving economic and social benefit from the responsible development of

nanotechnology. In the responses received, a number of priorities were repeatedly mentioned as areas for investment in nanotechnology, in particular, priorities linked to: 1) major economic and social challenges such as health, sustainable energy, the environment, agriculture and food and a growing global population; 2) competitiveness and development challenges such as industry upgrade, job creation, and education and research; and 3) the potential of the convergence of nanotechnology with other technologies (in particular the convergence of bio-, nano- and information and communication technologies) to address social and economic challenges.

Examples of priority areas, by country, for the development of nanotechnology are given in Box 1.

Box 1. Strategic areas for investment in nanotechnology

The Czech Republic: According to the Czech National Research Policy there are six priorities for Czech research to 2030: competitive economics, sustainable energy and materials research, environment for quality life, social and cultural challenges, healthy population, safe society. Nanotechnology is part of priority sustainable energy and material research under the "exploitation of nanomaterials and nanotechnologies" reference as well as the healthy population priority in the subtask "new diagnostics and therapeutic methods" (drug delivery, gene therapy, tissue engineering).

Germany: the Federal Government has the goal to use nanotechnology to contribute to growth and innovation in Germany, to make nanotechnology safe and sustainable, to tap the potential of nanotechnology in education and research and to tap the potential of nanotechnology to meet global challenges. In particular, the Federal Government wants to secure the contribution of nanotechnology to the protection of the environment and climate, to the securing of energy supply and the creation of a knowledge bioeconomy; use the possibilities of nanotechnology for health; and for sustainable agriculture and food safety; and achieve environmental and energy saving mobility through nanotechnology.

The Netherlands: since 2011, nanotechnology is part of the national top sector policy which aims at enhancing the knowledge economy by stimulating nine sectors. As a new enabling technology, nanotechnology can give a new impetus to innovation within the High Tech Systems and Materials (HTSM) sector and other top sectors, and in the future can also drive technological breakthroughs and solutions to social issues such as the ageing population, climate change, food for a growing population and clean water.

Mexico: Mexico's 2001-2006 Special Programme for Science and Technology considered nanotechnology as a strategic area of advanced materials, pointing the need to design a National Programme of Nanotechnology and a network for the exchange of information in this area. The 2001-2006 National Development Plan also pointed to nanotechnology as a strategic area for the energy sector, in particular for the Mexican Petroleum Institute. Nonetheless, the Special Programme did not include an operational implementation plan or budgetary support. The 2007-2012 National Development Plan considered nanotechnology, mechatronics and biotechnology as strategic sectors, and established the need to maximise productivity and competitiveness of the Mexican economy to achieve sustainable economic growth and increase the creation of jobs, by means of the "design of sectoral agendas for the competitiveness of high technology and value added sectors, precursor sectors, as well as conversion of traditional sectors, in order to generate employment with better salaries". Nanotechnology, mechatronics and biotechnology are precursor technologies because they have a great incidence over the development of several productive activities, and because it is foreseen that they also will be determinant factors for the development of branches in many sectors such as agriculture and livestock, industry, services, and consequently, for the productivity and competitiveness of the country.

The Special Programme of Science and Technology (PECiTI) 2008-2012 also considered nanotechnology as a strategic sector and it also determined a prioritised support for activities related to the topic.

Spain: Within the Spanish State Plan for Scientific and Technical Research and Innovation 2013-2016, nanoscience and nanotechnology and their convergence with other technologies are considered within the Key Enabling Technologies (KETs) Promotion sub-programme that is still under development. Strategic areas concerning KETs will be defined in the near future. Moreover, nanomedicine development is also considered within the National Research and Development and Innovation Programme oriented through the societal challenges, included in the aforementioned State Plan, specifically within the challenge "Health Demographic changes and well-being". Within this programme, nanotechnology is considered to be a priority topic as a tool in diagnostic processes and in the treatment of human diseases.

Turkey: Nanotechnology is included in the National Science and Technology Policies, Vision 2023 Strategy Document. In the document nanotechnology is identified as one of the strategic technological fields with strategic focus areas; nanophotonics, nanoelectronics, nanomagnetism, nanomaterials, nanocharacterisation, nanofabrication, nanosised quantum information processing and nanobiotechnology. In this regard, nanotechnology research centres, focusing on these areas are established. One of these nanotechnology research centres is the National Nanotechnology Research Centre-UNAM established in 2006 in Bilkent University that aims to train experts through a multidisciplinary graduate programme and develop new and high technologies based on nanoscience to strengthen the competitiveness of Turkish products in international markets and hence to contribute to the improvement of living standards in Turkey. At present, 32 research centres are conducting research in nanotechnology/nanoscience fields.

As well as national science and technology strategies, the importance of nanotechnology is also stated in other policies of the country. For instance, nanotechnology is identified as a priority field in the Ninth Development Plan (2007-2013) of Turkey which was prepared in line with international developments and basic trends for the 2007-2013 period and considered past developments in the Turkish economy. Nanotechnology is also mentioned in the Turkish Industrial Strategy Document 2011-2014 (Towards EU Membership). The industrial strategy and action plan aims to increase the competitiveness and efficiency of the Turkish industry and expedite the transformation to an industrial structure which has a more share in world exports, where mainly high-tech products with high added value are produced, which has qualified labour force and which at the same time is sensitive to the environment and the society. In the focus of the industrial strategy, the policies are directed to advance the technological development level of all companies. In this regard, development of knowledge intensive technologies and thus investments in fields like biotechnology and nanotechnology are identified as the priorities of the industrial strategy policy. Finally, nanotechnology is considered as a horizontal research area in the National Energy, Water and Food R&D and Innovation Strategies 2011-2016.

The United States: The National Nanotechnology Initiative (NNI), established in 2001, is a United States Government research and development (R&D) initiative involving 27 department and agency units working together toward the shared and challenging vision of "a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society." The combined, co-ordinated efforts of these department and agency units have accelerated discovery, development, and deployment of nanotechnology to benefit agency missions in service of the broader national interest. The 2011 NNI Strategic Plan is the framework that underpins the nanotechnology work of the NNI member agencies. The investment by each NNI member agency in eight programme component areas is reported in the annual NNI supplement to the President's Budget.

To accelerate nanotechnology development in support of the President's priorities and innovation strategy, the White House Office of Science and Technology Policy (OSTP) and the NNI member agencies have identified areas ripe for significant advances through close and targeted programme-level interagency collaboration. This collaboration now includes nanotechnology signature initiatives (NSIs) that are intended to enable the rapid advancement of science and technology in the service of national economic, security, and environmental goals by focusing resources on critical challenges and R&D gaps. As of May 2013, there are five NSIs: 1) Nanotechnology for Solar Energy Collection and Conversion: Contributing to Energy Solutions for the Future; 2) Sustainable Nanomanufacturing: Creating the Industries of the Future; 3) Nanoelectronics for 2020 and Beyond; 4) Nanotechnology Knowledge Infrastructure (NKI): Enabling National Leadership in Sustainable Design; and 5) Nanotechnology for Sensors and Sensors for Nanotechnology: Improving and Protecting Health, Safety, and the Environment.

Priorities for the responsible development of nanotechnology

Information on the consideration of Environmental, Health and Safety (EHS) issues and on possible Ethical, Legal and Social Implications (ELSI) was reported by some delegations (see Table 2), although in the majority of cases no information was available. In general, the actions/activities relating to EHS and ELSI were undertaken as initiatives within existing research programmes, with different departments/ministries in charge of their development, leading to potential difficulties in identifying how much investment is specifically directed towards nanotechnology. Taking the example of Germany, the actions (e.g. funding, public relations, regulation and legislation, topical and political dialogues) performed as initiatives within existing research programmes (on, for example, materials research, optical technologies, information and communication technologies and production research) are undertaken within the activities of a range of areas of government (e.g. in economy, health or environment). The particular funding activities are managed by the individual working units of the ministries.

Table 2: Examples of investments in EHS/ELSI by delegation

Delegations	Investments in EHS and ELSI
France	Around 3% of overall investment in nanotechnology
Israel	Less than 5% of overall investment in nanotechnology
Japan	*Ministry of Health, Labor and Welfare*: JPY 110 million in 2011 fiscal year *Ministry of Agriculture, Forestry and Fisheries*: JPY 98 million in 2011 fiscal year *Ministry of Economy, Trade and Industry*: – a part of JPY 950 million in 2012 fiscal year for "Innovative carbon nanotubes composite materials project toward achieving a low-carbon society" – JPY 330 million in 2012 fiscal year for "Development of Innovative methodology for Safety Assessment of Industrial Nanomaterials" *Ministry of Environment*: JPY 23 million in 2011 fiscal year
The Netherlands	As part of the national research programme on nanotechnology (NanoNextNL) one theme is completely dedicated to risk research and technology assessment, addressing ethical, legal and social issues. In addition, in other themes under the research programme, risk-research is a substantial part of the research performed. In total about 25% of the budget of NanoNextNL is dedicated to research related to risk research and technology assessment. In NanoLabNL (the national nanotechnology research infrastructure), about 50% of the funds go to equipment that can be used for risk related research.
Norway	At least 5% of the national programme's disposable budget is used for projects related to ELSA challenges that include humanities and social science research. At least 10% of the national programme's disposable budget, spread over all the programme's projects, to be applied to projects that build knowledge about the properties and different effects of nanomaterials on human health and/or ecosystem, so that these materials can be used in a safe and responsible manner.
South Africa	Around 10% of overall investments in nanotechnology
The United States	Cumulative NNI investment since fiscal year 2006, including the 2014 request, is approximately USD 15.5 billion with funding for investments in nanotechnology-related environmental, health, and safety research at approximately USD 770 million and investments in research on ethical, legal, and other societal implications of nanotechnology at approximately USD 376 million. These numbers equate to 5.0% of NNI investments for EHS research and 2.4% for ELSI research. Notably, funding for EHS research steadily increased from 2.8% in fiscal year 2006 to 7.1% in fiscal year 2014 request.

While specific data were not reported on investments in EHS and ELSI by all responding delegations, most responses to the questionnaire noted the protection of human health and the environment as being a key priority in ensuring the responsible development of nanotechnology. An informed public dialogue and the involvement of society in technological development were also largely mentioned as priorities among the responses. Education, including raising awareness of the potential risks and benefits of nanotechnology and its applications among the technology practitioners, in particular students, was also highlighted as key (see Box 2).

Box 2. Examples of national priorities for the responsible development of nanotechnology

Australia: the government's approach to the responsible development of nanotechnology outlines the approach of the Australian Government to capturing the benefits of nanotechnology whilst addressing health, safety and environmental concerns. The high level objectives set out in the approach are the following: protect the health and safety of humans and the environment; foster informed community debate; achieve economic and social benefits from the responsible development of nanotechnology.

Germany: the "Nano-Initiative – Action Plan 2015" is the common platform for the safe, sustainable and successful handling of nanotechnology in all its facets and hence co-ordinated innovation politics of the Federal Ministries is required. The action framework pools different approaches from SME-support, new lead innovations over enhanced risk research up to a comprehensive dialogue with the public regarding the chances and impacts of nanotechnology. Another focus of attention was and still is the regulation of nanomaterials-containing products. It is currently being examined to which extent the European and national legal frameworks need to be adapted to the use of nanomaterials in products in order to ensure consumer safety.

Korea: the National Comprehensive Development Plan for Nanotechnology has five major goals, among which are strengthening the social and ethical responsibilities of nanotechnology R&D. The development plan further specifies the objectives for addressing EHS concerns: by establishing a legal and regulatory framework for nanotechnology EHS; by developing fundamentals of nanotechnology EHS measurements and by enhancing networks and international collaborations for EHS research.

The Netherlands: One of the research themes of the national research programme on nanotechnology, NanoNextNL, is specifically dedicated to risk research and technology assessment (RATA theme). In addition, NanoNextNL is working on:

- Awareness raising with PhD-students, postdocs and researchers of industry via a training on technology assessment aspects and possible risks of nanotechnology;
- The obligation for nanotechnology PhDs to pay attention, e.g. by writing a chapter in their thesis, adding an annex or separate document etc., on the possible risks that may be related to their research;
- Creating interaction between the RATA-theme and other themes within NanoNextNL that are more focused on applications of nanotechnology and generic technology development;
- Research in other themes may not be directly related to risk research, but it will in some cases result in new research equipment that can also be used in risk research.

Norway: the Government's R&D Strategy for Nanotechnology 2012-2021 aims to promote responsible technological development by: facilitating an increase in the proportion of publicly funded R&D efforts in this field accounted for by EHS and ELSA research to a level which is among the highest internationally; facilitating the integration of EHS and ELSA into technology development projects involving nanotechnology, by making the EU "Code of Conduct for Responsible Nanosciences and Nanotechnologies Research" the norm for national R&D efforts; and co-operating with the Norwegian Board of Technology to increase the social dialogue and involvement of society in technological development within this field.

CONCLUSIONS

In 2012, the OECD WPN agreed to examine overarching national or regional approaches to the responsible development of nanotechnology. The WPN developed a survey activity in which 25 WPN delegations participated.

Delegations reported on national or regional approaches to the responsible development of nanotechnology by providing information on relevant policy and research programmes. The survey activity did not cover policies or programmes administered by government agencies or departments relating to applications of nanotechnology in specific product sectors. Responses to the survey indicated different national or regional approaches toward the responsible development of nanotechnology, as well as different approaches to the integration of this objective into national or regional policy and research programmes. In particular:

- Eleven delegations indicated they had a specific policy for the responsible development of nanotechnology;
- Nine delegations reported that there was no dedicated policy for the responsible development of nanotechnology, but that nanotechnology was included as part of other policies;
- Two delegations indicated that there was no dedicated policy for the responsible development of nanotechnology or a policy of which nanotechnology was a part, but those delegations either reported a dedicated research programme on nanotechnology or that nanotechnology was recognised as a strategic research area;
- Three delegations indicated that a dedicated policy for the responsible development of nanotechnology was under development.

National or regional policy and research programmes for nanotechnology, as indicated by the majority of delegations, included investment to support the responsible research, development and commercialisation of nanotechnology by increasing understanding of the environment, health and safety and potential implications of nanotechnology as well as its ethical, legal and social implications.

Three main strategic directions for nanotechnology could be identified from responses to the questionnaire, namely:

- Nanotechnology to address major economic and social challenges such as health, sustainable energy, the environment, agriculture and food and a growing global population;
- Nanotechnology for competitiveness and development challenges such as industrial upgrading, job creation, and education and research;
- The development of nanotechnology in convergence with other technologies, in particular the convergence of bio-nano- and information and communication technologies, to address social and economic challenges.

NOTES

[1] According to the OECD glossary of statistical terms, "the knowledge-based economy" is an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors, see http://stats.oecd.org/glossary/detail.asp?ID=6864.

[2] The survey did not aim to gather information on the policies or programmes administered by government agencies or departments for applications of nanotechnology in specific product sectors and, therefore, the results of the survey may not cover any such sector-specific policies or programmes.

[3] The OECD undertook a project on "Regulatory Frameworks for Nanotechnology in Food and Medical Products". This project was based on a survey, for each of the food and medical products areas, that addressed questions related to: 1) the regulatory frameworks being used to provide oversight for the use of nanotechnology in the relevant field; 2) the legislative frameworks relevant to these regulatory frameworks; and 3) relevant government-supported research programmes and institutions. The report for results of the survey activity was published in May 2013: OECD (2013), "Regulatory Frameworks for Nanotechnology in Foods and Medical Products: Summary Results of a Survey Activity", *OECD Science, Technology and Industry Policy Papers*, No. 4, OECD Publishing. doi: 10.1787/5k47w4vsb4s4-en

ANNEX 1. NATIONAL OR REGIONAL POLICY FOR THE RESPONSIBLE DEVELOPMENT OF NANOTECHNOLOGY BY DELEGATION

	Does your country have a policy for the responsible development of nanotechnology?	Is this policy National or Regional?	Is it a policy brief, regulatory framework, legislative regime, other?	Website	Has the policy been implemented?	Is nanotechnology part of other policies?
Argentina	Yes	National	The responsible development of Nanotechnology is implemented through the Recommendations and reports made by the National Ethics Committee on Science and technology: Guidelines for responsible conduct in research in nanoscience and nanotechnology.	The National Ethics Committee on Science and Technology www.mincyt.gov.ar/ministerio/estructura/unid_asesoras/cecte/index.php Argentinean Nanotechnology Foundation (FAN) www.fan.org.ar/		Yes, the National Ethics Committee on Science and technology (CECTE) covers all areas of scientific and technological research, with focus on nanoscience and nanotechnology.
Australia	Yes	National	Government's Approach to the Responsible Development of Nanotechnology	Government's Approach to the Responsible Development of Nanotechnology www.innovation.gov.au/Industry/Nanotechnology/NationalEnablingTechnologiesStrategy/Documents/ObjectivesPaper.pd	Yes	
Canada	No	-	-	-		Yes – a framework of legislation regulations, and policies is in place in Canada to ensure the responsible development of new technologies, including nanotechnology, for example: • Policy Statement on Health Canada's Working Definition of Nanomaterials www.hc-sc.gc.ca/sr-sr/pubs/nano/pol-eng.php; • Canada's S&T Strategy www.science.gc.ca/S&T_Reports-WS5F25C99B-1_En.htm

	Does your country have a policy for the responsible development of nanotechnology?	Is this policy National or Regional?	Is it a policy brief, regulatory framework, legislative regime, other?	Website	Has the policy been implemented?	Is nanotechnology part of other policies?
						• Policy principles for regulation and oversight as part of the Canada-US Regulatory Cooperation Council Nanotechnology Initiative (under development) http://actionplan.gc.ca/en/page/rcc-ccr/nanotechnology
China	Yes	National	Research programme	Notice of the Ministry of Science on nanotechnology research www.most.gov.cn/tztg/201206/t20120621_95215.htm National Nanotechnology Development 2001-2010. www.most.gov.cn/fggw/zfwj/zfwj2001/200512/t20051214_55037.htm	Yes	-
Czech Republic	No	-	-	-	-	Yes – the Check National Research Policy www.vyzkum.cz/storage/att/BDEBEF2534A2EA16F06E7B23B378747D/National%20priorities.pdf
Denmark	No	-	-	-	-	Yes – it is included in the regulatory framework regarding working environment, environment, ethics, etc.
European Union	Yes		Regulatory Framework Strategy	EUROPA website on Nanotechnology http://ec.europa.eu/nanotechnology/index_en.html Code of conduct for responsible nanosciences and nanotechnologies research http://ec.europa.eu/research/sciencesociety/index.cfm?fuseaction=public.topic&id=1303&lang=1	Yes	Yes – see Seventh Framework Progamme http://cordis.europa.eu/fp7/home_en.html; Horizon 2020 http://ec.europa.eu/research/horizon2020/index_en.cfm

In the case of the European Union, this refers to the European Union as whole, not individual countries

	Does your country have a policy for the responsible development of nanotechnology?	**Is this policy National or Regional?**	**Is it a policy brief, regulatory framework, legislative regime, other?**	**Website**	**Has the policy been implemented?**	**Is nanotechnology part of other policies?**
Finland	No	-	-	-	-	Yes – see for more information Nanovisio 2020 www.aka.fi/Tiedostot/Tiedostot/Julkaisut/2_11%20Nanovisio%202020.pdf
France	No	-	-	-	-	Yes - Nanotechnologies (nanomaterials) are taken into account in several risk policies against chemical hazards, occupational safety and security policies.
Germany	Yes	National	Action Plan of the Federal Government (Actin Plan Nanotechnology 2015)	Nanotechnology - A Future Technology with Vision www.bmbf.de/en/nanotechnologie.php	Yes	Yes – the High Tech Strategy www.hightech-strategie.de/de/390.php
Israel	No	-	-	-	-	Yes
Italy	Yes	Natiuonal	Policy Brief	Technology Platform for Nanotechnology www.assoknowledge.org/nan/obiettivi.html	Yes	-
Japan	No	-	-	-	-	Yes – the Science and Technology Basic Plan www8.cao.go.jp/cstp/english/basic/3rd-Basic-Plan-rev.pdf and the Basic Environment Plan of the Ministry of Environment (www.env.go.jp/en/policy/plan/basic/index.html
Korea	Yes	National	Policy Brief	-	Yes	-

	Does your country have a policy for the responsible development of nanotechnology?	Is this policy National or Regional?	Is it a policy brief, regulatory framework, legislative regime, other?	Website	Has the policy been implemented?	Is nanotechnology part of other policies?
Mexico	No	-	-	-	-	No – but since 2002, research in nanotechnology has been recognised as a strategic research area. See for example The Special Programme for Science, Technology and Innovation 2008-2012 http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/mx/policydocument/policydoc_0001; and the 2007-2012 National Development Plan www.uncsd2012.org/content/documents/Plan%20Nacional%20de%20Desarrollo%202007-2012.pdf
Netherlands	Yes	National	Policy brief	National nanotechnology policy : www.government.nl/issues/science/national-research (in English), www.rijksoverheid.nl/onderwerpen/nanotechnologie (in Dutch) www.htsm.nl	Yes	Yes – the National Top Sector Policy www.top-sectoren.nl/hightech (in Dutch)
New Zealand	No	-	-	-	-	No
Norway	Yes	National	Strategy	Government's R&D Strategy for Nanotechnology 2012-2021 www.regjeringen.no/nb/dep/nhd/aktuelt/nyheter/nyheter-2012/giske-lanserte-strategi-for-nanoteknolog.html?id=691701	Yes	-
Poland	No	-	-	-	-	Yes – the National Research Foresight Programme "Poland 2020" http://foresight.polska2020.pl/cms/en/ the Polish National Research Programme www.nauka.gov.pl/fileadmin/user_upload/eng/ministry/legal_acts/National_Research_Programme.pdf

	Does your country have a policy for the responsible development of nanotechnology?	**Is this policy National or Regional?**	**Is it a policy brief, regulatory framework, legislative regime, other?**	**Website**	**Has the policy been implemented?**	**Is nanotechnology part of other policies?**
South Africa	No	-	-	-	-	Yes – National Nanotechnology Strategy as part of the National Research and Development Strategy www.info.gov.za/view/DownloadFileAction?id=127107
Spain	Yes	National and Regional	Research and Development National and Regional Plans	Spanish Strategy for Science and Technology and Innovation (2013-2020) www.idi.mineco.gob.es/stfls/MICINN/Investigacion/FICHEROS/Politicas_I+D+i/Estrategia_espanola_ciencia_tecnologia_Innovacion.pdf	Yes, both at the national and regional level. Actions within new State R&D and Innovation Plan are still under development	
Sweden	It is under development (expected to be completed by September 2013)	-	-	-	-	Yes – Nanotechnology is today been addressed the same way than all the other areas but a change is in progress.
Turkey	It is under development (expected to be completed in the period 2013-14)	-	-	-	-	Yes - National Science and Technology Policies, Vision 2023 www.tubitak.gov.tr/en/about-us/policies/content-vision-2023 Ninth Development Plan 2007-2013 www.maliye.gov.tr/Lists/TabMenuIcerik/Attachments/106/9developmentplan.pdf Turkish Industrial Strategy Document 2011-2014 www.sanayi.gov.tr/Files/Documents/TurkiyeSanayiStratejisiIngilizce.pdf National Energy Water and Food R&D and Innovation Strategies 2011-2016 http://euraxess.tubitak.gov.tr/the-23nd-meeting-of-supreme-council-for-science-and-technology

	Does your country have a policy for the responsible development of nanotechnology?	**Is this policy National or Regional?**	**Is it a policy brief, regulatory framework, legislative regime, other?**	**Website**	**Has the policy been implemented?**	**Is nanotechnology part of other policies?**
United Kingdom	It is under development	National	-	The Nanotechnology Strategy Forum (NSF) www.defra.gov.uk/nanotech-forum/	-	-
United States	Yes	National	A component (Goal 4) of the 2011 NNI Strategic Plan; 2011 NNI Environmental Health and Safety (EHS) Research Strategy: and Policy Briefs (Memoranda for Heads of Executive Departments and Agencies)	2011 NNI Strategic Plan: www.nano.gov/node/581 2011 NNI Environmental Health and Safety (EHS) Research Strategy: www.nano.gov/node/681 White House Emerging Technologies Interagency Policy Coordination Committee (ETIPC) Policy Principles for the U.S. Decision-Making Concerning Regulation and Oversight of Applications of Nanotechnology and Nanomaterials: www.whitehouse.gov/blog/2011/06/09/responsible-realization-nanotechnologys-full-potential	Yes	Yes – Nanotechnology is also covered under White House ETIPC Policy Principles for Regulation and Oversight of Emerging Technologies: www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Principles-for-Regulation-and-Oversight-of-Emerging-Technologies-new.pdf In addition, an existing framework of legislation, regulations, and policies are in place in the United States to ensure the responsible development of new technologies – including nanotechnology.

ANNEX 2. RESEARCH PROGRAMME FOR NANOTECHNOLOGY BY DELEGATION

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Argentina	Yes	Yes	Nanotechnology Argentinian Sectorial Funds : Through calls, the Ministry spurs the implementation of projects that are between 1.5 and 10 million dollars, provided by public-private partnerships, to promote the development and transfer of nanotechnology products to the market and society. www.agencia.mincyt.gob.ar/ The ANR "Bio-Nano-Tics" is an instrument of the Argentinian Fund Agency of scientific and technological promotion aimed at financing projects of technological development in the areas of bioengineering, **nanotechnology** and ICT. www.mincyt.gob.ar NANOPYMES is a programme to partially finance projects having as a goal to improve the innovative capacity of companies producing goods and services in the sector of nanotechnology (nanomaterials, nanosensors and nanoenablers) to integrated projects, in cooperation with the European Union. www.nanopymes.mincyt.gob.ar/ Argentinean Nanotechnology Foundation: this strategic plan is oriented towards the creation of innovative companies based in nanotechnology and its applications. www.fan.org.ar
Australia	No	Yes	Research on nanotechnology is supported through mainstream research programs, such as the Australian Research Council and the National Health and Medical Research Council, and various programs to support industry R&D and commercialisation. There have also been programmes to support the development of research infrastructure and, at times with some of these programmes, nanotechnology (or aspects, such as health and safety issues) have been one of several priority areas. In addition, the Commonwealth Scientific and Industrial Research Organisation undertakes research on nanotechnology, although it is part of a wide range of research programmes across the organisation.
Canada	Yes	Yes	The National Institute for Nanotechnology (Website under development) Various groups within Canada's National Research Council are also active in nanotechnology – please visit www.nrc-cnrc.gc.ca/eng/about/index.html. Nanotechnology-related research is also supported under the programs of various other federal government departments and agencies. See for examples: • Canada Research Chairs Secretariat www.chairs-chaires.gc.ca/about_us-a_notre_sujet/index-eng.aspx www.cerc.gc.ca/cpov-pcap-eng.shtml www.cerc.gc.ca/cpan-pccs-eng.shtml#a7 www.cerc.gc.ca/chairholders-titulaires/boyd-eng.shtml

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Canada	Yes	Yes	• Natural Sciences and Engineering Research Council (NSERC) www.nserc-crsng.gc.ca/Students-Etudiants/index_eng.asp www.nserc-crsng.gc.ca/Professors-Professeurs/Grants-Subs/index_eng.asp www.nserc-crsng.gc.ca/Professors-Professeurs/RPP-PP/index_eng.asp • Networks of Centres of Excellence: www.nce-rce.gc.ca/index_eng.asp www.arboranano.ca www.aapsinc.com/ • Social Sciences and Humanities Research Council (SSHRC): www.sshrc-crsh.gc.ca/Default.aspx Environment Canada and Health Canada support internal and academic research to inform on the environment, and human health safety aspects of nanomaterials to feed into risk assessments.
China	Yes	-	Notice of the Ministry of Science on nanotechnology research and other six major national scientific research plan on the issuance of the "second five" special planning www.most.gov.cn/tztg/201206/t20120621_95215.htm
Czech Republic	No	Yes	There are several national programmes for funding the research projects which are provided mainly by the Grant Agency of the CR, Technology Agency of the CR, Ministry of Education, Youth and Sports and Ministry of Industry and Trade. The amount of projects on nanotechnology topics within the above mentioned programmes is quite high even if no specific programme is dedicated only to nanotechnology. See for example several institutions are specifically active in the field of nanotechnology safety and risks: • The Czech Office for Standards, Metrology and Testing (www.unmz.cz/office/en) • The National Institute of Public Health (www.szu.cz/index.php?lchan=1&lred=1) • The Occupational Safety Research Institute (www.vubp.cz/) • Czech Technological Platform on Industrial Safety (www.cztpis.cz/en/) • The Czech Republic Ministry of Agriculture cooperates with the European Food Safety Authority (EFSA) in a network for risk assessment of nanotechnologies in food and feed • The Nanosection of The Czech Society for New Materials and Technologies (www.csnmt.cz/en) • The Technology Centre of the Academy of Science of the Czech Republic (www.tc.cz/en)

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Denmark	Yes	-	The field of activity is new technologies - and in the interfaces between the technologies - that can create important and new opportunities to all sectors in the society, i.e. improve prosperity as well as welfare. The programme is under the Danish Council for Strategic Research http://en.fi.dk/councils-commissions/the-danish-council-for-strategic-research/about-the-council/the-programme-commissions/programme-commission-on-strategic-growth-technologies The National Research Centre for the Working Environment is also participating in collaborative research projects on nano-related issues. Please find list of on-going projects at www.arbejdsmiljoforskning.dk/en/forskning/strategiske-forskningsomraader/nanoteknologi
European Union	Yes	Yes	Further information at: • Seventh Framework Progamme http://cordis.europa.eu/fp7/home_en.html; • Horizon 2020 http://ec.europa.eu/research/horizon2020/index_en.cfm
Finland	No	-	Tekes and the Academy of Finland all fund some nanotechnology projects as part of their routine funding activity.
France	Yes	-	National Research Agency – Research programmes for nanotechnologies and nanosystems www.agence-nationale-recherche.fr/programmes-de-recherche/appel-detail/nanotechnologies-et-nanosystemes-p2n-2012/ The P2N programme has a strategic objective to strengthen national excellence in the field of micro-and nano-engineering of core technologies to systems and enable the transfer of scientific and technological knowledge into innovation; www.agence-nationale-recherche.fr/programmes-de-recherche/appel-detail/nanotechnologies-et-nanosystemes-p2n-2012/ The RTB programme aims to give France a research infrastructure technology to the highest international level for micro-nano-technologies (production, characterisation); www.rtb.cnrs.fr/accueil.php3 The Nano-innov programme has been launched in 2009 on the topics: Materials and energy, Internet of objects, Health and environment; www.enseignementsup-recherche.gouv.fr/cid25281/nano-innov-un-plan-en-faveur-des-nanotechnologies.html In European programmes, ANR (National Research Agency) is leader of the ERA-NET SIIN (security and toxicology of the nanosciences and nanotechnologies) In the national government framework "Investing for the future", there are several actions on nanotechnologies: - IRT (Institute for Technological Research) - Equipex and Labex programme - FSN programme (fund to support digital industry) - Nano biotechnologies programme

In the case of the European Union, this refers to the European Union as whole, not individual countries

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Germany	No	Yes	The actions (funding, public relations, regulation and legislation, topical and political dialogues, etc.) are performed as initiatives in existing research programmes, like materials research, optical technologies, ICT, production research, diverse governmental department activities in economy, health or environment. The particular funding activities are managed by the individual working units of the governmental ministries. Information exchange, debate about the general strategy and the discussion about regulation and legislation is performed by regularly holding meetings with the responsible persons of the involved departments.
Israel	Yes	-	Israel Nanotechnology Initiative www.nanoisrael.org
Italy	No	Yes	-
Japan	Yes	-	Ministry of Education, Culture, Sports and Science & Technology • Grants-in-Aid for Scientific Research (KAKENHI) www.jsps.go.jp/english/e-grants/index.html • Strategic Basic Research Programs www.jst.go.jp/kisoken/en/index.html • Nanotechnology Platform Project https://nanonet.nims.go.jp/english/ • Elements Strategy Initiative (ESI) • Tohoku Innovative Materials Technology Initiatives for the Reconstruction (TIMT) Ministry of Health, Labour and Welfare Systematic research to develop the processing and production technologies of nanometre-scale food particles (NFPs) and characterisation of structural, physicochemical properties of the products including solid, particle NFPs (www.naro.affrc.go.jp/org/nfri/yakudachi/foodnanotech/index_e.html) Ministry of Internal Affairs and Communications Development of ultrahigh-speed low-power-consumption organic photoelectric polymer optical switch technology and high-sensitivity superconducting single photon detection technology using nanofabrication technology, and their application to ICT systems (www.nict.go.jp/en/advanced_ict/index.html). Ministry of Economy, Trade and Industry • Tsukuba Innovation Arena http://tia-nano.jp/en/index.html

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Korea	Yes	-	Nanoconvergence 2020 project Nanomaterials technology development projects Industrial technology development project
Mexico	No	-	National Network of Nanoscience and Nanotechnology (INN network) Nanoscience and Nanotechnology Research Groups Network (REGINA network) National Network of Nanoscience and Nanotechnology
Netherlands	Yes	Yes	The National Research Programme NanoNextNL www.nanonextnl.nl Besides the research programme NanoNextNL, the Netherlands also has a national nanotechnology research infrastructure called NanoLabNL (www.nanolabnl.nl). The Dutch Science Foundation (NWO) also has a small programme on nanotechnology NWONano which aims to promote excellent fundamental and application-oriented nanoscience and nanotechnology research in the Netherlands
New Zealand	Yes	-	MacDiarmid Institute; http://macdiarmid.ac.nz/research Not all of the research related to nanotechnology is carried out through the MacDiarmid Institute. Other research is carried out at our universities and crown research institutes. Many of the researchers at these institutions are members of the MacDiarmid Institute.
Norway	Yes	-	NANO2021: www.forskningsradet.no/prognett-nano2021/Home_page/1253969916222 In addition there are two other programmes in the Research Council of Norway where the responsible development of nanotechnology plays an important role : • Ethical, legal and Social Aspects of Biotechnology, Nanotechnology and Neurotechnology – ELSA www.forskningsradet.no/prognett-elsa/Home_page/1224698247023 • Norwegian Environmental Research toward 2015 (MILJO2015) www.forskningsradet.no/prognett-miljo2015/Home_page/1224697848161
Poland	Yes	Yes	The GRAF-TECH Programme www.ncbir.pl/en/domestic-programmes/graf-tech/art.836.graf-tech-a-support-programme-for-rd-works-on-application-of-graphene.html • New material technologies are also a part of Applied Research Programme (www.ncbir.pl/en/domestic-programmes/applied-research-programme/
South Africa	Yes	-	The National Nanotechnology Strategy www.dst.gov.za/index.php/resource-center/strategies-and-reports/165-the-national-nano-technology-strategy

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Spain	Yes	-	Research programme is included within the State Scientific and Technical Research and Innovation Plan www.idi.mineco.gob.es/stfls/MICINN/Investigacion/FICHEROS/Politicas_I+D+i/Plan_Estatal_Inves_cientifica_tecnica_innovacion.pdf Various groups within Spain's National Research Council (CSIC) are also active in nanotechnology – please visit www.csic.es/web/guest/areas-cientificas At regional level, nanotechnology is included in general R&D&I Plans. Some examples from some regions are shown below: – Basque Country: In this region Nanosciences and Nanotechnologies are also a part of all the research programmes of the Basque Science, Technology and Innovation policies and it is highlighted as and Strategic scientific and technological action. The instruments, in this case, are mainly: R&D&I projects, projects for new product development, creation of new technology-based companies, training and enhancing human capital and production and further development of the Competitiveness and Innovation Itineraries. – Andalucia: Nanotechnology is considered as a part of the Andalusian Plan of Innovation in order to increase the competitiveness of the companies. – Aragon: Included in the "II Regional Plan for research, development and knowledge transfer of Aragon" (II PAID) within the strategic line "Technological development based on new materials and process".
Sweden	No	Yes	There is a substantial amount of nanotechnology research ongoing at the universities on project level. In addition a number of nanotechnology projects (not necessary under the label Nanotechnology) are financed by the different governmental research funding bodies such as: – The Governmental Agency for Innovation Systems, VINNOVA,(www.VINNOVA.se) – The Swedish Energy Agency, (www.STEM.se) – The Swedish Research Council, (www.VR.se) and foundations such as – The Swedish Foundation for Strategic Research, (www.Stratresearch.se) – The Knowledge Foundation, (www.kk-stiftelsen.org) A few years ago VINNOVA had a nano-dedicated programme called Green Nano and a few projects are still ongoing, and the Knowledge Foundation ran a programme called MINST. Besides these programmes a substantial amount of nanotechnology related activities is ongoing in Sweden. VINNOVA finance for instance two centres, VINN Excellence Centre a 10-year commitment, in which a major part of the research activities is related to nano technology. In the Research and Innovation bill presented in 2008 the government defined 23 strategic areas and one was nanotechnology which in the first 5-years period has received a dedicated budget.

Country	Does your county have a national research programme on nanotechnology?	Is nanotechnology part of other research programme?	Relevant information/website
Turkey	No	Yes	Nanotechnology related research and development projects are supported under these institution's programmes: • Support Programmes of the Ministry of Science, Industry and Technology: – Industrial Theses Support Programme (San-Tez) (www.sanayi.gov.tr) – Techno-Initiative Capital Support (www.sanayi.gov.tr) • Support programmes of the Scientific and Technological Research Council (TUBITAK) – Support Programme for Scientific and Technological Research Projects (1001) and – Industrial R&D Funding Programme (1501). • Technology Development Foundation of Turkey-TTGV carries out Technology Development Projects including nanotechnology. • Ministry of Development provides infrastructural supports for the establishment of the research and application centres. • Turkey also participates in 21 FP7 projects in this field. More specifically Turkish universities participates in the regulatory testing and risk issue related projects such as NANOMICEX and NanoReg. Small and Medium Enterprises Development Organisation (KOSGEB) provides financial support and consultancy services for succesful entrepreneurs that work in the fields of industry, science and technology including nanotechnology.
United Kingdom	Yes	Yes	Nanotechnology research is driven forward in the United Kingdom by: – Government departments as part of their integrated research programmes. Where EHS issues are identified as priorities these are funded by relevant departments and agencies; – The UK Research Councils through research projects funded in responsive mode. – The UK's Technology Strategy Board welcomes proposals undertaking nanotechnology R&D in response to calls in e.g. materials, photonics The United Kingdom is also an active participant in the EU Framework Programme and the OECD's nanosafety research programme, delivered through the WPMN's priority nanomaterial sponsorship programme.
United States	Yes	Yes	The National Nanotechnology Initiative (NNI) Strategic Plan (www.nano.gov/node/581) is the framework that underpins the nanotechnology work of the NNI member agencies. It lays out guidance for agency leaders, programme managers, and the research community regarding planning and implementation of nanotechnology R&D investments and activities. The investment for each Programme Component Area by NNI member agency is reported in the annual NNI supplement to the President's Budget (www.nano.gov/about-nni/what/funding).

ANNEX 3. QUESTIONNAIRE ON THE RESPONSIBLE DEVELOPMENT OF NANOTECHNOLOGY

The Responsible Development of Nanotechnology aims to stimulate the growth of nanotechnology applications in diverse sectors of the economy, while addressing the potential risks and the ethical and societal challenges the technology might raise. Initiatives and policy for the responsible development of nanotechnology aim at supporting research and implementing effective legal and regulatory frameworks in order to assure that the risk and safety standards are met. They also aim at supporting and stimulating the debate on the place of science and technology in the society today; engaging with the public on societal and ethical issues.

For the purpose of this questionnaire, a responsible development policy can address all or some of the issues raised in the above definition.

1. Does your country have a policy for the responsible development of nanotechnology?

[ ] Yes
[ ] No (go to question 6)
[ ] It is under development

1a. If Yes, is it:
[ ] a national policy
[ ] regional policies

1b. If Yes, is it:
[ ] A policy brief
[ ] Regulatory framework
[ ] Legislative regime
[ ] Other (please provide details)

2. If your country has a policy, or has one under development, could you please provide a short summary of the policy?

3. If existent, please provide a web link to more information on your country's nanotechnology policy (in English).

4. In what ways is this policy being implemented?

5. Can you share some examples of the implementation and some information on what worked smoothly and what didn't work, or was difficult in your country?

6. If there is no specific nano-policy in your country, is nanotechnology a part of other policies?

[ ] Yes
[ ] No

6a. If Yes, is it part of risk policy, legislative regimes, regulatory framework, or something other?

7. Does your country have a dedicated national research programme on nanotechnology?

[ ] Yes
[ ] No (go to 7c)

7a. If Yes: what are its main topics?

7b. If Yes: please provide a short summary and web link of the research programme

7c. If Yes: what percentage of funding is for Environmental Health and Safety (EHS) research and/or Ethical, Legal, and Social issues? To what use(s) are the funds for EHS and ELS being put within the research programme (e.g. research, awareness raising on possible risks or ethical issues, courses to inform and train scientists on EHS and/or ELS)? The responder should try to share any good practices and identify things that worked particularly well and/or did not work well, also indicating the reasons for their relative success or failure.

7d. If No, does your country have research programs of which nanotechnology is a part?