Opinion of the European Economic and Social Committee on 'Nanotechnology for a competitive chemical industry'

(own-initiative opinion)

(2016/C 071/05)

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On 28 May 2015, the European Economic and Social Committee, acting under Rule 29(2) of its Rules of Procedure, decided to draw up an own-initiative opinion on:

Nanotechnology for a competitive chemical industry

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The Consultative Commission on Industrial Change (CCMI), which was responsible for preparing the Committee's work on the subject, adopted its opinion on 5 November 2015.

At its 512th plenary session, held on 9 and 10 December 2015 (meeting of 9 December), the European Economic and Social Committee adopted the following opinion by 115 votes to 2, with 4 abstentions.

1. **Conclusions and recommendations**

1.1. The EESC supports the activities for developing a European industrial policy and in particular those supporting key enabling technologies (KETs), which strengthen our competitiveness. When Europe speaks with one voice internationally, its role within global dialogue is strengthened. The innovative power of nanomaterials and nanotechnology — particularly in the chemical industry — is making an important contribution in this regard.

1.2. An initiative to promote nanotechnology can also help further develop common European industrial policy. Research and development are so complex that they cannot be undertaken by individual companies or institutions working alone. They require overarching cooperation between universities, scientific institutions, companies and business incubators. Research hubs, such as those set up in the chemical and pharmaceutical sector, are a positive approach. It must be ensured that SMEs are included.

1.3. European clusters of excellence (nanoclusters) should be further developed to support nanotechnology. Specialists from the world of business, science, politics and society must form networks in order to promote technology transfer, digital and person-to-person cooperation, better risk assessment, a special life-cycle analysis and the safety of nano products.

The financial instruments provided for in the Horizon 2020 research framework programme relating to the area of nanotechnology must be made simpler and more flexible, particularly for SMEs. Public financing must be reinforced and the supply of private capital stimulated.

1.4. In order to better anchor multidisciplinary nanotechnology within education and training systems, qualified scientists and technicians from disciplines such as chemistry, biology, engineering, medicine or the social sciences should be involved. Businesses must meet their staff's growing need for qualifications through targeted initial and further training measures. Employees, with their experience and competences, should be included.

1.5. The EU standardisation process should be further boosted. Standards play a key role in ensuring compliance with laws, particularly where employee safety requires a risk assessment. Tools should therefore be devised for certified reference materials, in order to test the procedures for measuring the characteristics of nanomaterials.

1.6. Consumers should be fully informed about nanomaterials. It is essential to promote acceptance of these key enabling technologies. Regular dialogues must take place between consumer and environmental organisations, businesses and politicians. Pan-European information platforms and tools for increasing acceptance must be developed to this end.

1.7. The EESC expects the European Commission to set up an observatory to record and evaluate the development processes, applications, use (recycling) and disposal of nanomaterials. It should also monitor and assess the impact on employment and the labour market and describe the political, economic and social conclusions to be drawn. An up-to-date 'Report on nanomaterials and nanotechnologies in Europe' should be presented before 2020, identifying development trends to 2030.

2. **Nanotechnology in an innovative Europe**

2.1. There have been and continue to be various European Commission initiatives designed to promote innovation and key enabling technologies with a view to increasing competitiveness. Examples include the Commission communications on a common strategy for key enabling technologies (2009 and 2012) and its 2014 communication on research and innovation. Particular attention has been paid to nanotechnology in several EESC opinions ([1]).

2.2. With the adoption of the 2014 Juncker Plan, EU industrial policy is taking on a special importance — as is the promotion of innovative technologies. The favoured technologies set out show that a competitive European industrial policy must focus strategically on forward-looking technologies and materials. This particularly applies to the chemical and pharmaceutical industry.

2.3. The European chemical and pharmaceutical industry drives innovation in other sectors. Nanotechnology plays a key role in developing new products. This improves competitiveness and also contributes to sustainable industrial development.

2.4. Nanomaterials are already present in many everyday products (e.g. sports clothing, cosmetics, coatings). Innovations for new products and processes are also emerging (for example, energy and environmental technology, medical technology, optics, the development and manufacture of chips, technical data protection, the construction industry, as well as varnishes and paints, medicinal products and medical technology).

2.5. Due to their small size, nanomaterials can have new optical, magnetic, mechanical, chemical or biological properties. They can be used to develop innovative products which incorporate new functionalities and special features.

2.6. According to a recommendation adopted by the European Commission, nanomaterials are materials whose main elements measure between 1 and 100 billionths of a metre. This definition is an important step forward, as it clearly describes which materials should be regarded as nanomaterials and makes it possible to select the most appropriate test procedure ([2]).

([1]) EESC opinion on 'Growth Driver Technical Textiles' (OJ C 198, 10.7.2013, p. 14); EESC opinion on 'Strategy for Micro- and Nanoelectronic Components and Systems' (OJ C 67, 6.3.2014, p. 175).

([2]) European Commission, Brussels, 18 October 2011. One nanometre equates to one billionth of a metre. This is long enough to fit around 5-10 atoms. The relationship between a nanometre and a metre is equivalent to that between a football and the Earth. The term nanotechnology refers to the targeted and controlled measurement, development, production and application of nanomaterials, whose structures, particles, fibres or platelets measure less than 100 nanometres.

2.7. Nanotechnology offers huge potential for growth. Experts expect the market to grow from USD 8 billion in 2006 to USD 119 billion in 2021 ([3]).

3. **Nanotechnology in the chemical industry and medicine** ([4])

3.1. The range of nanotechnology used in the chemical industry is enormous. It must be noted that much of what comes under the heading 'nano' today is nothing new, though 'nanotechnology' may sound new. Mediaeval stained-glass church windows, for example, include gold nanoparticles. What is actually new about nanotechnology as we understand it today is the fact that we now have a better understanding of how it works.

3.2. Medicine offers many fields of application for nanotechnology. The desire to deliver active substances to diseased tissue in a targeted way is as old as the production of medicines and stems from the fact that many active substances have powerful side effects. These side effects are often caused by active ingredients being distributed throughout the body in a non-specific way. The development of nano-scale drug delivery systems makes it possible to concentrate active substances in the diseased tissue and thereby reduce side-effects.

3.3. There are specific nano developments in the field of life sciences such as, e.g. 'biochips' for tests which enable the early diagnosis and treatment of diseases such as Alzheimer's, cancer, multiple sclerosis and rheumatoid arthritis ([5]). Nanoparticle-based contrast media bind specifically with diseased cells, leading to significantly faster and better diagnostics. Nanogels speed up the regeneration of cartilage. Nanoparticles that can cross the blood-brain barrier may help, for example, with the targeted treatment of brain tumours ([6]).

3.4. In artificial membranes, small pores measuring around 20 nanometres ensure that bacteria and viruses can be filtered from water. 'Ultrafiltration' is used in the purification of both drinking water and process water, i.e. water from industrial production processes.

3.5. In the near future nanotechnology will significantly increase the efficiency of solar cells. Energy generation and energy efficiency can be increased considerably through the use of new surface coatings.

3.6. Whether as an additive in plastics, metals or other materials, nanotubes, carbon nanotubes or graphene can provide materials with new characteristics. For example, they improve electrical conductivity, increase mechanical resilience or promote lightweight construction.

3.7. The use of wind turbines can also become more efficient using nanotechnology. Modern building materials make wind turbines lighter, leading to lower energy generation costs and optimised construction.

3.8. Around 20 % of the energy consumed globally is used for lighting. Nanoresearch promises energy-saving light bulbs that use much less electrical energy, with the result that energy consumption is set to fall by more than a third. Electric cars will also become cost-effective thanks to lithium-ion batteries, which would not be possible without nanotechnology.

3.9. Concrete is one of the most commonly used building materials. Using nano-based calcium crystals, precast concrete components can be manufactured very quickly and to a higher standard using less energy.

3.10. The automotive industry is already working with nano-coatings, each with their own particular characteristics. The same is true of other carriers, such as planes or ships.

([3]) Source: www.vfa.de/…/nanobiotechnologie-nanomedizin-positionspapier.pdf
([4]) In the following text, the term 'chemical industry' can be taken to include the pharmaceutical industry.
([5]) Source: www.vfa.de/…/nanobiotechnologie-nanomedizin-positionspapier.pdf
([6]) Source: www.vfa.de/…/nanobiotechnologie-nanomedizin-positionspapier.pdf

4. **Nanotechnology as an economic component**

4.1. The competitive factors in the global market are constantly changing. Whilst many things are planned, much of what happens is unforeseen. Policy programmes are drawn up in order to secure development. For example, 2010 saw the adoption of the Europe-2020 strategy. This strategy aims at sustainable and inclusive growth with greater coordination of pan-European policy measures. It is hoped this will lead to success in the headlong race for innovation. The strategy concerns research and development, patent protection, production sites and jobs.

4.2. The chemical industry is one of the EU's most successful sectors, boasting EUR 527 billion in sales in 2013, which makes it the second-largest producer. But despite this strength, there seems to be reason for concern about the current situation. Following a rapid cyclical trend, production has stagnated since the beginning of 2011. Over a longer time horizon, the EU's share of global production and exports has fallen ([7]).

4.3. In 2012, the EU chemical industry invested around EUR 9 billion in research. Since 2010, the amount spent has plateaued at this level. In contrast, the research and development of nanotechnology occupies an increasingly important position for example in the USA and China, but also in Japan and Saudi Arabia, meaning that competition in this area is set to increase further.

5. **Nanotechnology as an environmental component**

5.1. Green business practices are a significant factor for competitiveness in European industrial policy, both with regard to the single market and the global market.

5.2. Whether as upstream, intermediate or finished products, nanomaterials with their multifarious properties help to increase the efficiency of energy conversion and to reduce energy consumption. Nanotechnology offers the prospect of reducing CO_2 emissions ([8]). As such, it contributes to climate protection.

5.3. The German state of Hesse has published a study highlighting the innovation potential of nanotechnology in the area of environmental protection ([9]), e.g. for water treatment and purification, waste prevention, energy efficiency and air purification. This will mean stronger orders, particularly for SMEs. The chemical industry is researching and developing the foundations and the relevant upstream and finished products.

5.4. The environmental component must be integrated into the strategies of businesses, including SMEs, as part of a sustainability approach. Employees should be actively involved in this process.

5.5. The precautionary principle is an integral part of current EU environmental policy and health policy. Harm or risks to the environment or human health should be minimised from the outset. However, it is necessary to ensure the proportionality of the costs, benefits and burdens involved in implementing preventive measures, in particular to protect SMEs.

([7]) Oxford Economics Report, *Evolution of competitiveness in the European chemical industry: historical trends and future prospects*, October 2014.

([8]) For example, the German **Fraunhofer Institute for Wind Energy and Energy System Technology** and the Italian National Agency for New Technologies (ENEA) have developed the technology for converting CO_2 to methane and storing it. Source: **Fraunhofer Institute for Wind Energy and Energy System Technology, 2012.**

([9]) Source: State of Hesse, Ministry of Economics and Transport, 'Einsatz von Nanotechnologie in der hessischen Umwelttechnologie' (*Use of nanotechnology in environmental technology in Hesse*), 2009.

6. **Nano as an employment/social component**

6.1. Nanotechnology's potential to create jobs worldwide is very high. The number of nano-related jobs in the EU is already estimated at between 300 000 and 400 000 ([10]).

6.2. Alongside this growth, the risks associated with job losses, the relocation of production sites and the evolving qualification spectrum must also be considered.

6.3. The number of jobs is one thing; the quality of those jobs is another. The jobs created in nano-related areas of various businesses, not just in the chemical industry, tend to be well-paid jobs for skilled employees ([11]).

6.4. This generates a significant need for education and training within businesses. New forms of cooperation emerge. Social partnership itself becomes a factor in innovation in the sense that an ongoing dialogue is needed, e.g. regarding the organisation of work, occupational health and training. In the German chemical industry, there are far-reaching social partnership agreements ([12]) to this end.

7. **Opportunities and risks associated with nanotechnology**

7.1. The European Commission is already spending between EUR 20 and 30 million annually on nano-safety research. This is on top of roughly EUR 70 million from the Member States ([13]). The scale of this effort is appropriate and sufficient.

7.2. A comprehensive programme of public and private long-term research should be coordinated at European level with view to expanding knowledge about nanomaterials, their characteristics and the potential opportunities and risks for employee and consumer health and the environment.

7.3. Many chemical companies have taken various risk management measures in order to implement sustainable occupational and product safety in a responsible manner. In many cases this is done under the umbrella of the chemical industry's global Responsible Care initiative ([14]). Similar initiatives also exist in other sectors.

7.4. The principle of product stewardship applies from the research stage through to disposal. As early as the development stage, companies examine how their products can be manufactured and used safely. The examinations must be completed and safe usage guidelines drawn up before products are released on the market. In addition, companies must also provide details on how to dispose of the products correctly.

7.5. In its publications regarding the safety of nanomaterials, the European Commission stresses that scientific studies have shown that nanomaterials essentially qualify as 'normal chemicals' ([15]). Knowledge about the properties of nanomaterials is constantly increasing. Existing risk assessment methods can be used.

([10]) Otto Linher, European Commission, Grimm et al.: Nanotechnologie: Innovationsmotor für den Standort Deutschland (*Nanotechnology: an innovation driver for Germany*), Baden-Baden, 2011.

([11]) IG BCE/VCI: Zum verantwortungsvollen Umgang mit Nanomaterialien (*On the responsible use of nanomaterials*). Position paper, 2011.

([12]) IG BCE: Nanomaterialien — Herausforderungen für den Arbeits- und Gesundheitsschutz (*Nanomaterials: challenges for occupational health and safety*).

([13]) Otto Linher, European Commission.

([14]) http://www.icca-chem.org/en/Home/Responsible-care/

([15]) Background paper for WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials.

7.6. The European Commission considers REACH ([16]) to be the best framework for managing the risks associated with nanomaterials. Some clarifications and further details are required in the annexes to the REACH Regulation and the European Chemicals Agency guidance documents — but not in the main text of the regulation ([17]).

7.7. In the pharmaceuticals industry, 'Good Manufacturing Practices' (GMP) play a key role in the processing of nanomaterials. This relates to the quality assurance guidelines for the production processes associated with the production of pharmaceutical drugs and active ingredients.

7.8. It goes without saying that consumers must be informed. The dialogues on nanotechnology conducted by large chemical companies are positive examples of this ([18]). These dialogues aim to provide information, promote acceptance and identify hazards. To improve access to information about nanomaterials, the European Commission launched a web platform at the end of 2013 ([19]). This includes references to all available information sources, including national and sectoral registers.

8. **Competitiveness factors/Stimulus for nanotechnology in Europe**

8.1. A positive climate for research and innovation is an essential factor for competitiveness. This applies to innovations in products and processes as well as social renewal. The importance of nanotechnology should also be more strongly reflected and supported in the EU's priorities and in its research and regional funding programmes.

8.2. Research and development must take on a key role in the EU. Europe-wide networking, cooperation and clustering between start-ups, established businesses, universities and research institutions focusing on fundamental and applied research are important in this regard. Nowadays, this is the way to generate effective innovation potential. Hubs linking companies are being set up at key geographical points in order to optimise cooperation.

8.3. Initial and further training are a key factor in highly innovative processes such as nanotechnology. A mixture of skilled workers and graduates produces the strongest innovation effects, with the exchange of knowledge between employees with different types of qualification supported by complementary organisational and HR policy measures such as teamwork, job rotation and the delegation of decision-making. Global competition for innovation also gives rise to competition for skilled workers. Appropriate incentives must be developed by policy-makers and industry stakeholders.

8.4. More freedom in research focus and fewer bureaucratic requirements would ensure competitiveness. Medicines, medical technology, surface coatings and environmental technology are very important for European exports and the single market. In particular, the single market with its regional hubs opens up a wide range of opportunities in this area for SMEs.

8.5. Labour-related costs should not be solely taken to mean salaries. The administration costs entailed (e.g. control activities, quality assurance) must be included in the assessment.

8.6. Energy costs are a relevant factor for competitiveness in the energy-intensive chemical industry. Competitive prices and a stable energy supply in the EU are preconditions for competitiveness, particularly for SMEs.

Brussels, 9 December 2015.

The President
of the European Economic and Social Committee
Georges DASSIS

([16]) REACH is the European Regulation on the registration, evaluation, authorisation and restriction of chemicals. http://echa.europa.eu/web/guest

([17]) Source: Sector Social Dialogue, Committee of the European Chemical Industry.

([18]) http://www.cefic.org/Documents/PolicyCentre/Nanomaterials/Industry-messages-on-nanotechnologies-and-nanomaterials-2014.pdf

([19]) https://ihcp.jrc.ec.europa.eu/our_databases/web-platform-on-nanomaterials