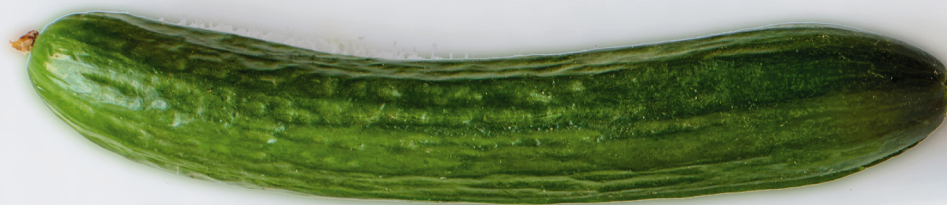




**GONANO CITIZEN MEETINGS  
FUTURE ENERGY AND NANOTECHNOLOGIES  
INFORMATION MATERIAL**



## ABOUT THE MEETING AND THE GONANO PROJECT

Thank you for participating in the GoNano citizen meeting on future food and nanotechnology! At the citizen meeting you will work together with other citizens to create an overview of aspirations and concerns for innovations in nanotechnology by focussing on how they could affect your future everyday interaction with food and drink.



## WHAT HAPPENS AFTER THE GONANO MEETING?

1. GoNano researchers will analyse what you have said. In their analysis they will focus on the needs, concerns and desires you have expressed.
2. GoNano researchers will use the analysis in the second step of the project: expert workshops with researchers, engineers, industry, civil society organisations and policy. They will ask them to use your requirements as a starting point for designing future nanotechnologies.
3. In spring 2019 you and other citizens across Europe will receive an invitation to evaluate the innovation ideas from the expert workshops.
4. In expert workshops, researchers, engineers, industry, civil society and policy representatives, will re-work the design suggestion to try and take the feedback of the public into account.
5. GoNano researchers will present the result to EU policy-makers, and make the results available online, together with teaching material that show how people could work with citizens to develop innovative product designs.



## WHY ARE WE FOCUSING ON FOOD FOR THE FUTURE?

Together as a society we face an increasing number of people, pressure on producing enough food, pollution from food production (e.g. pesticides), and from food packaging (e.g. plastics), food waste and deep inequalities in access to good nutritional food and clean water. Nanotechnologies could possibly contribute to improving food packaging so that it would degrade in nature, new more nutritional foods, and inexpensive and easy to use nano-filters for cleaning of water. Governments must decide on if and how much to invest in the development of nanotechnologies. It is a difficult decision as we are not sure if and when the benefits of nanotechnologies will be realised, and how much it might cost.

## IN THE FOLLOWING SECTIONS, WE WILL:

- ♥ Provide you with a brief introduction to nanotechnology,
- ♥ Explain how nanotechnology could contribute to food production in the future,
- ♥ Introduce questions and uncertainties related to nanotechnology and food,
- ♥ Introduce scenarios of how everyday life could look like in 2030,
- ♥ End with a summary and information on how we will follow up on the meeting, and how you can follow the progress of the project as well as how you may get in contact with us.

# WHAT IS NANO-TECHNOLOGY?

Nanotechnology is generally referred to as 'the science of the very small'. The prefix nano actually derives from the Greek νᾶνος (nanos in Latin), meaning dwarf.

A human hair can be used to illustrate size at the nanoscale. A human hair is approximately 80,000-100,000 nanometres wide. Another way to illustrate how small this is would be to say that comparing a nanoparticle to a basketball is roughly the same as comparing a basketball to planet earth. Nanomaterials can be found to occur "naturally" e.g. in dust or volcanic ash, in car exhaust fumes or in the smoke produced by a burning candle, or can be designed and fabricated artificially.



## NANOTECHNOLOGY TODAY

**Water-repellent fabrics:** Some water-proof fabrics are not actually water-proof. In fact, the natural fabric may not repel water at all; however, nanotechnology can be used to create tiny patterns or nanostructures, or to add very thin layers, that then make the surface water-repellent.

**Nano-cure for nail fungus:** A new treatment for nail fungus is under development that combines nanoparticles with anti-fungal medication to deliver the drugs more effectively to affected area of the nail.

**Nano-robots clear away bacteria and toxins:** Researchers are developing tiny nano-robots (made from gold nanowires) that can be controlled with ultrasound. The nano-robots can be used to quickly clear bacteria and toxins from biological fluids like blood.



# RISKS AND REGULATIONS

## NANOTECHNOLOGY, HUMAN AND ENVIRONMENTAL HEALTH

There are many types of engineered nanomaterials; some are potentially hazardous but can be used safely under controlled circumstances. Most safety concerns relate to nanoparticles in free form, where they are harder to control and are not particles bound up in solid materials or fluids. But even then, are we able to control them? Are they toxic? Do they evade the natural defences of the body, and what are the implications of this? Do they damage cells? Could nanotechnologies have different effects on men than women, and could there be differences in effects across ethnicities?

Some people argue that we already use many dangerous technologies and substances in our everyday life (e.g. gasoline). They think we should talk about how we regulate and use dangerous technologies and substances,

instead of talking about if we should use them. Others worry that the very properties that make nanomaterials desirable, are the very properties that make them hard to control and regulate. They therefore think that we should talk about whether or not we should be developing nanotechnologies as all.

## YOUR SUNBLOCK COULD CONTAIN NANOPARTICLES

Many products already contain nanoparticles. E.g. a sunblock that rubs in clear on your skin could contain nanoparticles. Producers of sunblock are not obliged to indicate on the label if your sunblock contains nanoparticles. They are obliged to tell you what is in your sunblock, but not how small the particles are. A lot of research has been carried out to confirm that sunblock containing nanoparticles is safe to use for humans, but what about when we wash the sunblock off our skin? Has enough evidence been gathered about the possible environmental impacts of such products before allowing their use?

## HOW IS NANOTECHNOLOGY REGULATED?

The question of whether and how to regulate nanomaterials has been ongoing in the European Union (EU) for over a decade. The EU was the first jurisdiction in the world to provide nano-specific legal provisions to address health and safety concerns of nanomaterials. Implementation of the EU legislation has, however, proven challenging. The various EU agencies need time to figure out who has the responsibility to implement oversight and regulation. Regulators need time to keep up with scientific developments. Industry and business need time to understand how to categorise and index their products.



# NANOTECHNOLOGY AND FOOD: WHAT ARE THE VISIONS?

## SMART FOOD PACKAGING

Today, plastic is widely used for food packaging. Plastic presents a threat to the environment in the form of greenhouse gas emissions, and micro plastic in our oceans. Scientists imagine nanotechnology will lead to smart food packaging in biodegradable materials with e.g. anti-microbial, anti-fouling, stain-resistant, water repellent properties. In addition, nanosensors in the food packaging may in the future detect contaminated food and warn you by showing a red dot on the package. Overall, these properties could be used to realize so called “customer specific” packaging solutions. Benefits include: extended self-life, improvement of food security, and reduction of the environmental impact from production and degradation of food packaging.

## NOVEL FOODS

Imagine if we could optimise our food, so that we would be sure to get all the nutrients we need for a healthy body. Imagine if we could offer healthy, cheap and nutritious food to the global population, ending malnutrition, hunger and disease caused by a lack of (good) food and water. Researchers imagine it will be possible to encapsulate vitamins and other nutrients in nanoparticles, add



it to our food, and thereby improve the nutritional value in everyday food. Nanoscale approaches could also be used to develop low fat foods or to change how certain foods taste or how they look like.

## NANO FILTERS

Water pollution is a global societal issue. Nanofiltering for purification of drinking water is already providing low-cost solution for water purification in some developing countries. Nanofilters can remove bacteria, viruses, heavy metals and organic materials from water.



## HOW SHOULD WE DESIGN NANOTECHNOLOGIES?

### WILL NANOTECHNOLOGY LEAD TO BETTER FOOD AND LESS ENVIRONMENTAL IMPACT FROM FOOD PRODUCTION?

In order to work, nanotechnology innovations need to be implemented in our societies, everyday lives and (inter)national systems. How would nanotechnology innovations in food impact us and food production systems? Some of the unanswered questions on this include:

- ♥ How will nano-enriched food influence our eating habits? Will we eat more or less?
- ♥ Will nanotechnologies empower developing countries, or will international cooperation's gain further control over their food production systems?
- ♥ Will nano-food be available for everyone?
- ♥ Will it be a luxury product, or will it be seen as cheap food for the poor?
- ♥ Could nano-foods have health risks for some ethnic groups and not for others?

## HOW COULD NANOTECHNOLOGIES BE DEVELOPED TO SUIT YOUR NEEDS?

### HOW DO WE MAKE SURE THAT:

- ♥ We design nanotechnologies that fit with the wishes of citizens across the world?
- ♥ We avoid the risks and enjoy the benefits of nanotechnologies?

Research has shown that because nanoscience is dominated by men, ideas of future nanotechnology products are also male oriented. Men and women also think differently about risk. Perceptions of risk vary between some ethnic groups, with some men having a lower perception of risk. Women are more likely to think nanotechnologies are dangerous, and are less likely to engage with nanotechnologies because of this.

Research has also shown that religious beliefs and differences in culture can play a role in how we judge the potential of nanotechnologies, as well as how we believe nanotechnologies should or should not be used.



## WHAT DO YOU THINK?

- ♥ Do you think culture, gender or religion influence how you think about using nanotechnologies for food and drink production, and for food packaging?
- ♥ Do you think there are some traditional and cultural values we should support with new technologies for food and drink production, or food packaging?
- ♥ How should nanotechnologies for food and drink be developed?

# FUTURE VISIONS OF NANOTECHNOLOGY AND FOOD IN 2030

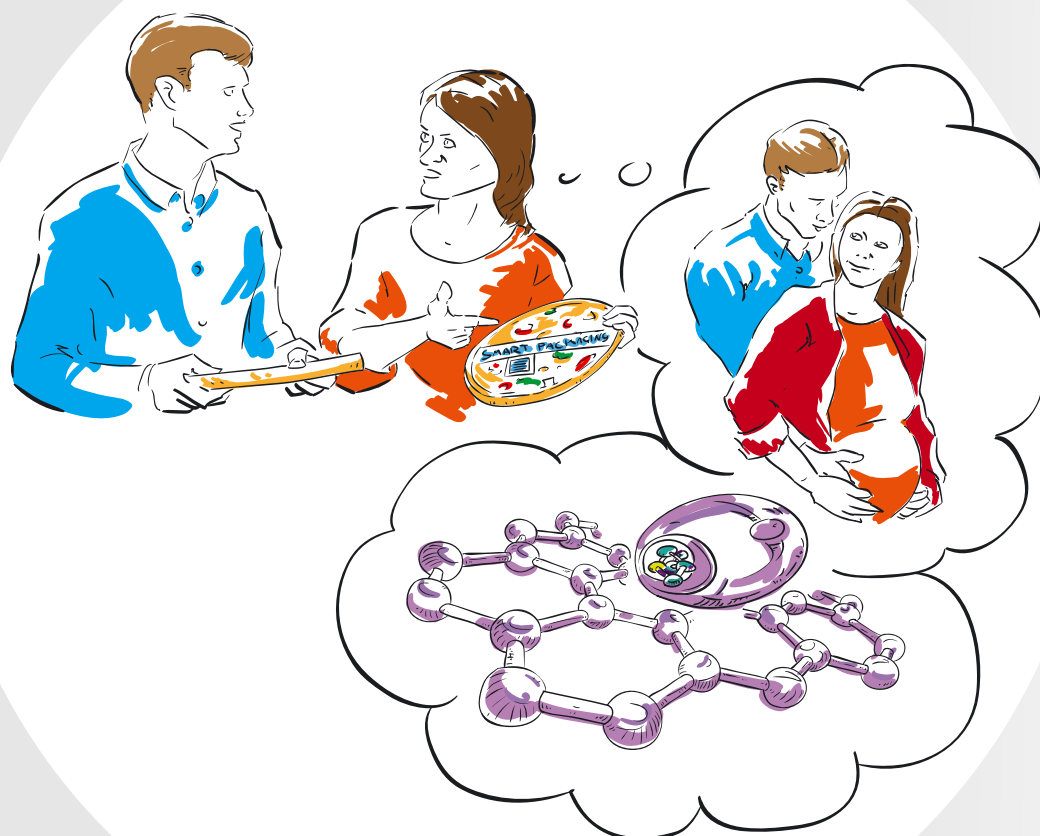
## PIZZA FOR TWO

Peter and Sofia are in the supermarket to shop for dinner. It's a little late, and they are both already starting to feel hungry. They decide on pizza. Neither of them have any interest in or patience for cooking tonight. They see some freshly made pizza - ready for the oven. Perfect. As they grab for two pizzas Sofia notices there is something different about the packaging. It must be the new smart nano packaging that they have heard so much about on the news!

Sofia reads aloud the text written on the packaging. Apparently, it is a new smart packaging that extends the shelf life of the pizza. It contains antibacterial nanoparticles, in-built sensors that warn you if the food is contaminated or has been exposed to harmful bacteria, and it is made of biodegradable plastic. Peter thinks it sounds great but Sofia is not convinced. She has just read that recent studies have shown that the nanoparticles can migrate into the food and contaminate it. The exact health related risks associated with the nanoparticles is

still uncertain, but some researchers suspect that exposure to the nanoparticles might be related to infertility in women. The scientific community and the regulatory authorities are not in agreement on how to deal with this uncertainty.

Sofia and Peter stare at each other in silence. They were planning to start trying for a baby soon, so they are not sure whether to eat the pizza or not. Glurg, glurg glurg, rumbles Peter's tummy. They start laughing hysterically. They are both very hungry and they decide to eat the pizza. As they walk out the supermarket they continue to discuss the smart packaging. They both agree it is good to have food that can stay fresher for longer, but Sofia doubts that it is really necessary. She thinks she would always be able to see or smell if food is fresh. Peter wonders how it was possible for the packaging to be in the supermarket when there is still uncertainty surrounding the health effects of the nanoparticles. Sofia has to laugh a bit about Peter's concerns. She points out to him that we often accept health risks in relation to food, reminding him of the countless beers and cigarettes he had at the party last Saturday night.





## DREAMING OF CARROT CAKE

Theresa is 80 years old. She is living in a nursing home. Her family visit her often. She particularly likes the visits of her daughter, Sofia. She always brings a carrot cake, made from old-fashioned carrots and covered in thick sugary icing. The nurses at the home have told Sofia to stop bringing the cake. It's unhealthy. Luckily for Theresa, Sofia refuses to listen to the nurses. It makes Theresa happy to eat the cake. It reminds her of her own mother and her childhood in the countryside. She looks outside the window and dreams about when she was a young girl. She lived with her parents in a small village. She would spend her Saturdays at the local market with her mother, shopping for the best vegetables and meat. They would then take the rest of the afternoon to prepare the family meal for the Saturday evening. They would always make a carrot cake for desert.

Today, very few people cook a meal like she and her mother used to. Instead, most people eat the new super

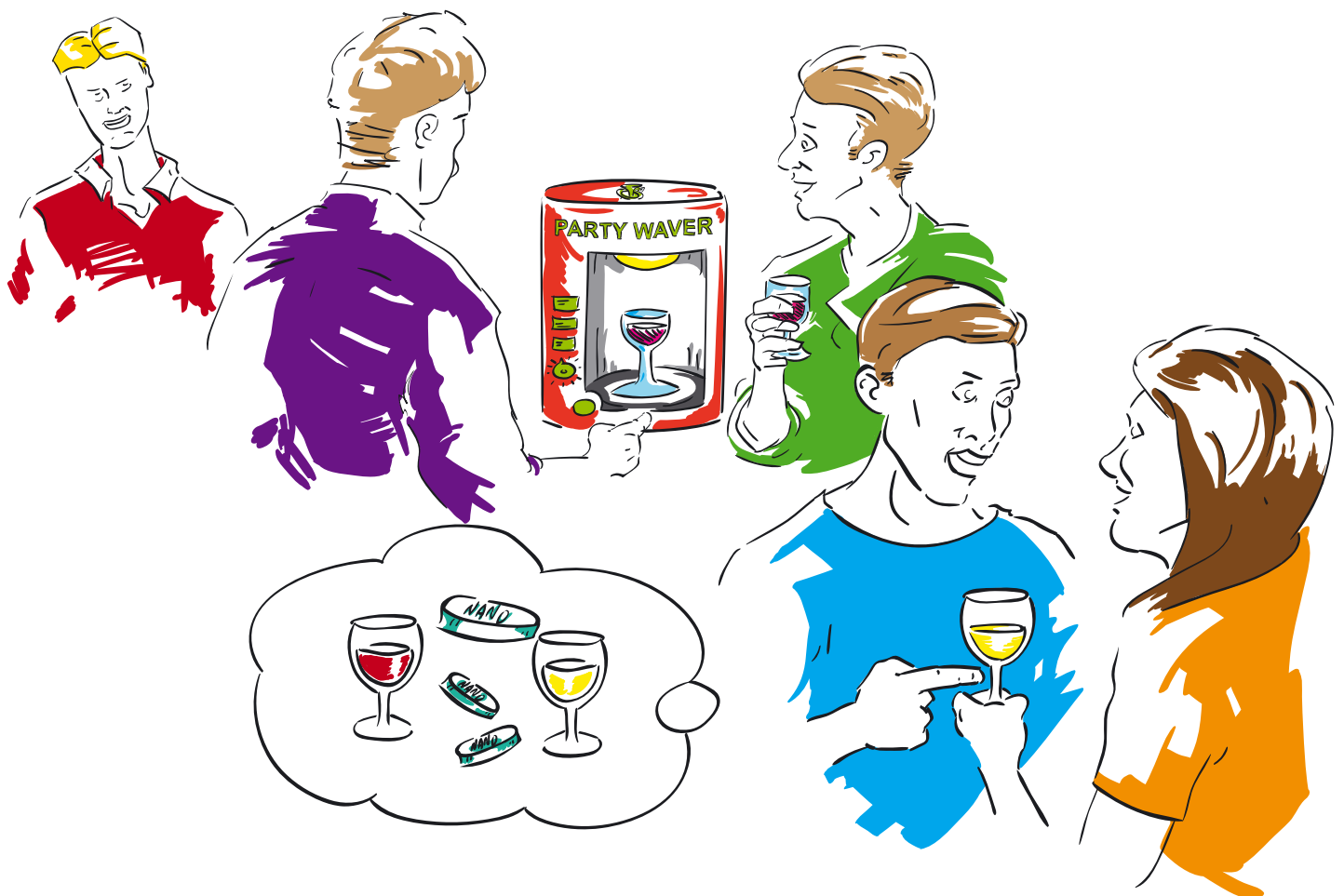
foods, made using nanotechnology and fancy processing techniques. The new super foods are a huge success. Everyone loves them. There are so many choices available: any flavour, any texture, any colour; ready to eat, hot or cold. And none of them are unhealthy! Even the triple chocolate hamburgers contain all the main vitamins and minerals you need. You can even buy the food tailor-made for different age groups and genders to make sure all your nutritional needs are met. Sofia is always telling Theresa how difficult it is these days to buy old-fashioned vegetables. They are very expensive, and only found in small exclusive shops. Theresa's day-dreaming is interrupted as a nurse knocks on her door to tell her Sofia has arrived. She smiles. She can already smell the carrot cake as Sofia makes her way down the hallway.

## FUTURE PARTY TRICKS

John looks around the room on the guest for his 35th birthday. Everyone seems to be having a good time. He walks over to the corner to speak to Peter and Andrew. They are busy trying to determine their next drink. For his party John has bought a lot of the new nano liquids. The nano liquids can be programmed to many different colours, tastes, nutrient and alcohol levels. All you have to do is decide the drink you would like to make, and then zap the nano liquid with a microwave transmitter. This will activate nano-capsules in the liquid that then turn the drink into your desired choice. John is relieved that no one has mentioned any concerns over the nano capsules in the liquid. The producer of the nano liquid writes the capsules are excreted out the body during normal digestion processes.

Peter is arguing for enhancing the wood smoke flavour of the next drink, while Andrew is more in favour of enhancing the taste of green pepper – maybe adding a bit of omega-3 oil to get a little bit of a health effect. Sofia comes over to join the conversation. She hands Peter a glass of white wine to ask for his opinion. Peter tries a sip, and almost spits it out as he discovers it is actually red wine. Sofia explains the wine was made using nano filters that can remove the red colour.

John laughs at them all, and suggests they set up a competition for the craziest combination of ingredients in a drink that still has to taste good.





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