Innovative Sector Exchange Project

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EUROPEAN UNION
2 Seas Mers Zeeën
ISE
European Regional Development Fund

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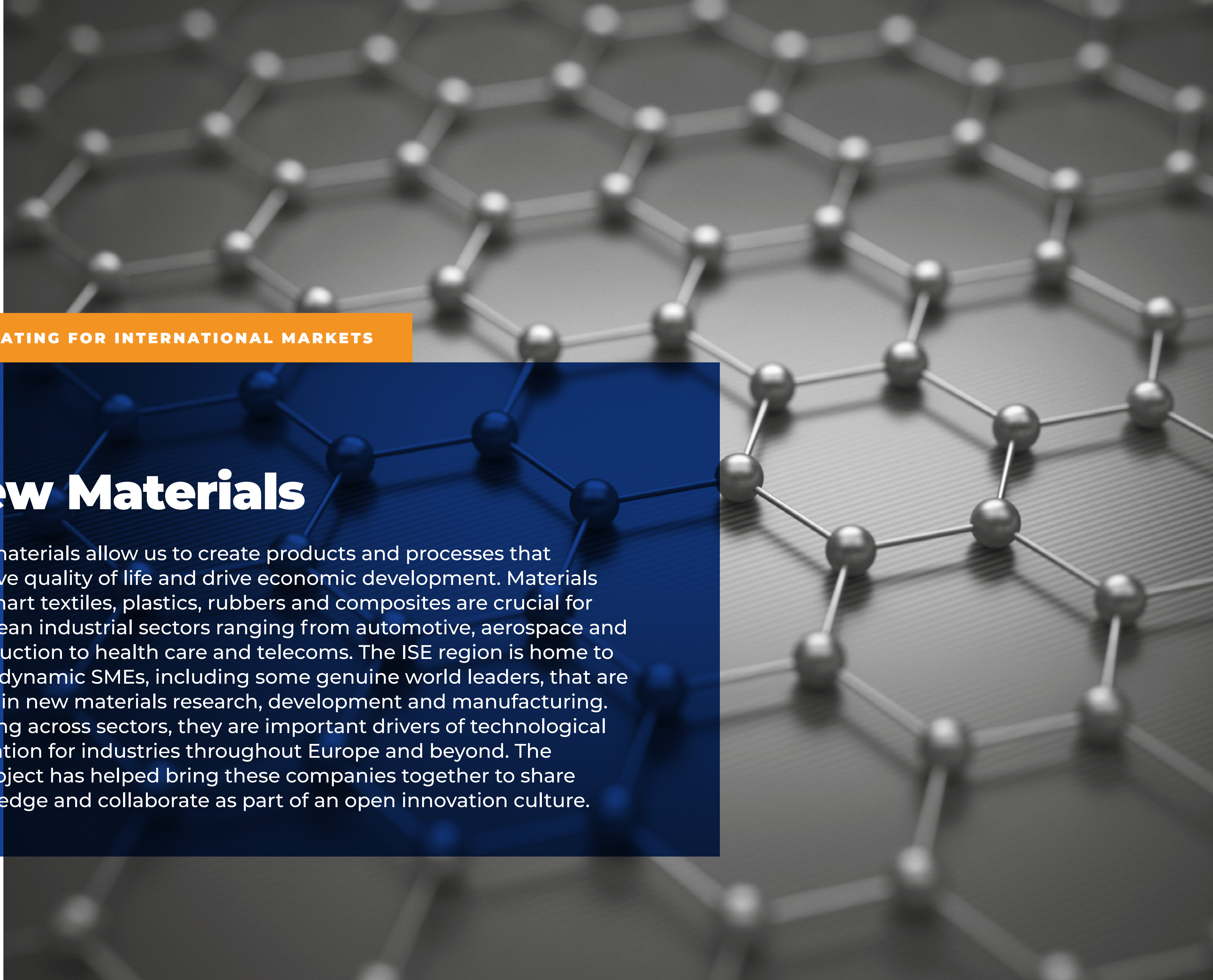
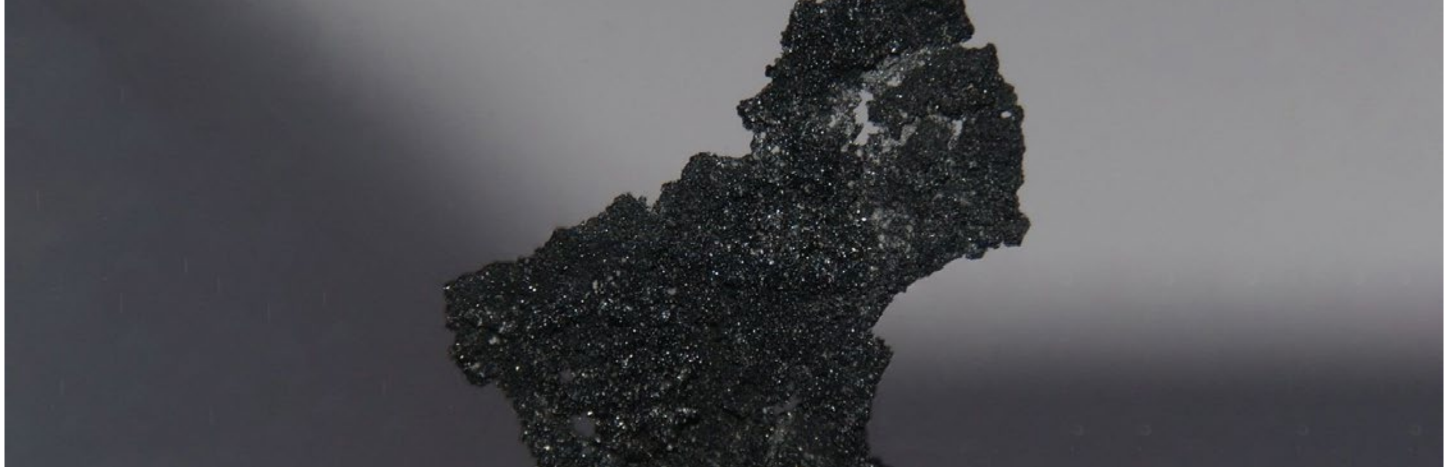


INNOVATING FOR INTERNATIONAL MARKETS

New Materials

New materials allow us to create products and processes that improve quality of life and drive economic development. Materials like smart textiles, plastics, rubbers and composites are crucial for European industrial sectors ranging from automotive, aerospace and construction to health care and telecoms. The ISE region is home to many dynamic SMEs, including some genuine world leaders, that are active in new materials research, development and manufacturing. Working across sectors, they are important drivers of technological innovation for industries throughout Europe and beyond. The ISE project has helped bring these companies together to share knowledge and collaborate as part of an open innovation culture.



New Materials – New Opportunities

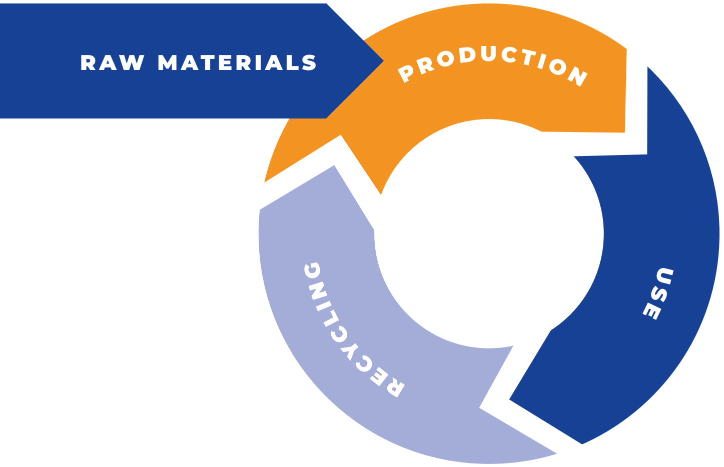
> Experience suggests that, over time, other 2-D materials will follow graphene's path from the exotic to the everyday to produce an almost unlimited range of specific new materials

Throughout history, human progress has been marked by advances in materials. The first revolution came when people replaced their stone tools with bronze; that metal was itself displaced by iron, then steel; today, materials like concrete and silicon are the basic foundations of 21st Century life. Bringing together various disciplines including metallurgy, ceramics, solid-state physics and chemistry and modern materials science research and innovation tends to be focused on areas such as energy, electronics, health care, infrastructure, manufacturing, efficient materials and nanoscience.

The next materials revolution is set to come from the emerging world of two-dimensional materials: substances consisting of a single, lattice-like layer of atoms. Recent discoveries include graphene (carbon) borophene (boron) gemanene (germanium) silicene (silicon), phosphorene (phosphorous) and stanene (tin). More 2-D materials have been shown to be theoretically possible but not yet synthesized.

Each of these materials has its own properties and potential. Graphene, for example, is stronger than steel and harder than diamond, yet lighter than almost any other known material. It's also transparent, flexible, an ultrafast electrical conductor, and impervious to most substances except water vapor, which flows freely through its molecular mesh. Initially more costly than gold, its price has tumbled thanks to improved production technologies: in fact, it's now cheap enough to use in water filters, which could make desalination and waste-water treatment far more affordable. In future, graphene could be added to road paving mixtures or concrete: since it absorbs carbon monoxide and nitrogen oxides from the atmosphere, this could help to improve air quality in urban areas.

Experience suggests that, over time, other 2-D materials will follow graphene's path from the exotic to the everyday. What's more, scientists and engineers can mix and match these innovative compounds to produce an almost unlimited range of specific new materials for a wide range of functions. This technology presents enormous innovation and internationalisation opportunities for SMEs within the ISE region.



Bio-based plastics

An excellent example is a group of new materials called bio-based plastics. In 2017, the Netherlands Enterprise Agency considered how these can help with a move to a more circular economy. It reached five important conclusions.

1 Bio-based plastics generally have a positive impact on climate change compared to oil-based plastics. Plastics made from sugar crops or agricultural waste have the lowest Indirect Land-Use Change (ILUC) risk, while mechanical recycling results in less demand for raw materials compared with incineration or digestion. Composting biodegradable bio-based plastics is carbon-neutral but is favourable only when it adds value, such as increasing the amount of food waste collected to be composted and reducing the amount of oil-based plastics ending up in composting systems.

2 Bio-based plastics can contribute to reducing demand for fossil resources; however, they require natural resources such as fertile land, fresh water and phosphate fertilizers to grow. Using agricultural waste as a raw material has the lowest environmental impact, followed by beet and cane sugar, then maize: oil crops have the greatest impact. All can be mitigated through sustainable agricultural practices, focussing on water and nutrient management and maintaining soil quality.

3 Biodegradable bio-based plastics are most effective where there is either a direct use or tangible side-benefit, such as increasing separately-collected food and garden waste, and decreasing contamination with non-biodegradable plastics.

4 Biodegradable bio-based plastics can reduce plastics pollution in soil and water, but are not a direct solution to litter, which can only be tackled by changing people's behaviour.

5 In designing a circular and environmentally-optimal system, mechanical recycling is a good option, and the input is sustainable; however, it only becomes economically viable above certain volumes. Bio-based plastics that are chemically identical to their oil-based counterparts (such as bio-PET) are already recycled; in a truly sustainable circular system, mechanical recycling should be optimised, and the additional primary input should be as sustainable as possible.

Summary

There are endless possibilities for SMEs to make use of new materials in their products or production processes. These materials can be manipulated to give very precise characteristics, allowing companies to find better, more functional or more cost-effective alternatives to existing materials and methods. Switching to bio-based plastics, for example, could help businesses improve their environmental and ethical credentials and provide a real competitive point of difference. New materials can also help businesses grow and expand into new markets by enabling them to turn new ideas and concepts into practical realities.

sustainably together: if combined with biofuel production, it may help stabilise food prices, providing farmers with more secure markets. Consumers benefit too, with materials like PLA helping food to stay fresh longer, extending sell-by dates.

CASE STUDY

Bio-based Plastics in Packaging

In 2015, bio-based and biodegradable plastics accounted for just 1% of total global production, but it's been predicted that this will more than double by 2020. At present, these plastics are generally more expensive than oil-based plastics by weight; however, costs are more stable since they are not affected by fluctuations in oil prices – and with future economies of scale in production, prices should start to fall.

Food Packaging

Most bio-based and biodegradable plastics are currently used in food packaging and foodservice ware. Materials like bio-PE and bio-PET are identical to their conventional equivalents and can be used in exactly the same applications: other materials like PLA, starch-based plastics and cellophane have specific properties and require certification for food use.

Sustainability issues

Crops grown to produce bio-based plastics currently occupy just 0.02% of the global arable area. This would rise to around 5% if these materials replaced worldwide oil-based plastics production.

However, research shows bio-based plastics and food can be produced

End-of-life options

Biodegradable plastic food packaging (and rubbish bags) can help ensure a larger share of domestic kitchen waste goes for industrial composting – a form of organic recovery or recycling – rather than to landfill. However, there is a risk that people will use non-compostable, oil-based bags in their green bins by mistake: at present about 1% of kitchen waste is non-biodegradable plastic. Biodegradable plastic packaging can also be incinerated, allowing energy recovery. A new pictogram showing how these materials can be disposed of has been introduced in the Netherlands.

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