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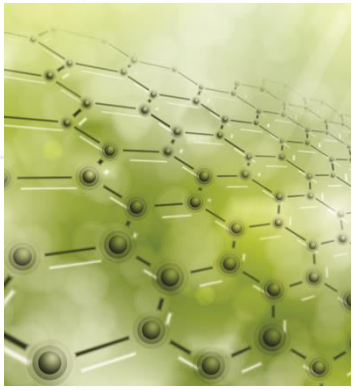

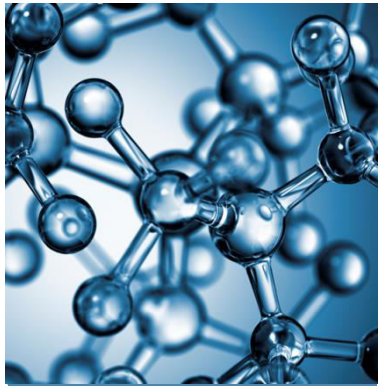

SusChem Priorities

Working Groups update

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SusChem Initiatives
Working Groups Update

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- Energy Union – SET plan
- Digitization of Industries
- Circular Economy

Societal Challenges

SusChem Technologies	Industrial Leadership		Bio-Economy	Clean Energy	Green Transport	Resource Efficiency, Raw materials	Health
	NMBP*	ICT*					
Raw Material & Alternative Feedstocks							
Energy Source for Chemical Processing							
Process Technology							
Materials for…							

*NMBP: Nanotechnologies, Advanced Materials, Biotechnology, and Advanced Manufacturing and Processing

** ICT: Information and communications technology

SusChem Initiatives
Working Groups Update

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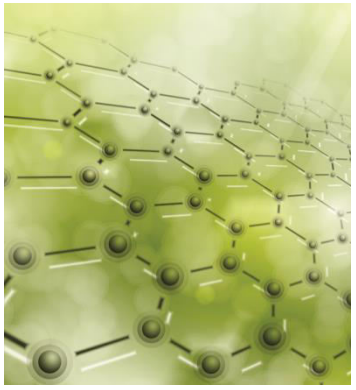
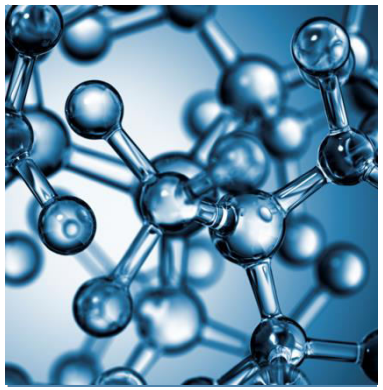
- Energy Union – SET plan
- Digitization of Industries
- Circular Economy

Societal Challenges

SusChem Technologies	Industrial Leadership		Bio-Economy	Clean Energy	Green Transport	Resource Efficiency, Raw materials	Health
	NMBP*	ICT*					
Raw Material & Alternative Feedstocks	● ●		●			● ●	
Energy Source for Chemical Processing	● ●		● ●	●		● ●	
Process Technology	● ●	●	● ●	● ●		●	
Materials for…	● ● ●	●	●	● ●	●	● ● ●	●





Sustainable Bioeconomy Innovation Priorities

Dr. Flavio Benedito
Innovation Manager @ Cefic

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… A Flashback …

SusChem creation in 2004:

Recommendations for cooperation between the chemical and bio-based industries

SPIRE and BBI establishment in 2012:

Joint narrative to look for synergies between the two PPPs

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SPIRE Impact

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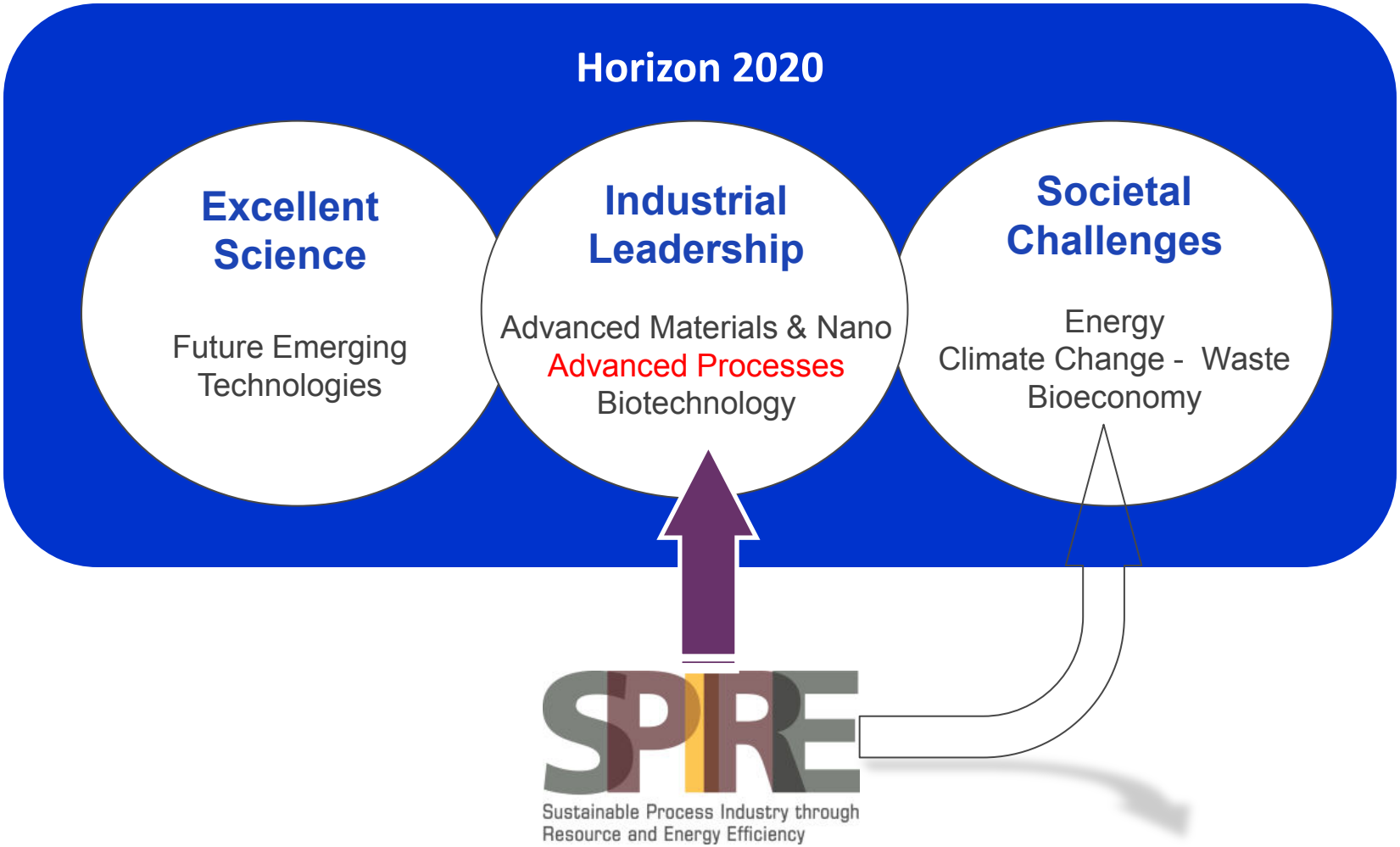


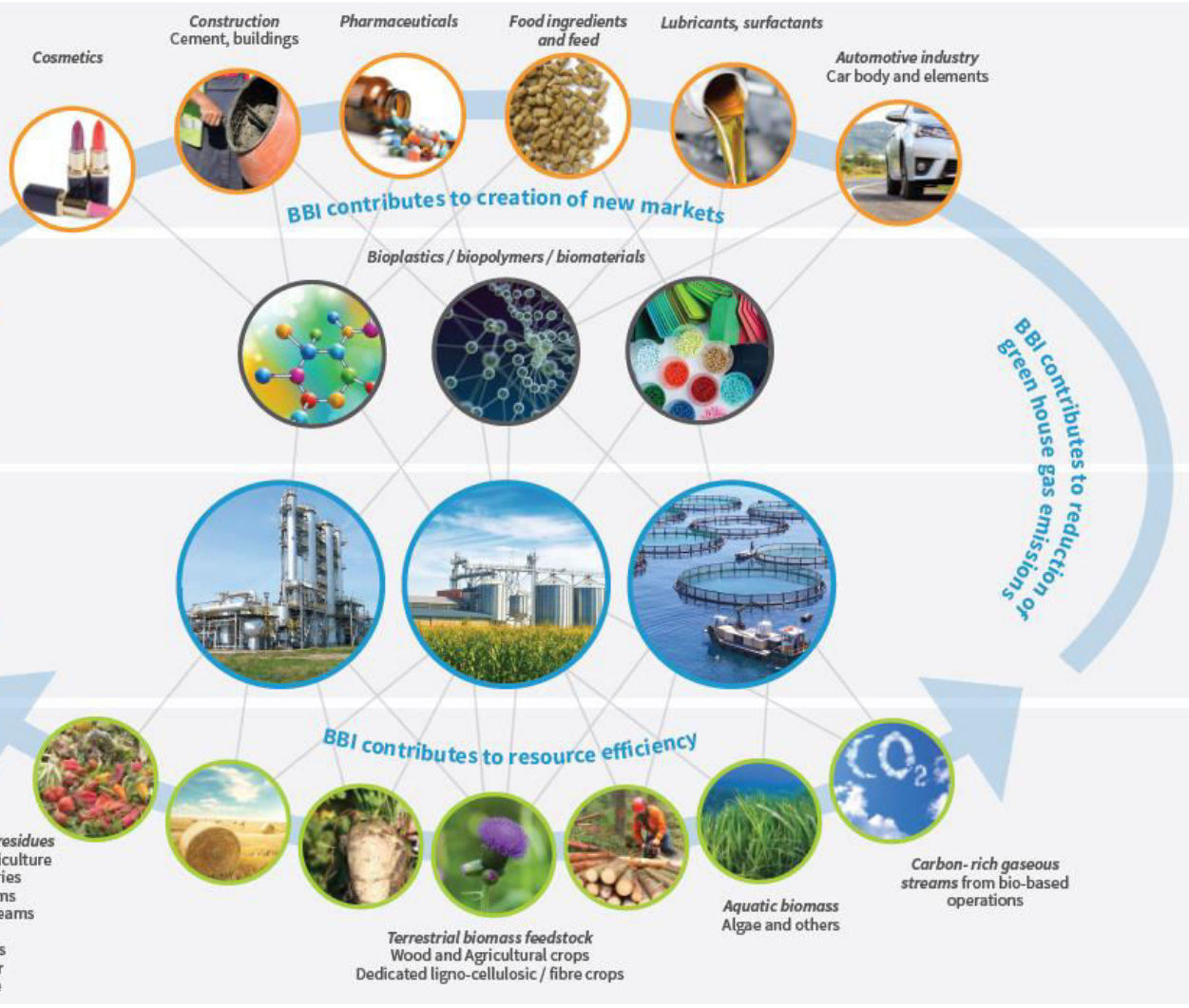
BBI Impact

Bio-Based Products and Markets

Bio-based chemicals, building blocks and materials

Biorefineries

Biomass and organic waste



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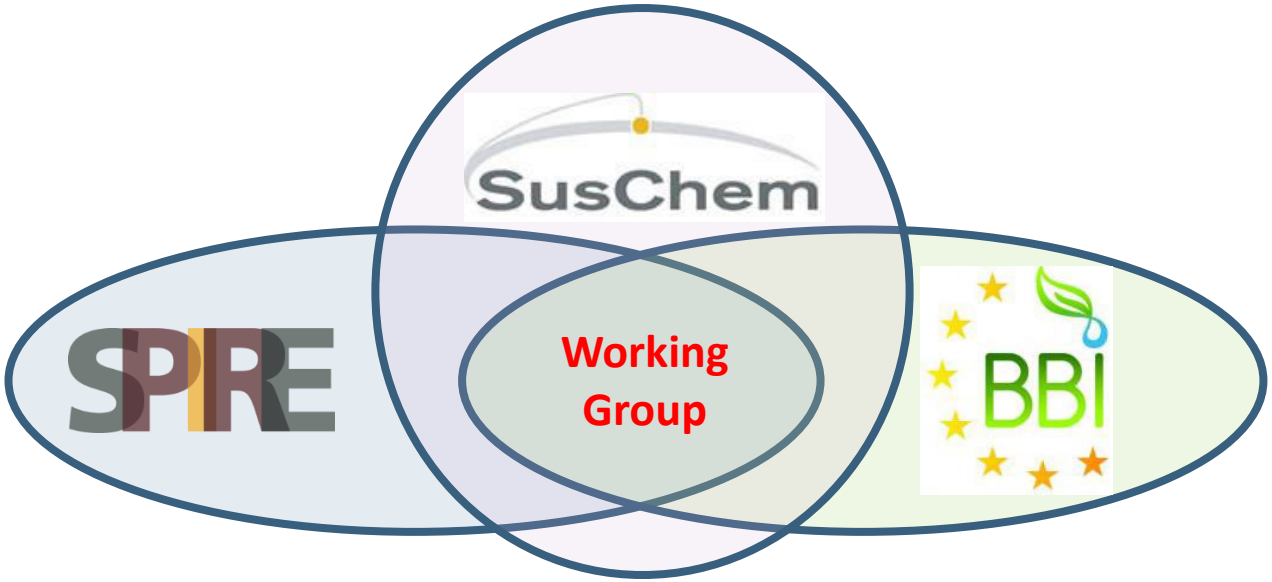
… and more recently…

- SusChem initiative: Workshop with SPIRE, BBI, industry and EC (Feb. 2016)
- Goals: Creation of a working group find possible synergies



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Working Group Impact

Identity

Drafting – Approval – Supporting

Publication
&
Implementation

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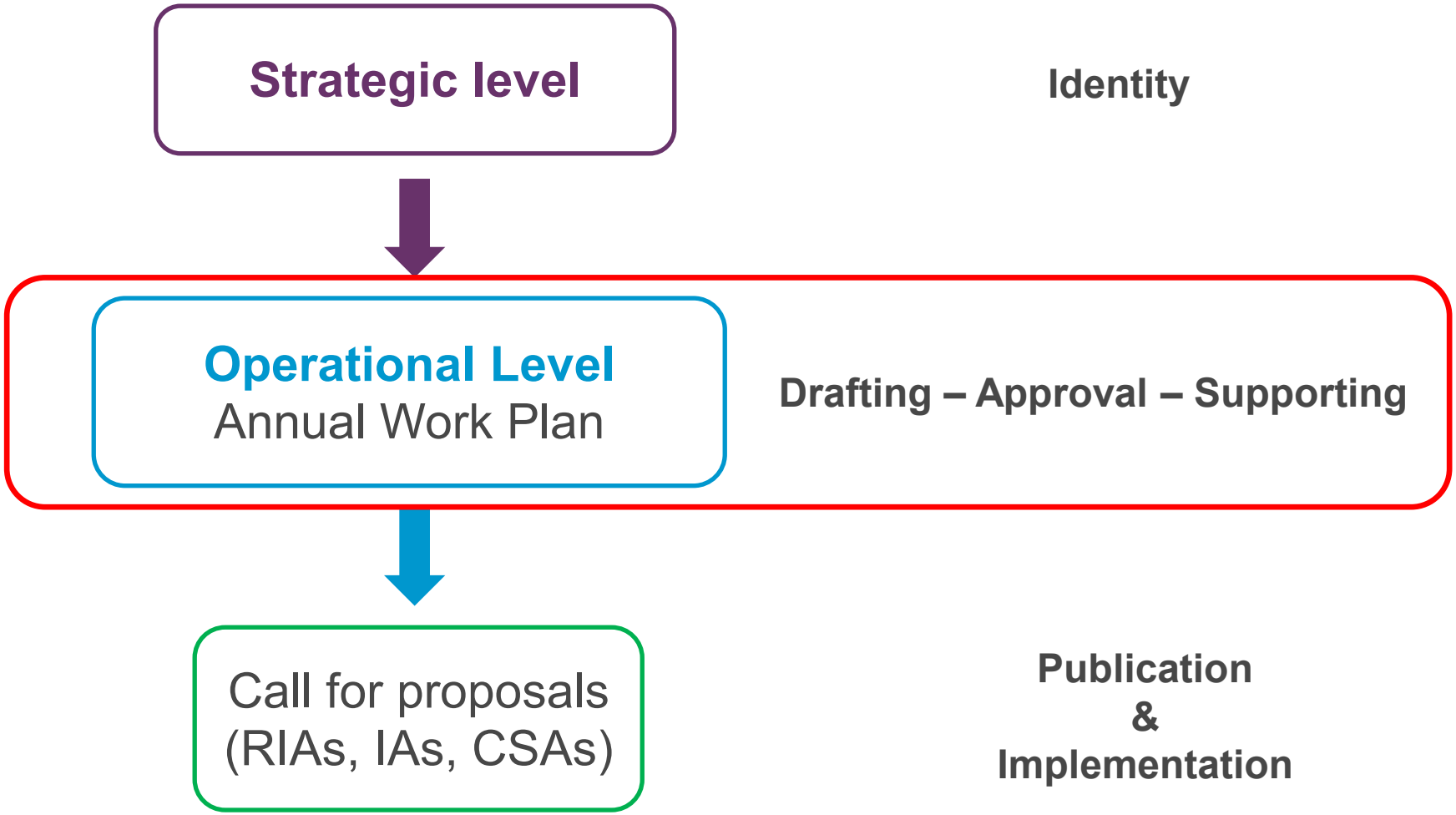
Working Group Impact



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Working Group Actions

Short term:

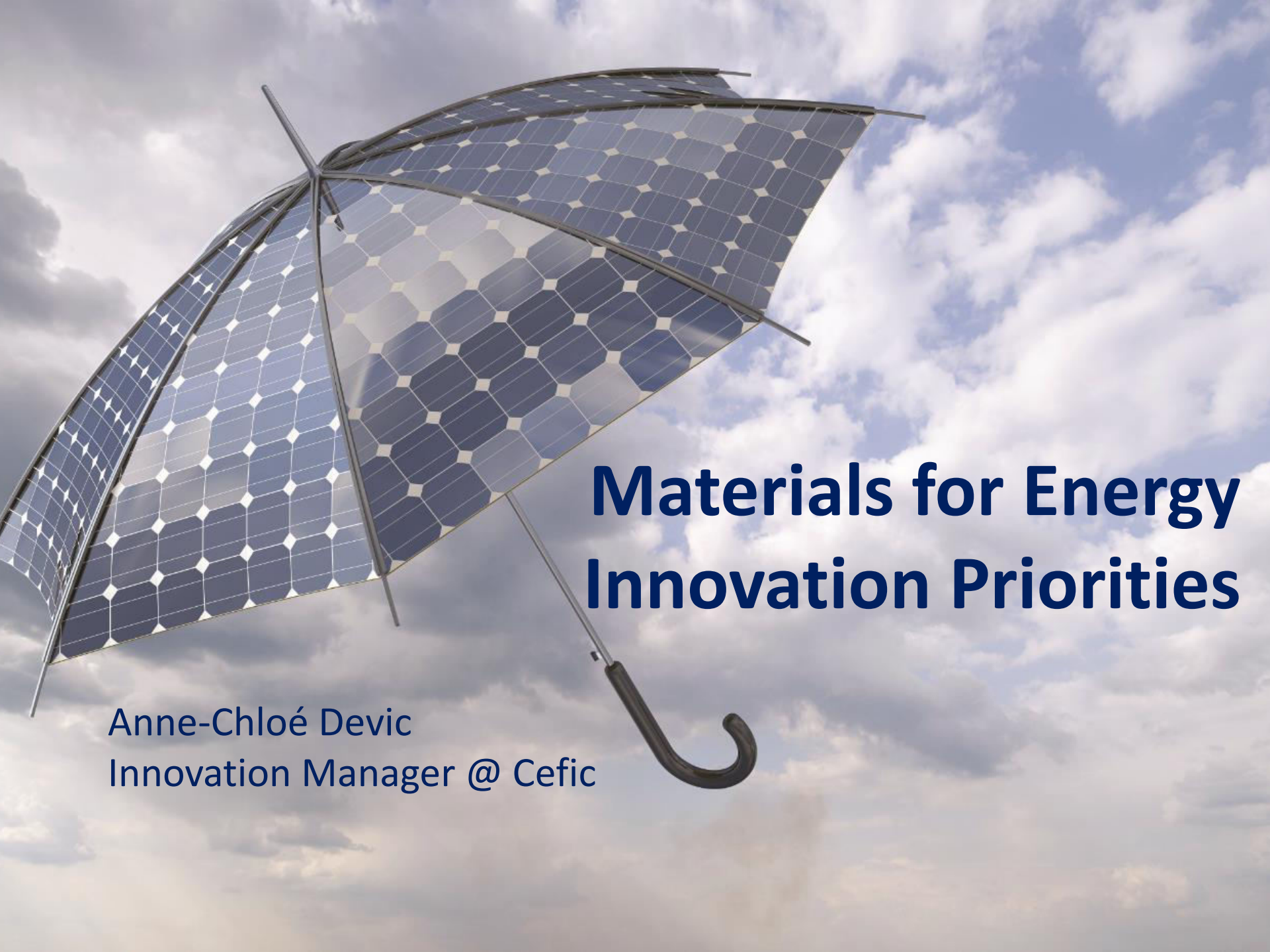
- The community will be informed and motivated to consider possible synergies during the consortium and project establishment phase

Mid term:

- Past successful projects from both PPPs will be analyzed and the identified examples of complementarities will be communicated
- Identify a common area of interest to develop content for future SPIRE and BBI Working Programs

Long term:

- Implementation of the topics in future Working Programs



Materials for Energy Innovation Priorities

Anne-Chloé Devic
Innovation Manager @ Cefic

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Materials and the SusChem SIRA agenda

- The market of **advanced materials for energy applications** represents an important opportunity for the European Industry
- Following the SIRA publication in 2015,
  they have been established as a key priority
- SusChem responded to the NMBP consultation early May

SusChem SIRA published March 2015

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Materials in the Energy Union agenda

- Advanced materials for **sustainable production of renewable electricity**
- Advanced materials and technologies **for renewable energy storage**
- Efficient energy systems to make the **building** stock energy neutral
- More sustainable **transport** systems

Innovation Priorities
New composites materials for wind mills blades
Materials for photovoltaic technologies
Recyclability of materials (Eco-Design)
3D Printing
Electrical storage: Materials for advanced batteries
Chemical energy storage: Power-to-gas and power-to-liquid technologies
Thermal storage of energy via phase change materials
Advanced materials for thermal insulation
Efficient lighting, phase change materials … for buildings
Lightweight materials, materials for more fuel efficient tires, advanced battery technologies

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Materials: SusChem Innovation Priorities

- The area of **Materials for Energy** is vast and priorities need to be narrowed down
- Priorities have been gathered by stakeholders and the formation of working groups is ongoing:
  - A gap analysis was carried out in terms of projects and calls over 10 years
  - The call for experts in materials is still open
  - Next step: Definition of prioritized detailed topics


"Catalysis is an important source of technology-based efficiency improvement potential…energy savings potential approaching - by 2050 - the equivalent to the current annual primary energy use of Germany"
Source: DECHEMA
Catalysis Innovation Priorities
Dr. Martin Winter
Innovation Manager @ Cefic

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Catalysis

Catalysis might be one of the single most important and pervasive interdisciplinary technology in the chemical industry - certainly one of the areas with the largest societal impact, nevertheless often underestimated or invisible

Chemical Industry

- Today's catalysts ensuring that raw materials and energy are used efficiently in the production of various industrial large scale and specialty chemicals, plastics or fuels
- Catalysis and catalytic processes (direct or indirect) account for about 25% of the world GDP

SusChem SIRA

- New Raw Materials and Feedstocks
- New Industrial Biotech Processes
- Waste Reduction and Recovery
- Energy Efficiency in the Chemical Industry
- Enhanced Energy Storage Technologies
- Alternative Fuels for Transport
- Nano-structured Materials

SusChem SIRA published March 2015

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Catalysis: SusChem Actions

SusChem achievements in 2016:

Input from various industry/academia experts from the chemical sector to:

- ✓ Exchange on 'Catalysis' topics an a European level to define and prioritize H2020 (2018-2020) innovation priorities reflecting needs and areas of common interest in our sector
- ✓ Built the base for delivering input and knowledge for reviewing initiatives like the ***European Cluster on Catalysis*** created by the European Commission with its aim to develop a ***European Roadmap on Catalysis***

The work has been supported by **7 companies** + several experts from **RTOs/Universities**

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Catalysis: Innovation Priorities:

- Catalysts for the **conversion of CO_2** to chemical building blocks or fuels
- Catalysts to directly produce **renewable H_2** from sunlight (photo-catalysis)
- New catalytic technologies enabling **recycling of plastic waste**
- More robust and versatile catalytic systems for processing **variable feedstock's**
- New catalytic systems allowing **softer reaction conditions** (e.g. lower pressure and/or temperature) to save energy and enable potential retrofitting of existing plants
- **Online analysis** during the reaction steps to access to kinetic parameters, development of in-operando techniques
- **High throughput experimentation** methods in catalyst development
- **Computational modeling** methods for rational development of catalytic materials, catalyst by design, molecular simulation and experimentation, including high performance computing and simulation algorithms

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Closing the loop & Next Steps

- Catalysts have a significant contribution to energy efficiency of production processes in the chemical industry
- Catalysts can contribute to large-scale storage of renewable energy and production of advanced sustainable alternative fuels for transport

✓ SusChem will provide input for H2020 programmes and contribute to Catalysts Roadmaps

"Ninety-five percent of chemicals industry respondents said they foresaw digital technology innovation at their company over the next three years, and 50 percent expected breakthrough or radical advances"

Source: Strategy&/pwc 2015

ICT Innovation Priorities

Dr. Martin Winter
Innovation Manager @ Cefic

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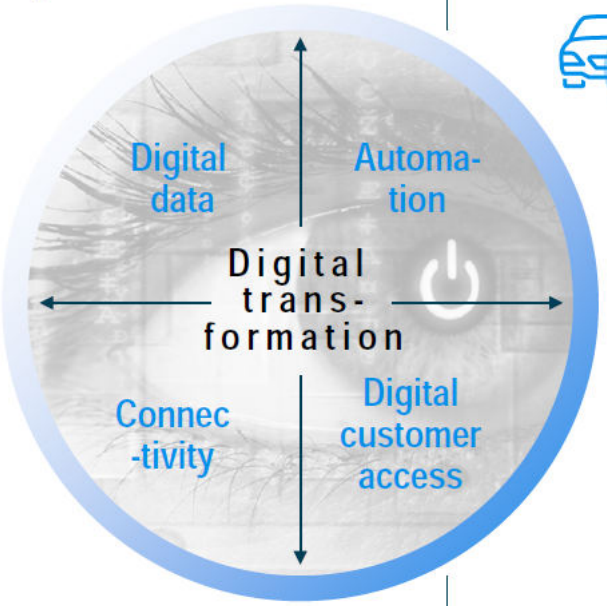
Digital will continue to impact the chemical industry

300 decision makers were surveyed, 30 CEOs interviewed, expert workshops held on:

The **four levers** of the digital transformation …



… and their impact on the **industrial heart** of Europe [bn GVA][1)]

- Automotive 140
- Aerospace & aviation 35
- Chemicals 124
- Electrical engineering 87
- Medical technology 43
- Logistics 271
- Mechanical & plant engineering [2)] 299

1) GVA = Gross value added, 2013, EU-15 states plus Norway, Turkey 2) Including energy systems

Source: Roland Berger

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ICT

Europe in its way to digitization to strengthen its competitiveness, as recently re-enforced by the European Commission Communication to the European Parliament on

'*Digitizing European Industry - Reaping the full benefits of a Digital Single Market*'

Chemical Industry

- For decades the chemical industry has made extensive use of ICT systems throughout its value chain, from logistics, to modeling, design, control, monitoring and repair
- In addition, the chemical industry is a key provider of materials and technologies that form the basis for many ICT solutions

SusChem SIRA

- Chemical Plant of the Future
- Smart Chemical Processes (batch-to- continuous/intensified processing)
- Energy Efficiency in the Chemical Industry
- Industrial Symbiosis
- Smart Materials (enabling ICT)

SusChem SIRA published March 2015

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ICT: SusChem Actions

<u>SusChem achievements in 2016:</u>

Launch new ICT 'Task Force' with industry/academia experts from the chemical sector to:

- ✓ Exchange on 'Process Control and Digitization' topics an a European level and to built a strong base for future projects and collaborations
- ✓ Define and prioritize H2020 (2018-2020) innovation priorities reflecting needs and areas of common interest in our sector
- ✓ Built base for exchange with other process industries sectors, e.g. *ESTEP's I2M Working Group* or for input to the European Commission

First ICT workshop in Brussels organized by SusChem in March with
18 participants from 10 companies + several experts from **RTOs/Universities**

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Innovation Priorities: 'Towards Cognitive Plants'

- Plants are interconnected by several carriers of energy and of various intermediates and should be operated in a way to make the best possible use of energy, materials, and by-products reaching highest quality output, uptime and safety
- Data are useful asset to plant operators who should be informed - in real-time
- Model-based solutions will play a crucial role

R&I needs:

- Reliable sensors for continuous and batch processes (materials, energy, plant condition)
- Combining rigorous models and data analytics (=>high performance computing) to enable cyber-physical systems to do the plant control, e.g. recognition of unusual situations in complex plants, proposal of adequate measures, monitoring of environmental KPIs, including retrofit of 'brownfield' assets
- Humans in the loop - what is the role of humans in the operation of plants in the process industries, how can their knowledge and experience be optimally combined with advanced control algorithms and optimization

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Innovation Priorities: ‘Digital Supply Chain and Business Models’

- Digital support to support physical customer support, digital customer solution design, link of ICT systems down the value chain
- Optimization of supply chains

Innovation Priorities ‘Materials Modeling’

- Example from *Catalyst Working Group*: Development of computational modeling methods for rational development of catalytic materials, catalyst by design, molecular simulation and experimentation, including high performance computing and simulation algorithms

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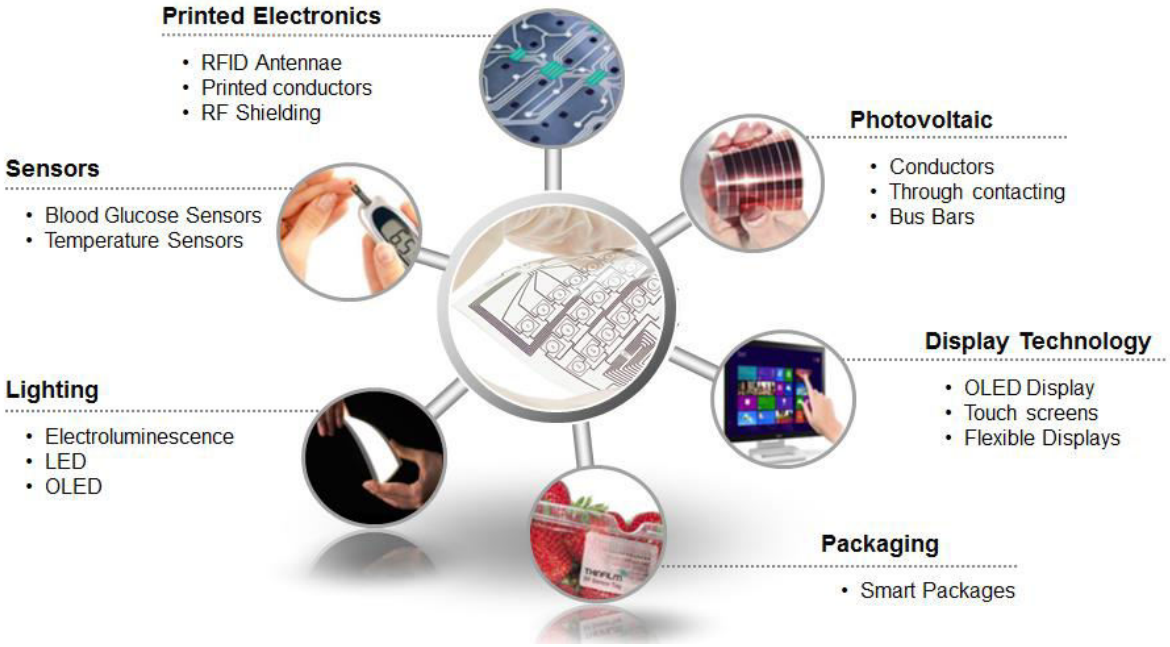
Innovation Priorities: ‘Materials for ICT’

- New materials enable smarter and more sustainable production of electronic devices with higher performance (less manufacturing steps, less water, less energy etc.)



- SusChem priorities in this field will be further aligned with a materials strategy

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Closing the loop & Next Steps

- The chemical industry uses more and more digital innovations

- Smart materials developed by our sector enable new, more sustainable and higher performing ICT developments

✓ SusChem will continue to provide input for H2020 programmes (SPIRE, FoF etc.) and continue to built an platform for exchange on priorities

✓ It also will support the exchange between our industry and the European Commission on 'Digitization' topics

Water Innovation Priorities

Henk Pool
Innovation Manager @ Cefic

Water

- *A colourless, transparent, odourless, liquid which forms the seas, lakes, rivers, and rain and is the basis of the fluids of living organisms**

Chemical Industry

- Water use (cooling, washing, diluting, transporting, …)
- Water management solutions (membranes, treatment, …)

Quantity
Quality

SusChem SIRA: *Water is a scare resource*

- Water Conservation, Recycling and Reuse
  - Water Treatment and Recovery
  - Water and Energy Efficiency (Nexus)
  - Water Supply

SusChem SIRA published March 2015

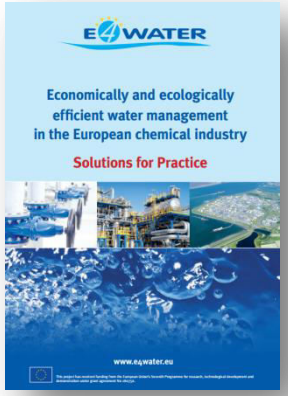
** Definition from Oxford Dictionaries*

Water: EU Agenda

- **EIP Water**: Strategic Implementation Plan (SIP) 2013
  - Reuse, Recycling, Waste Water Treatment, Recovery of Resources, Water-Energy Nexus, Flood & Drought Risk Management, Ecosystem Services

- Horizon 2002 "Water" innovation project calls
  - 2014 & 2015 11 calls
  - 2016 & 2017 5 calls
    - SPIRE 01-2016 & **SPIRE 12-2017**: Efficient water use, adoption of processes and water re-use
    - **CIRC 02 2016-2017**: Business models & partnerships along the water value chain
    - PILOT 02-2016 & **PILOTS 03-2017**: Water treatment pilot opportunities
  - 2018 -2020 ? calls

- E4WATER **FP7** funded project *Shows the way* *(2012-2016)*
  - Integrated approach efficient & sustainable water management Chemical Industry
    - ✓ Reduction of 20-40% in water use — All 6 pilots
    - ✓ 30-70% in wastewater production — Close Loops, Symbiosis
    - ✓ 15-40% reduction in energy use — All 6 pilots
  - 60% direct economic benefits — All 6 industrial case study sites



Water: SusChem Innovation Agenda and Priorities

- Industry Working Group
  - Participants: 6 companies
  - Peer Group: 5 companies
- 2018-2020 Innovation Priorities
  - **> Sources of Water** Desalination, Re-use, Rainwater, Condensation
  - **Treatment, Re-use, Recovery** Additives, removal, Specific selectivity, Membranes
  - **Process & Analysis Close Loop** SMART & Online Analysis, Process dev. & dosing
  - **Water Distribution Systems** Retrofit leak repair and maintenance
  - **Water – Energy Nexus** Low energy waste water treatment, Recovery of low energy from water loops, Low water consuming processes (eg. BioTech)
- Impact: ***De-coupling*** *of growth in economic activity and actual water use*

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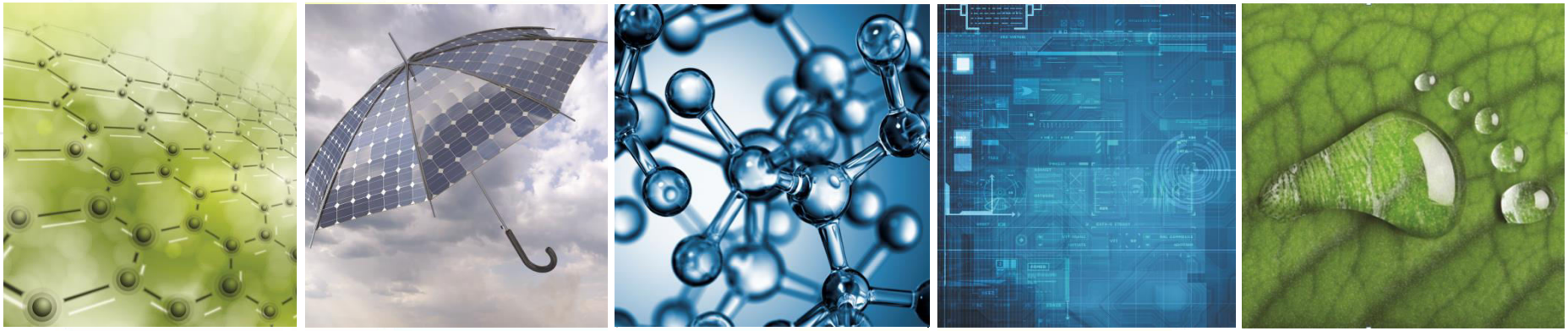

Thank you for your support and attention