

# Digitization within the Chemical (Process) Industries



SINTEF Workshop: Co-creating a Digital Process Industry

30 November 2017

Dr. Martin Winter/Cefic Innovation Team

# This is Cefic



Since its creation in 1972, Cefic has grown to become one of the largest industry trade organizations in Europe and in the world

- Representing over 95% of the European Chemical Industry
- Representing **29 000** chemical companies in Europe
- **30** National Chemical Federations across Europe
- Over **600** direct Company Members from Europe
- More than **30** Associate Company Members from around the world
- **40** Partner Companies & Associations
- **25** European Affiliated Associations
- Operates **94** Sector Groups focusing on 120+ product families and over **79** Strategy Implementation and Issue Teams dealing with the industry's horizontal issues (REACH, International Trade, Energy & Climate Change, Research & Innovation, ...)
- About **5000** industry experts from companies and federations participate in the Cefic groups

# Profile of the EU Chemical Industry




- ✓ 29 000 companies, 96% SMEs
- ✓ 1.17 million of jobs
- ✓ €551 billion of revenues
- ✓ 15% of the world's chemical sales

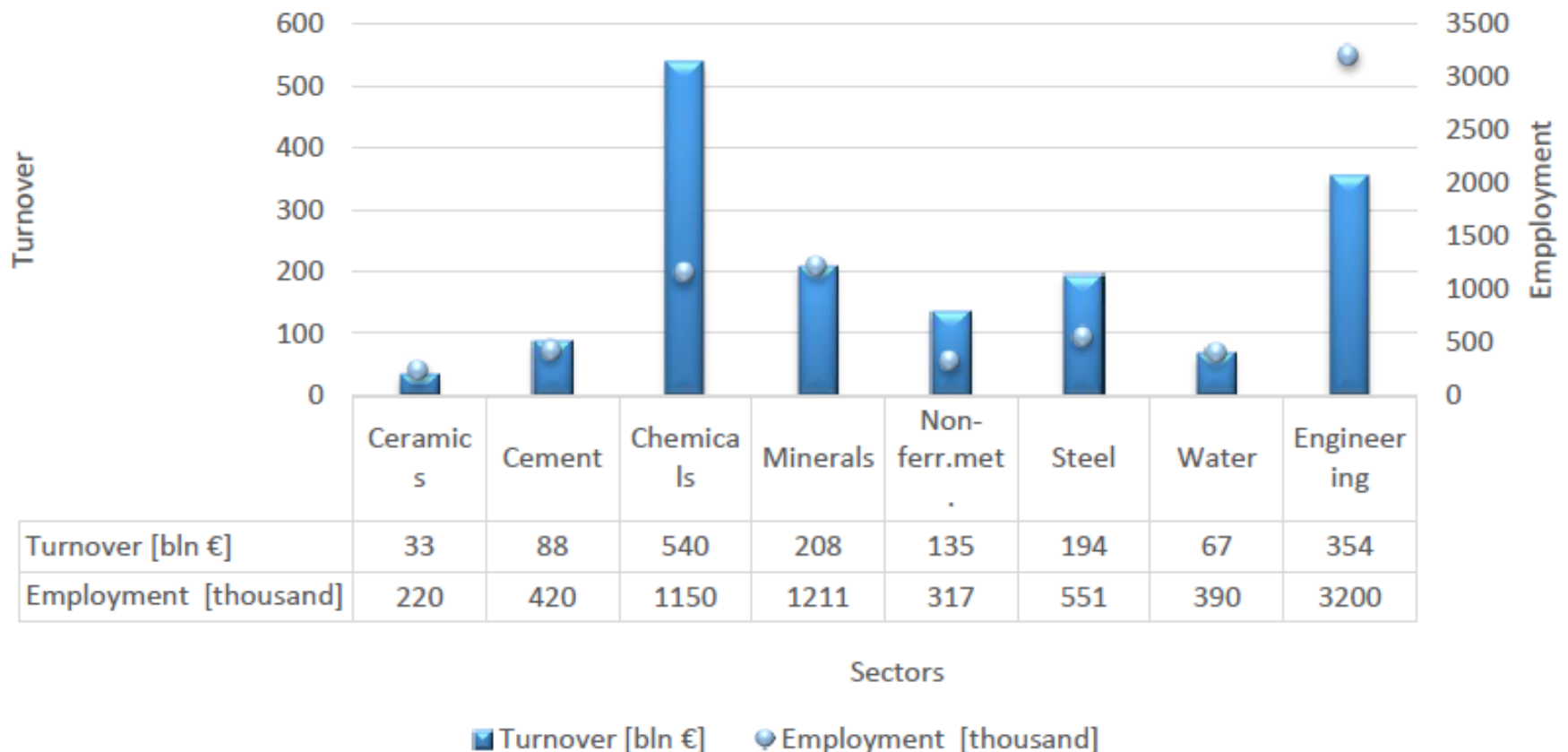
= key EU economic sector

# Providing the essentials through the value chain



The Process Industries provide about 47% of all industrial employment (7% of all employment) 

## Sectors data: Turnover and employment



# Challenges of Globalization



- ✓ Climate Change
- ✓ **Industrial revolution 4.0/ ICT**
- ✓ Complex security challenges
- ✓ Demography
- ✓ Need for further consolidation, competitiveness and cohesion

## The Future of European Economy

- ✓ Low-carbon economy
- ✓ Circular economy
- ✓ **Digital economy**

# Upcoming Bulgarian EU Council Presidency: 4 main priorities



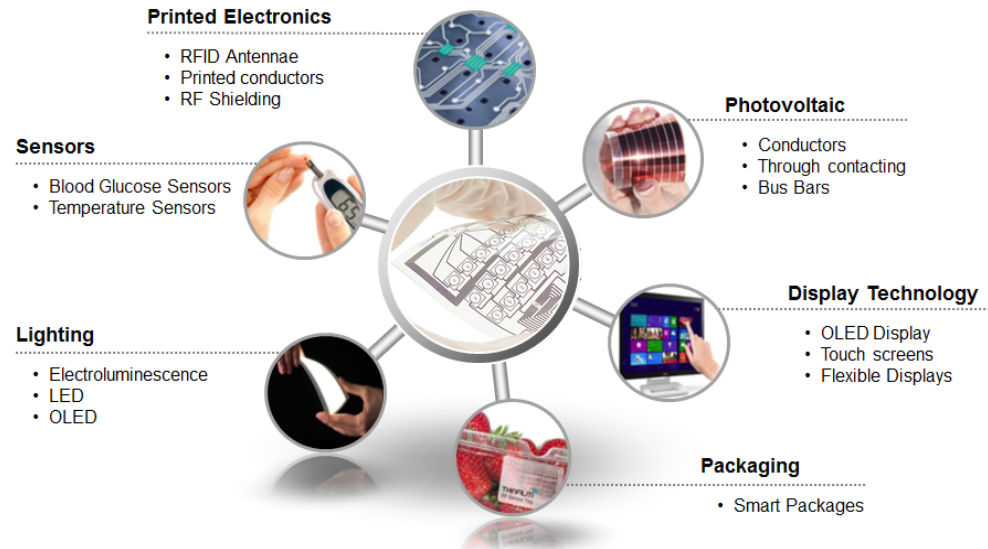
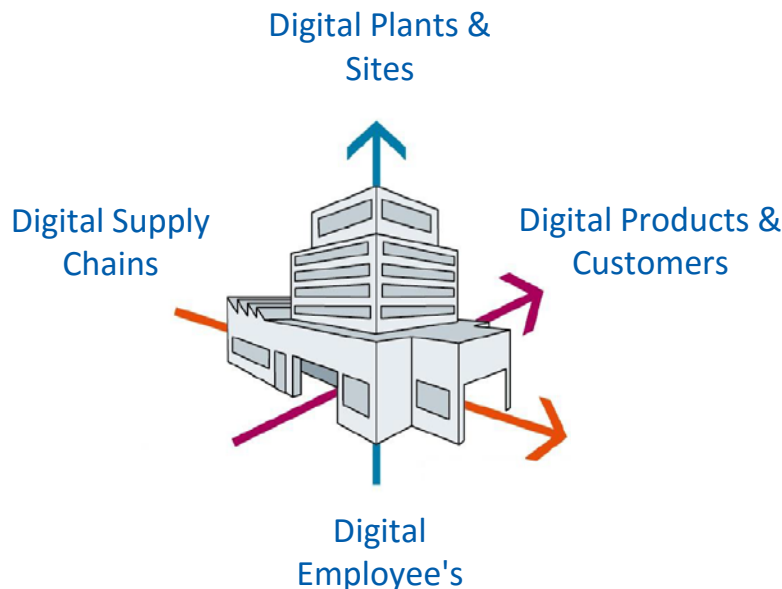
1. Future of Europe and Young people – economic growth and social cohesion
2. European perspective and connectivity of the Western Balkans
3. Security and stability in a strong united Europe
4. **Digital economy and skills for the future**

# Two perspectives: Advanced materials as key driver for digitization, and digitization as key driver for the transformation of the industry



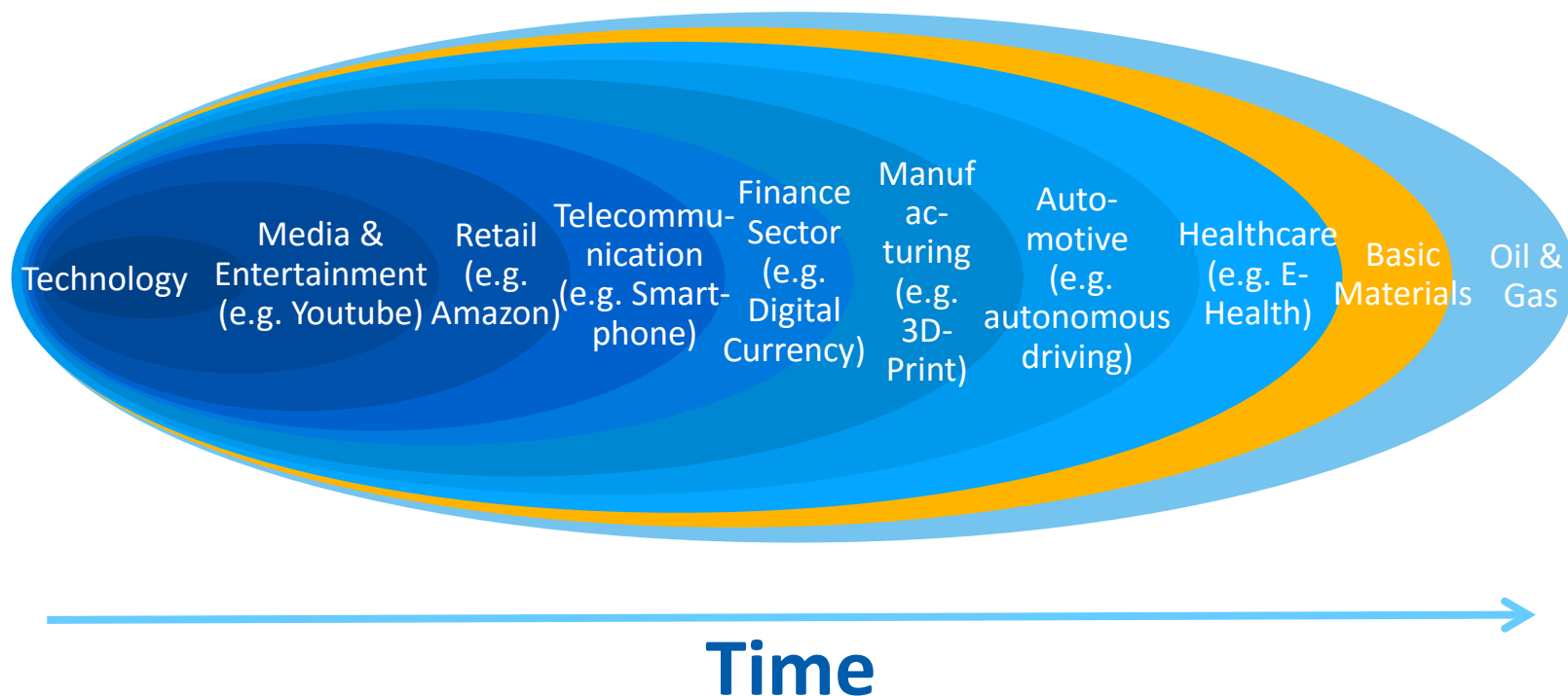
1. Unlocking the potential of going digital in operations and value chains and networks

2. Enable smarter and more sustainable production of electronics through advanced materials





# Digitization will certainly affects all businesses – we can learn from other sectors including the more digital industries



# The industry thinks already beyond providing chemicals and materials only



**Stefan Oschmann**  
Chairmann of Executive Board & CEO



“Big data is becoming as important as chemistry for us”



**Felix Hanisch**  
Head of Technology and Innovation



“Covestro's approach to digital constitutes of three horizons of implementation: Optimize supply, leverage growth and start a new game“



“BASF applies big data in catalyst research - we reached a factor of 3 reduction in cycle times from customer request to the first promising product proposal”

**Frithjof Netzer**  
Senior Vice President  
BASF 4.0



“Digitalization is a growth driver for our company. Our goal is to open up a market that is worth billions”

**Henrik Hahn**  
Evonik Chief Digital Officer//Evonik Digital



# Emergence of new technologies all at the same time – and development goes faster and faster



**5G**

**Cloud Technology**

**Cognitive Computing**

**Digital Twins**

**IoT**

**Data Fusion**

**Virtual Reality**

**Gamification**

**PAT**

**Big Data**

**Track & Trace**

**RFID**

**HPC**

**Social Media**

**Deep Learning**

# Digitization fosters both higher efficiency and opens new business areas which will increase companies profitability



**10 - 20%**  
reduced Costs for Quality

**10 - 40%**

**20 - 50%**

reduction of Maintenance Cost

reduction in Time-to-Market



**3 - 5%**

**20 - 50%**

Productivity Increase

decreased costs for Inventory Holding

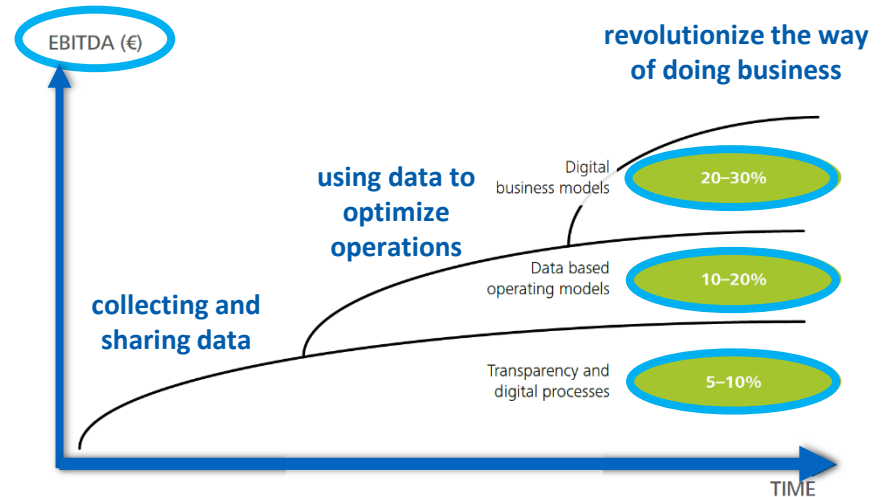
**85+%**

**30 - 50%**

increased Forecasting Accuracy

reduction of total Machine Downtime

**business as usual:  
risk of fast erosion**



Sources:

"Manufacturing's next act", McKinsey, June 2015  
"Chemie 4.0", Deloitte 2016

# 1) Digital Plant



## Digitalization enables the entire manufacturing chain for more efficient operations

- a. **Real-time sensing capability** - provide correct process information to authorized users in real-time
  - b. Feedback control to detect deviations and adjust operations immediately decision support
  - c. **Asset performance management**/predictive maintenance
  - d. Advanced **operator support**
  - e. **'Digital Twin'** (virtual plant/process models) to predict the of impact of (design) decisions and to anticipate looming events and bottlenecks
  - f. Integrated production planning
  - g. Information integration across operations and enterprise technology layers
  - h. End-to-end (financial) visibility from top-floor to shop-floor
- ✓ Higher plant availability and throughput
  - ✓ Better predictability of manufacturing
  - ✓ Reduced lead times
  - ✓ Higher flexibility and agility/remote operations
  - ✓ Less quality issues
  - ✓ Less consumption of energy and raw materials
  - ✓ Less costs for lab analyses
  - ✓ More efficient plant maintenance
  - ✓ More efficient allocation of staff
  - ....

# 2) Business Excellence



## Exploit new revenue opportunities incl. radically different business models

- a. Pricing excellence
- b. Sales and service excellence
- c. Marketing excellence
- d. Marketing & sales channel optimization

- 
- ✓ New business models
  - ✓ Increase revenue/decrease cost-to-serve
  - ✓ Seamless multi-channel experience
  - ✓ Better understanding of evolving market needs
  - ✓ Improved insight into the competitive landscape
  - ✓ Ability to more quickly react to market demand and cyclicalities
  - ✓ Tailored products
  - ✓ Customer awareness

# The Contractual Public Private Partnership SPIRE – the European funding instrument for the **Process Industries**



**SPIRE**  
Sustainable Process Industry through  
Resource and Energy Efficiency



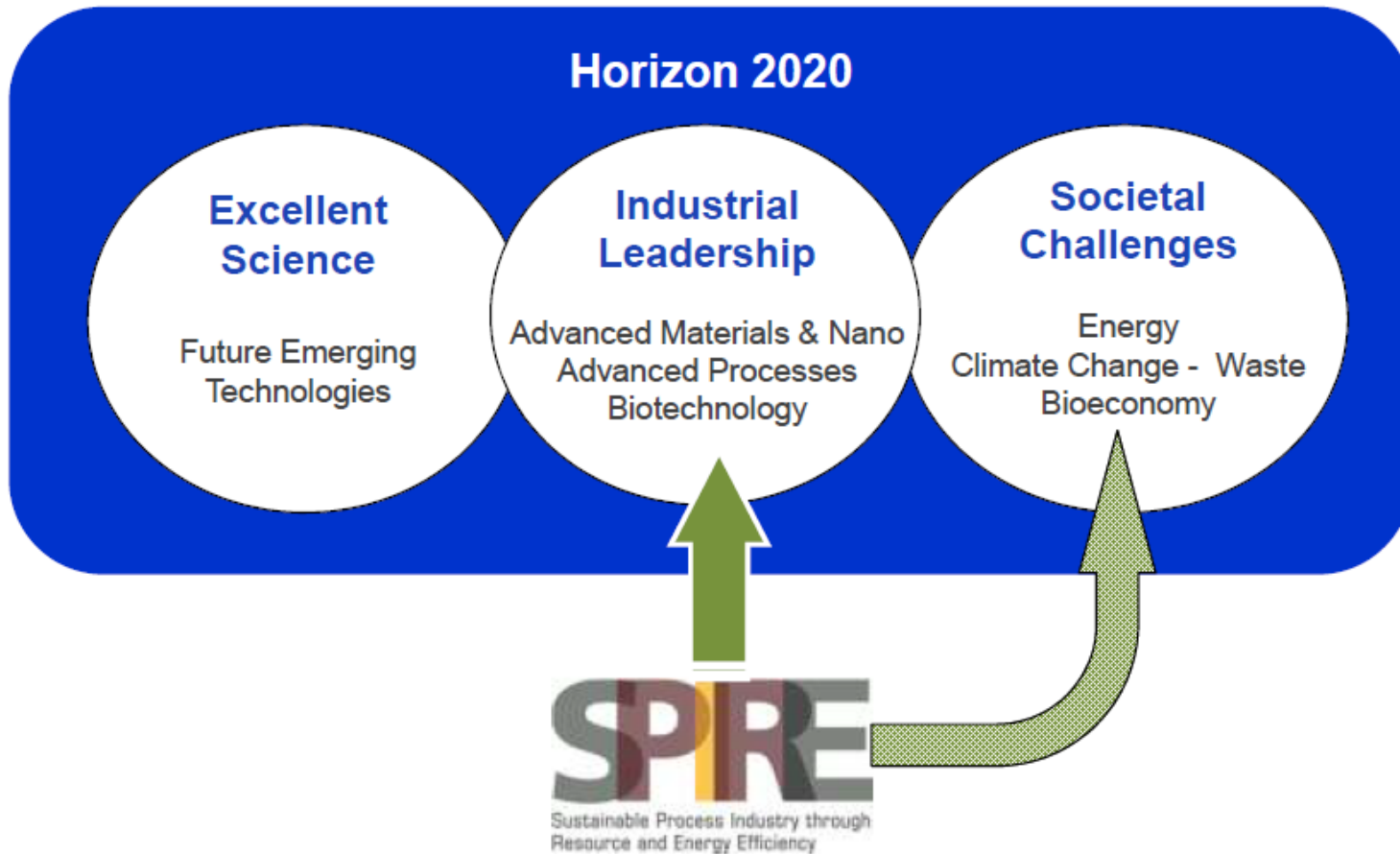
**2014** – first-ever PPP with process industry

comprising **8** sectors

**2015** – first SPIRE projects launched

**146** industry and research members

# SPIRE cPPP in H2020



1st cPPP for Process Industry

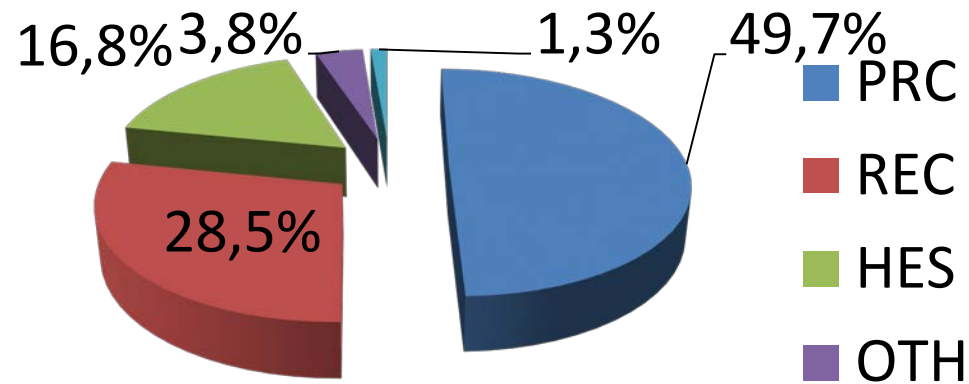
900 M EUR allocated



# SPIRE project participation overview – SPIRE is industry driven



Share of EU funding per type of organization in SPIRE calls (2014, 2015 & 2016)



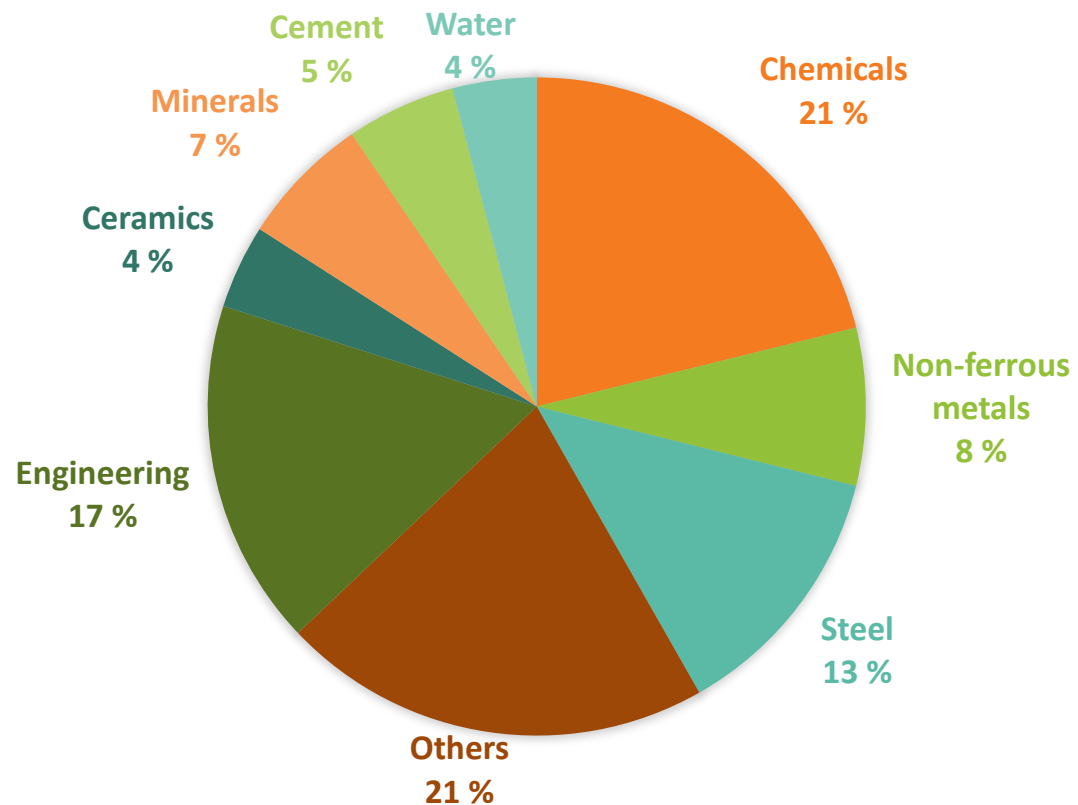
*Based on progress until end 2016; only SPIRE calls*

# SPIRE PPP cross-sectorial approach



Global sectors participation in SPIRE projects:

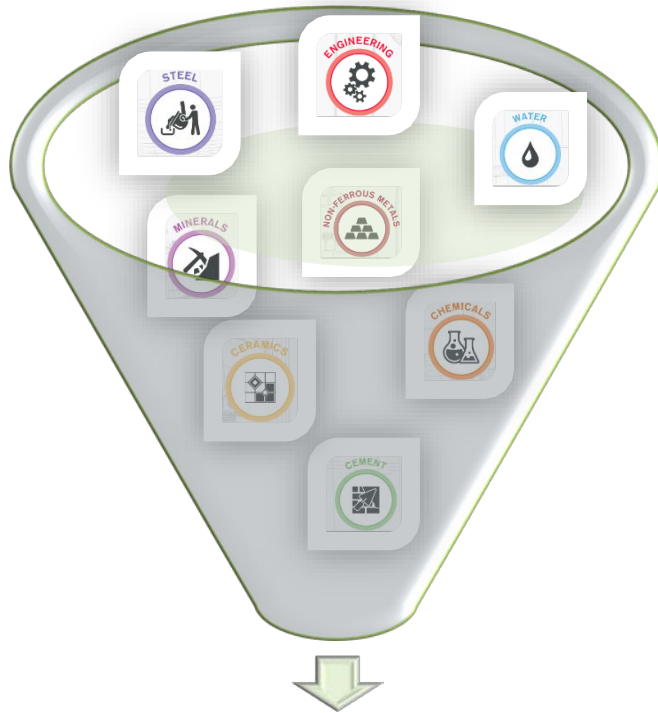
All sectors benefit



# SPIRE has a cross-sectorial approach



**SPIRE**  
Sustainable Process Industry through  
Resource and Energy Efficiency



**SPIRE  
PROJECTS**

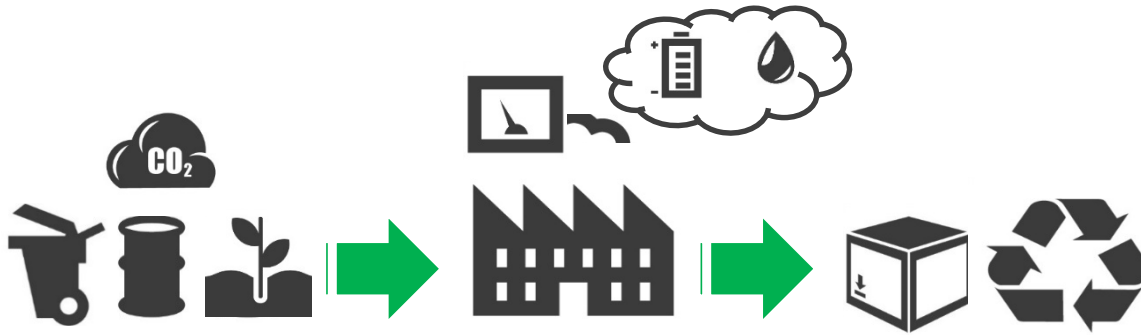
Cross-sectorial collaboration is  
cornerstone for SPIRE projects:

- Minimum: **2 sectors/project**
- 7 or 8 sectors together are collaborating in various projects
- Average: **2.67 sectors/per project**

# SPIRE PPP 2030 roadmap



## TO TOMORROW'S SCENARIO:



- **(Re)invent** feedstock (waste, bio, CO<sub>2</sub>)
- **Reduce** emissions; **(re)invent** energy & resource management concepts, incl. industrial symbiosis
- **Introduce** digital devices for better monitoring and control
- **(Re)invent** materials for optimised processes
- **(Re)invent** processes & materials with a significantly increased impact on resource & energy efficiency down the value chain: transport, housing
- **Reduce** waste & **(re)invent** technologies for valorisation of waste streams within and across sectors

# SPIRE PPP projects in Process Control



## Integrated Process Control

(SPIRE-01-2014, projects started January 2015)

- ... improved capabilities for valid, reliable and real-time measurement of the properties and quality of process streams and final products for existing and for more flexible process operation concepts.
- ... better process operations with respect to resource and energy efficiency



## Plant-wide Monitoring and Control of Data-Intensive Processes

(SPIRE-02-2016, projects started end of 2016)

- ... integration of local control [...] into an overarching real-time optimisation and scheduling system controlling and monitoring the operations of the whole plant
- ... ensuring a robust real-time optimisation of the plant's operations



# Summary and topics to debate



1. Many companies have **built-up significant resources and additional organizational structures** to start capture the full range of digital opportunities - but **different digital operating models** in place
2. Digital is seen by most chemical players as **clear growth opportunity** - chemical value chains known by today might change completely through digitalization, products and related process getting more personalized creating and delivering higher value for customers through empowering of local, **more specialized value chains**
3. Digital will further **improve operations, e.g. cognitive plants**, advanced maintenance, digital process and plant design through **in-silico “digital twins”**
4. New type of **education and job profiles** will be required to transform the industry, digital is not limited to the use of digital tools and devices, but should be a real **company mindset** instead
5. Expand **innovation funding support**: Investments in further **innovation is required** to support the development and demonstration/ implementation of **fast emerging digital technologies** related to a **circular economy, higher resource efficiency.....and industrial symbiosis**

# Thank you for your attention



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# European “digital in chemical processing” innovation in FP7/H2020 inspired innovation activities in the U.S.



European innovation activities in process intensification ...



Program of the European Commission



...initiated recently \$70 million funding partnership in the U.S.



Up to \$70 million in federal funding and an additional \$70 million in private cost-share commitments from over 130 partners for advancement in Process Intensification

**Advance the production of high-value products enabled by fast and accurate online sensing of key product and process parameters including closed-loop control and online optimization**

Characteristics		Benefits
Miniaturized equipment		Product uniformity
Intensified heat & mass transfer		Sustainability
Possibly modular setup		Fast adaption to market demand
		Innovative products

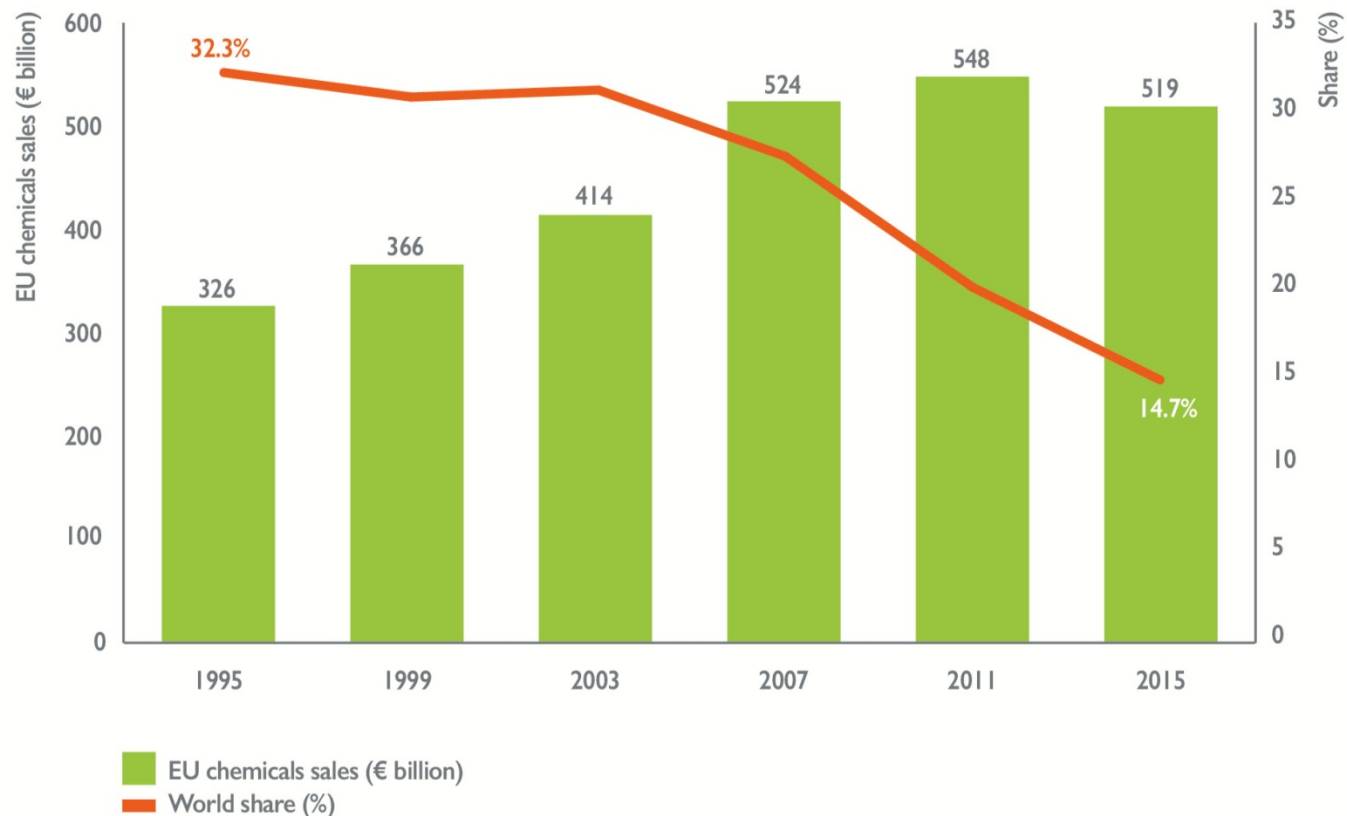
**SPiRE** Sustainable Process Industry through Resource and Energy Efficiency



# EU chemicals sales increase by nearly 60% in 20 years, while its world market share halves



## EU share of global chemicals market



# Grant-it: Easy access to funding opportunities by key words

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## Grant-it

**grant it** Fast-track access to EU funding information

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GRANT-IT is your one-stop access to funding opportunities from the European Commission and Regional and National governments in the field of sustainable chemistry.

SusChem and Cefic members can use GRANT-IT resources to search for funding, identify project opportunities, propose project ideas and search for potential project partners.

## GRANT-IT

is a password protected free service offered to CEFIC and SusChem members to boost industry participation in research and innovation activities.

Looking for:

- ✓ Funding Opportunities
- ✓ Project Opportunities
- ✓ Consortium Building

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[Propose a project](#)

### SEARCH BY SUSCHEM PRIORITIES (please specify Main technology area and then Specific technology)

Main technology area

Specific technology



OR SEARCH WITH THE FILTERS BELOW

TITLE	DESCRIPTION
CE-NMBP-24-2018: Catalytic transformation of hydrocarbons	Increasing the exploitation of natural gas, stranded resources and biogas is creating new opportunities for the utilisation of low cost light alkanes. High value can be added through improved catalytic transformations to C2-C4 olefins, C-C coupling and/or C1 chemistry together...
CE-NMBP-25-2019: Photocatalytic synthesis	The efficient storage and utilisation of solar energy in the form of chemicals or chemical energy will play a key role to transform the European industry into a low-carbon economy. In the long term, the focus will be on highly...
CE-NMBP-26-2018: Smart plastic materials with intrinsic recycling properties by design	Developing of multifunctional materials based products with smart intrinsic recycling and/or sorting abilities that harmonise with circular economy principles will create a real paradigm shift in the market and a clear benefit for society. The field shall benefit from the...

# Example innovation in process digitization

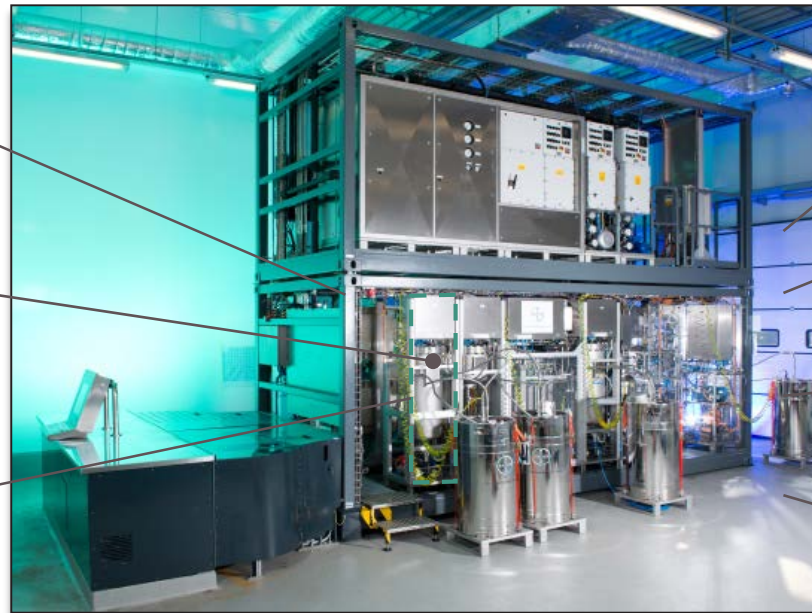
Advance the production of high-value products that meet high quality demands in flexible intensified continuous plants: Not possible without fast and accurate **online sensing of key product and process parameters including closed-loop control and online optimization**

## Characteristics

Miniaturized equipment

Intensified heat & mass transfer

Possibly modular setup



## Benefits

Product uniformity

Sustainability

Fast adaption to market demand

Innovative products



Sustainable Process Industry through Resource and Energy Efficiency



# Investment in digital innovation to strengthen competitiveness of industry is required



- **Modeling, Simulation and Forecast:** integrate modelling of single processes into production routes and value chains
- **Digital Twin - Virtual Plant Models:** predict the of impact of (design-) decisions and to anticipate looming events and bottlenecks
- **Real Time Data Availability:** through reliable, fast, accurate and intelligent self-optimizing measurement systems (sensors), product quality, plant equipment
- **Transforming 'Big Data' to relevant Information:** identify universal and reliable solutions to “mine”, handle and interpret data, high performance computing
- **Condition Based Advanced Maintenance:** develop tools and methods allowing remote control of equipment, prediction and prevention of failures
- **Resource and Energy Life-Cycle Assessment:** enable monitoring of environmental targets into all control systems to optimize performance
- **Data Security:** develop advanced security solutions to prevent misuses of stored / cloud data
- **Standardization:** software and hardware platforms
- **Human-Machine Interface:** develop intuitive and user friendly interfaces
- **Operator Skills:** The digital engineer and plant operator



# DISIRE (H2020-SPIRE-2014; 01/01/2015 - 31/12/2017)

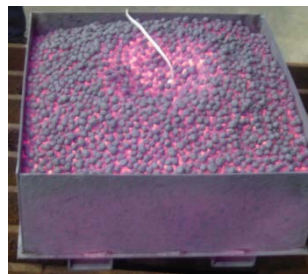
Integrated Process Control Based on Distributed In-Situ Sensors into Raw Material and Energy Feedstock

## 5 FULL SCALE DEMOS

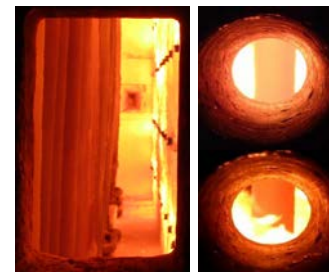
Blast Furnace



Sintering plant



Cracking furnace



Walking Beam Furnace



Cooper mining





# DISIRE – Cross-sectorial Impact



- Increase overall energy efficiency by 2% - 5%
- Reduce GHG emissions by 2000 toe/year per cracking furnace
- Optimizing predictive controller for improvement of processing control
- Increase safety of operations



- Increase overall energy efficiency by 1% - 4%
- Increase the amount of extracted copper with 0.1%
- Decrease energy consumption of conveyor belts up to four times
- Decrease downtimes and maintenance costs



- Reduction of shipment deviation with up to 50%
- Reduction of deviating inventory positions of up to 50%
- Reduction of operating costs by up to 20%
- Reduction of oil and coal usage of 0.1 l/ton

