



“CO₂ as raw material – industry view”
Workshop « CO₂ Reuse technologies »
October 24, 2012, Brussels

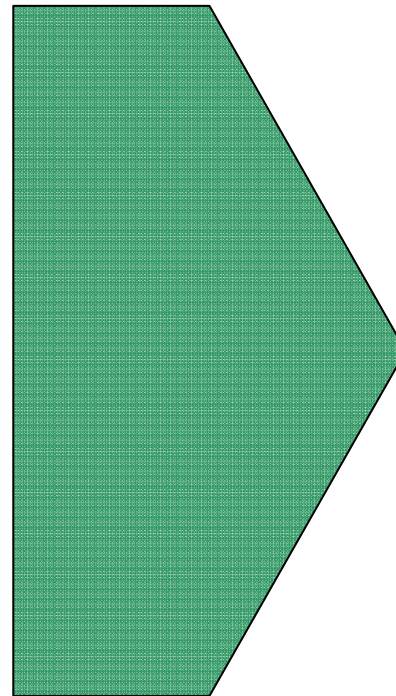


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Societal challenges



- employment
- Climate change
- Health and ageing
- Use of natural resources
- Energy security
- Clean transport
-



- Powerful drivers of **change** in economy and society
- Major global market **opportunities**
- Requiring cooperation **along the value chain**
- From research to **solutions**
- Needs **EU critical mass**

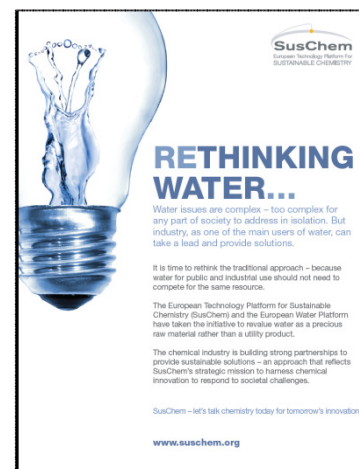
New needs → new ideas → new solutions

EU Chemical industry in future



- Recognition of shift from technology support to demonstration of societal value
- Mindset shift to more pre-competitive cooperation within sector and open innovation along value chain
- Visible leadership of Chemical Industry in Public-Private Partnership on societal challenges – “value chain captain”
- Broaden engagement of companies (big + SME 's) in Public Private Partnerships
- Change way we do things (i.e. more with less, change to renewables, closed loops, specialisation)

EU Innovation Union: Visible leading role for Chemical Industry





CO₂ as raw material

Why and How?



Strategic vision for the EU

Why the EU should create a Master Plan for CO₂ economy?

- CO₂ is the only raw material that the EU has everywhere in abundance
- And the more CO₂ is used, the better to achieve the ambitious targets of CO₂ emission reduction: The perfect raw material for the European Chemical Industry
- The EU should not fall behind USA and Japan in this future technology.
- The development of the CO₂ technology will secure the technological competitive of Europe – linking Europe's top sectors: Chemical Industry, Engineering and Renewables
- Big central and small decentralized easy to run facilities to convert CO₂ to the desired molecules will boost the EU export of technology and facilities



Why develop CO₂ economy in EU?

The development of a CO₂ economy is within EU's reach

- The EU has the potential to develop a full CO₂ economy concept and to implement it
- EU Universities and Research Centres are among the best in the world and forerunners in almost any field involved in the development of CO₂ economy
- EU, national governments and private companies have a long tradition of developing PPPs (are the instrument of choice in financing long lasting, higher risk projects)
- EU needs to secure raw material and energy supply for the future: CO₂ from the atmosphere and sunlight are abundant
- EU needs a new approach to secure and create domestic jobs through innovative technologies

Scattered activities



Worldwide

USA
Canada
China
Japan
Germany
The Netherlands
UK

Companies

Bayer
BASF
Clariant
DSM
Evonik
Repsol
Solvay

How to gain critical mass?



How?



Do what plants do.....*better*

$\text{CO}_2 + \text{Water} + \text{sunlight} \rightarrow \text{oxygen} + \text{carbohydrates}$



Visionary project

CEFIC/EuCheMS roundtable



BASF

Bayer

DOW

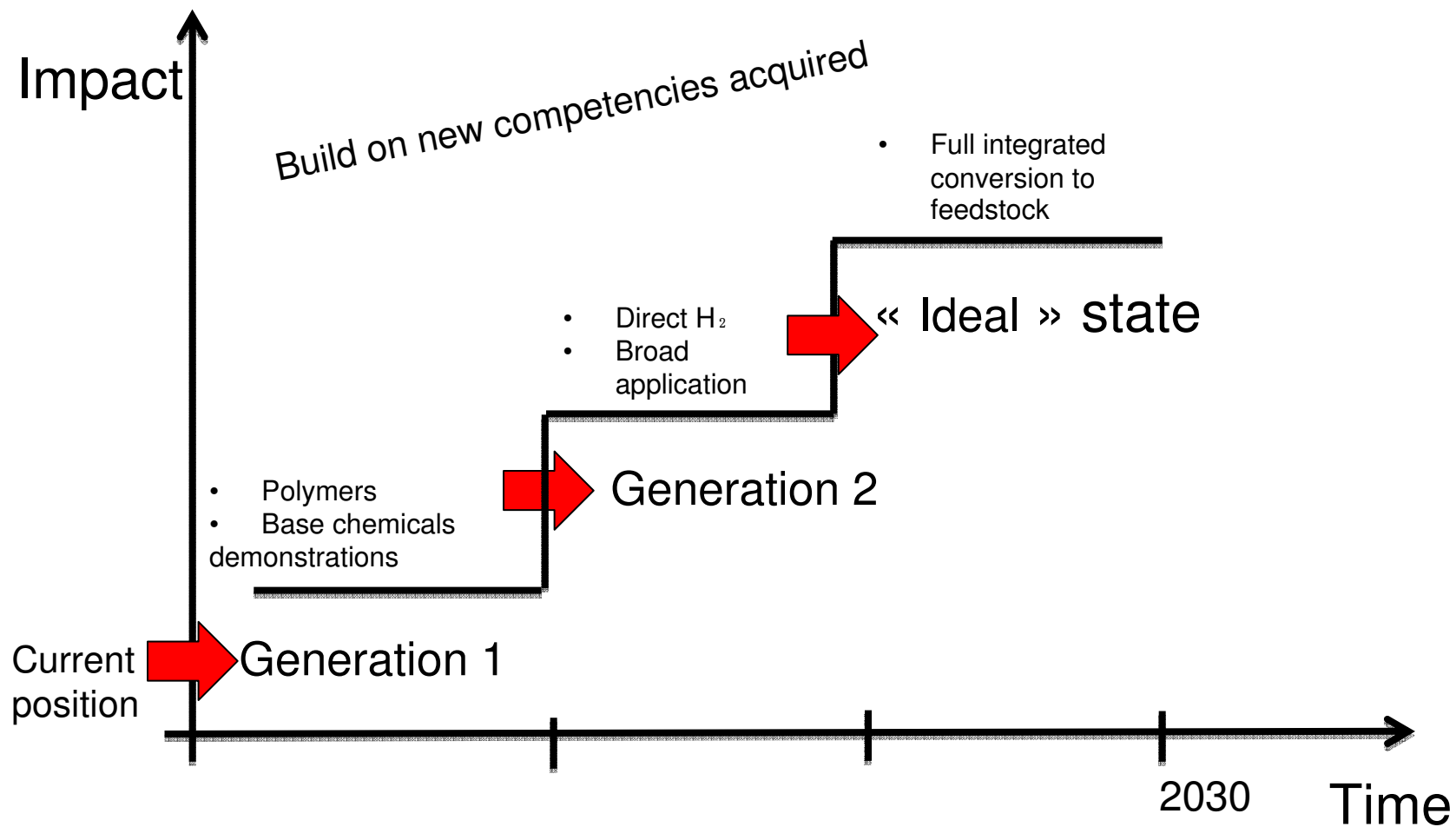
Evonik

Repsol

Solvay

- *ACATEC*
- *DECHEMA*
- *EuChemS*
- *Imperial College*
- *ISOF*
- *Max Planck Institutes*
- *SINTEF*
- *Tecnalia*
- *Technimont KT*
- *Technion*
- *TNO*
- *TU Munich*
- *University of Bari*
- *University of Messina*
- *University of Sheffield*

The CO₂ stairway



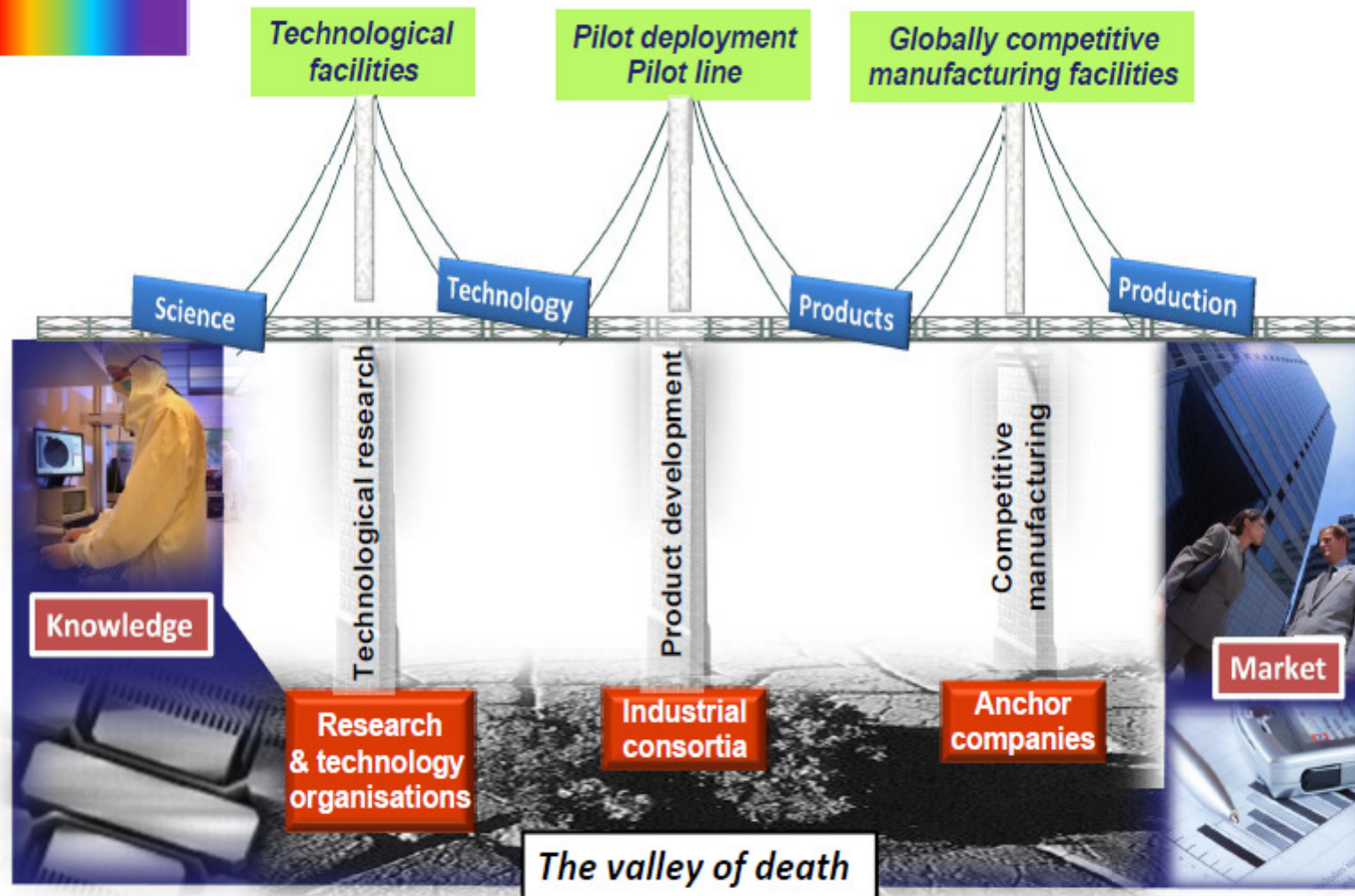
CO₂ Economy: Different generations of CO₂ utilization



Technology	First Generation: Electrochemistry with renewable (surplus) electricity for hydrogen generation	Second Generation: Advanced electrochemistry with renewable (surplus) electricity and photochemistry for direct water splitting	Third Generation: Full-inorganic photoelectrocatalytic device to convert directly CO ₂ to the target products using photons and water
CO₂ source	<div> Central: Flue gas from power plants and cement industry </div> <div>→</div> <div> Central and decentralized: Capture and concentrate CO₂ from the air or from diluted industrial streams </div>		
Output	Fuels and chemicals (methane, methanol, light olefines, formic acid, alcohols and hydrocarbons) can be produced in all generations, down-stream processes should be developed from the very beginning to be ready, when Second and Third Generation are realized - fully competitiveness only with Third Generation		

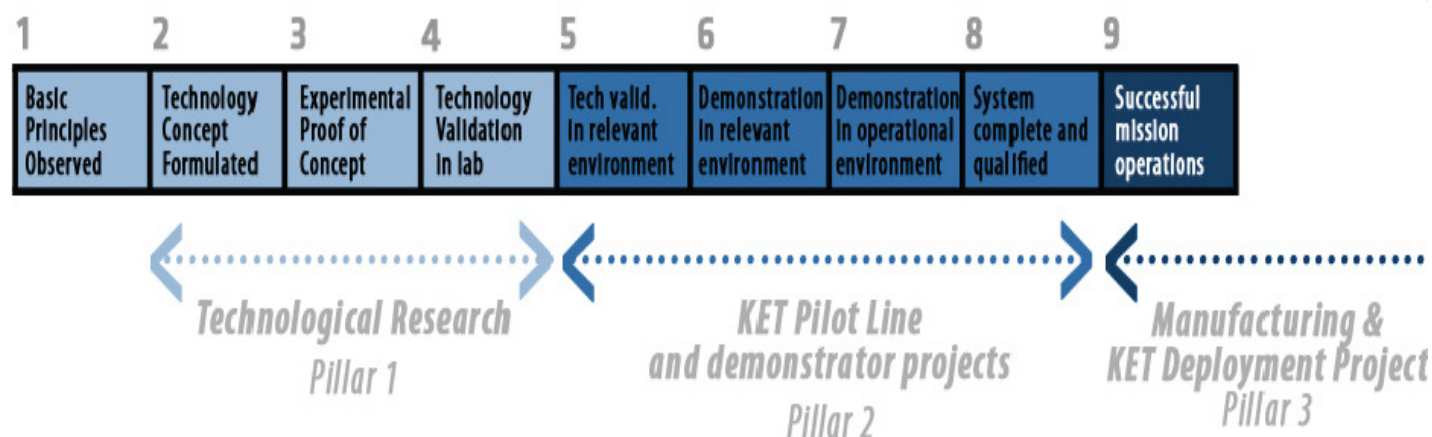


European « three pillars bridge » to pass across the « valley of death »





Technological Readiness Levels scale



(Source: High-Level Expert Group on Key Enabling Technologies report 28 June 2011)

A European strategy for KETs



COM(2012)341

- **KETs research and innovation financing – an integrated approach** (EUR 6.663 billion budget for KETs in Horizon2020/LEIT including support for pilot lines and demonstrator projects, incl. those of larger scale, for achieving technology and product validation under industrial conditions)
- **KETs in Cohesion Policy**
- **State aid**
- **The European Investment Bank**
- **Skills**
- **Enhancing cooperation along value chain**
- **KETs monitoring mechanism- Collecting market data on KETs**

High level Group on KETs- Final report

Key recommendations of interest for the chemical industry



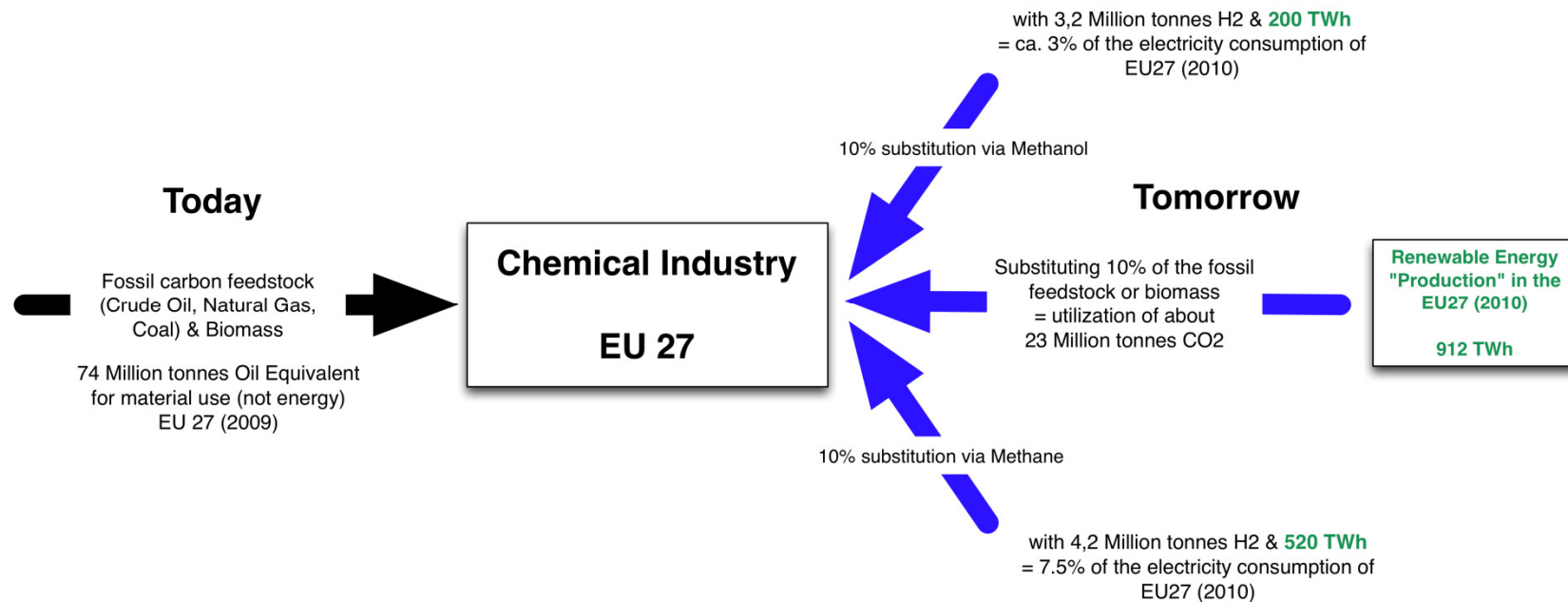
- Creating a distinct funding line for KETs in Horizon 2020
- Extending R&D definition to allow also public funding of pilot and demonstrators
- Combining funding through EC, member states and regional / structural funds with the special focus to strengthen manufacturing in Europe.
- Establishing value chain cooperation as a key selection criteria for future EC programmes
- Addressing skills needs
- Strengthening network of big and small enterprises as the backbone of the EU economy

Potential volume of the CO₂ economy



If the European Chemical Industry EU27 would cover the full carbon feedstock demand for material use by CO₂, this would correspond to utilize 233 Million tonnes of CO₂ (2009):

- = 5.5% (10%: 0.55%) of the total CO₂ emissions from EU27 (4,200 Million tonnes of CO₂)
- = 24% (10%: 2.4%) of the total CO₂ emissions from transportation fuels in EU 27 (966 Million tonnes of CO₂)

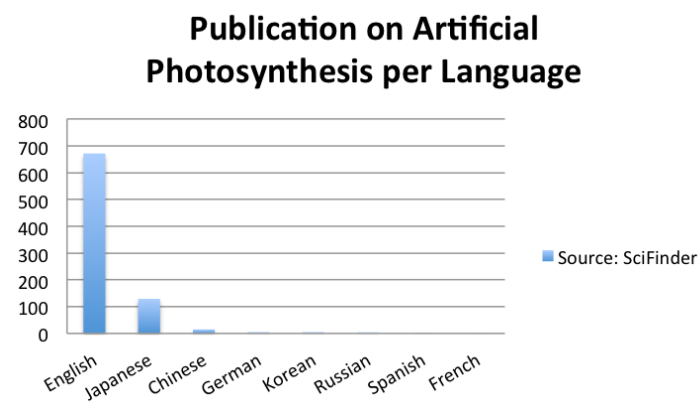
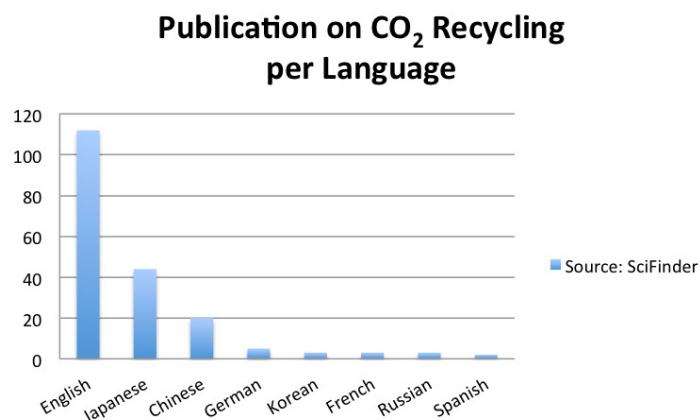
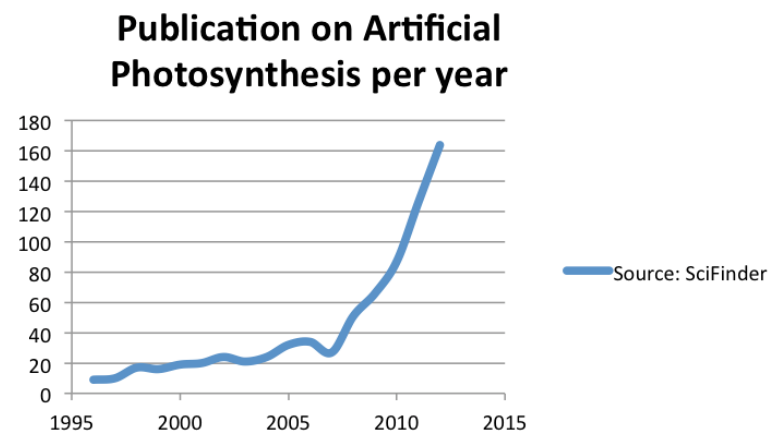
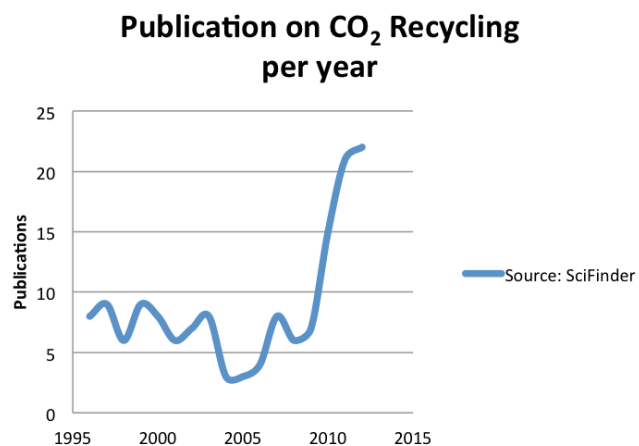


Added value of coordinated EU approach



- Complementarity and resource efficiency
- Critical mass and speed
- Sustainable by linking technologies, policies and societal elements
- Give hope for future – new positive policy approach

Publications on CO₂ recycling and artificial photosynthesis



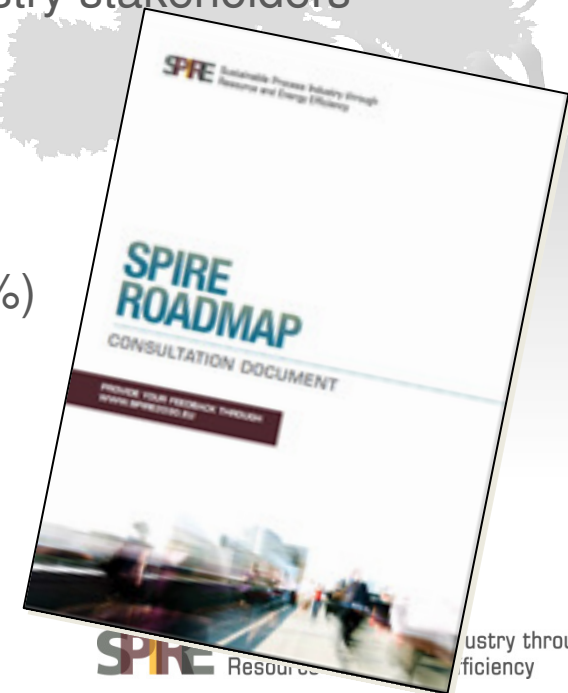
Now it is the right time to enter this field with the right strategy and target

A.SPIRE – Sustainable Process Industries - proposal for a Public Private Partnership -

An association formed to represent the private sector as a partner in the Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) Public-Private Partnership (PPP) to be launched as part of the Horizon2020 framework programme.

- 8 sectors: chemical, steel, engineering, minerals, non-ferrous metals, cement, ceramics and water
- More than 50 industrial and research process industry stakeholders
- More than 450 thousand enterprises.
- Employ over 6.8 million employees,
- Generating more than 1,600 billion € turnover
- The founding basis of the European Economy (20%)
- Struggling with declining global competitiveness

www.spire2030.eu



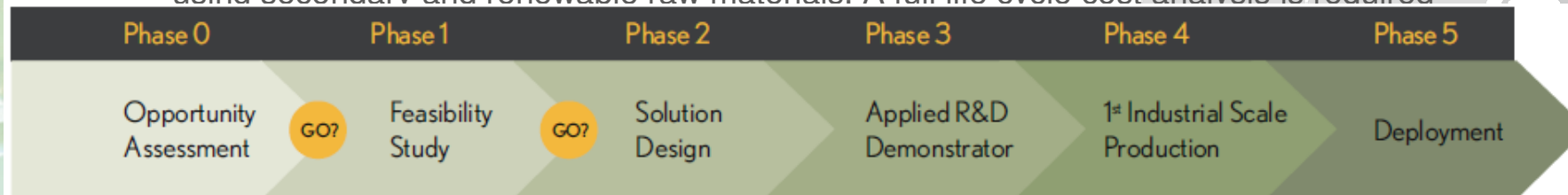
SPIRE Resource

Industry through
Efficiency

SPIRE: Ambitions for PPP proposal

“do more / better with less”

- **A reduction in fossil energy intensity of up to 30%** from current levels by 2030 through a combination of, for example, cogeneration-heat-power, process intensification, introduction of novel energy-saving processes, and progressive introduction of alternative (renewable) energy sources within the process cycle.
- By 2030, **up to 20% reduction in non-renewable, primary raw material intensity** versus current levels, by increasing chemical and physical transformation yields and/or using secondary and renewable raw materials. A full life cycle cost analysis is required

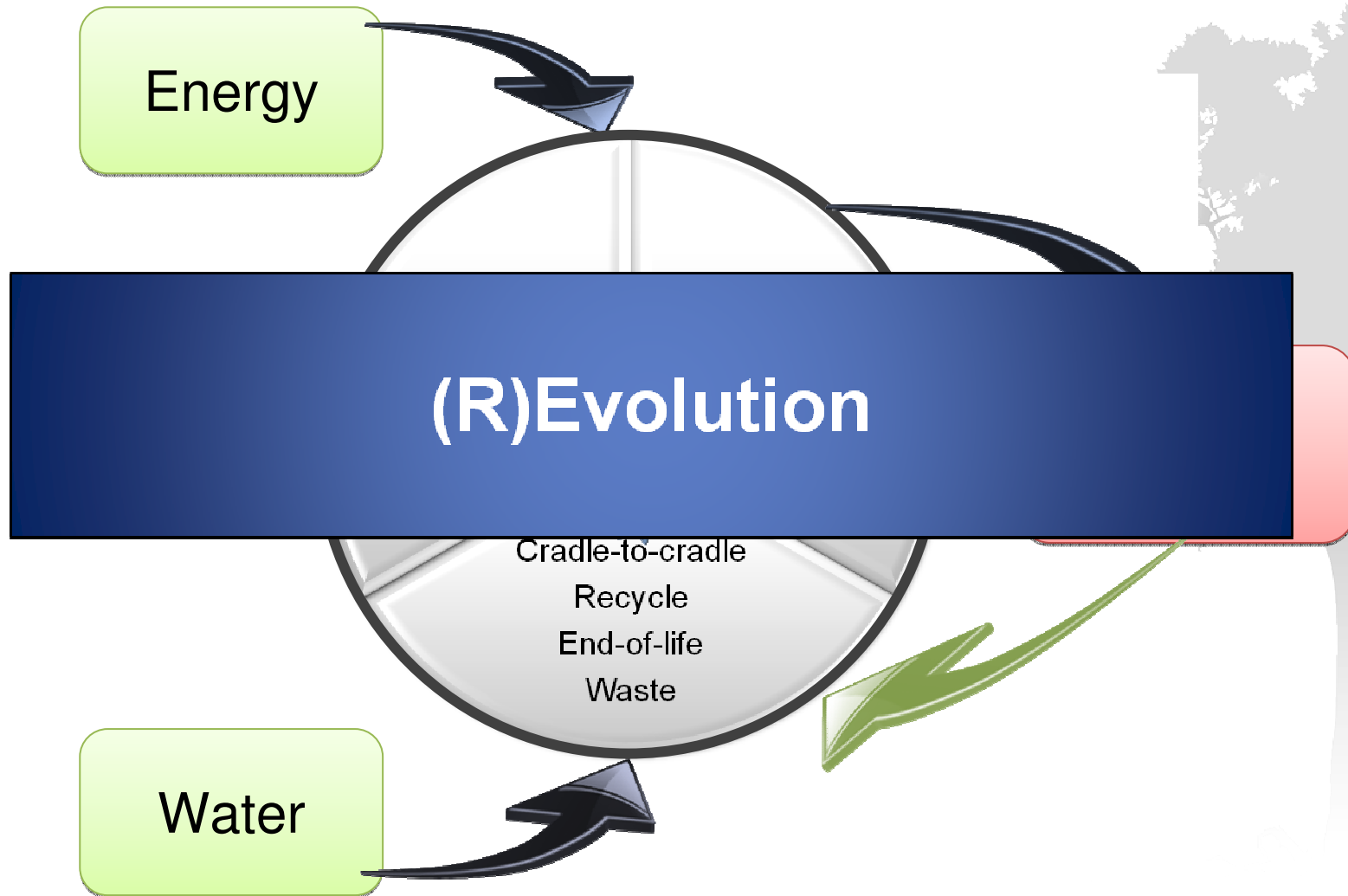


Both these aspirations will make a significant contribution to the political and societal objectives of drastic **efficiency improvement in CO₂-equivalent footprints of up to 40% by 2030**. Potential improvements extend beyond “industry” to all indirectly supplied and dependent economic sectors such as transport, construction, water, electronics etc.

Note: The reference data is based on Eurostat data and definition of ‘current level’ is the period 2008-2011.

SPIRE Roadmap Components

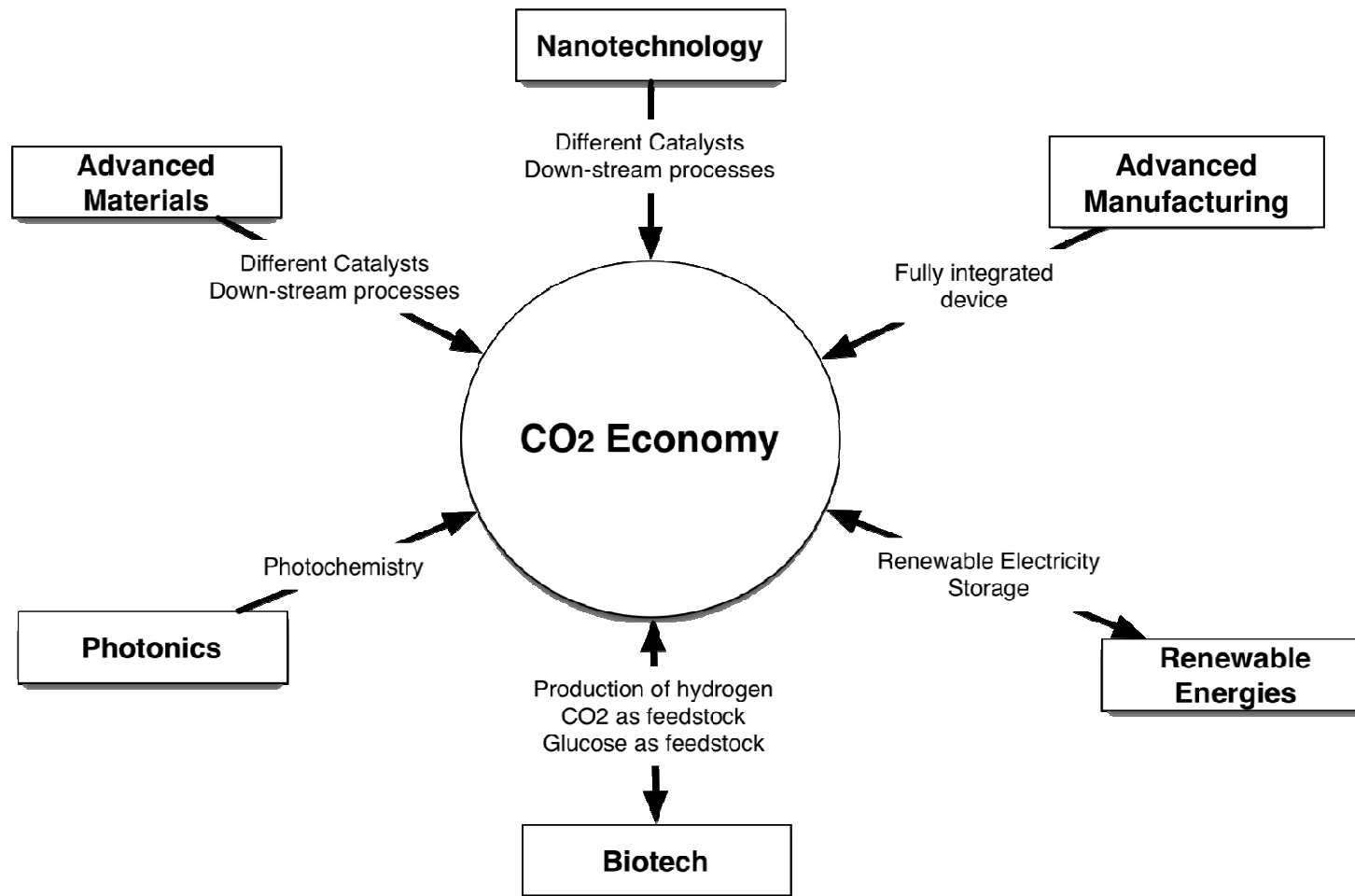
Energy and Resource Efficiency



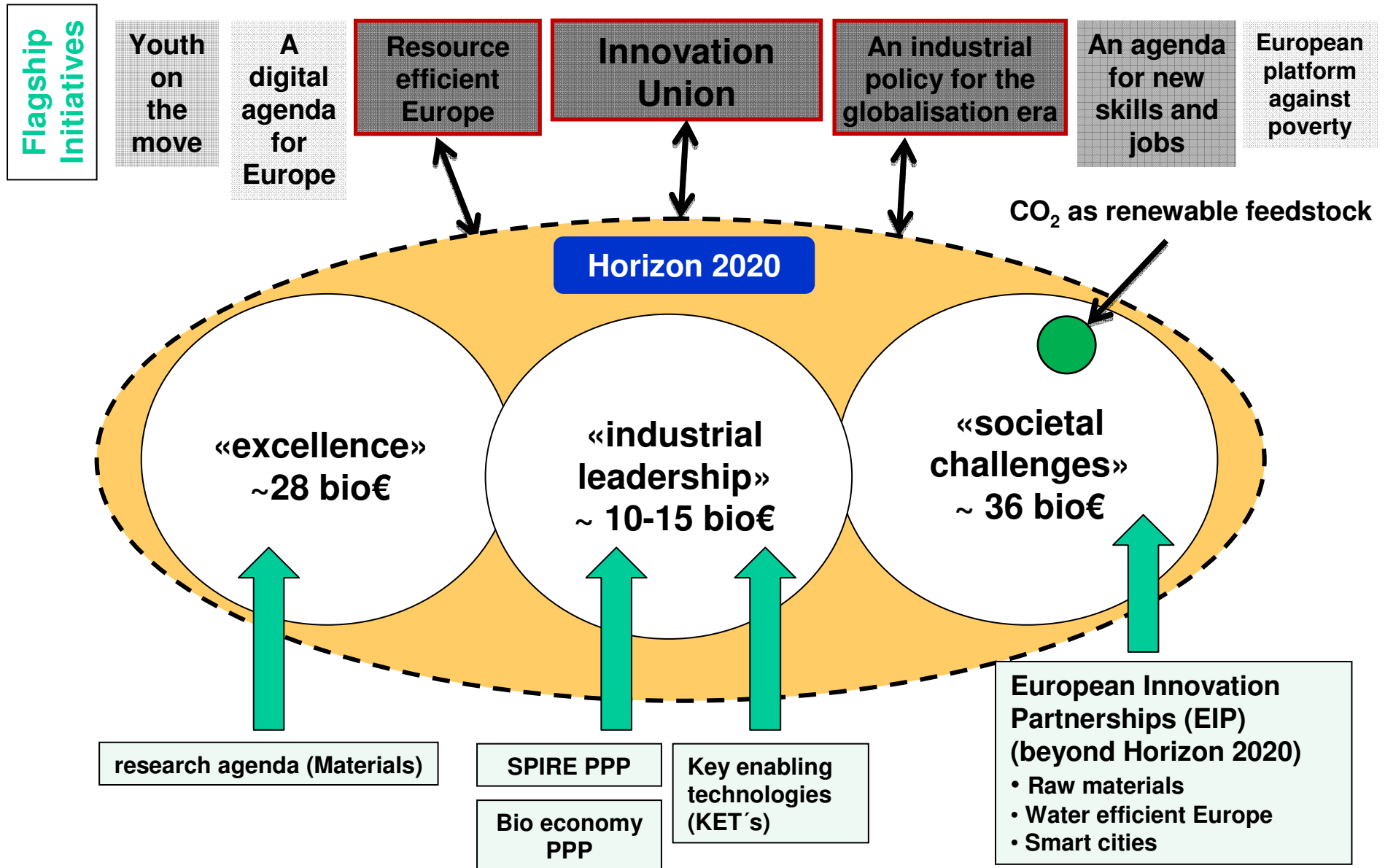
Six key Components

1. **Feed**: Increased energy and resource efficiency through better preparation and product mix of raw materials, higher levels of alternative and renewable feedstock (including waste and waste water), as well as better managing increased quality variations in material resources.
2. **Process**: Solutions for more efficient processing and energy systems for the process industry, including industrial symbiosis.
3. **Applications**: New processes to produce materials for market applications that boost energy and resource efficiency up and down the value chain.
4. **Waste2Resource**: Valorisation and re-use of waste streams within and across sectors, including recycling of post-consumer waste streams and new business models for eco-innovation.
5. **Horizontal**: underpinning the accelerated deployment of the R&D&I opportunities identified within SPIRE through sustainability evaluation tools and skills and education programmes as well as enhance the sharing of knowledge and best practices.
6. **Outreach**: Reach out to the process industry, policy makers and citizens to support the realisation of impact through awareness, stimulating societal responsible behaviour.

CO₂ Utilization: High demand for European Key Technologies

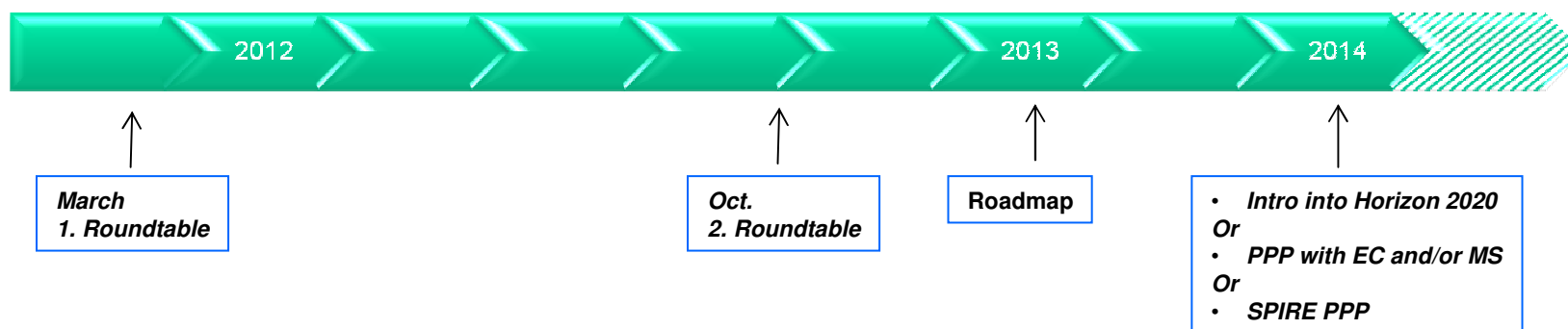


Europe 2020





Timeline (short term)



Project: - 150 Mio € till 2020
- PPP preferred model (interest from EC, NL and UK)
- cooperation with EuCheMs (supported by WBCSD)

Next steps



- Joint strategic roadmap proposal (till early 2013)
- Gap analysis and way forward for
 - Co2 to polymers, fine chemicals, basic chemicals, fuels & Power to gas etc.
 - Policy and societal challenges
- Implementation with SPIRE PPP and KET programme
- Promote as input to societal challenges in Horizon2020
 - Establish programme with member states
 - (next meeting December 12)



Do what plants do.....*better*

CO₂ + Water + sunlight → oxygen + carbohydrate



- Timeline: < 10 years
- Volume:
 - Phase 1 1-2 Mio € (2012-2014)
 - Phase 2 150 Mio € (2014 - 2020)(scale up not included)
- Target: Basis for Co₂ Economy
- Partners: CEFIC, EUChemS, EC and MS ...
- Profit: EU competitiveness
- Planet: landuse, CC, energy, biodiversity
- People: give hope, societal impact



Key messages

- Europe is good place to start develop „CO₂ economy“
- Innovation means new ways of working together
- Significant improvements needed on both public and private side (efficient PPPs to scale up, reliable policies)
- Cross-border cooperation needed (especially in public side)
- CO₂ treated as renewable feedstock in policies and regulations
- Incentives rather than regulations to match global competition

From „carbon leakage“ to carbon usage



Thank you for your attention !