knowledge 4 innovation

K4I Forum of the European Parliament

K4I Forum Dinner Debate in cooperation with RECREATE

How can European R&I policy best support the Circular Economy and Nature-Based Solutions?

Hosted by Pavel Telička, MEP

28 June 2016

19:00 - 22:00

Members' Salon, European Parliament, Brussels

recreate

Bio-based Industries Consortium

recreate

***RE**search network for forward looking activities and assessment of research and innovation prospects in the fields of **C**limate, **R**esource **E**fficiency and raw m**ATE**rials*

JIIP Joint Institute for Innovation Policy · ArcelorMittal · AWI Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung · cefic · DTU Technical University of Denmark · eco logic · eirma · PIK

PNO · SP · tecnalia Inspiring Business · TNO innovation for life · Trinomics · UCL ISR · VTT · Wuppertal Institute for Climate, Environment and Energy

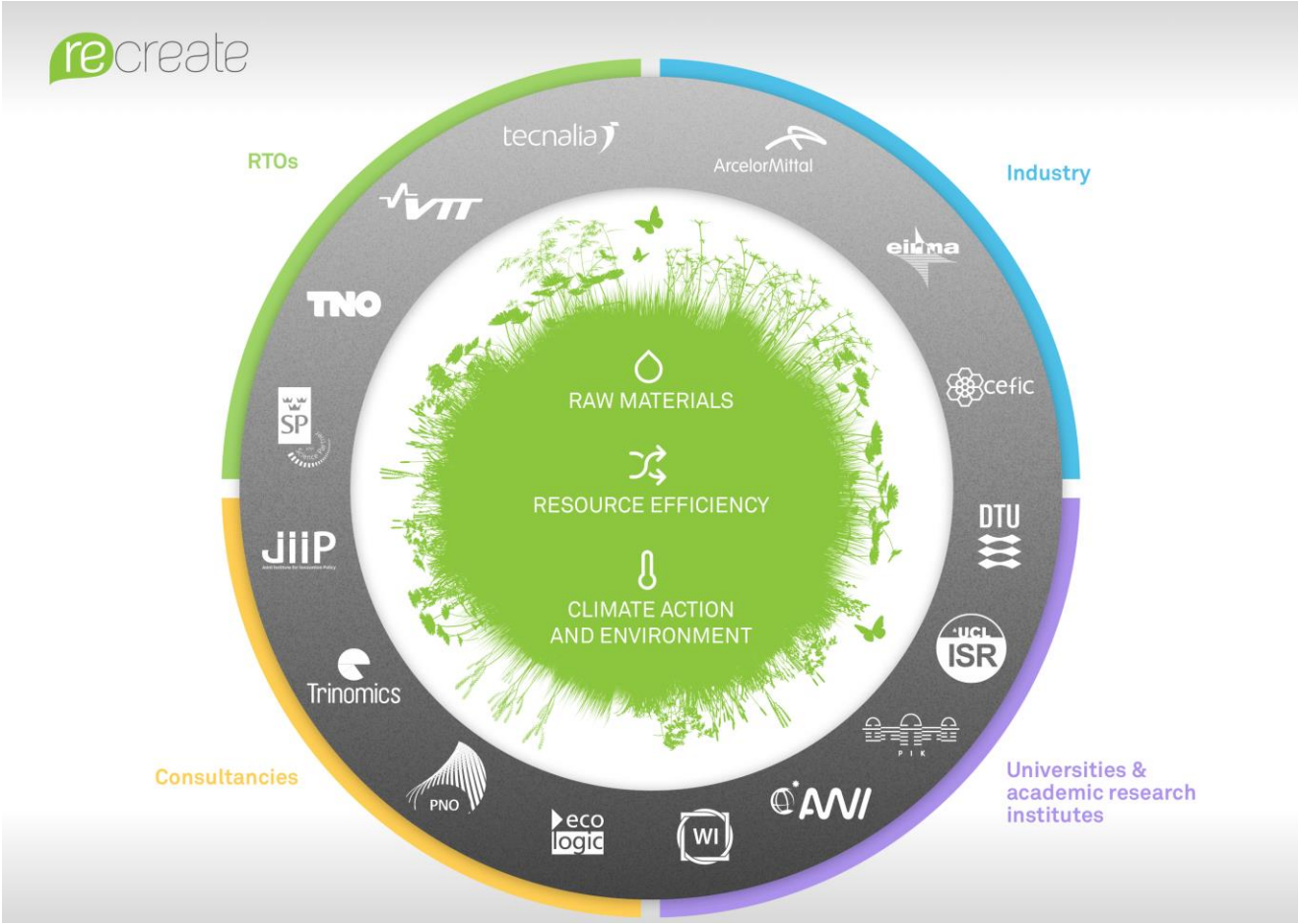
Overall objective

- Support the European Commission in the definition of funding priorities for Horizon 2020
- Specific focus on “Societal Challenge 5: Climate Action, Resource Efficiency and Raw Materials”

Key project data

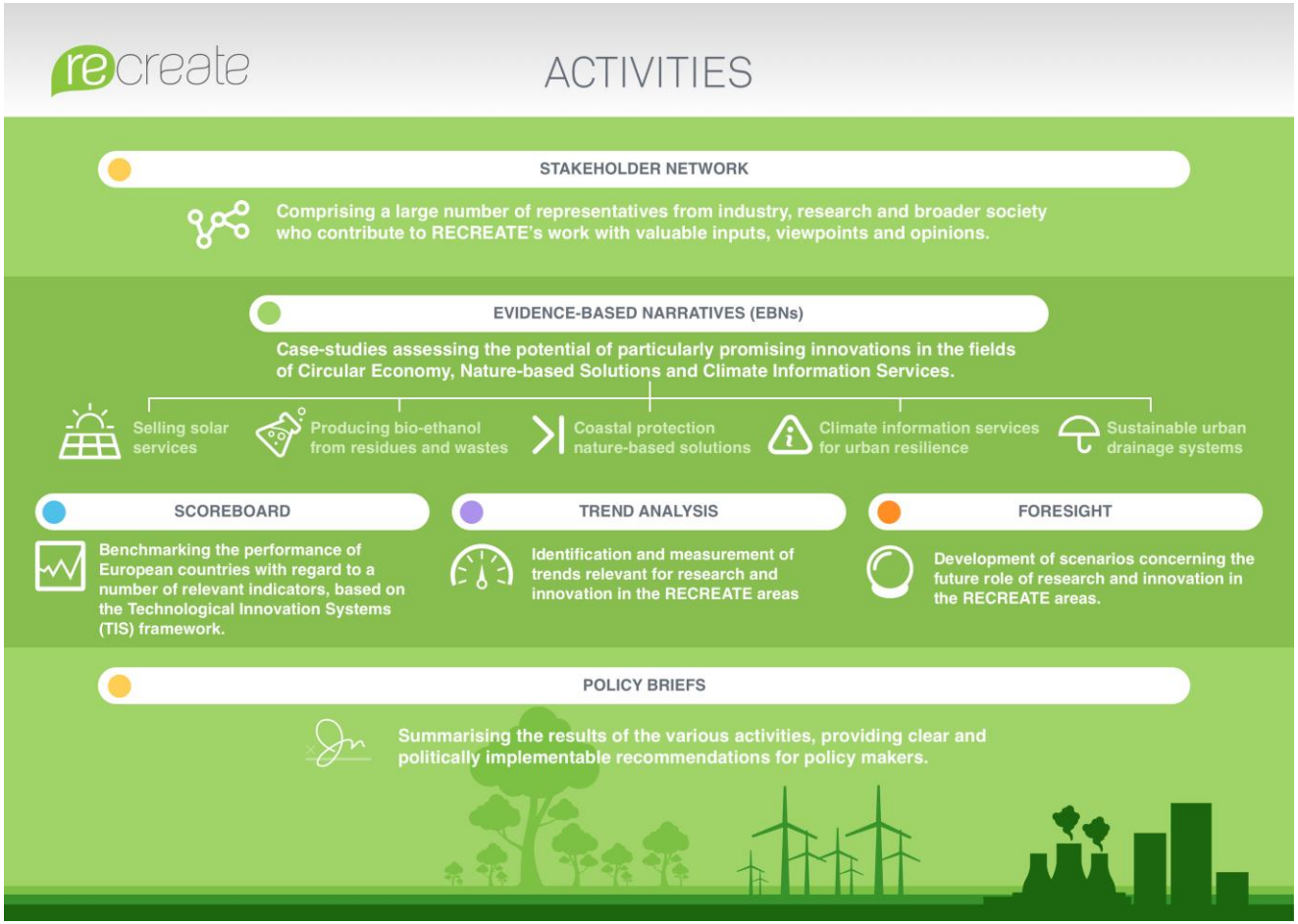
- Funding source: FP7 Coordination and Support Action
- Budget: 3 million EUR
- Project duration: July 2013 – June 2018
- Coordinating organisation: Joint Institute for Innovation Policy (JIIP), Brussels
- In total, 16 partners from a wide range disciplines and domains

The consortium



Bio-based Industries Consortium

Activities



BIORIZON - WASTE TO CHEMICALS A POTENTIAL LARGE SCALE INITIATIVE

Peter Wolfs

TNO innovation for life

INTRODUCTION TNO

OUR MISSION

TNO connects people and knowledge to create innovations that boost the sustainable competitive strength of industry and well-being of society.

'INNOVATION FOR LIFE'

staff establishment

3009

2014 **3276** 2013

Consolidated Turnover 2014 526 Meuro

LOCATIONS IN THE NETHERLANDS

TNO VALUE PROPOSITION FOR THE CHEMICAL INDUSTRY

TNO helps to improve the competitiveness of the industry by reducing costs and time to market of new product and production development.

FEEDSTOCK FLEXIBILITY | **EFFICIENT PROCESSING** | **IMPROVED PRODUCT FUNCTIONALITY**

Biorizon

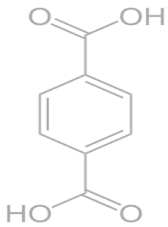
The way to aromatics

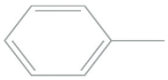
A **Shared Research Program** of TNO & VITO at the Green Chemistry Campus in the Netherlands

World Class in Bio Aromatics Technology
Our mission: To **enable commercial production** of bio-aromatics by 2025

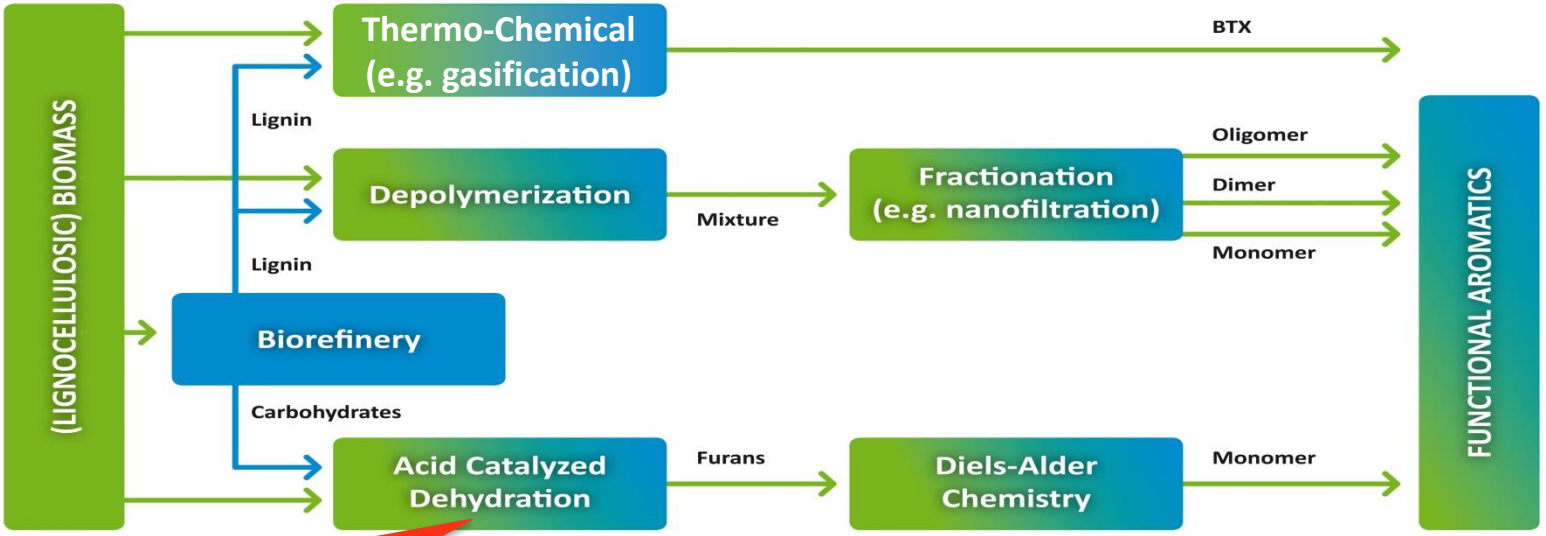
Aromatics, basis of our daily life

Drivers to invest in bio-aromatics:
- Growth market (+5%)
- Security of supply
- Reduction of CO_2 footprint
- Cost reduction





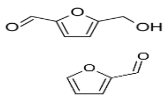
Biorizon Value Chains



Project: Waste2Aromatics
12 partners along the value chain

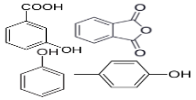
Dehydration

Furans:



Cycloaddition

Aromatics:



Waste is Widely Available

But you need to understand it because not all waste is the same

- Eurostat database: 240 Mton MSW/year in EU-27

Biogenic fraction of MSW 25-50%
15-30 Mton sugars in MSW available

With the current yield of furans from waste (45%), EU-potential is 5-15 Mton/yr aromatics from MSW.
Total market worldwide is ~80Mton/yr

Goal: Find best fit for the market objective and match with the best technology

Next steps

2016/2017: Test continuous process on demo-bench scale (2-5kg/h) and deliver a blue print for a pilot plant (1ton/day)

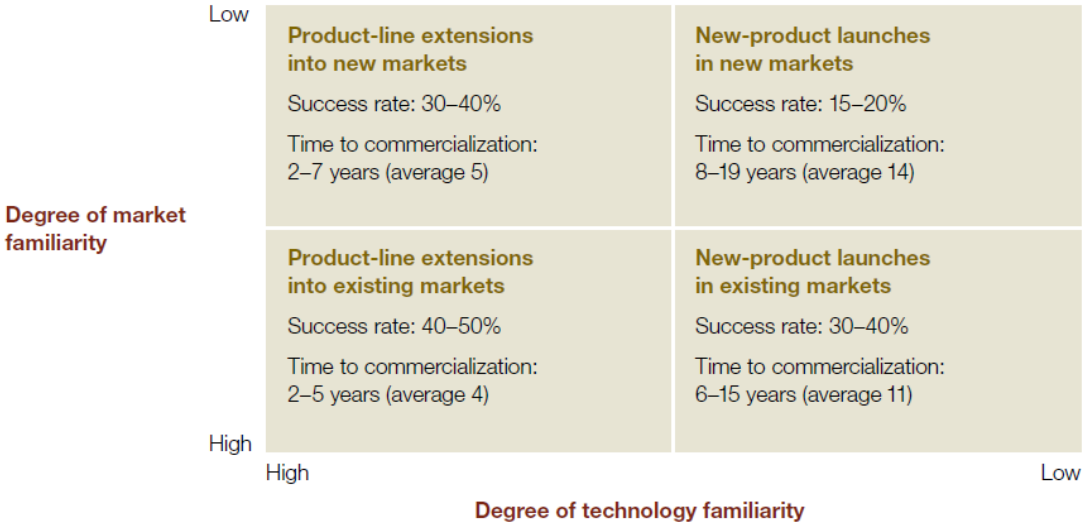
2018: Finance and build the pilot plant

2019-2020: Test continuous process at pilot plant

2021: finance and build a demo / semi commercial plant

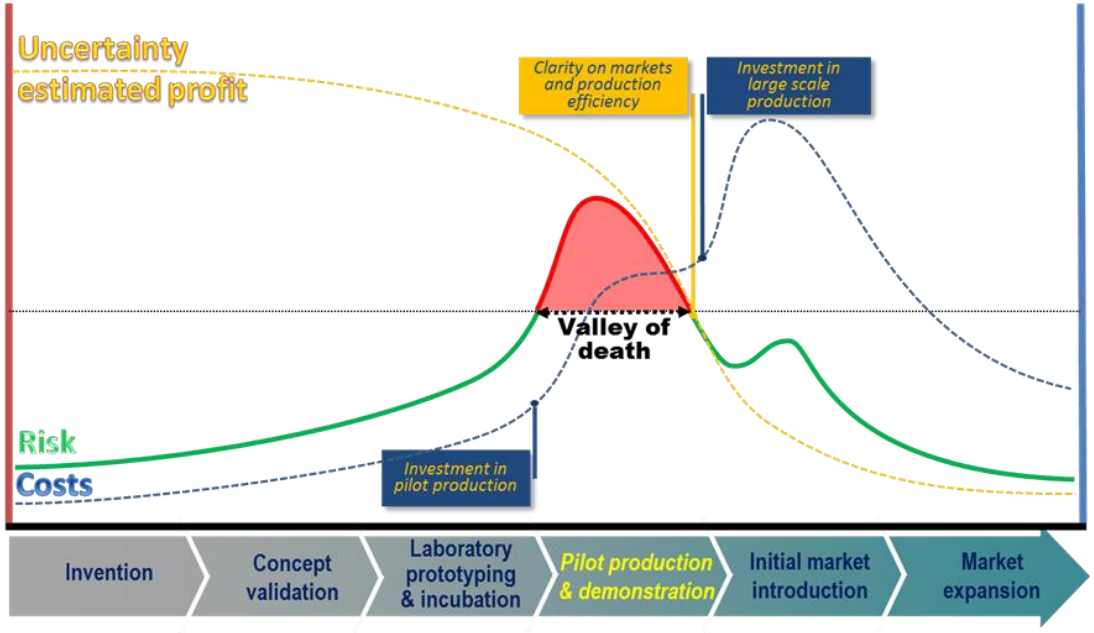
ADOPTION OF INNOVATIONS CAN TAKE LONG AND THE RISK CAN BE HIGH

The time required for commercialization can vary substantially.



Source: McKinsey

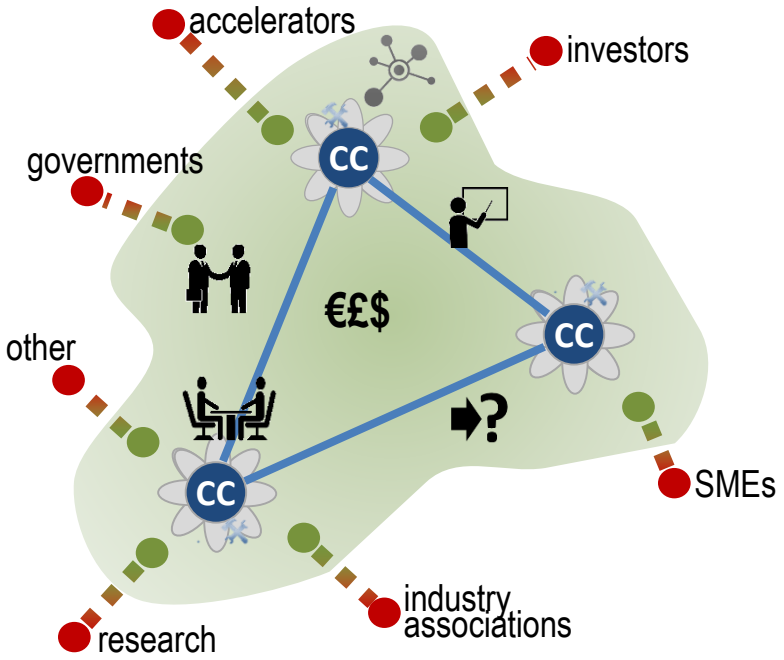
UNCERTAINTY REDUCTION AND COST INCREASE OUT OF SYNC



This project has received funding from the European Union's Horizon 2020 research and innovation programme Contract No 646107

THE IMPORTANCE OF LARGE-SCALE RDI INITIATIVES (PPP)

"Large-scale RDI initiatives (LSI) are industry and application driven, long-term, broad (open) access, multi-stakeholder partnerships strategically targeting large-scale research, development and innovation activities using a combination of different funds aiming at accelerating the commercialisation of technology, boosting competitiveness of companies and renewing industrial ecosystems towards sustainable economic growth and well-being of society."



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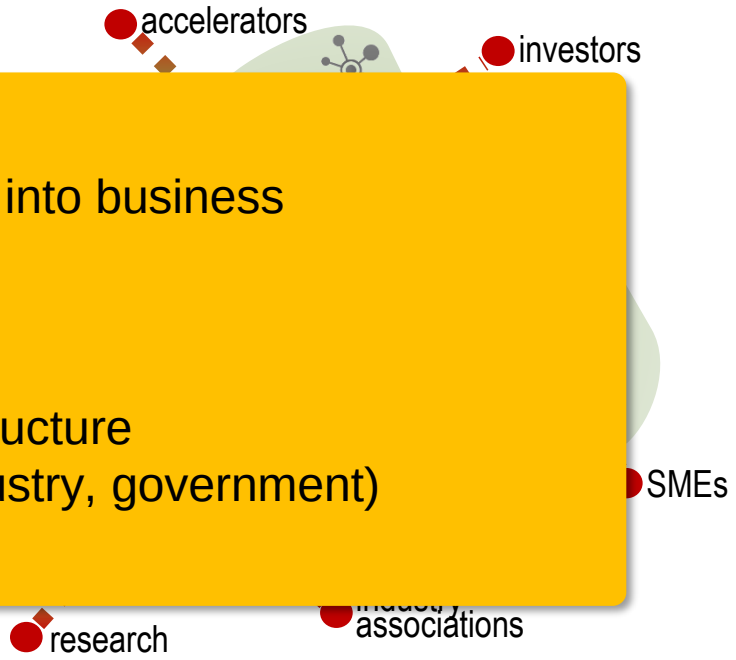
economic growth and well-being of society."

Some characteristics:

- Focusing on valorisation of research into business
- Supporting TRL4-7
- Open to different customers
- Providing specific expertise
- Sharing equipment and other infrastructure
- Tripartite cooperation (research, industry, government)
- Combining many services



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ADDED VALUE LSI IN CROSSING THE VALLEY OF DEATH

- They create a critical mass of activities, normally to small for individual companies
- Sharing infrastructure will reduce costs and lower economic risks
- Sharing research capacity will enhance the quality of researchers
- Sharing expertise on scale-up/valorisation will create vast experience
  - Both technological and non-technological
- Creating/maintaining the innovation ecosystem will stimulate efficient cooperation
- More activities on the topic enables better awareness creation

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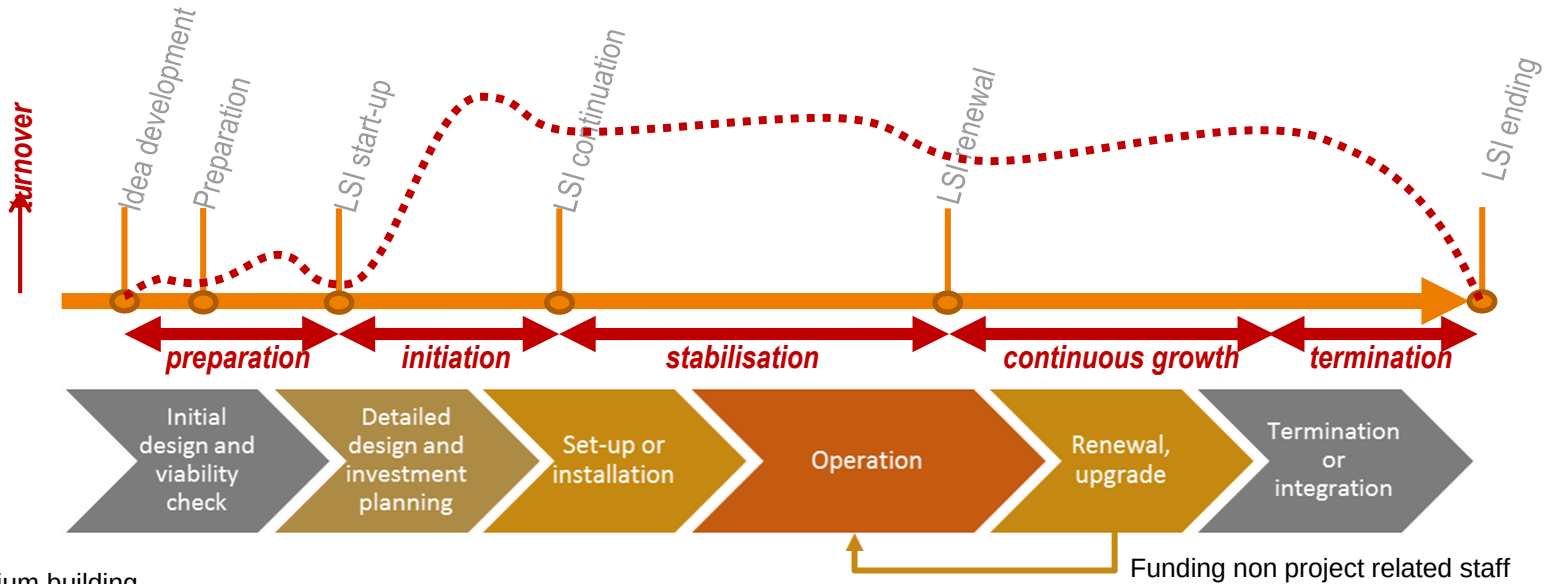
EVOLUTION OF LSI'S/PPP FROM THE PERSPECTIVE OF FINANCING



Consortium building,
Market analysis,
Development Business plan,
Development Research agenda

Build up physical
Infrastructure & equipment

Implementation of projects running within framework & management of these projects

Funding non project related staff
Business development
Rent for buildings
Maintenance infrastructure
PR, Communication and networking

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EU-Great

OVERVIEW OF ALL POTENTIAL SOURCES OF FINANCE

Own

- Private debt financing
- Own resources partners (human, financial, technical)

Private

- Private equity
- Sponsoring (financial, technical)
- Third party in-kind HR contributions
- Memberships

Public

- Public equity
- Public funding for infrastructure
- Public funding for projects
- Public loans and guarantees

Revenues

- R&D and pilot production projects
- Commercial fees (infrastructure use, consultancy, testing/validation)
- Conference contributions
- IPR/licensing

This project has received funding from the European Union's Horizon 2020 research and innovation programme Contract No 646107

EU IS CRUCIAL FOR THE INITIATION AND MAINTENANCE OF LSI'S/PPP

- The preparation of LSIs is often very difficult and hardly funded by national and regional level
- Although LSIs often start at regional level, after 5 years also the international market is relevant => Smart specialisation is required
- Transnational (even trans-regional) cooperation is secondary for LSIs
- A systematic approach to create a viable LSI is complex
- Focusing on valorisation of research requires high budgets, and cooperation on national/regional/EU level
- The combination of H2020 with ESIF and even EFSI is important
- Coordination is essential

This project has received funding from the European Union's Horizon 2020 research and innovation programme Contract No 646107


THANK YOU
TNO innovation for life

Conditions for stimulating growth of bio-based chemicals

cefic

K4I dinner event: How can European R&I policy best support the Circular Economy and Nature-Based Solutions

Responsible Care®
OUR COMMITMENT TO SUSTAINABILITY

Why chemicals trade is important for everyone!

Health & Nutrition

9 billion people will live on earth by 2050!

- How can we guarantee food and water supply for everyone?
- What are possible bene-fits and contributions of plant science?

Construction & Housing

67% of the world population will live in cities by 2025!

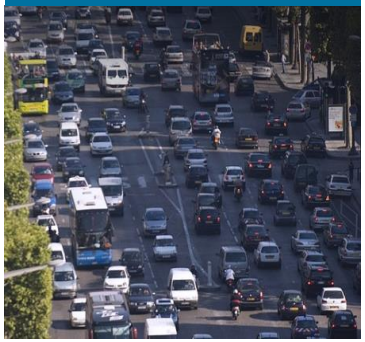
- What does future architecture look like?
- Which materials are needed to make energy consumption more efficient?

Energy & Resources

50% more primary energy needed in 2030!

- What is the ideal energy mix of the future?
- How big is the stake of renewable energy?

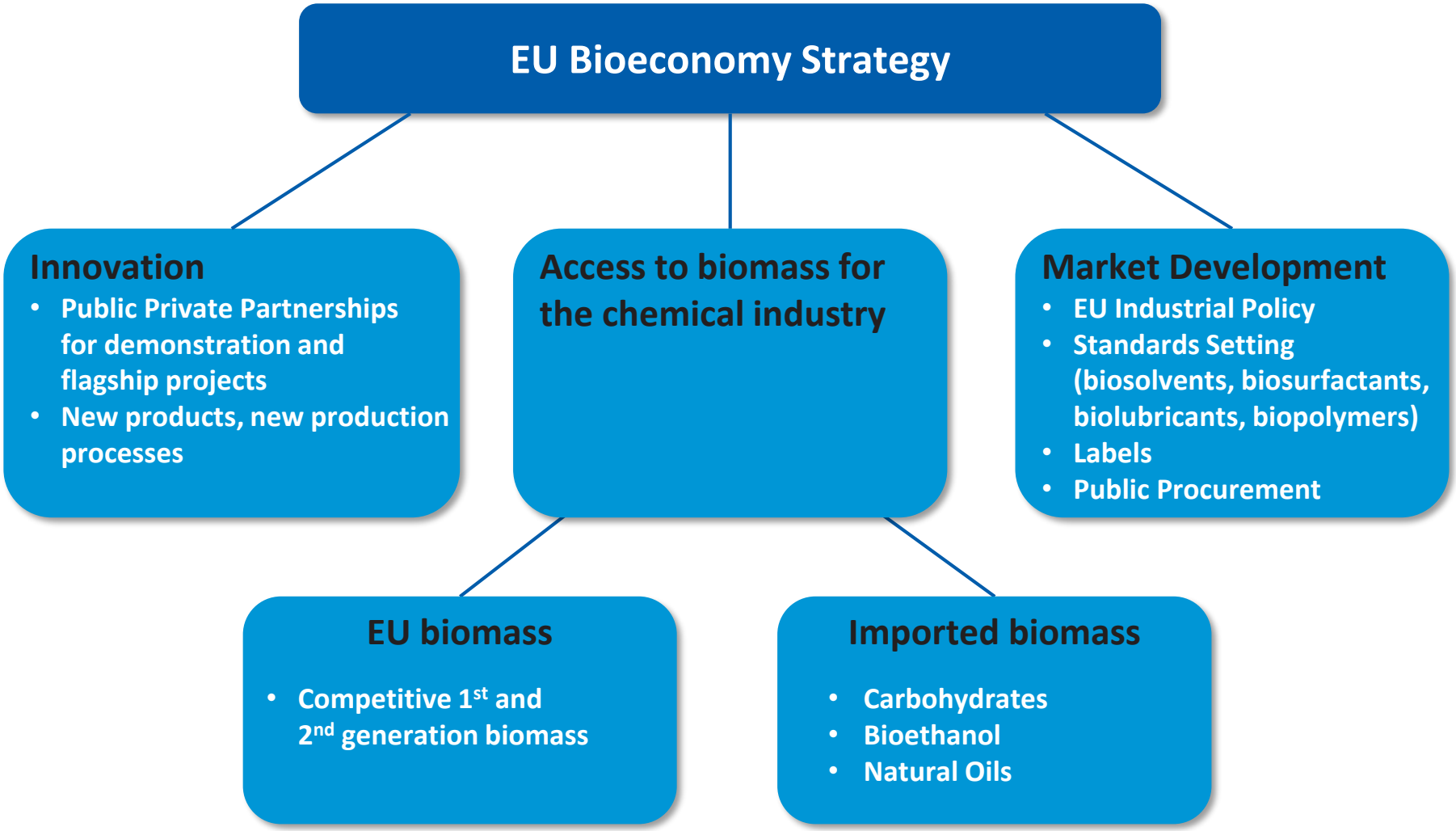
Mobility & Communication



1.2 billion cars will drive on earth by 2020!

- How can we reduce emissions and fuel consumption ?
- What will future cars be made off ?

The dimensions of the Bio-economy for the EU Chemical Industry



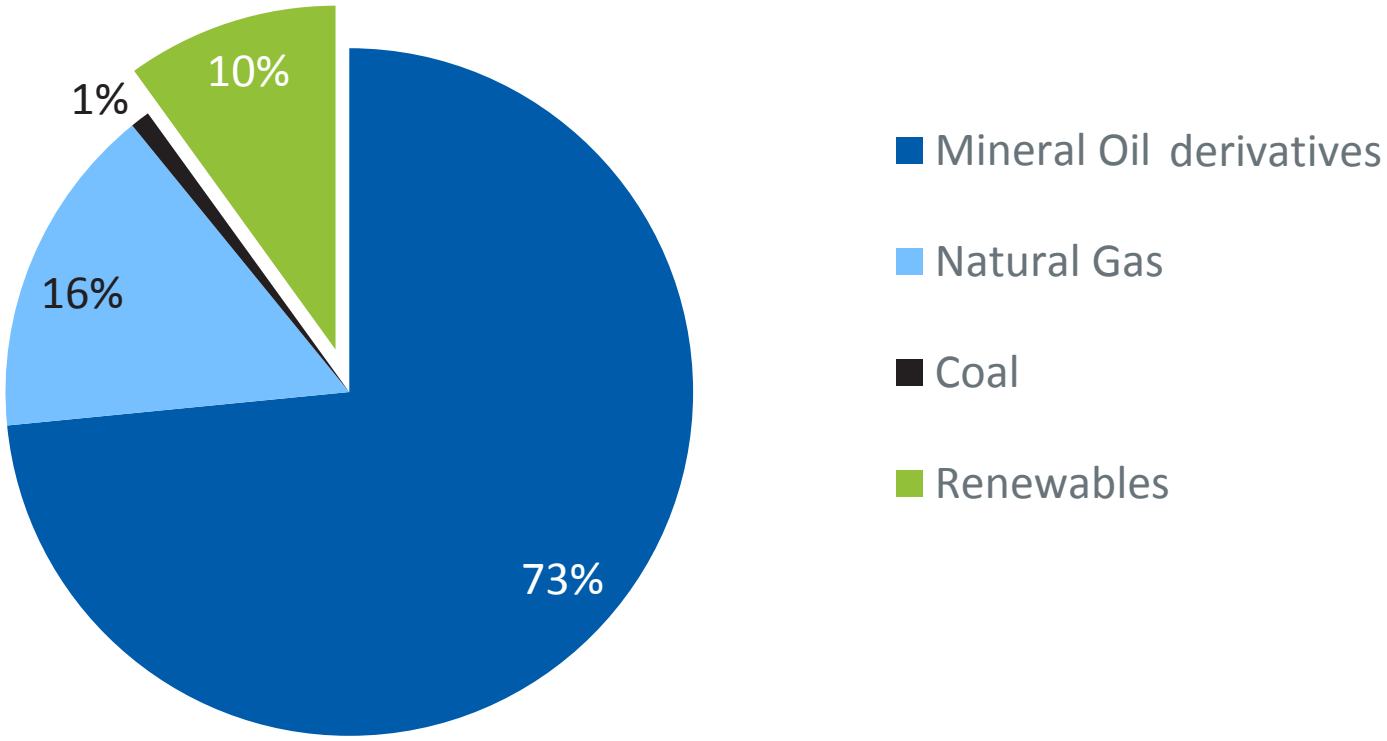
The Chemical Industry: key player

Mix of traditional and new applications:

- Carbohydrates used in specialties like enzymes, vitamins, organic acids, polymers
- Animal fats/vegetable oils used in surfactants/emulsifiers for detergents, cosmetics, coatings
- Natural extracts for cosmetics and fragrances
- Bio-based plastics, eg. PLA (polylactic acid), starch based or bio polyethylene, bio PET (polyethylene-terephthalate), PEF (polyester polyethylene-furanoate)

Renewables hold a10% share of our carbon-containing Raw Materials

Shares in total organic raw materials – material (feedstock) use only
EU chemical industry, **2014**



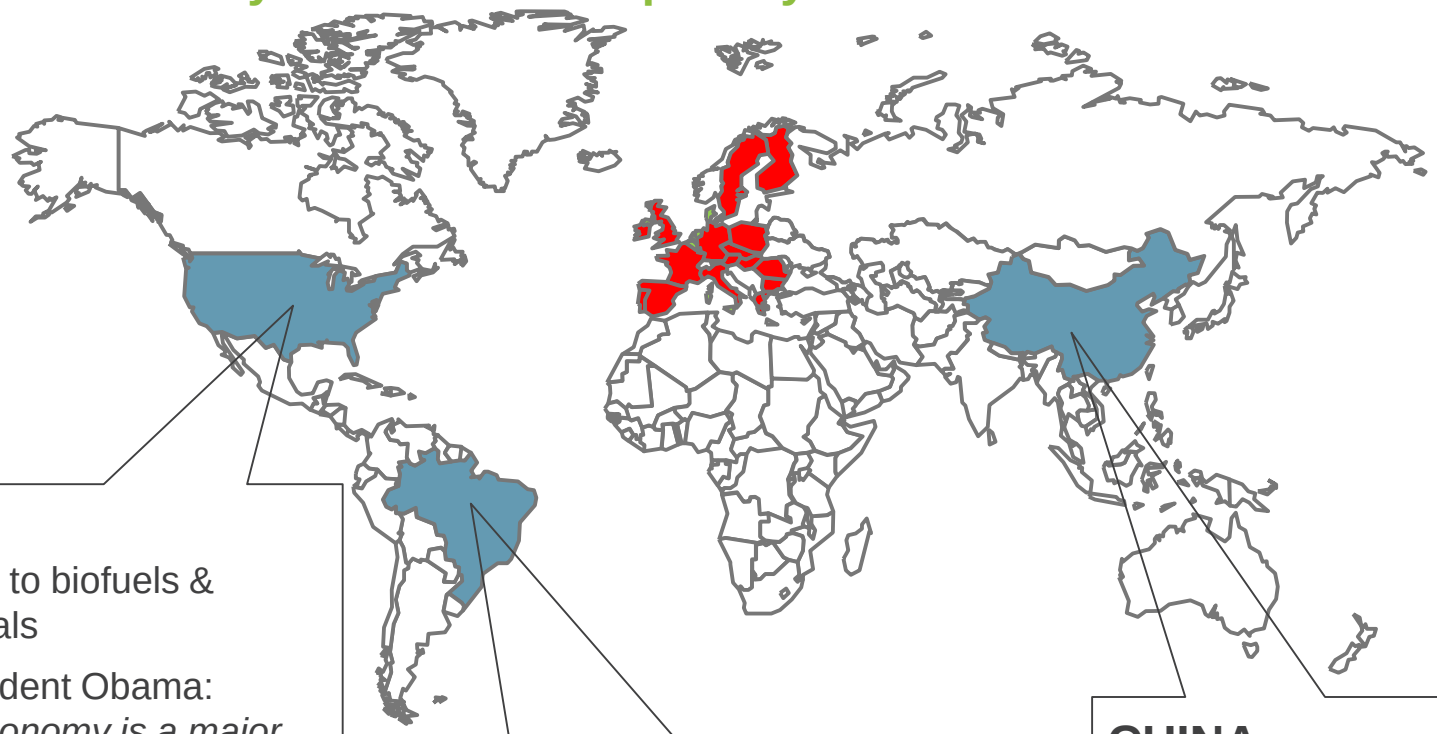
Why bio-based?

- Awareness for intrinsically sustainable products
- Increased political support
- Europe's highly sophisticated chemical industry
- Expansion of our raw material base
- Development of new, differentiated & sustainable products
  - **new or drop-in**
- Integration of fermentation into chemical processes

Bio-based Industries Consortium

What Europe is up against

The bio-economy is a world wide priority



US

- ~$50 billion to biofuels & bio-chemicals
- 2012, President Obama: "*The bio-economy is a major engine for American innovation and economic growth*"

BRAZIL

- Aims to be N°1 Global Bio-economy
- R$ 3,3 billion for 2nd generation bioethanol, bio-chemicals and biomass gasification technologies

CHINA

- > $300 billion in Science & Technology with biotech as a major priority over 2011-2015
- Substitute 20% of crude oil imports by 2020

Challenges

- Free and fair access to (renewable) raw materials
  - Competition for resources (food vs energy vs materials);
  - Discrimination fossil vs ‘green’ feedstock;
  - Discrimination vs 3rd countries having (free) RM access, Brazil, US;
  - Discrimination between agricultural products for chemical use (palm oil vs bio ethanol);
  - Tariff anomaly (duties on RMs vs finished goods)

- Stable, coherent and predictable policy framework to foster innovation and competitiveness

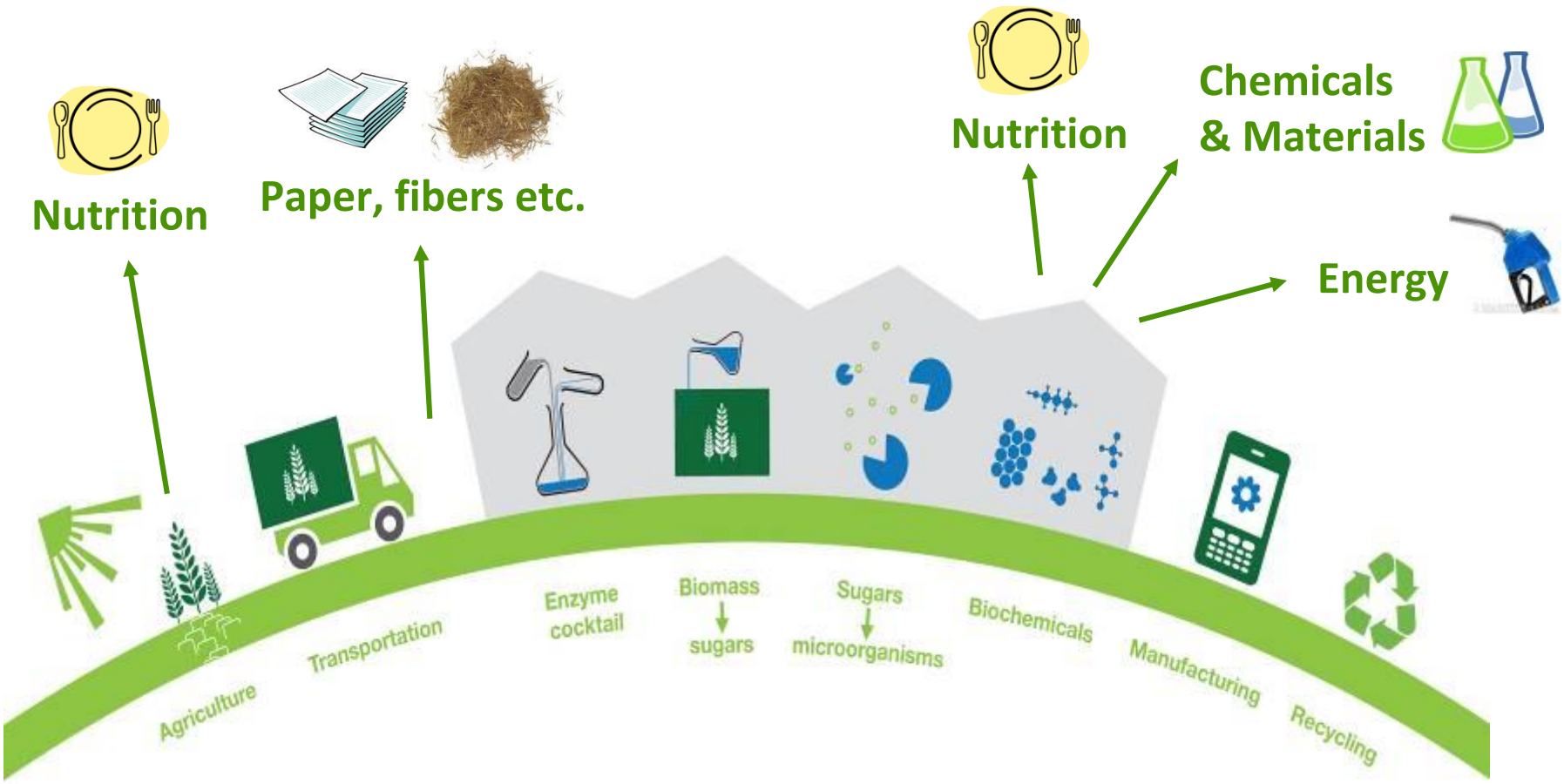
Win-Win situation chemical and rural sector

Development of bio-based production is creating a great opportunity for both the European chemical industry as well as for the rural sector, promoting the much desired investment and job creation. Common denominators for both chemical and rural sector are:

- Promoting bio-based economy will allow to develop new markets to which the agricultural sector can feed into, but most importantly, help boosting economic growth;
- The EU is (relatively) not well positioned with regards to resources and developing bio-based economy will help extending our feedstock range;
- Developing bio-based economy will help meet the (growing) consumer demand for bio, that is predominantly concentrated in the EU (automotive, construction, cosmetics, packaging materials).

➔ This requires a holistic policy approach across the Commission DGs that removes discrimination and market distorting practices and stimulates innovation. Key success factor is collaboration throughout the entire value chain, from agriculture to bio chemicals.

Value chain: Agro meets Chemicals to form one key pillar of the circular economy



Lithium Ion Battery Materials & Recycling @ Umicore

Prof. Dr.Ir. Egbert S.J. LOX

Senior Vice President Government Affairs

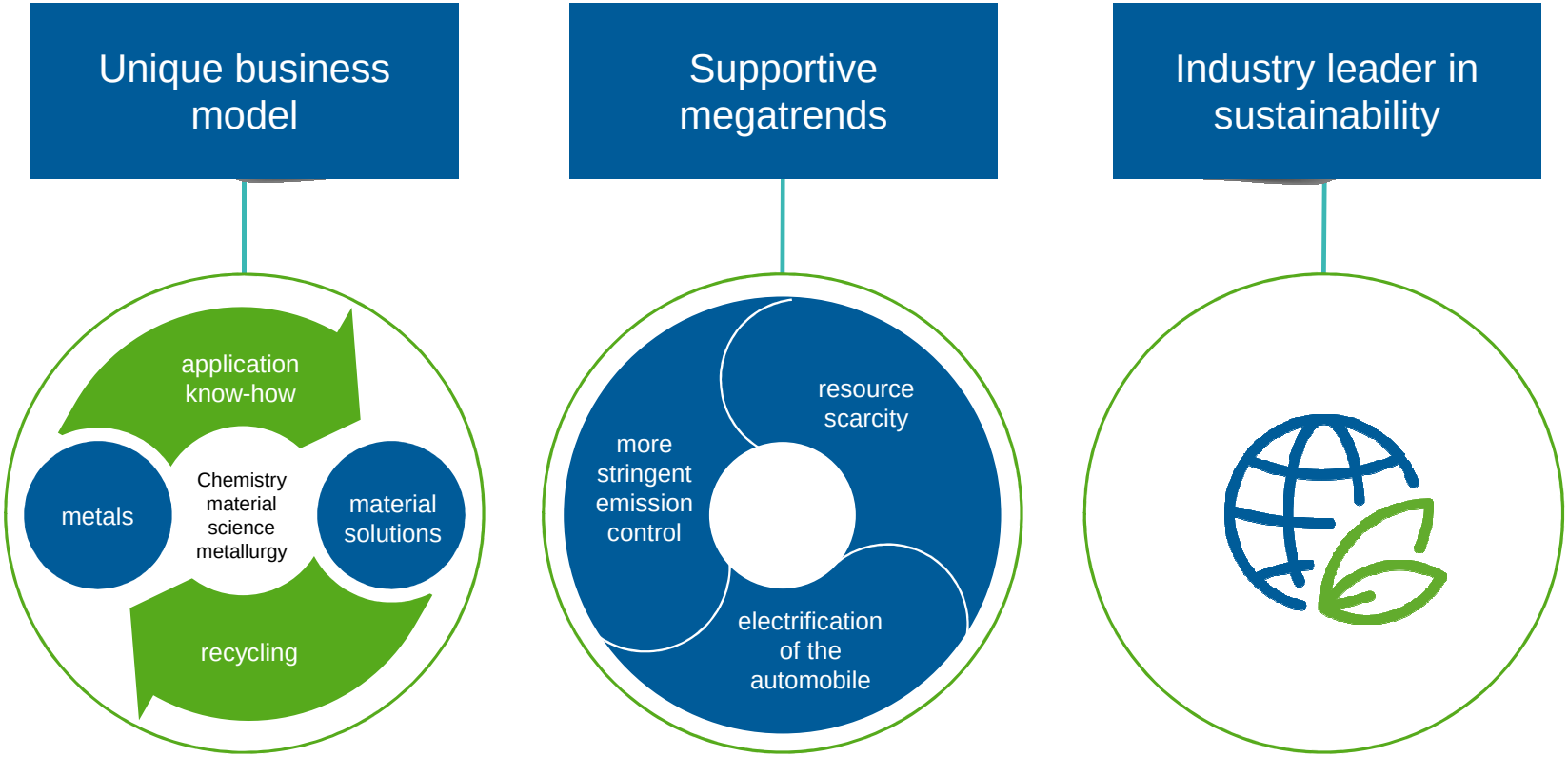
Umicore

K4I/JIIP/CEFIC/EIRMA Meeting

European Parliament Brussels

June 28th, 2016

Our foundations



Global presence:
10,429 people, 66 manufacturing sites

North America

857 people

11 industrial sites

Europe

6,694 people

29 industrial sites

South America

692 people

4 industrial sites

Africa

309 people

2 industrial sites

Asia / Pacific

1,877 people

20 industrial sites

Figures exclude associated companies (December 2015)

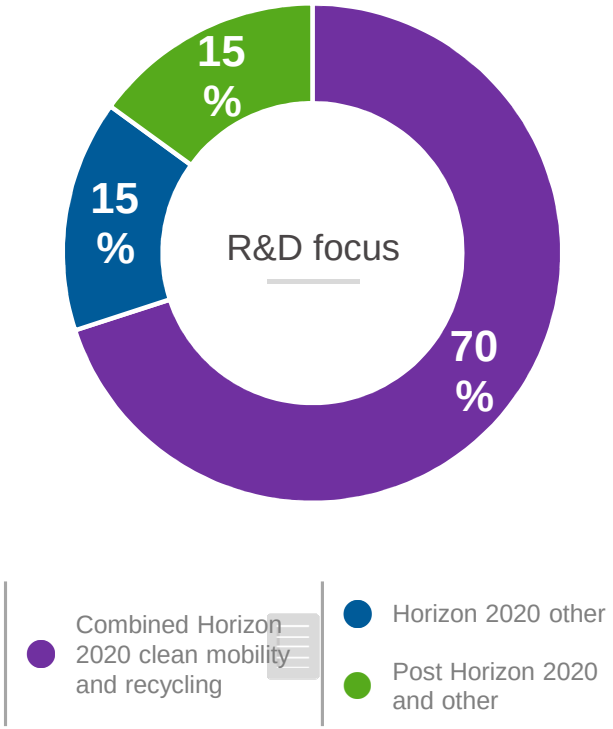
Strong commitment to innovation

R&D spend **€ 145 m**

5.5% of revenues invested in R&D

Focus on **clean mobility and recycling**

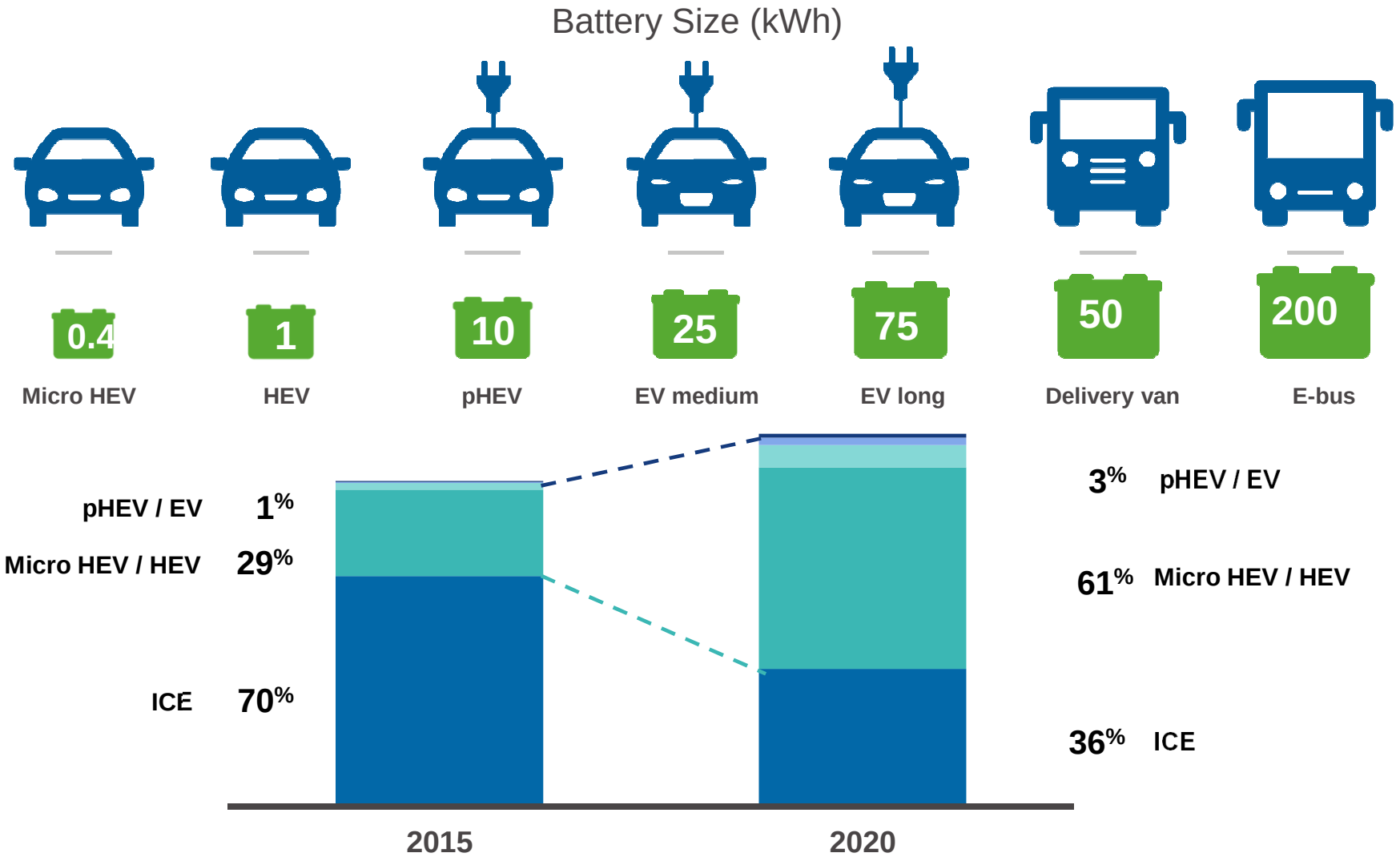
520 patent families, 46 patents filed in 2015



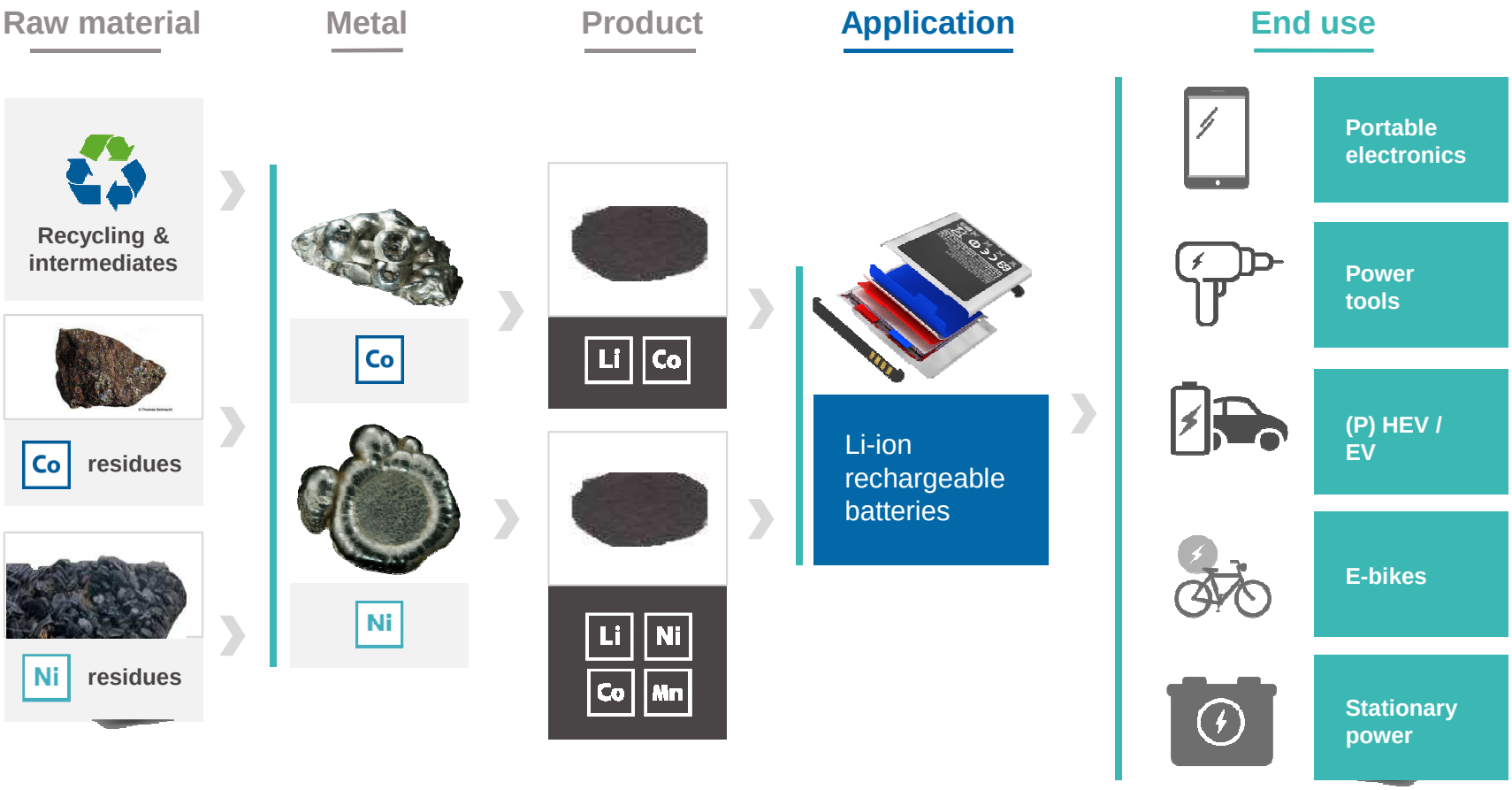
PhD graduate Stefan Knoppe wins Umicore Materials Technology Award

Market development electrified powertrains

Segments



Unique integration in the value chain



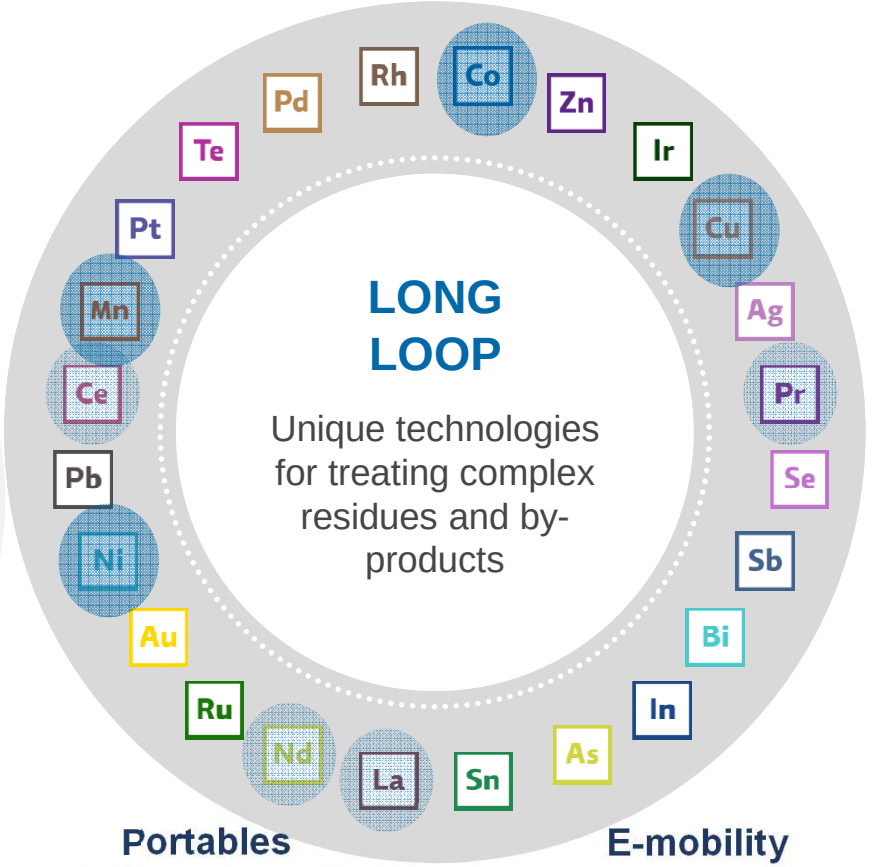
Umicore occupies a unique position in the value chain guaranteeing high speed to market, supply security, and responsiveness to customer needs

Product portfolio cathode materials

	Energy	Power	Safety	Life	Cost
LCO lithium cobaltite $LiCoO_2$	+++	+++	+	++	+
NCA lithium nickel aluminium cobalt oxide $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$	+++	++	-	++	-
LMO lithium manganese oxide $LiMn_2O_4$	-	+++	++	-	++
NMC nickel manganese cobalt $Li(Ni_xMn_yCo_{1-x-y})O_2$	++	++	++	+++	+++

Example application

Unique position in (Li-ion battery) recycling



Battery Production scrap

Portables

E-mobility

Energy storage

UBR feed portfolio: variable battery sizes

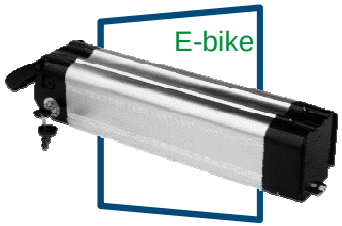
No pre-treatment necessary

= direct feed into Umicore UHT furnace in Hoboken (Belgium)

± 0,030 kg

0,5 – 0,7 kg

1 – 1,5 kg

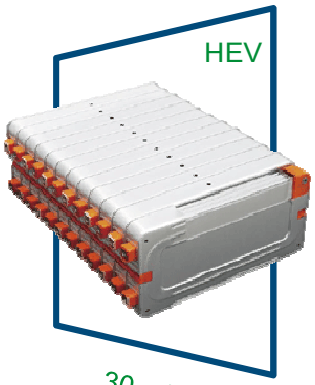


± 3 kg

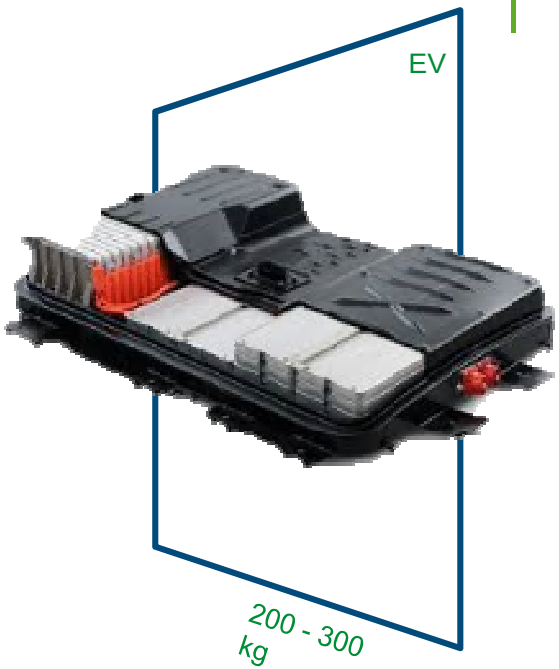
Pre-treatment necessary

= dismantling to module/cell level

Umicore Dismantling facility, Hanau (Germany)



30 - 40 kg

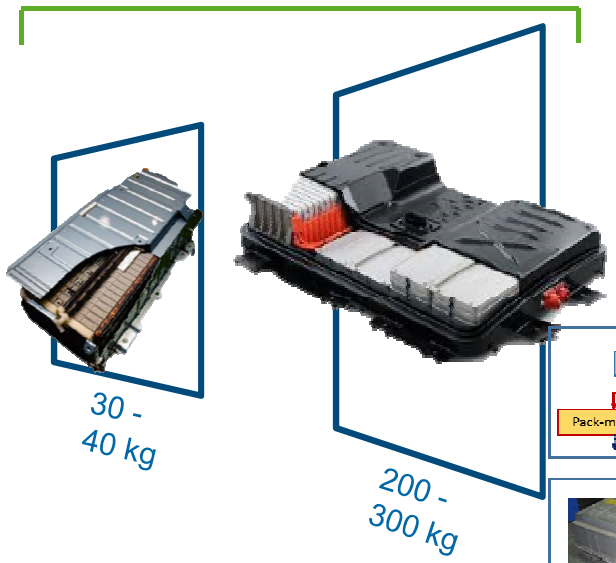


200 - 300 kg

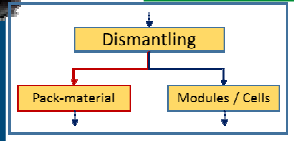
(H)EV Battery Drop-Off-Point & Dismantling-Service in Hanau (Germany)

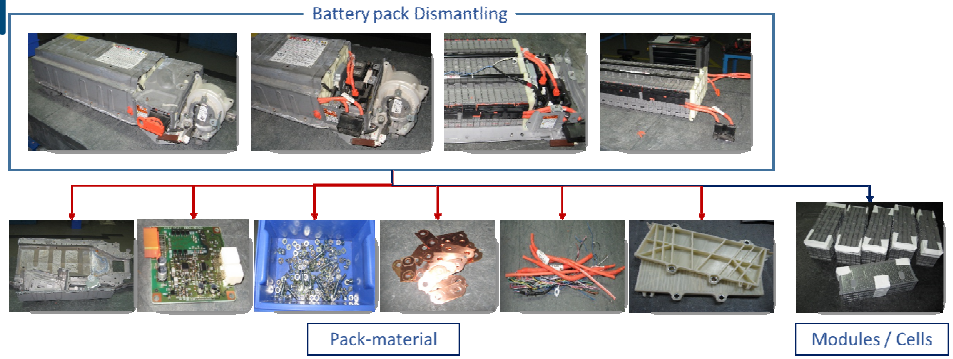
Pre-treatment necessary

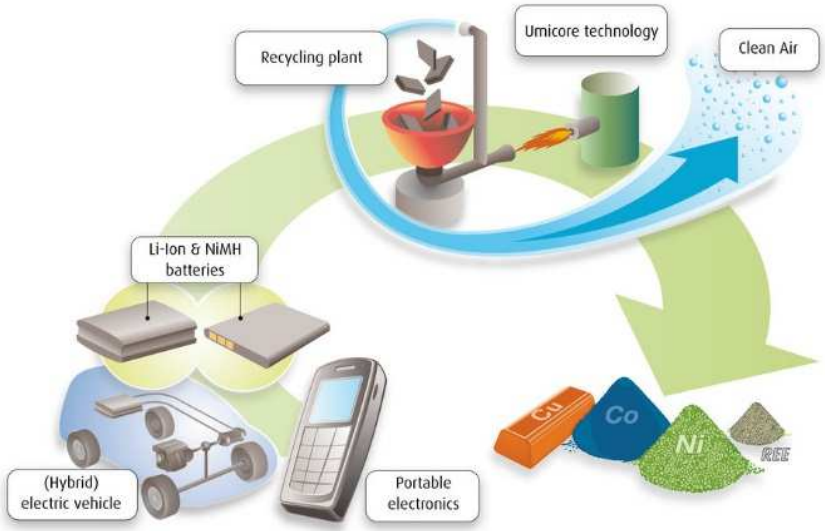
= dismantling to module/cell level



Dismantling of xEV-Battery-Packs to **Module** or **Cell-level for further processing**







Umicore UHT furnace technology in operation in Hoboken (Belgium)

Capacity: 7,000 mt/yr of NiMH or Li-ion Batteries

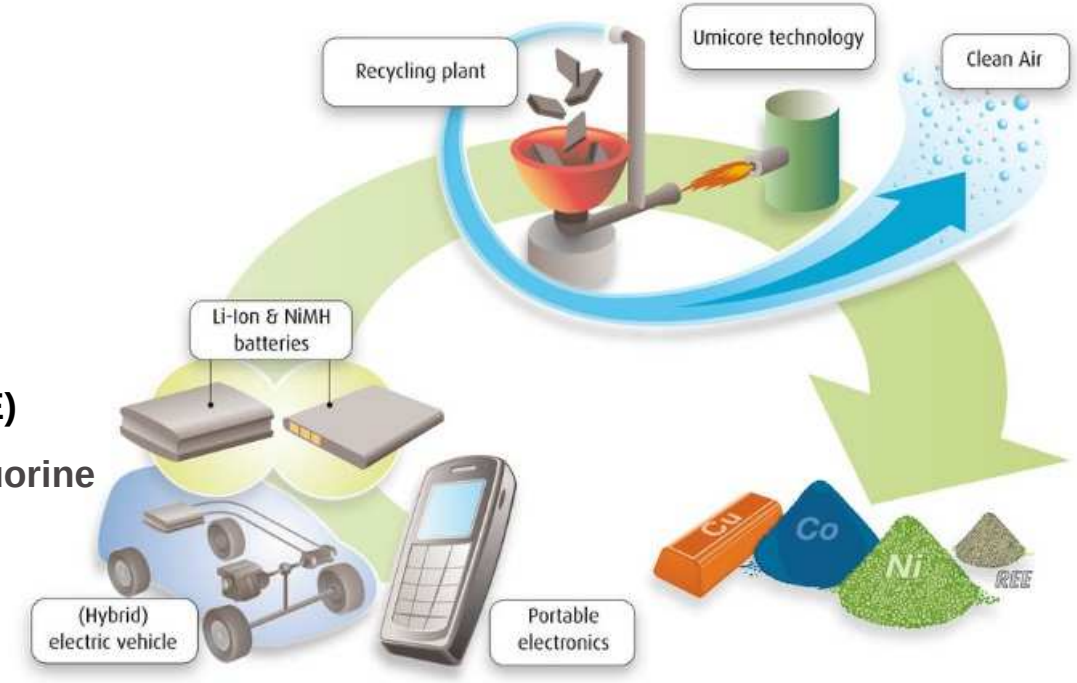
- ± 250 mio mobile phone batteries
- ± 200,000 HEV's
- ± 35,000 EV's

Recycling:

- **Alloy:** Cu – Co – Ni
- **Slag :** for Li-Ion: used in construction
  for NiMH: rare earth concentrate (REE)
- **Flue dust:** controlled separation of Fluorine

Eco-efficient:

- Close-to-zero waste
- Advanced gas cleaning
- Energy of battery used to obtain high temperature (electrolyte, metals, plastics)



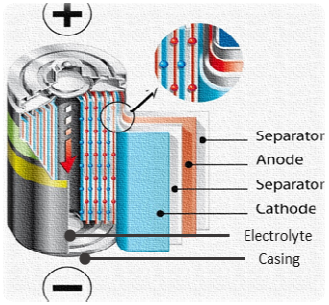
Umicore Battery Recycling Technology

Umicore UHT furnace technology in operation in Hoboken (Belgium)

Winner of 2012 European Business Awards for the Environment

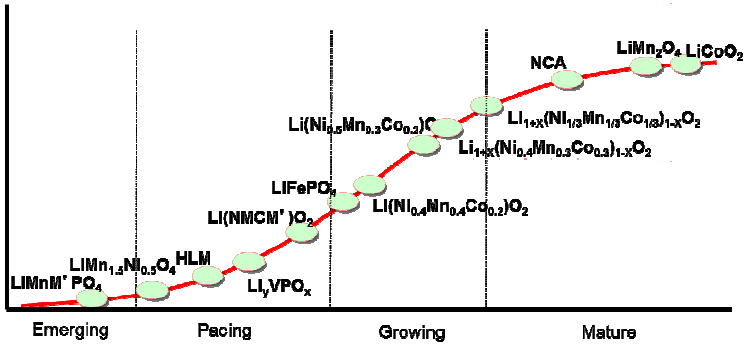
Umicore UHT furnace technology: able to treat all types of Li-ion batteries

- **Li-ion battery = complex mix of materials containing metals, organics, halogens.**



- **Strong variation in cathode chemistries with more variation to come.**

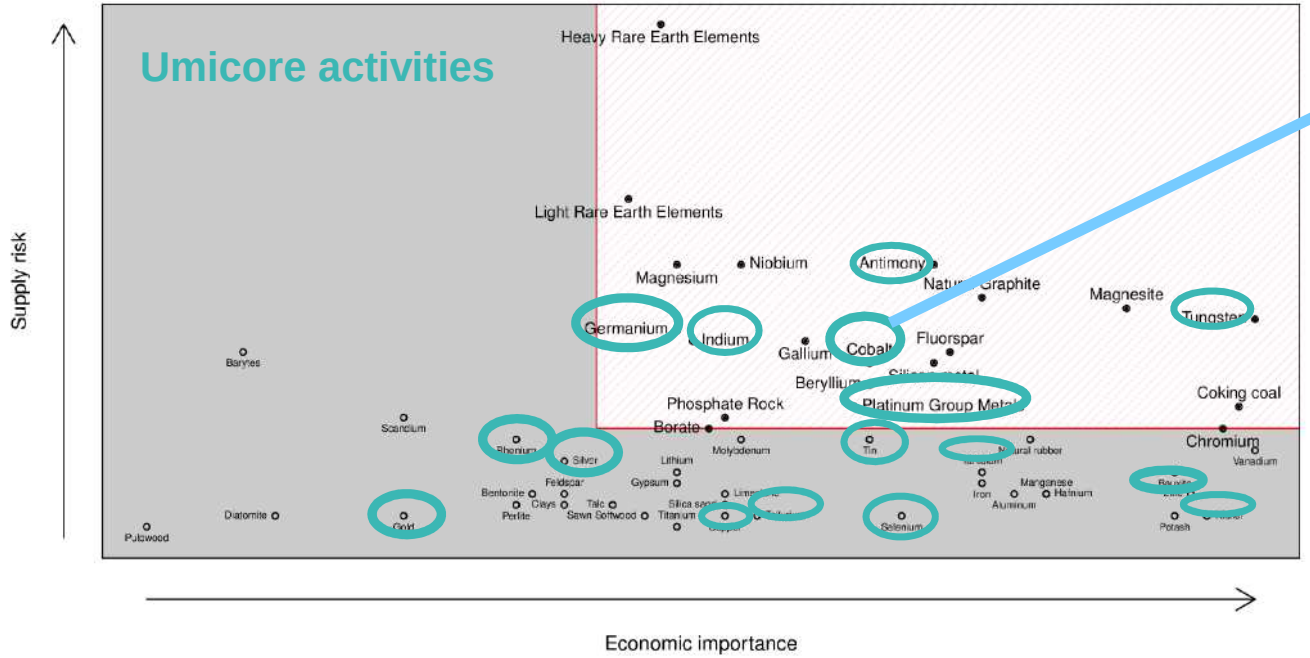
- **Umicore has knowledge on battery chemistry evolution through its Rechargeable Battery Materials division**

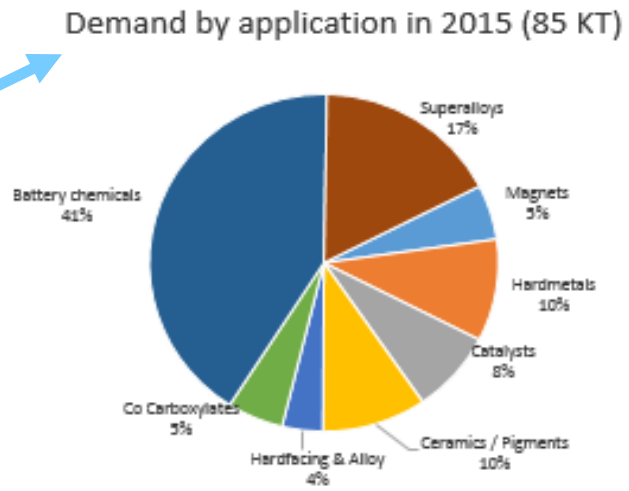


→ Umicore's UHT-process is designed to handle this complexity and variability

Umicore activities and Critical materials according to the EU assessment

Co Cobalt	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	S Sulfur	
Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	In Indium	Sn Tin	Sb Antimony	Te Tellurium	Ta Tantalum	W Tungsten
Re Rhenium	Ir Iridium	Pt Platinum	Au Gold	Pb Lead	Bi Bismuth	La Lanthanum	Ce Cerium	Pr Praseodymium	Nd Neodymium





source: European Commission, Topic Critical Raw Materials for the EU (updated report July 2014)

Cobalt sourcing by Umicore

Challenging environment in DRC (>60% of WW Co production)…

Given the

- **Health issues related to cobalt;**
- **Safety and health issues related to artisanal mining;**
- **Child labor issues in DRC;**
- **Social and environmental issues related to cobalt sourcing worldwide**

the “Sustainable Procurement Framework for Cobalt” was created to ensure Umicore and its downstream partners that its cobalt comes from sustainable sources.

Sustainable procurement framework for Cobalt

Sustainable procurement of cobalt means to Umicore taking into account economic, environmental and social impact of its suppliers in the decision process of buying materials.

- **Dedicated purchasing framework was created to asses the performance of Umicore's suppliers and eventually select or reject suppliers**
- **Decision tree includes background check, red flag check, plant visit, orange flag check, risk assessment and risk mitigation plan**
- **Plant visit an essential step!**
- **Umicore has visited all mines that contribute >1% of Co volumes**

Red Flags :

- **any form of torture, cruel, inhuman and degrading treatment or punishment;**
- **any form of forced or compulsory labor;**
- **any form of child labor;**
- **any form of bribery and corruption;**
- **hand-picking and/or artisanal mining (as primary source)**

EMIRI works for the future of Advanced Materials for Low Carbon Energy in EU (1/2)

EMIRI is an Industry Community coming together …

3M, AGC Glass Unlimited, ArcelorMittal, Bekaert, Bosch, Danish Power Systems, Dow Corning, DSM, H.C.Starck, Heraeus, Laborelec, Plansee, Sabic Saibic, JSR Micro, Saft, Siemens, Solvay, Topsoe Fuel Cell, umicore, voestalpine

* Founding / current members

Supported by Research & Technology Organizations

bay, cea, CIC energiGUNE, Cranfield University, Centro Sviluppo Materiali S.p.A., ECN, ENEA, Jülich, K4 Research Alliance, IFE, imec, IREC, ISQ, itma, KU Leuven, LEITAT, RSE, SINTEF, stw, DTU, tecnalia, TNO, UNINOVA, Université de Liège, Vrije Universiteit Brussel, Politecnica, SIM, vito, VTT, universiteit hasselt, Fraunhofer Materials

With key Associations bringing in their expertise

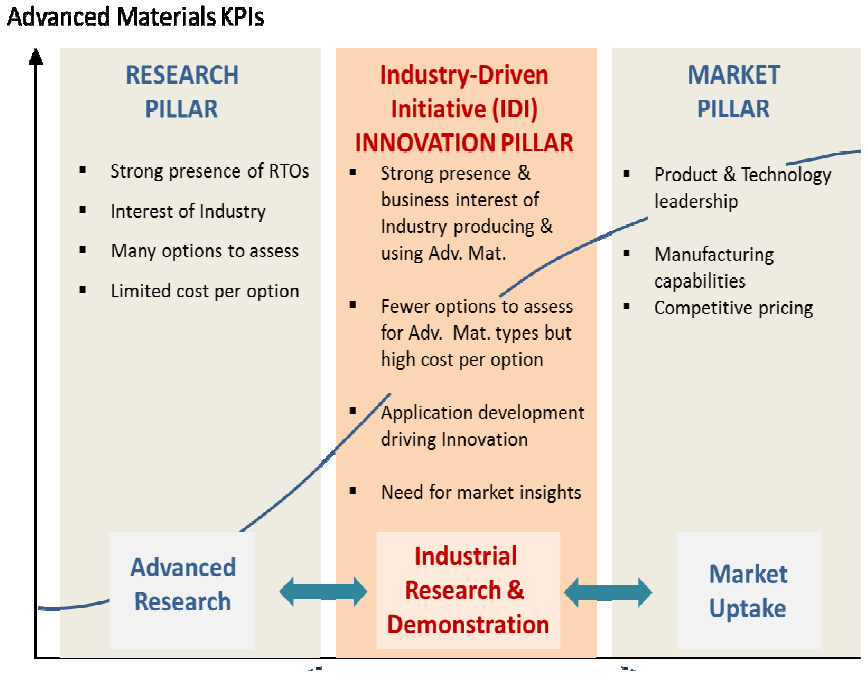
E-MRS, E2B Energy Efficient Buildings, ENERGYIN, ESTEP, EUMAT, EUREC, FEMS, IOM3 The Institute of Materials, Minerals and Mining, KMM-VIN, Jernkontoret The Swedish Steel Producers' Association, NANOfutures, SusChem European Technology Platform For Sustainable Chemistry, MANUFUTURE-EU, cefic

The EU sector of Adv. Mat. for LCE

Revenues from operations in EU ~ 30 billion €	Manufacturing sites > 300
Direct jobs ~ 110.000 Direct & indirect jobs > 500.000	Researchers in industry ~ 5.000 researchers
R&D spending ~ 800 million €	Capital expenditures ~ 2 billion €

Presence in 19 EU countries, over 80 innovation centers, over 50 manufacturing sites

EMIRI works for the future of Advanced Materials for Low Carbon Energy in EU (2/2)



- **To reduce innovation risks & accelerate innovation in Advanced Materials, EMIRI calls for the creation of an Innovation Pillar**, based on reinforced public private interactions and aligned with priorities of Industry & Integrated SET Plan

- **EMIRI works with EU Commission DG R&I to launch the Industry-Driven Initiative (IDI) called EMERIT** (Energy Materials for Europe – Research & Industry innovating Together) which lays the foundations & innovation priorities of the Innovation Pillar

- **In Horizon 2020 and beyond, implementation of EMERIT via a cPPP or other tools (beyond business as usual) is key to stimulate investments in R&I to reinforce presence in Europe of a competitive industry impacting growth and jobs** (+50% beyond 2025) and creating strong innovation systems to collaborate & compete globally

Thank you

Further information : egbert.lox@umicore.com