EMIRI

EMERIT

"Energy Materials for Europe – Research & Industry innovating Together"

The Industry-Driven Initiative promoted by EMIRI

EMIRI – Energy Materials Industrial Research Initiative
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www.emiri.eu

EMIRI Association works for the future of Advanced Materials for low carbon energy (LCE) in Europe

EMIRI
Bridging the Innovation Gap

EMIRI is an Industry Community coming together …

3M, AGC Glass Unlimited, ArcelorMittal, Bekaert better together, Bosch, Danish Power Systems, Dow Corning, DSM, H.C.Starck, Heraeus, Laborelec GDF Suez, Plansee, Sabic, JSR Micro Materials Innovation, Saft, Siemens, Solvay, Topsoe Fuel Cell, umicore, voestalpine Einen Schritt voraus.

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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, rtmo Materials Technology, KU Leuven, LEITAT Technological Center, RSE, SINTEF, stw, DTU, tecnalia, TNO, UNINOVA, Université de Liège, Vrije Universiteit Brussel, Politécnica, SIM, vito, VTT, universiteit hasselt, Fraunhofer Materials

With key Associations bringing in their expertise

E-MRS, C2B Energy Efficient Buildings, ENERGYIN, ESTEP, EUMAT, EUREC The Association of European Renewable Energy Research Centres, FEMS Federation of European Materials Societies, 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

EMIRI in 4 key numbers

> 4 billion €
Sales of Adv. Mat. for Energy

> 400 million €
Investment in R&I on Adv. Mat. for Energy

> 20.000 direct jobs
Manufacturing of Adv. Mat. for Energy

> 4.000 researchers
Human resources for R&I on Adv. Mat. for Energy

* Founding / current members

EMIRI is a pan-European initiative spanning Innovation & Manufacturing of Advanced Materials for LCE

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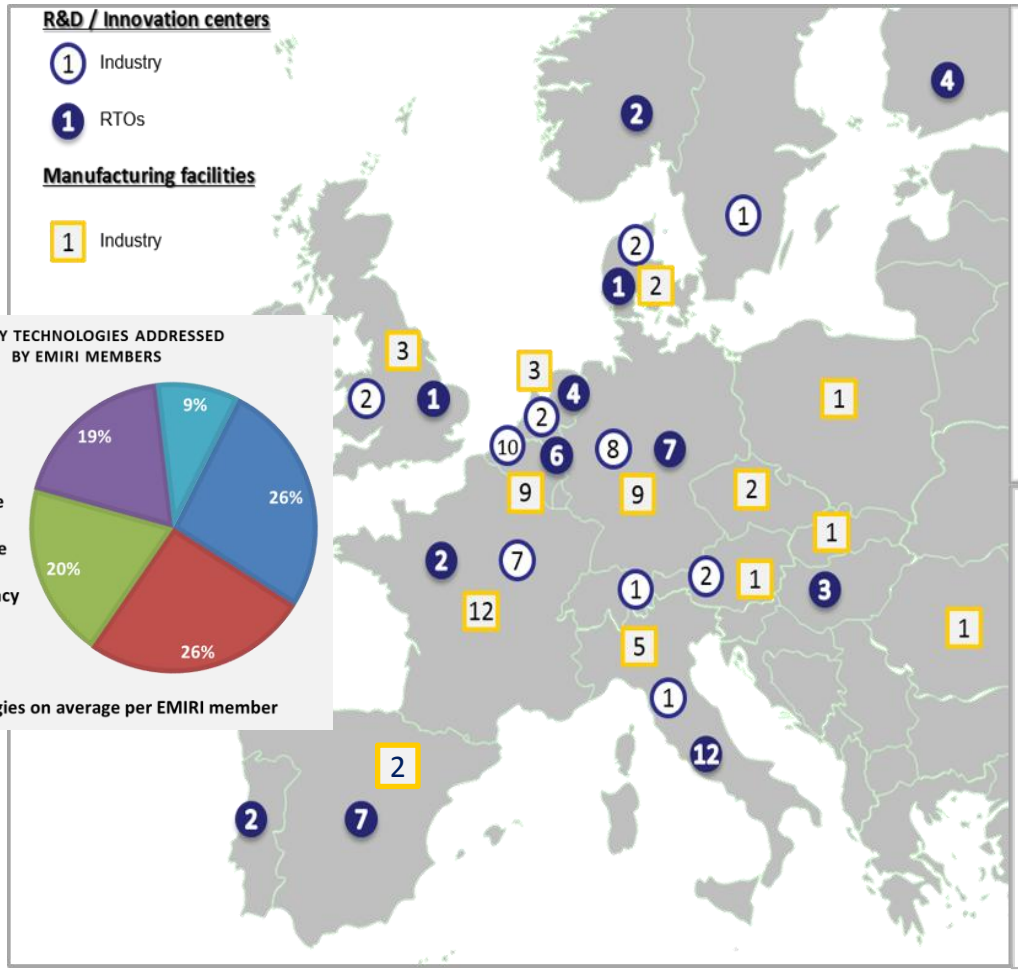

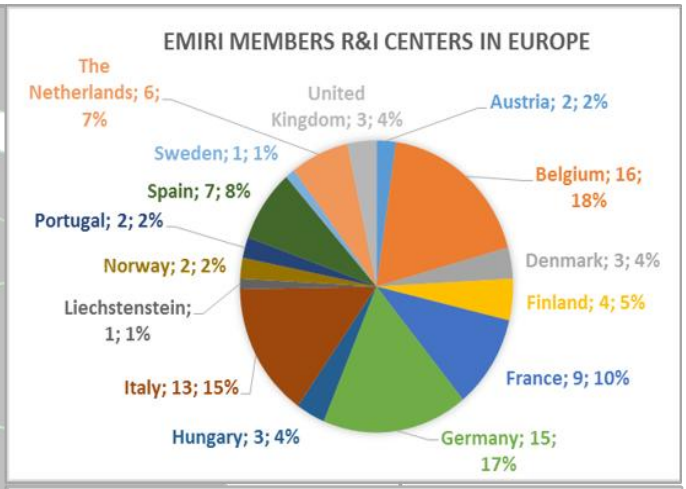

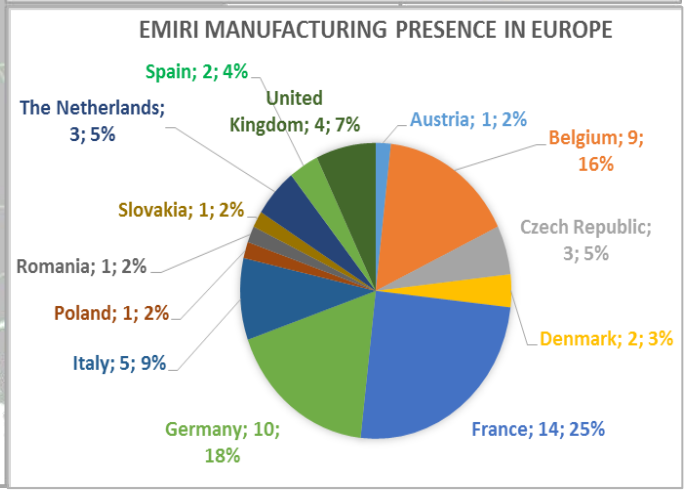

Presence in 19 EU countries, over 80 innovation centers, over 50 manufacturing sites

The EU-based Industry of Advanced Materials for LCE is a source of growth and jobs for EU

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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 €**

* EMIRI internal evaluation

Advanced Materials are a Key Enabling Technology to accelerate transformation of EU energy system

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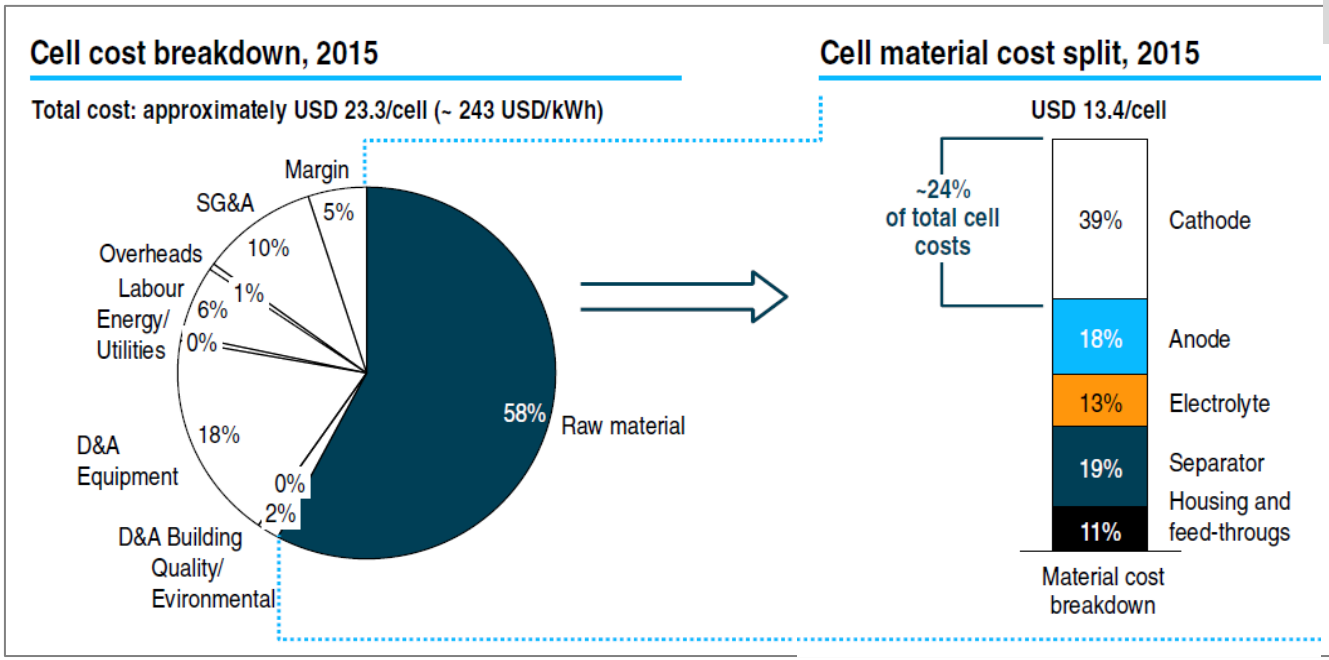
- **Cost** of low carbon energy (LCE) technologies must keep coming down to ensure their adoption & deployment across EU
- This is made possible by reduction in **cost, increase in performance, and extension of lifetime** of the Advanced Materials enabling these low carbon energy technologies
- **Innovation** in Advanced Materials is crucially needed and long, risky and capital-intensive innovation cycles would benefit from risk-sharing tools at EU level

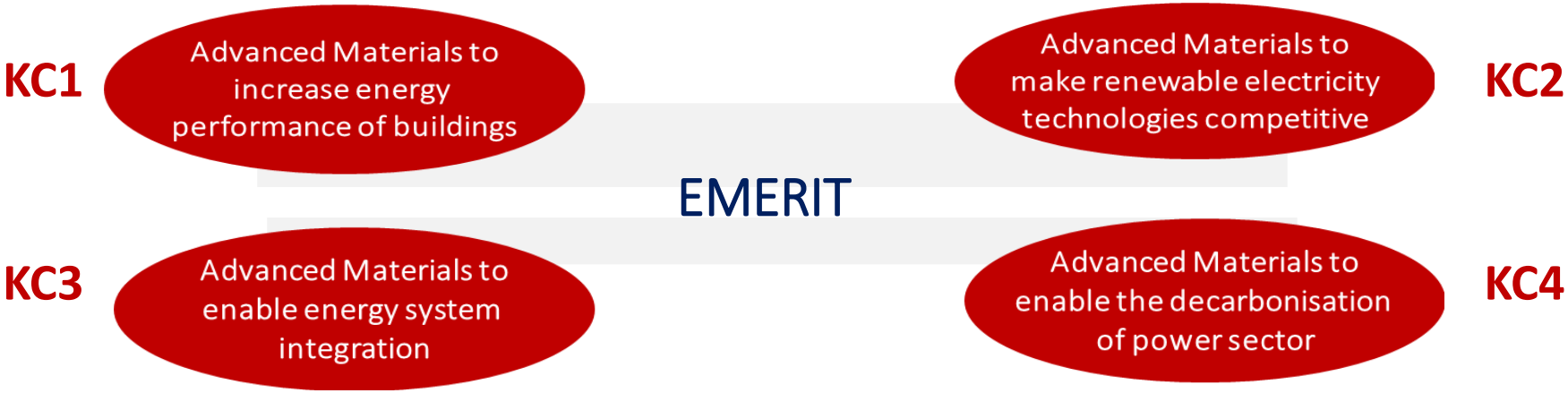


Example for battery cells

- Reducing cost/kWh
  - Reducing cost/kg
  - Increasing kWh/kg

The Industry-Driven Initiative promoted by EMIRI calls for prioritization & action in R&I on Adv. Materials

- Following collaboration of EMIRI members (Industry, Research Organizations, Associations) with DG R&I (Key Enabling Technologies), a focused R&I program on Advanced Materials for LCE was defined
- The R&I program is the backbone of the Industry-Driven Initiative (IDI) called EMERIT (Energy Materials for Europe – Research & Industry innovating Together)
- The IDI focusses on 19 topics (in range of TRL 4-7) spread over 4 key components addressing the challenges of the European Energy System … and contributing to relevant actions listed in the SET Plan Integrated Roadmap document
- **The IDI aims at bridging the gap between lab and market in Advanced Materials, reducing innovation risks and accelerating innovation in Advanced Materials to enable faster development of low carbon energy technologies**



K2: Advanced Materials to make renewables competitive

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solar energy – 4 Innovation Topics

K2-I3 Advanced Materials for innovative multilayers for durable solar energy harvesting

K2-I4 Advanced materials and innovative designs for high efficiency solar energy harvesting

K2-I5 Advanced Materials and associated processes for low cost manufacturing of solar energy harvesting systems

+ K1-I4 Advanced Materials & new deposition processes for building-integrated photovoltaics (BIPV)

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PLANSEE JSR Micro JSR MATERIALS INNOVATION AGC ArcelorMittal

Priorities of EMERIT IDI support the implementation of key elements of SET Plan Integrated Roadmap

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Example of solar energy

Technology-related actions identified for Photovoltaics in SET Plan Integrated Roadmap		Contribution of IDI on Adv. Materials
#1	**Novel PV technologies for low cost and/or high efficiencies**	**Strong**
#2	**Enhanced PV conversion efficiencies and lifetimes**	**Strong**
#3	**Cost reduction through lower materials consumption and use of low-cost materials**	**Strong**
#4	**Reduction of LCOE by enhanced PV system energy yield and lifetime**	**Strong**
#5	**Pilot production lines**	**Strong**
#6	**Demonstration of new PV solutions**	**Strong**
#7	Making PV mainstream source of power	Low
#8	Industrial RTD for demonstration of higher performance ratios	Low
#9	**Long-term reliability of PV modules and systems**	**Strong**
#10	**Building-integrated Photovoltaics**	**Strong**

Each of the 5 topics is simply described in the IDI document (available from EMIRI)

K2-I3 - Advanced Materials for innovative multilayers for durable solar energy harvesting (Innovation Actions)

Advanced multilayer coatings are needed to increase reliability, sustainability and energy generation of PV and CSP systems and thus decrease the costs of solar energy generation. New mirrors, absorbers, barriers, encapsulants and durable coatings that enhance lifetime and extend the working conditions and energy output should enable system lifetime increase to >25 -35 years and >50% maintenance cost reduction. New guidelines and standards for testing of materials durability and prediction of lifetime could be generated.

K2-I4 - Advanced Materials and innovative designs for high efficiency solar energy harvesting (Research & Innovation Actions)

Advanced Materials and processes for high efficiency PV and CSP technologies can bring down the LCOE of solar energy to 0.06 - 0.15 €/kWh in 2020. Pilot production readiness (TRL 4-7) of two emerging high efficiency concepts using new functional materials and particles, thin films, nanostructures, high temperature fluids, phase change materials and receptors into innovative tandem or multi-junction device architectures with 21 - 24% module efficiency needs to be demonstrated in 2020.

K2-I5 - Advanced Materials and associated processes for low cost manufacturing of solar energy harvesting systems (Research & Innovation Actions)

Reduction of manufacturing process costs of PV and CSP solar systems is required for LCOE reduction to 0.06 - 0.15 €/kWh in 2020. Material-enabled manufacturing innovations ranging from efficient solar grade materials to thin films for high conversion efficiency, cost-competitive and environment-friendly processes (e.g. non vacuum processes), low cost and lightweight modules for PV and ranging from high temperature fluids to tubes, mirrors, structural components, light materials and composites for CSP have to be brought to pilot scale level (TRL 5-7) to enable the cost reduction

K1-I4 - Advanced Materials & new deposition processes for building-integrated photovoltaics (BIPV) – Efficient transparent barriers for organic photovoltaics used in BIPV (Research & Innovation Actions)

Organic photovoltaics (OPVs) can offer integration into existing building structures with negligible disturbance to the inhabitant or user of the building. Some of the main characteristics of OPVs - flexibility, homogeneous transparency, lightweight, potential low cost - make them very attractive to be embedded in building integrated systems. A big challenge for OPV is however to meet the PV and building durability standards since organic materials are very sensitive to UV and water. Innovation is therefore needed in Advanced Materials to develop efficient transparent barriers for achieving durability in compliance with construction standards and norms. Barriers need to include weathering protection layers, impact and wear protection layer… and must be chemically and mechanically compatible with the carrying substrate and/or the encapsulation materials used in combination with the given substrate.

Each topic is also more described in terms of challenges,activities and expected outputs Example

Key Component 2 - Advanced Materials to make renewable energy technologies competitive (PV - CSP)	
K2-I3	**Advanced Materials for innovative multilayers for durable solar energy harvesting (Innovation Actions)**
Innovation Challenges	Advanced Materials and processes to bring the efficiency of solar (PV or CSP) systems to a next level beyond 2020 are needed to make solar energy generation competitive. Innovative multilayers can reduce the LCOE by increasing the lifetime of solar energy harvesting systems beyond that of the current solar technologies. This will require application of new multilayers throughout the solar system manufacturing that enhance lifetime and lower operation and maintenance costs.
Activities	Address the development of innovative multilayer systems (mirrors, selective absorbers, diffusion barrier, anti-reflection, cell metallization systems, encapsulant, semiconductor stacks, conductive back sheets ...) for solar energy conversion. A sustainable increase in system durability should be clearly demonstrated including improved lifetime testing methods and protocols. The proposed Advanced Materials should ensure resource availability. Improving the long-term performance of systems by extending the working conditions to more demanding environments (higher temperature, ambient air operation for CSP) is also requested. The cost effectiveness, manufacturability and the commercial potential of the innovative technologies compared to the solutions currently available on the market should be quantified.
Expected Outputs	• Significant increased system durability, >35 years at 80% performance for PV, >25 years for CSP • Decreasing the LCOE of solar energy technologies by increasing reliability of the systems (LCOE of 0.06 – 0.10 €/kWh (PV) and 0.10 – 0.15 €/kWh (CSP) in 2020) • To place the solar energy in a significant position on roadmap of energy generation technologies • Contribute to strength the European position in the solar energy conversion technologies • Accelerated test protocols and standards for life-time prediction and durability validation adapted to new materials • To reduce by 50% the maintenance costs with a durability scope for CSP of at least 25 years and for PV of at least 35 years

Finally KPIs were elaborated within EMIRI Technology WGs for each topic to guide innovation

Advanced Materials to make renewable energy technologies competitive (PV - CSP)		KPI	2020	2025	Beyond
K2-I3	Advanced Materials for innovative multilayers for durable solar energy harvesting	Increased PV & CSP system durability	> 35 years at 80% performance for PV, > 25 years for CSP	> 40 years at 80% performance for PV, > 30 years for CSP	> 40 years at 80% performance for PV, > 30 years for CSP
		Decreasing LCOE of solar energy technologies by increasing reliability of the systems	LCOE of 0.06 – 0.10 euro / kWh (PV) and 0.10 – 0.15 euro / kWh (CSP) in 2020	LCOE of 0.05 – 0.08 euro / kWh (PV) and < 0.10 euro / kWh (CSP)	LCOE of < 0.05 euro / kWh (PV) and < 0.05 euro / kWh (CSP)
		Reduce the maintenance costs with a durability scope for CSP of > 25 years and for PV of > 35 years	40%	50%	> 50%
K2-I4	Advanced Materials and innovative designs for high efficiency solar energy harvesting	The demonstration of device designs and fabrication processes	For at least two high efficiency technologies : 18 % (module), > 22% (cell)	For at least two high efficiency technologies : 21 % (module), > 25% (cell)	For at least two high efficiency technologies : 24 % (module), > 27% (cell)
		The demonstration of pilot production readiness	Of at least two emerging and / or novel high efficiency technologies with a potential LCOE of 0.06 – 0.10 euro / kWh (PV) and 0.10 – 0.15 euro /kWh (CSP) in 2020	Of at least two emerging and / or novel high efficiency technologies with a potential LCOE of 0.05 - 0.08 euro / kWh (PV) and < 0.10 euro / kWh (CSP) in 2020	Of at least two emerging and / or novel high efficiency technologies with a potential LCOE of < 0.05 euro / kWh (PV) and < 0.05 euro / kWh (CSP) in 2020
K2-I5	Advanced Materials and associated processes for low cost manufacturing of solar energy harvesting systems	Reduction in manufacturing cost of PV and CSP systems at preserved technology performance to decrease LCOE	LCOE 0.06 – 0.10 euro / kWh (PV) and 0.10 – 0.15 euro / kWh (CSP)	LCOE of 0.05 – 0.08 euro / kWh (PV) and < 0.10 euro / kWh (CSP)	LCOE of < 0.05 euro / kWh (PV) and < 0.05 euro / kWh (CSP)

For information KC3: storage (complimentary to PV)

Key Component 1 Advanced Materials to increase energy performance in buildings			Research & Innovation Actions TRL 4 - 6	Innovation Actions TRL 5 - 7
K1-I5	Innovation Topic #5	Advanced Materials for thermal energy storage (TES) - Next generation thermal energy storage technologies		

Key Component 3 Advanced Materials to enable energy system integration			Research & Innovation Actions TRL 4 - 6	Innovation Actions TRL 5 - 7
K3-I1	Innovation Topic #1	Advanced Materials for lower cost, high safety, long cycle life & environmentally friendly electrochemical batteries - Li- ion batteries		
K3-I2	Innovation Topic #2	Advanced Materials for lower cost, high safety, long cycle life & environmentally friendly electrochemical batteries - Next generation electrochemical batteries		
K3-I3	Innovation Topic #3	Advanced Materials for lower cost storage of energy in the form of hydrogen or other chemicals (power to gas, power to liquid technologies)		
K3-I4	Innovation Topic #4	Advanced Materials to facilitate the integration of storage technologies in the grid		

Thank you for your attention