Establishing the Industrial Leadership of Europe in Advanced Materials for the Energy Union

Towards a European Industrial Strategy powered by Innovation

Dr Fabrice Stassin - Managing Director - fabrice.stassin@emiri.eu
EU Commission President Juncker wants secure, affordable and sustainable energy for European citizens & business ... Towards an Energy Union *

* Based on strong progress in the EU’s “20-20-20 by 2020” targets on energy & climate change
Energy Union R&I & Competitiveness dimensions are implemented through (Integrated) SET Plan

SET (Strategic Energy Technology) Plan aims at **speeding up the transition to an Energy Union through the implementation of 10 Actions** to develop & integrate innovative technologies and system solutions while better aligning public & private R&I agendas.

* More on http://setis.ec.europa.eu
EMIRI Association in a nutshell ...

- EMIRI is an industry-driven grouping of over 60 organizations (established in 2012)
- With a balance of industry players, research organizations, associations
- Across Europe & across Energy Technologies,
- Aiming to be a key player in shaping & implementing a **EU policy for Advanced Materials**
- To promote a strong and vibrant EU-based sector of **Advanced Materials for low carbon energy & energy efficiency & restore Industrial Leadership**
- Inspired by the **SET Plan** & supporting **Energy Union**
- Focusing on **innovating & bringing to market** Advanced Materials solutions to contribute to tackling Energy & Economic challenges of EU
EMIRI works for the future of Advanced Materials * for low carbon energy (LCE) technologies in Europe

EMIRI is an Industry Community coming together ...

Supported by Research & Technology Organizations

With key Associations bringing in their expertise

Spanning Innovation & Manufacturing

* Advanced Materials such as steel, non-ferrous metals, alloys, glass, ceramics, polymers, composites ...
Shift to LCE technologies by the power sector will contribute most to reduce CO₂ emissions

- In a BAU scenario, power sector represents ~ 30% of CO₂ emissions by 2030
- Reducing CO₂ emissions relies upon innovations in energy efficiency, sustainable energy harvesting, energy storage and CCS/CCU

![Cumulative CO₂ reductions by sector and technology in the 2DS to 2050](image)

Source: International Energy Agency 2015
The development of these LCE technologies relies strongly upon Advanced Materials

- Cost of low carbon energy (LCE) technologies must keep coming down to ensure their adoption & deployment across EU in frame of Energy Union
- This is made possible by reduction in cost, increase in performance, and extension of lifetime of the Advanced Materials
- Innovation in Advanced Materials is crucially needed and long, risky and capital-intensive innovation cycles would benefit from risk-sharing at EU level
And the EU-based Industry of Advanced Materials for LCE is a source of growth and jobs for EU

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Revenues from operations in EU</strong></td>
<td><strong>Manufacturing sites</strong></td>
</tr>
<tr>
<td>~ 30 billion €</td>
<td>&gt; 300</td>
</tr>
<tr>
<td><strong>Direct jobs</strong></td>
<td><strong>Researchers in industry</strong></td>
</tr>
<tr>
<td>~ 110,000</td>
<td>~ 5,000 researchers</td>
</tr>
<tr>
<td>Direct &amp; indirect jobs</td>
<td></td>
</tr>
<tr>
<td>&gt; 500,000</td>
<td></td>
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<tr>
<td><strong>R&amp;D spending</strong></td>
<td><strong>Capital expenditures</strong></td>
</tr>
<tr>
<td>~ 800 million €</td>
<td>~ 2 billion €</td>
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</table>

* EMIRI internal evaluation

Global trends are however affecting the EU-based Industry of Advanced Materials for LCE and (future) EU policies need to take these into account.
**Trend 1** Developing countries now invest more than developed countries in RE* and China has already overtaken the EU in terms of investment.

* RE stands for Renewable Energy (a subset of low carbon energy)
**Trend 2** Consequently RE capacity is developing much faster in China than anywhere else in the world.

"China is becoming world’s renewable energy power station”

<table>
<thead>
<tr>
<th>Investment in RE (billion USD) over 2012-2015</th>
<th>Change in RE capacity (GW) over 2012-2015</th>
<th>RE capacity (GW) in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global 1.050 USD</td>
<td>Global 405 GW</td>
<td>Global 1.965 GW (+26% vs. 2012)</td>
</tr>
<tr>
<td>ROW 318 billion USD (30%)</td>
<td>ROW 124 GW (31%)</td>
<td>ROW 753 GW (38%) + 19%</td>
</tr>
<tr>
<td>USA 157 billion USD (15%)</td>
<td>USA 32 GW (8%)</td>
<td>USA 215 GW (11%) + 17%</td>
</tr>
<tr>
<td>Europe 260 billion USD (25%)</td>
<td>Europe 72 GW (18%)</td>
<td>Europe 493 GW (25%) + 17%</td>
</tr>
<tr>
<td>China 315 billion USD (30%)</td>
<td>China 177 GW (44%)</td>
<td>China 504 GW (26%) + 54%</td>
</tr>
</tbody>
</table>

* RE – Renewable Energy
**Trend 2** In the next 5 years, China will take the lead in RE with EU following.

- **Wind Turbines Installed every hour in China**: 2
- **Solar Panels Installed every hour in China**: 7,000

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- Building on its leadership in wind and solar energy, China’s next energy challenge will be electric vehicles (EVs).
- In 2015, EV sales in China were 50% higher than in EU.
- China plans a 10-fold increase by 2020 with strong involvement in battery value chain.

Sources: European Commission; EWEA; IEA; E3G; Xinhuanet; State Grid.
**Trend 3** Manufacturing of components & devices moving to growing markets (leading to new industrial champions & EU being dependent on imported technologies)
**Trend 4** Europe is losing leadership in R&D investment in the field and risk is strong that Innovation Centers also offshore to growing markets

- R&D spending on RE technologies almost unchanged at $9.1 billion in 2015
- China challenged Europe in R&D spending each $2.8 billion
- Spending in Europe fell 8% compared to 2014 while it rose 4% in China driven by Government support
- Global R&D spending by Governments was 3% lower than in 2014 (18% lower in EU but 7% higher in China) but offset by corporate R&D
- Solar continues to dominate renewable energy R&D with $4.5 billion spending equal to spending in all other sectors combined
**Impact** Strong impact on job creation in RE in Europe versus other regions - EU is losing leadership at less than 15% of jobs in the sector (20% in 2012)

**Net change in RE jobs over 2012-2015**

Global + 2,380,000 jobs

**RE jobs in 2015**

Global 8,080,000 jobs (+42% vs. 2012)

- **ROW 453,000 (19%)**
- **USA 157,000 (7%)**
- **Europe 3,000 (~0%)**
- **China 1,770,000 (74%)**

- **ROW 2,620,000 (32%)**
- **Brazil 924,000**
- **Rest of Asia 1,001,000**
- **USA 770,000 (10%)**
- **Europe 1,170,000 (14%)**

- **Europe 4,000**
- **ROW 3,650**

**Jobs created per added GW of RE (over 2012-2015)**

- **RE technology exporter**
  - China 10,000
  - Global 5,880
  - USA 4,900
  - Europe 4,000 *1
  - ROW 3,650

- **RE technology importer**
  - China 3,520,000 (44%)
  - Europe 0

*1 when accounting only for jobs created and not considering job loss

* RE – Renewable Energy
**Impact** Over 2012 – 2015, only China met the job creation potential enabled by growth in domestic renewable energy production capacity.

Europe missed the opportunity of creating more than 400,000 jobs!
Impact However EU-based sector of Advanced Materials for LCE remains vibrant but EU must maintain Industrial Leadership in the field

- EU-based Industry of Advanced Materials for LCE energy represents more jobs than any renewable energy (RE) value chain in EU and close to 50% of total EU-based jobs in RE

- EU-based Industry of Advanced Materials is strongly anchored due to “lower mobility” of industrial production and fact that some Advanced Materials are used in other applications than LCE and also still competitive in supplying markets outside EU (scale and scope effects vs. logistics costs)

- Upstream part of the LCE value chain must be given attention with appropriate energy, industrial and innovation EU policies to safeguard presence in EU and compete for market leadership positions ... while possibly reviving the presence in EU of manufacturing of LCE techs.
**Impact**

Presence of a EU-based Industry of Advanced Materials contributes to attracting manufacturing of LCE techs to EU

- **If** end-markets grow, downstream value chain players are present and require strong local integration, and manufacturing costs are in check
- **Then** the presence of a EU-based Industry of Advanced Materials contributes to attracting manufacturers of LCE techs (foreign operators investing in Europe) or developing these
- **Example of e-mobility in Europe and how it triggers battery cell production in EU**

Battery cell production in Europe is quasi-inexistent but not same situation when it comes to Advanced Materials & battery packs & car-makers … Development of e-mobility markets in EU and European car-makers moving ahead in a Tesla-driven “clean mobility arena”

* Source LEITAT – Not exhaustive mapping
**Impact**

Innovation in Advanced Materials is key to restoring European competitiveness in manufacturing of LCE technologies necessary for the Energy Union.

For example: c-Si PV module

- **CEMAC Reports** – USA Department of Energy

<table>
<thead>
<tr>
<th>Cost of Advanced Materials</th>
<th>United States</th>
<th>Urban China</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour cost</td>
<td>$0.74</td>
<td>$0.66</td>
<td>$0.79</td>
</tr>
<tr>
<td>Electricity cost</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Materials cost</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EU cannot compete on labour cost or electricity cost and process innovation has limited impact**
**Impact** As Advanced Materials enable increase in performance of LCE techs, they further reduce the cost advantage built on cheaper labor & electricity outside EU.

For example, in wind energy, larger blades increase opportunities for “outside China manufacturing” as labor becomes a proportionally smaller share of factory gate prices and share of cost of Advanced Materials in total cost increases accordingly (and logistics costs are up).
A policy for re-industrialization of EU in LCE should aim at balancing the 3 dimensions of sustainability:

**CLIMATE**
- Reduction in CO₂ & other GHGs
- Resource efficiency
- Clean environment

**CITIZENS**
- Secure access to low carbon & affordable energy
- Clean environment
- Quality jobs
- Local investments by industry

**INDUSTRY**
- Help competitiveness
- Provide market opportunities
- Ensure profitability
- Ensure access to raw materials (apply Circular Economy)
**Actions** 3 main EMIRI Strategic Recommendations to EU and Member States to maintain leadership of EU-based industry of Advanced Materials for LCE techs

Our industry is strongly anchored in Europe and serving global markets but to maintain leadership, develop manufacturing presence and innovation power in Europe, we recommend that EU, Member States and Regions:

1. **Stimulate, in frame of Energy Union, a stronger growth of European market for LCE technologies and their manufacturing in Europe when possible** … Otherwise the Europe-based sector of advanced materials may not develop further local manufacturing presence if growing markets are outside Europe.

2. **Increased & focus innovation support for Advanced Materials on fewer priorities in line with business realities so that EU-based industry can develop competitive innovation-driven products** … Otherwise manufacturing of LCE technologies could still happen in Europe but based on innovation from elsewhere.

3. **Create a business-friendly environment so that manufacturing in Europe comes at a benefit** … Otherwise the European markets could become steadily served from outside.
Action Innovation is key to Industrial Leadership of EU in Adv. Materials for LCE techs & Adv. Materials are key to restoring EU competitiveness in LCE techs

- EMIRI calls for creation at EU level of the Innovation Pillar bridging the gap between research and market and providing Industry with a stable framework stimulating innovation.

- Innovation Pillar on Advanced Materials for LCE techs will reduce innovation risks and accelerate innovation to reach faster and better the market.

- Innovation Pillar should be based on strong public private interactions, engage actors along the value chain and build on orientations strongly supported by Industry & Research.

- In collaboration with EU Commission DG R&I (and in line with Integrated SET Plan), EMIRI developed the blueprint for this Innovation Pillar ... EMERIT Industry-Driven Initiative (IDI).

- EMERIT (Energy Materials for Europe – Research & Industry innovating Together) focusses on TRL 4-7 and covers 20+ Innovation Topics on Advanced Materials for LCE techs.
**Action** EMERIT rests upon 4 Key Components featuring 20+ Innovation Topics covering priorities supported by Industry & Research in LCE technologies

- **KC1**: Advanced Materials to increase energy performance of buildings
  - Identify clear priorities for industrial growth & jobs in EU-based sector of Advanced Materials for low carbon energy technologies
  - And develop a strong presence in Europe of innovation ecosystems and manufacturing value chains
  - By innovating with Advanced Materials fit to serve the demanding & growing market of low carbon energy technologies

- **KC2**: Advanced Materials to make renewable electricity technologies competitive

- **KC3**: Advanced Materials to enable energy system integration

- **KC4**: Advanced Materials to enable the decarbonisation of power sector

+ E-mobility & lightweight EVs (in EMERIT IDI v2.0 under preparation)
**Action** Less is more ... Industry calls for clear focus to reach critical mass & ensure innovation success

**Example of Advanced Materials to enable energy system integration, E-mobility and lightweight EV’s (Key Component 3)**

<table>
<thead>
<tr>
<th>Key Component 3</th>
<th>Advanced Materials to enable energy system integration, E-mobility and lightweight EV’s</th>
<th>Research &amp; Innovation Actions</th>
<th>Innovation Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>K3-I1</td>
<td>Innovation Topic #1: Advanced Materials for lower cost, high safety, long cycle life &amp; environmentally friendly electrochemical batteries for stationary energy storage - Li-ion batteries</td>
<td>TRL 4 - 6</td>
<td></td>
</tr>
<tr>
<td>K3-I2</td>
<td>Innovation Topic #2: Advanced Materials for lower cost, high safety, long cycle life &amp; environmentally friendly electrochemical batteries for stationary energy storage - Next generation batteries</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I3</td>
<td>Innovation Topic #3: Advanced Materials for lower cost, high safety, long cycle life &amp; environmentally friendly electrochemical batteries for E-Mobility-Li ion batteries</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I4</td>
<td>Innovation Topic #4: Advanced Materials for lower cost, high safety, long cycle life &amp; environmentally friendly electrochemical batteries for E-Mobility- Next generation batteries</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I5</td>
<td>Innovation Topic #5: Lightweight materials for Battery packaging and Powertrain</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I6</td>
<td>Innovation Topic #6: Lightweight materials for EV passenger cars and EV Heavy duty</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I7</td>
<td>Innovation Topic #7: Advanced Materials for lower cost storage of energy in the form of hydrogen or other chemicals (power to gas, power to liquid technologies)</td>
<td>TRL 5 - 7</td>
<td></td>
</tr>
<tr>
<td>K3-I8</td>
<td>Innovation Topic #8: Advanced Materials to facilitate the integration of storage technologies in the grid</td>
<td>TRL 5 - 7</td>
<td></td>
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</tbody>
</table>
**Result**  EMIRI’s actions contributed to supporting the evolution in EU R&I funding on Adv. Materials for LCE

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**EU NMBP * funding on Advanced Materials for Energy in Horizon 2020**

<table>
<thead>
<tr>
<th>Year</th>
<th>Funding (M€)</th>
<th>Increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>87</td>
<td>+45%</td>
</tr>
<tr>
<td>2016-2017</td>
<td>127</td>
<td>+70%</td>
</tr>
<tr>
<td>2018-2020</td>
<td>~200</td>
<td></td>
</tr>
</tbody>
</table>

* NMBP stands for Nanotechnology, Advanced Materials, Biotechnology, Processes - Based on estimates
Result Despite strong progress in EU funding support of Advanced Materials, an adjustment is needed in FP9

Collectively we need to promote better Advanced Materials

Advanced Materials for LCE techs

~ 400 million € funding support in Horizon 2020

~ 500,000 jobs in EU

LCE techs

~ 2.65 billion € funding support in Horizon 2020

~ 500,000 jobs in EU
**Impact** Achieving the specific innovation objectives of EMERIT will contribute to ...

1. **Getting the right Advanced Materials faster to the market** by addressing innovation risks (execution, adoption and co-innovation risks)

2. **Accelerating the development & deployment of LCE technologies** enabled by Advanced Materials (contributing to tackle Energy Union Challenges)

3. **Driving competitiveness of industrial sector of Advanced Materials for LCE and maintain / develop Industrial Leadership of EU** (towards 20% of GDP from manufacturing by 2020)

4. **Securing R&D and capital investments of the Industry in EU**

5. **Safeguarding & creating quality jobs in EU for operators, researchers, engineers**

<table>
<thead>
<tr>
<th>Conservative estimate of Europe-based industry of Advanced Materials for low carbon energy and its potential for policy-driven growth</th>
<th>The business opportunity</th>
<th>In 2015</th>
<th>In 2025+</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Revenues from operations</td>
<td>~ 30 billion €</td>
<td></td>
<td>~ 45 billion €</td>
</tr>
<tr>
<td>• Capital expenditures</td>
<td>~ 2 billion €</td>
<td></td>
<td>~ 3 billion €</td>
</tr>
<tr>
<td>• R&amp;D spending</td>
<td>~ 800 million €</td>
<td></td>
<td>~ 1.3 billion €</td>
</tr>
<tr>
<td>• Direct jobs</td>
<td>~ 110,000 people</td>
<td></td>
<td>~ 175,000 people</td>
</tr>
<tr>
<td>• Researchers in Industry</td>
<td>~ 5,000 people</td>
<td></td>
<td>~ 8,000 people</td>
</tr>
</tbody>
</table>

* Based on < 5% annual market growth rate and partial capture of market growth by European Industry
TAKE AWAYS
Advanced Materials are key to tackle climate change, Energy Union and re-industrialization in EU

Environmental Challenge
- One of today’s most pressing global environmental challenge is climate change mitigation

Technology Challenge
- Accelerating transformation of the energy systems towards LCE is a crucial part of the solution (also offering energy security)
- LCE technologies cover energy performance of buildings, harvesting of renewable energy, energy storage, decarbonization
- Cost of LCE technologies must keep coming down to ensure adoption & deployment of LCE in Europe and rest of the world

Innovation Challenge
- Advanced Materials accounting for important share of cost of LCE technologies, innovation in Advanced Materials is needed to reduce intrinsic cost, increase performance and lifetime of these technologies

Business Challenge
- EU is losing leadership in LCE technologies and represent today less than 15% of jobs in the sector (China is at 45% and growing)
TAKE AWAYS (ct’d)
And this is a Business Opportunity for EU
But EU should act better & faster to capture it …

The business opportunity

- EU (based on historical industrial strengths) has industrial leadership in Advanced Materials for LCE - This represents 500,000 jobs direct & indirect (close to 50% of EU-based jobs in LCE technologies)
- Policies stimulating market pull & technology push of LCE technologies to ensure manufacturing could lead, by 2025+, to creation of 300,000 jobs in EU-based sector of Advanced Materials

The way forward

- To accelerate innovation in Advanced Materials, industry players and research community within EMIRI call for an Innovation Pillar, based on open collaboration between innovation actors
- EMIRI has worked over 2015 in collaboration with EU Commission DG R&I on the creation of the EMERIT Industry-Driven Initiative (IDI) laying the foundations & priorities of the Innovation Pillar
- EMERIT IDI will contribute to reinforcing presence in Europe of a competitive industry impacting economic growth and employment (+50% beyond 2025), safeguarding investments and creating strong innovation ecosystems for the Energy Union
- Up to EU now to reflect this into Horizon 2020 and beyond in terms of ambitious funding support as well as clearly delineated priorities
The added value of being an EMIRI member …
Join us to help shape the future of Advanced Materials for a low carbon Energy Union

Membership is open to all organizations having operations in Europe with a strong interest in Advanced Materials for low carbon energy technologies … JOIN US!

**WHY SHOULD YOU BECOME A MEMBER?**

- Participate in setting long-term priorities.
- Benefit from enhanced visibility towards European and national policymakers.
- Join a proactive, motivated network of potential future consortium partners.
- Be informed about EU and Member State priorities and funding opportunities.

More on EMIRI at www.emiri.eu or by email to fabrice.stassin@emiri.eu
EMIRI benefits from committed industrial presence, supporting open innovation and interacting with leading European RTOs / Universities

“Advanced Materials are a critical component of many if not all of the innovative technologies that are needed to implement the low carbon economy. EMIRI has succeeded in bringing together a critical mass of industrial, academic and research actors to form a true Energy Materials Union. Therefore Dow Corning believes that it is THE best vehicle to work in close collaboration with the EU Commission, to translate research into industrial application and implement some of the daunting technical solutions that are needed to bring the Energy Union to life.”

Marc Van den Neste
Chief Technology Officer
AGC’s Global & European Building & Industrial Division

“AGC is a co-founder & member of EMIRI because we believe from the start that energy generation & energy efficiency challenges need cross-sectoral and integrated solutions. The glass material has a lot to offer and we stand ready to collaborate with partners & bring European research to market while fostering sustainable economic activity.”

More on www.emiri.eu

Marc Van Sande
Executive Vice-President
Energy Materials
Umicore

“Innovation in advanced materials is key to increase performance, reduce cost and extend lifetime of low carbon energy technologies. To accelerate innovation in that field, EMIRI advocates for the creation in EU of a market-oriented, industry-supported innovation pillar. This is why Umicore strongly supports EMIRI, an initiative, grouping industry leaders and research organizations, engaged to bridge the gap between lab and market.”

Anders Werme
General Manager Global R&D
Energy Market Products
ArcelorMittal

“At ArcelorMittal, we believe that innovative steels and steel solutions are necessary for the progress of the economy and society in Europe. The development of innovative steel solutions is needed to help Europe to have an economically competitive energy transition. Working on the European scene with different actors, as EMIRI does, reflects the presence of our customers all over Europe. We decided to join EMIRI because it has the right scale to support material innovation for a low carbon economy.”