Innovation through Advanced Battery Materials From FP7 to Horizon 2020

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European Green Vehicles Initiative
Expert Workshop – Post Lithium Ion Batteries for electric automotive applications

What is Horizon 2020

A core part of Europe 2020, Innovation Union & European Research Area:

- **Responding to the economic crisis** to invest in future jobs and growth
- **Addressing people's concerns** about their livelihoods, safety and environment (transport, energy, health….challenges)
- **Strengthening the EU's global position** in research, innovation and technology

Smart, sustainable and inclusive and growth

What is Horizon 2020

- **Financial instrument to implement the Innovation Union**
- **Commission proposal for almost 80 billion euro research and innovation funding programme (2014-2020)**
- **Coupling research and innovation, by taking research ideas from the lab to the market**
- **Emphasis on excellent science, industrial leadership and tackling societal challenges**

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Horizon 2020

Total indicative budget: 77 B €*

Excellent science

- *European Research Council*
- *Future and EmergingTechnologies*
- *Marie Curie actions*
- *Research infrastrutures*

Indicative Budget:
24.4 B €*

Industrial leadership

- ***Leadership in enabling and industrial technologies***
- *Access to risk finance*
- *Innovation in SMEs*

Indicative Budget:
17.0 B €*

Societal challenges

- *Health, demographic change and wellbeing*
- *Food security, sustainable agriculture, marine and maritime research and the bioeconomy*
- *Secure, clean and efficient energy*
- ***Smart, green and integrated transport***
- *Climate action, resource efficiency and raw materials*
- *Inclusive, innovative and reflective societies*
- *Secure societies*

Indicative Budget:
29.7 B €*

* budget 2014-20; 77 B€ include also EIT, JRC, "widening participation", "science with and for society" that are not shown above

Research and Innovation

Leadership in enabling and industrial technologies (LEIT)

Priority 1: Excellent Science

Priority 2: Industrial Leadership

Leadership in enabling and industrial technologies (LEIT) *(i) ICT including micro- and nano-electronics and photonics* **(ii) Nanotechnologies** **(iii) Advanced Materials** **(iv) Biotechnology** **(v) Advanced Manufacturing & Processing** *(vi) Space*	**This Work Programme**
Access to risk finance *Leveraging private finance and venture capital for R&I*	
Innovation in SMEs *Fostering all forms of innovation in all types of SMEs*	

Priority 3: Societal Challenges

Industrial Leadership

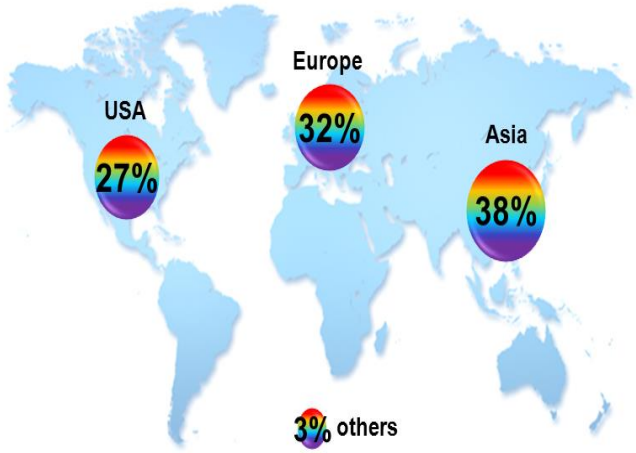
- **To be achieved through development of European Key Enabling Technologies (KETs) and support to industry**

- **Strong focus on the contribution of Key Enabling Technologies to societal challenges**
  - **Transport**
  - **Healthy aging**
  - **Energy**
  - **Environment**
  - **etc.**

- **Emphasis on R&D and innovation with strong industrial dimension**

The issues regarding KETs

- **Europe has strong position in science and in patenting activity**
- **EU actors are at top of patent ranking in each KET**
- **But there is a gap between the technology base and the manufacturing base**



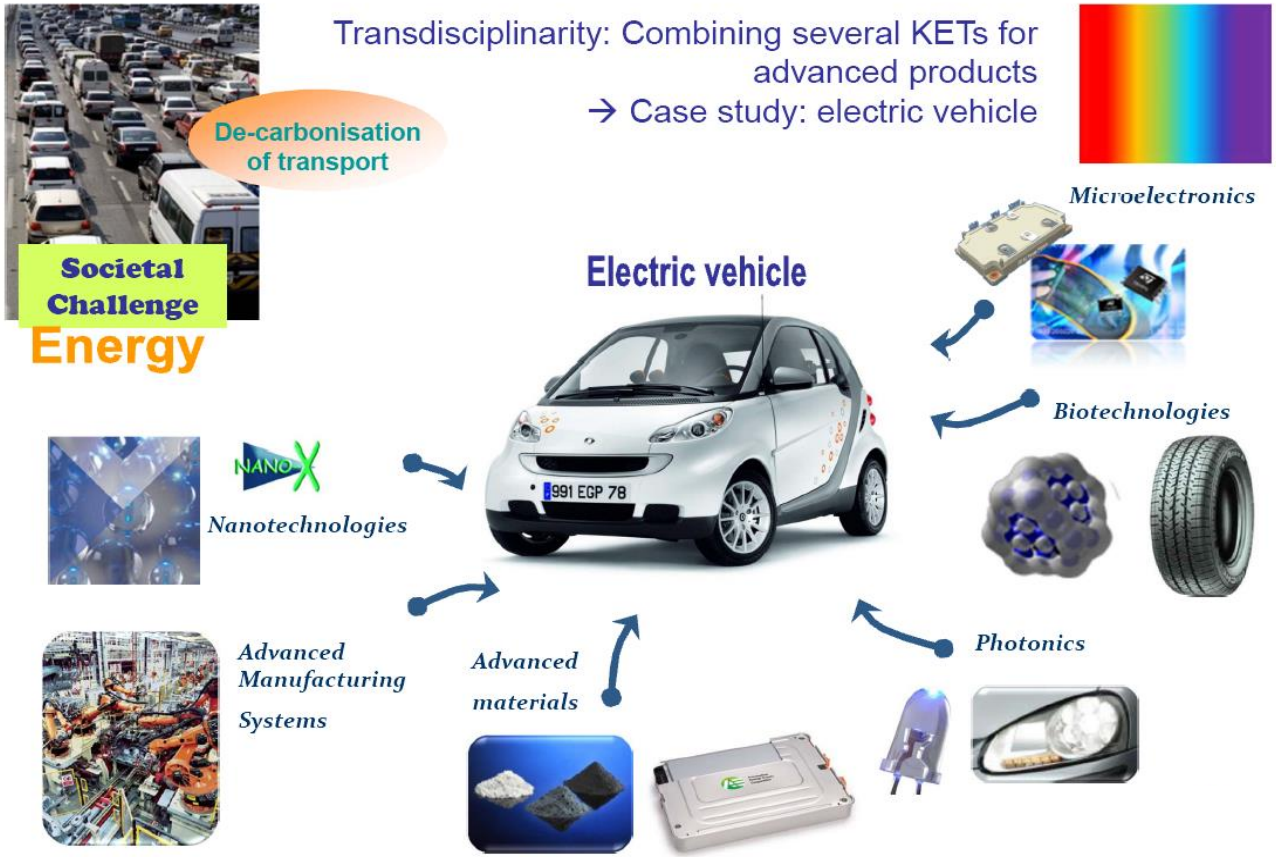
> We need to add demonstrators, competitive manufacturing and product development to the technologies

> And we need to consider the whole value chain

From Lab to Industry to Market

(see also: "A European strategy for Key Enabling Technologies - A bridge to growth and jobs COM(2012)341)

Case example: the electric car



Why is funding of automotive (battery) research needed?

(An Integrated Industrial Policy Approach for the Globalisation Era – Putting competitiveness and Sustainability at Centre Stage COM (2010)614)

- **Motor vehicles and transport equipment will play a major role in developing solutions for sustainable mobility**
- **Those sectors have to be improved where value chain consideratrions are particularly important, as transport equipment manufacturers**
- **EU industry leadership will have to be developed, especially on battery technologies and potential replacement for Lithium**

Value chain

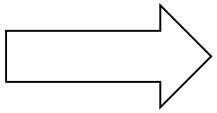
Raw materials suppliers

Cathode suppliers
Anode supliers
Electrolyte suppliers
Separator suppliers
Binder suppliers

Cell suppliers

Battery packs and system suppliers

Others (….)



Raw materials supply?

63000 t (2011)
32200 t
21000 t
440 M m2
4800 t

10% margin

10% margin

….

Christophe Pillot
Avicenne, Batteries2012
Nice 24-26 October 2012

Case Study: Li-ion batteries

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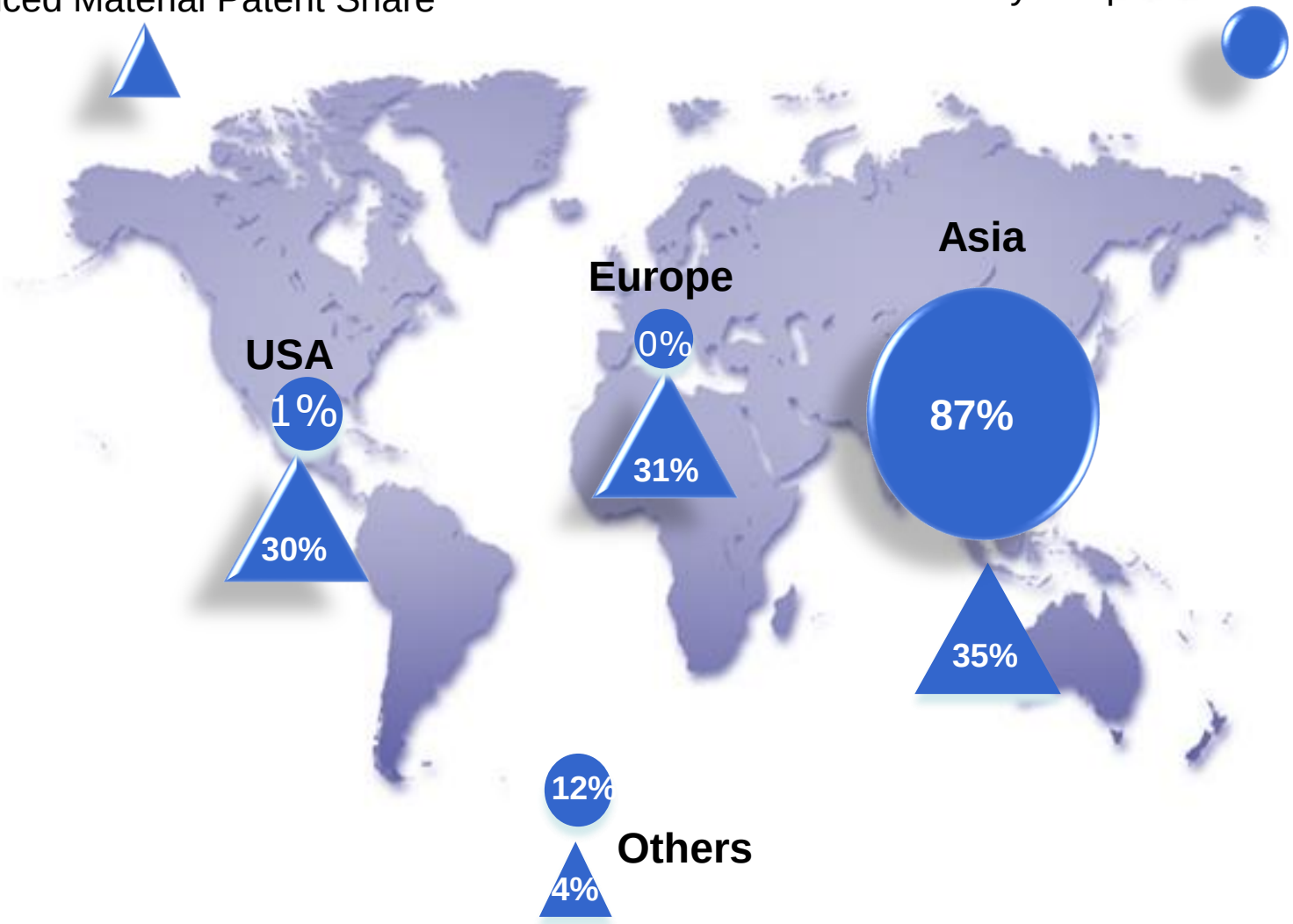
Advanced Material Patent Share

Li-ion battery cell production share in 2008



Source: European Competitiveness Report 2010, European Competitiveness in Key Enabling Technologies (TNO/ZEW), CGGC, Lithium-ion Batteries for Electric Vehicles : THE U.S. VALUE CHAIN, October 2010

Research and Innovation

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Policy objectives

- **Maintain R+D knowldege and production capacity of future battery technologies in Europe**
- **Consider an European approach (to overcome fragmentation)**
- **Enable European industry to obtain sustainable and competitive products**
- **Create jobs and wealth**

Industrial Leadership (in H2020)

- **Activities primarily developed through relevant industrial roadmaps (ETPs, PPPs)**
- **Contractual Public-Private Partnerships (cPPPs) will be used extensively for the implementation and deployment of the KET**
- **They will allow industry to directly participate in the definition and implementation of research and innovation priorities**
- **Involvement of industrial participants and SMEs to maximise expected impact -> key aspect of proposal evaluation**
- **Funded projects will be outcome oriented, developing key technology building blocks and bringing them closer to the market**

PPPs in H2020

- Industrial Investment Package of 10 July 2013 :
  - Joint Technology Initiatives (JTIs) implemented by Joint Undertakings
  - Contractual PPPs (cPPPs)
  - Public-Public Partnerships (P2Ps)
- PPPs in H2020 :
  - Continuation of existing JTI's : Clean Sky, Innovative Medicines Initiative (IMI), Hydrogen and Fuel Cells (HFC)
  - New JTI's : Joint Technology Initiative on Electronic Components and Systems for European Leadership (ECSEL), Bio-based industries (BBI)

  <u>cPPPs</u>
  - Robotics
  - Photonics
  - Advanced 5G Network Infrastructures
  - Factories of the Future (FoF)
  - Energy-efficient Buildings (EeB)
  - Sustainable Process industry (SPIRE)
  - Clean vehicles

Current Industry objectives

FIA, EUCAR and ERTRAC endorse battery research

EGVIA:

a) Continue Li-Ion research to improve batteries for immediate application in ready to use EV/HEV vehicles

b) Prepare for the next future and keep industrial leadership in research, development and production of "post-Li ion batteries" (batteries with chemistry improvemets going far beyond the current technology)

Public Private Partnership
European Green Vehicles Initiative

Scope of EGVIA:

- **(Resources – Basic Materials)**
- **Green Vehicle core research**
  - **Modules**
  - **Systems**
  - **Vehicles**
- **(Infrastructure - Grid)**

So: basic materials research is not directly funded in the Green Vehicle PPP -> LEIT complementary activity

Materials for Green Cars NMP WP 2010-2013

- **WP 2010 battery materials and electrical components**
- **WP 2011 battery manufacturing**
- **WP 2012 battery materials - post Li**
- **(WP 2012 structural materials)**
- **WP 2013 ageing of battery materials**

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FP7 NMP-GC projects related to batteries:

2010	Labohr	2011	Elibama	2013	Mat4Bat
	Amelie		Greenlion		Mars
	Apples	2012	Eurolis		Batteries2020
	Somabat		Lissen		
	Euroli-ion		Stable		
			Necobaut		

Battery technology - Where are we now?

- **Li- Ion - started to be used in car industry, but unsatisfactory performance yet, e.g. too low energy density ~210 Wh/kg (FEV) compared to CFE with ~1700 Wh/kg**
- **Safety concerns?**
- **Li-air technology Theoretical 5400 Wh/kg? But is it cyclable? - blockage of porous carbon cathode; degradation of cathode by environmental humidity; decomposition of electrolyte and anode by atmospheric moisture ….**
- **Other chemistries and technologies , LiS, …?**

Md. Arafat Rahmann, X.Wang, C. Wen, J. Appl. Elechtrochem(2014) 44; 5-22

-> This workshop will show the state of the art !

H2020-NMP-GV-2014 Post lithium-ion batteries for electric automotive applications

Contribution from the "Leadership in enabling and industrial technologies" (LEIT) part of Horizon 2020 to the European Green Vehicles Initiative-PPP

This call is complementary to a separate one present in the Horizon 2020 Work Programme under the Transport Challenge "Smart, green and integrated transport":

Call Mobility for Growth H2020-GV-2014 GV-1-2014

"Next generation of competitive lithium ion batteries to meet customer expectations"

H2020-NMP-GV-2014 Post lithium-ion batteries for electric automotive applications

- *Specific challenge:* **Electrification of road transport is key for environmentally friendly mobility**
  - Need to develop cost competitive and sustainable storage technologies for Electrified Vehicles (EV) with significantly improved performance;
  - Get EVs with similar performance of current internal combustion engine vehicles (e.g. driving range);
  - Build on the progress already obtained through previous projects (mainly through the Green Car PPP);
  - Gain competitiveness so that the next generation of batteries will be "made", i.e. developed and produced in Europe.

H2020-NMP-GV-2014 Post lithium-ion batteries for electric automotive applications

- *Scope:* **Progress well beyond current Li-ion cell is needed**
  - Increase energy density, power density, the ability to work under severe thermal conditions, charging speed, and inherent safety of the battery cells (including crash and abuse conditions);
  - Address e.g. new chemistries and/or develop new materials e.g. for cathodes and electrolytes to get high-energy densities;
  - Understand and improve ageing of the new chemistries, in order to achieve a longer battery lifetime;
  - Consider competitive cost, environmental issues, raw materials, LCA;
  - Develop prototypes to show clear progress beyond existing post Li-ion technology (durability, cyclability and energy density);
  - Consider scalability up to full scale for automotive applications (TRL4).

H2020-NMP-GV-2014 Post lithium-ion batteries for electric automotive applications

- *Expected Impact:* **Significant improvements of the usability of EVs**
  - Extended driving range and improved battery durability (recharging, cyclability and safety) obtainable at competitive costs;
  - The energy density of the proposed new batteries should reach at least twice the energy density in comparison to the best in class Li-Ion technology at the same power density;
  - Better acceptance of EV in society, and thus contribution to the improvements of sustainable transport, reducing pollution and noise in urban areas;
  - European competitiveness through development of new key technology and related production capacities.

H2020-NMP-GV-2014 Post lithium-ion batteries for electric automotive applications

- *Type of action:* **Research and Innovation Action**
  - Total indicative budget foreseen: 16M €
  - Proposed size of project 6-8 million € (not compulsory)
  - Evaluation type: single stage
  - Deadline for submission: 07 October 2014, 17:00 h
  - Standard eligibility conditions (parts B and C of the General Annexes to the Work Programme), but - exception:
  - Outline of the initial exploitation and business plans needed!
  - Standard evaluation criteria apply (part H of the General Annexes to the Work Programme), but – exception:
  - Threshold of "Excellence" and "Impact": 4; Overall threshold: 12

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Find out more on Horizon 2020:

http://www.ec.europa.eu/research/horizon2020

Participant Portal:

https://ec.europa.eu/research/participants/portal/page/home

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Battery materials are the problem ?

Battery materials are the solution !

Thank you for your attention !