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Materials for Energy Storage

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"the two main possibilities to store energy that require the contribution and development of the chemical sciences. ***Firstly physical devices, such as batteries or super-capacitors; and secondly the storage of energy (e.g. from renewable energy sources) in the chemical bonds of a compound***, to release the stored energy at another time and place."

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The definition of a battery

Message 1

The storage of energy (e.g. from renewable energy sources) in chemical bonds of a compound, to release the stored energy as electrical energy at another time and place."

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Message 2

The efficiency of cycing stored electrical energy in batteries is very high – between 77-95% dependent of type of battery

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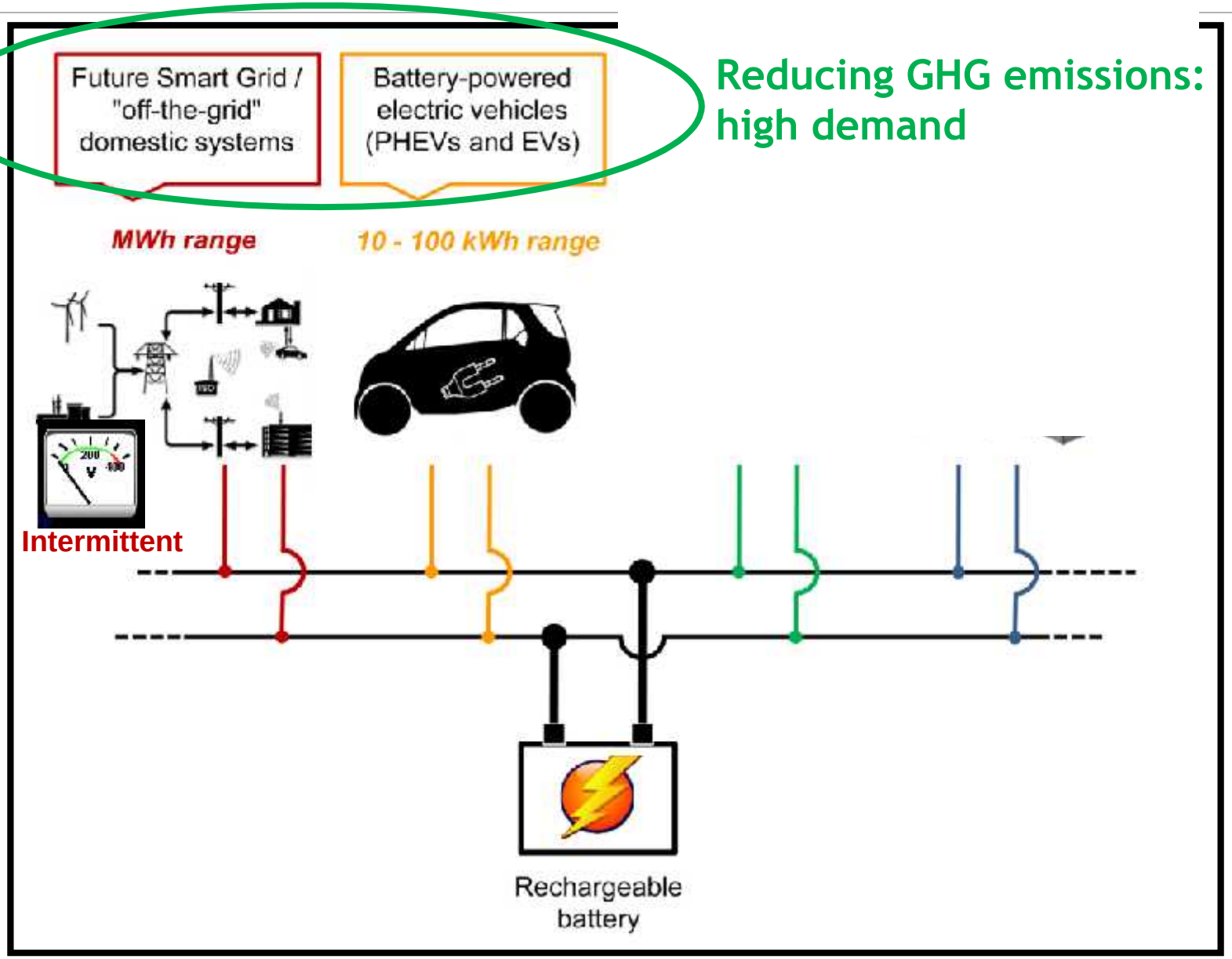
Rechargeable batteries: a key component



Reducing GHG emissions: high demand

P. Poizot, F. Dolhem, *Energy Environ. Sci.*, **4**, 2003 (2011).

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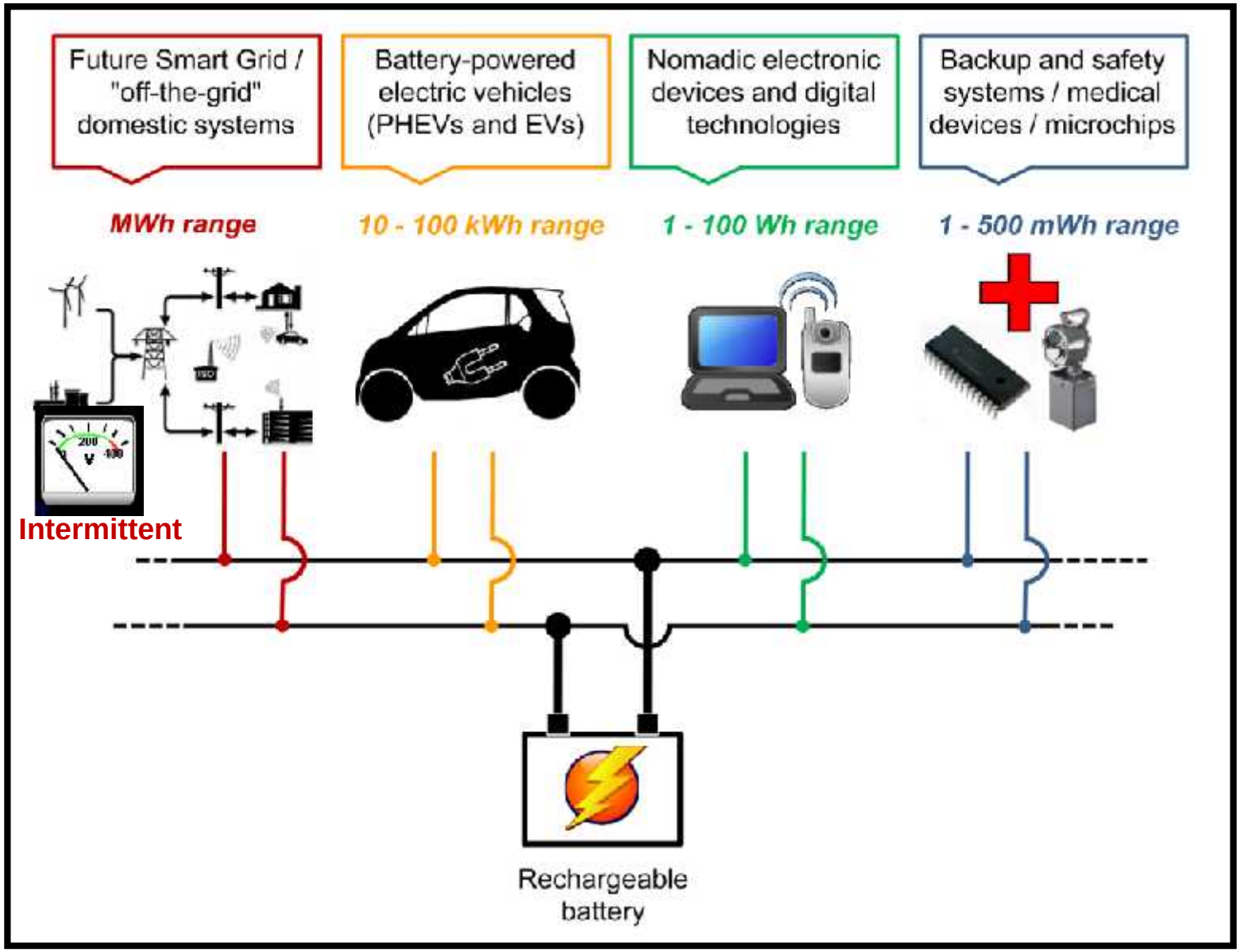
Rechargeable batteries: a key component



P. Poizot, F. Dolhem, *Energy Environ. Sci.*, **4**, 2003 (2011).

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Conclusion – we need materials!

Automobiles

1.10^9 cars 10% electric

➔ 200.10^6 tons batteries

Load-levelling

World electricity production = 2.10^{13} kWh 10% stored/d

➔ 10^9 tons batteries

Sustainability a prime criterion!

From M. Armand, 2013

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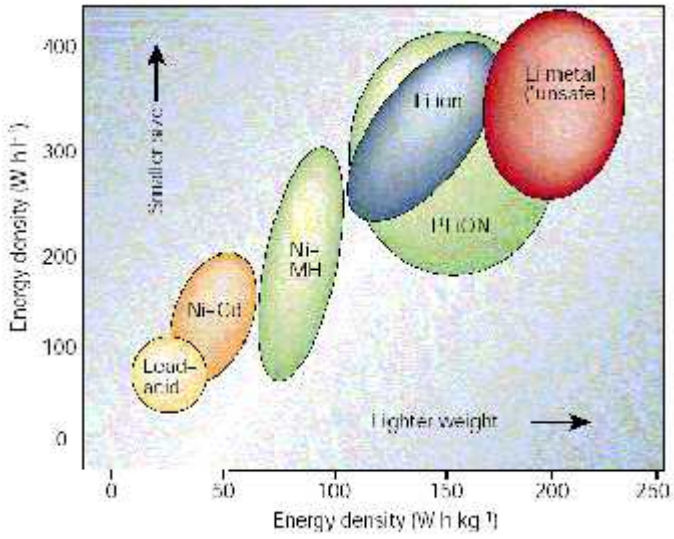
Lithium and sodium batteries



Energy density

x 2

"Greener"

250 Wh/kg, 800Wh/l

Li-air

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Sony

Sony

Nexelion

Sony

A123

A123 system

Nano-cathodes

Organic cathodes

Li-S

Na-ion chemistry

1990

1995

2005

2007

2015

2020

Future

Future

Future

??????

From J.-M. Tarascon

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Li- and Na-ion batteries can be optimized either for power or storage

Increasing size

Energy density
Safety
Life time Cost
Power efficiency

Safety
Power/Energy denisty
Life time Cost

Life time Cost
Up scalability
Power/Energy density
Safety

ÅABC

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Message 3

We need to chose materials depending on the application it is to be used for.

- Inorganic dense materials as electrodes for Li-ion batteries for vehicles that need high energy density per volume
- Organic renewable materials where lower energy denisty per volume is OK

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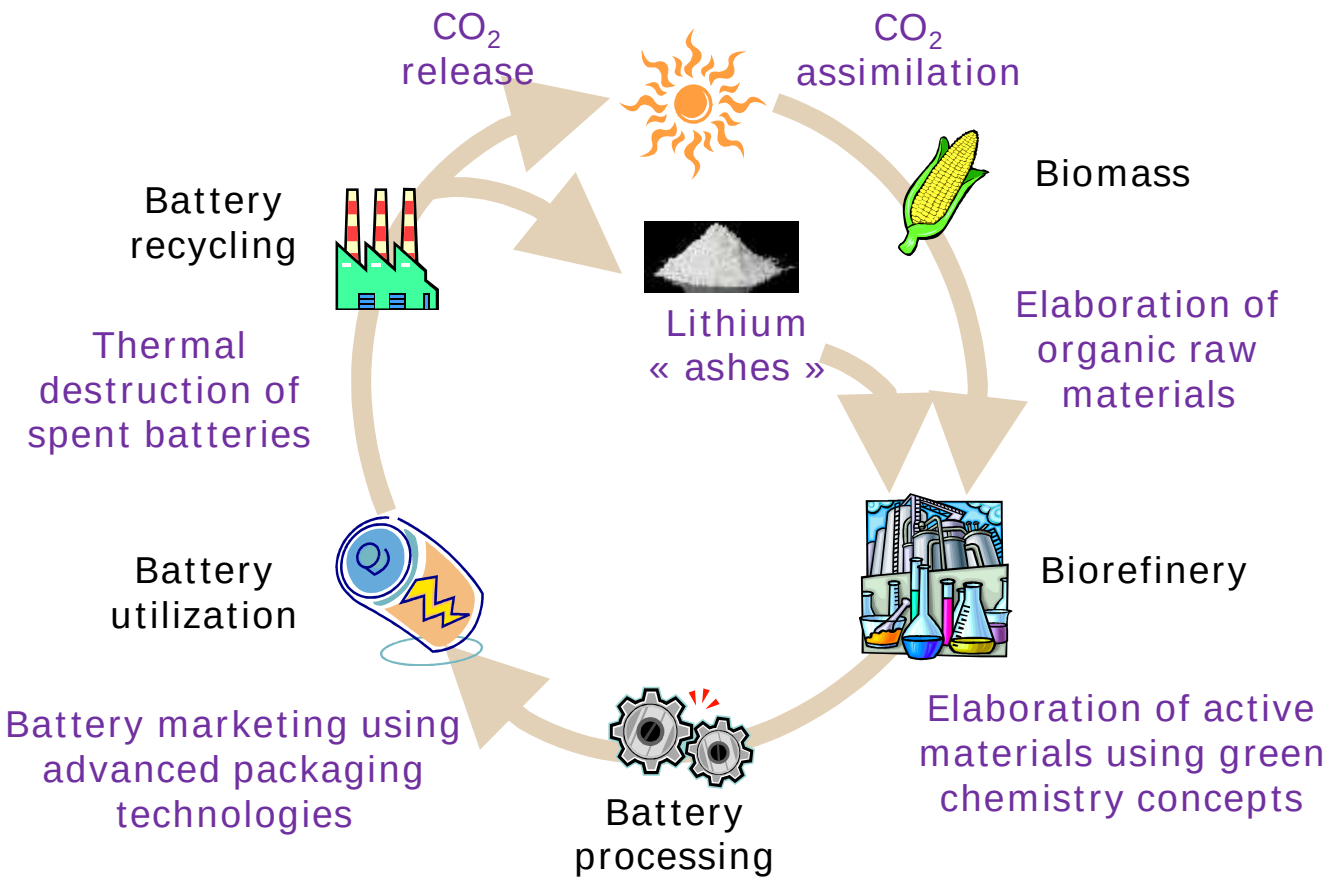
Organic based batteries



Recycling will be important!

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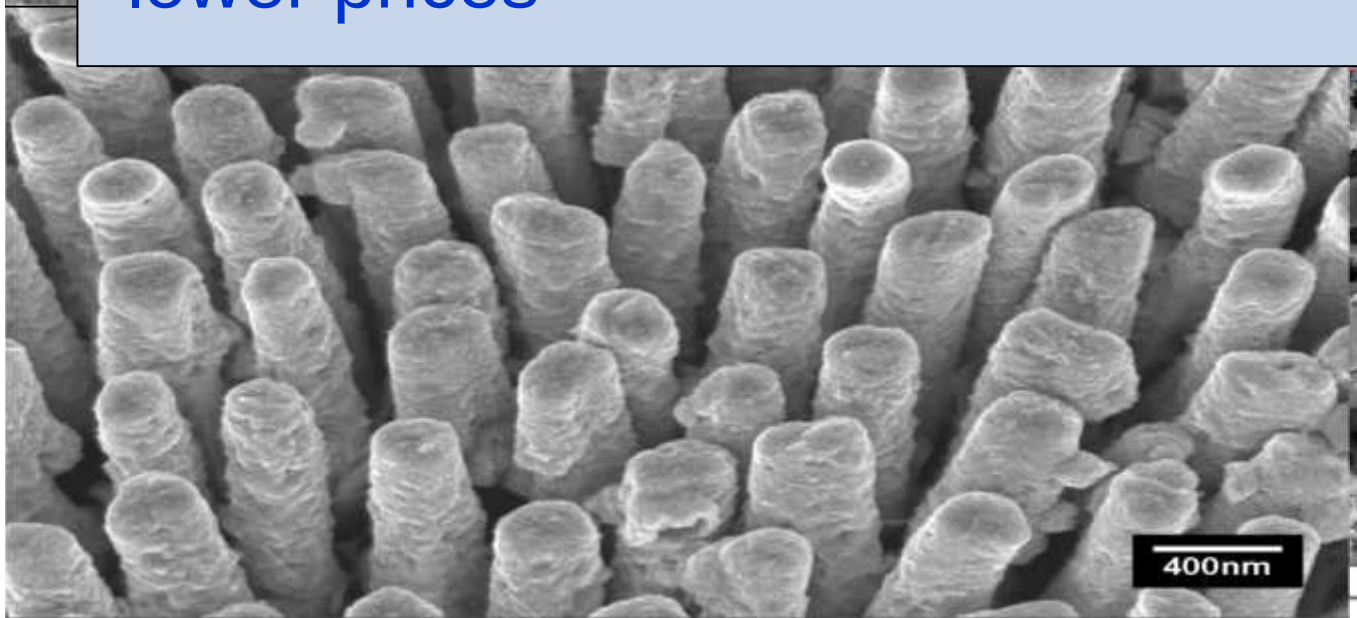
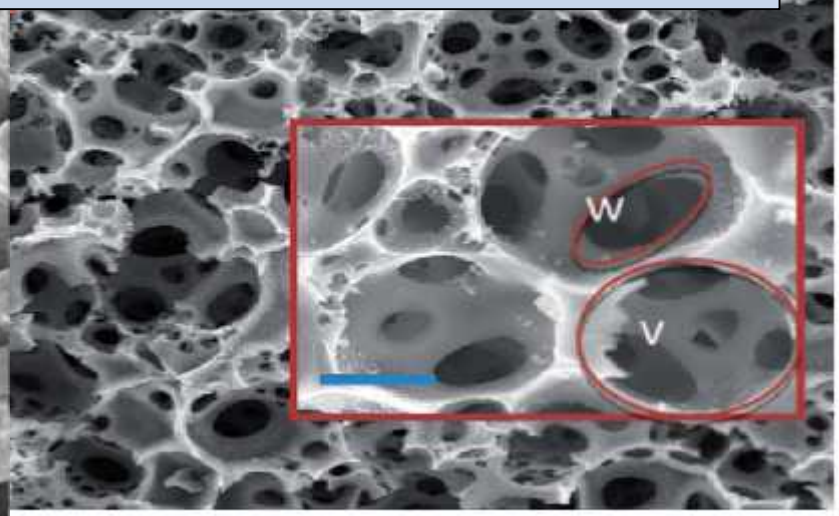
Message 4

We have today a tool box to create new materials that can give batteries with higher energy denisties, better life times and higher safety characteristics preferably to a lower prices





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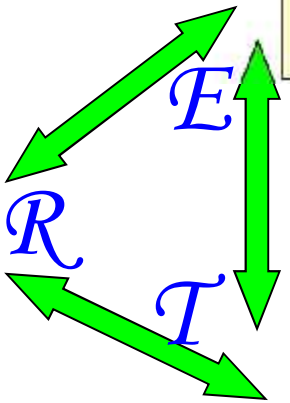
Final message – European networks integrate the knowledge triangle

Alistore
European Research Institute

20 laboratories



European Industrial Club

17 companies

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eit Knowledge & Innovation Community

KIC InnoEnergy