The Role of Collaborative Materials Research in the Development of Clean and Efficient Fossil Energy and Related Technologies

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Prof. John Oakey

Head, Institute for Energy and Resource Technology

Outline

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- EU Developments in Energy Strategy
- The Challenge for the UK
- Responses – in the UK and EU
  - ✓ Materials UK – Energy Materials Working Group
  - ✓ EuMaT (Platform on Advanced Engineering Materials and Technologies)
  - ✓ EU SET Plan – Materials Road Map
- Response from Industry - EMIRI (Energy Materials Industrial Research Initiative)

EU Developments

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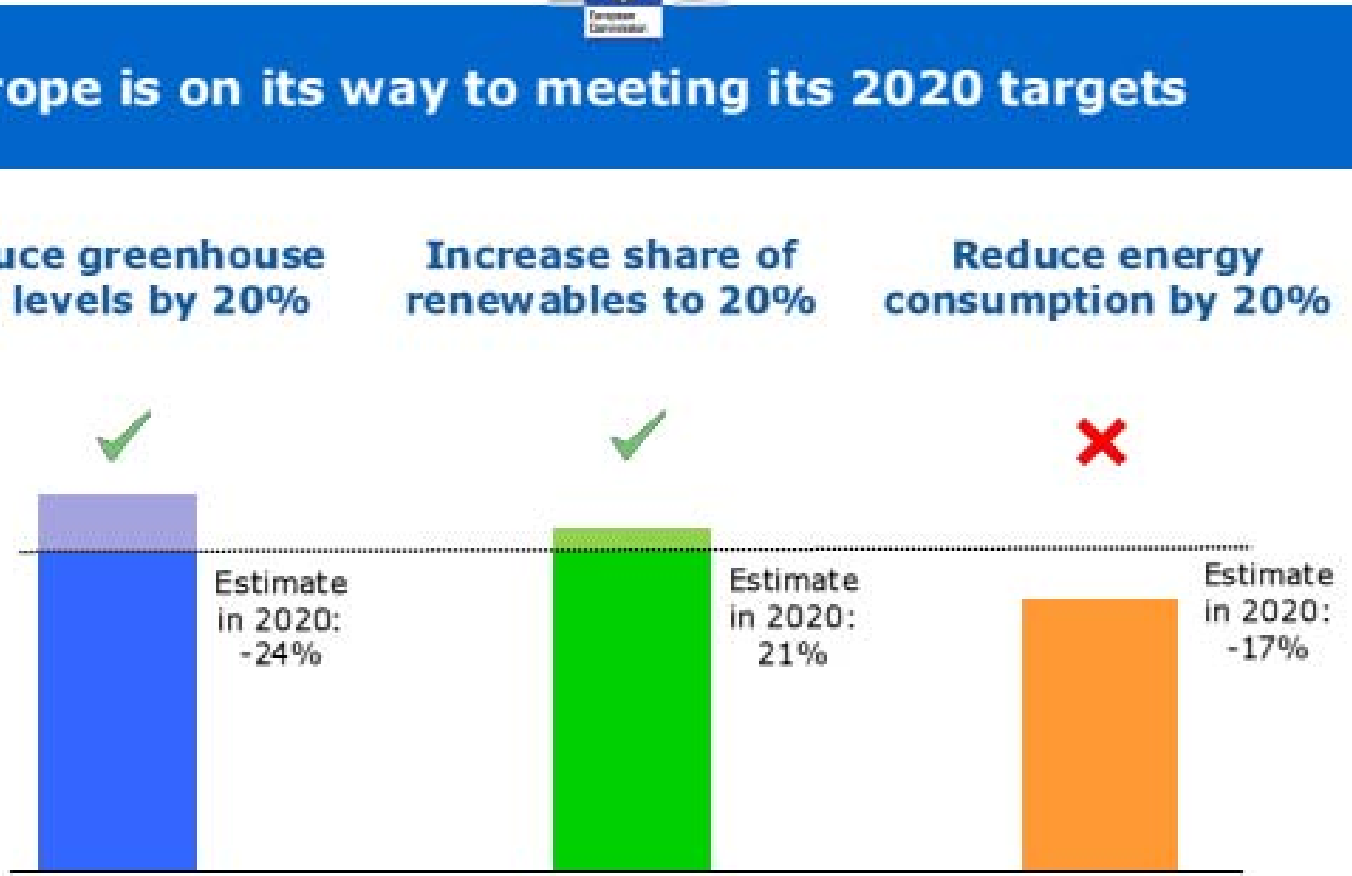
Europe is on its way to meeting its 2020 targets



Presentation of J.M. Barroso to the European Council, 20-21 March 2014

Source: European Commission

EU Developments

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A renewed ambition for 2030

2020

- 20% greenhouse gas reduction
- 20% renewable energy
- 20% energy savings

2030

- 40% greenhouse gas reduction
- ≥27% renewable energy
- Energy efficiency: review in 2014

Dedicated governance

- National plans
- Common indicators
- Monitoring

Presentation of J.M. Barroso to the European Council, 20-21 March 2014

EU Developments

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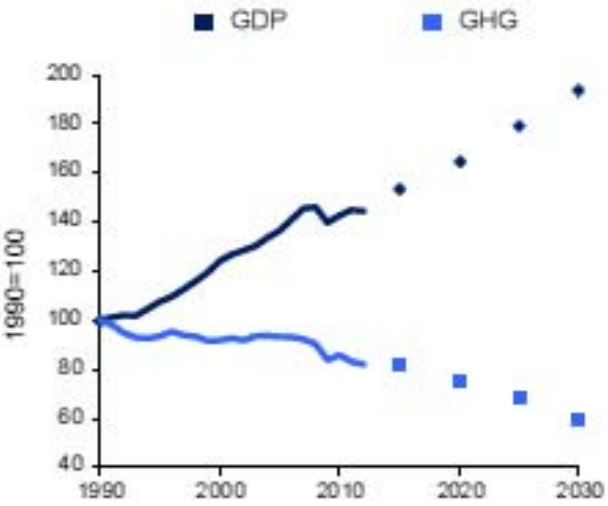
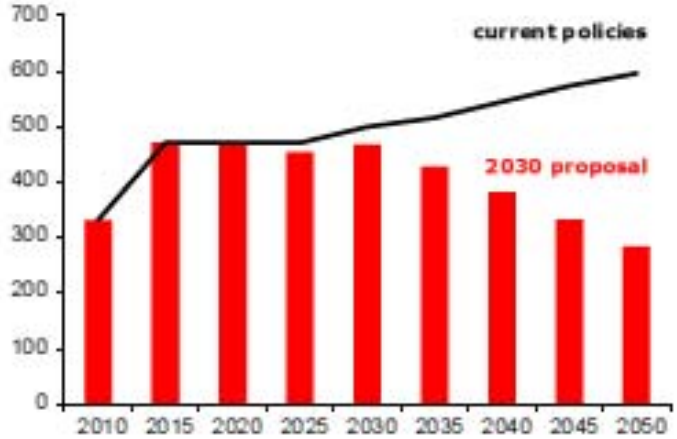
Growing while saving

Decoupling GDP from greenhouse gas emissions (GHG), 1990-2030



Reducing the EU fuel import bill with our 2030 proposal
(import expenditure, in € billion)



Presentation of J.M. Barroso to the European Council, 20-21 March 2014

Source: European Commission

EU Developments

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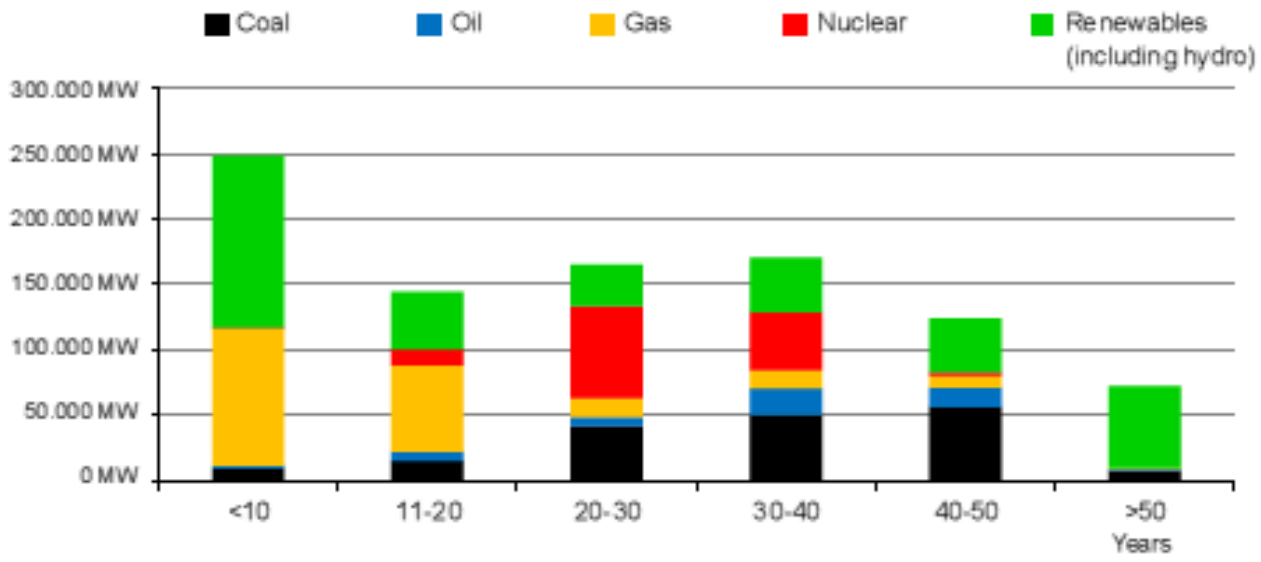
This is about investing in our future: 45% of our power generation capacity is more than 30 years old

Age of power generating capacities in the EU in 2013 (in years)



Presentation of J.M. Barroso to the European Council, 20-21 March 2014

Source: Platts Power Vision

EU Developments

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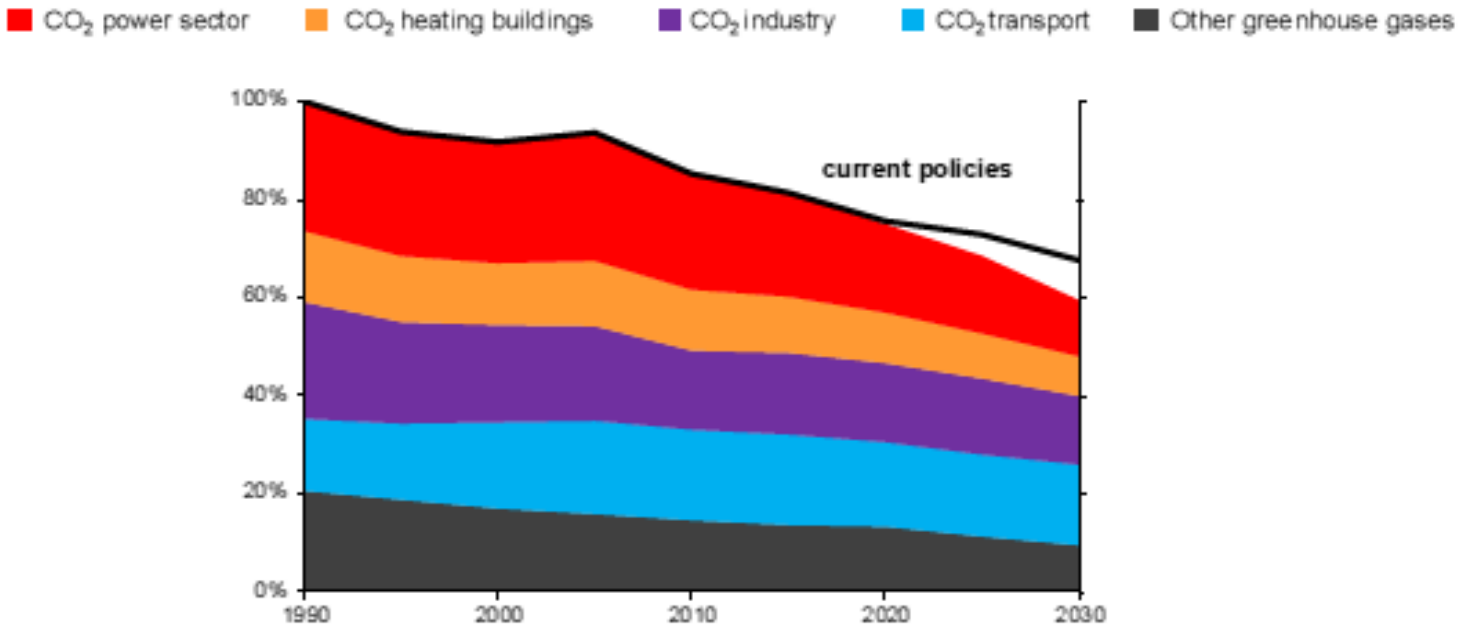
All sectors should contribute

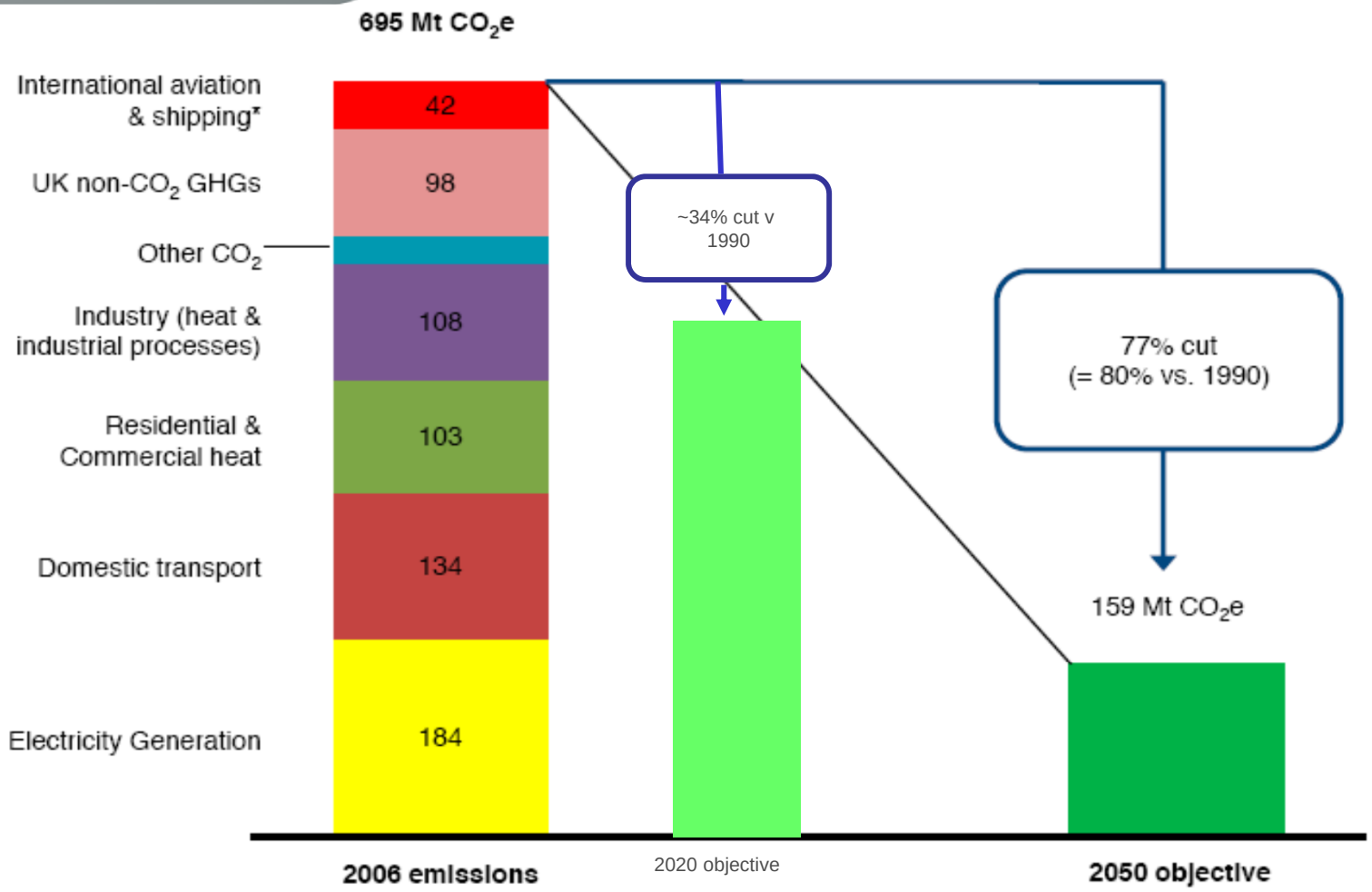
Share of greenhouse gas emissions, per sector and gas



Presentation of J.M. Barroso to the European Council, 20-21 March 2014

Source: European Commission

The UK Challenge



Source: UK National Atmospheric Emissions Inventory (2008).

CCS is expected to be competitive with other low carbon generating technologies

DEPARTMENT OF ENERGY & CLIMATE CHANGE
Office of Carbon Capture and Storage

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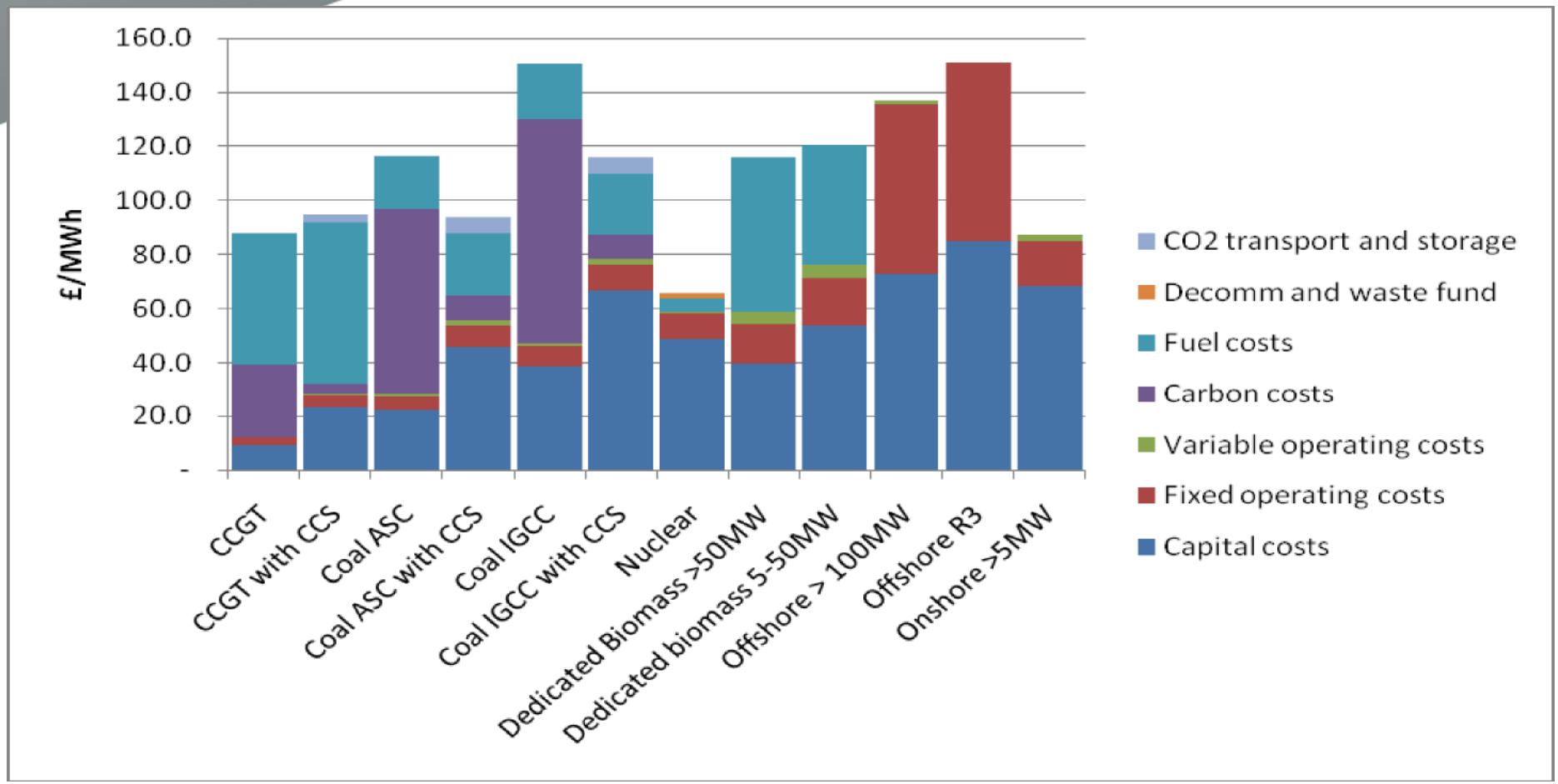
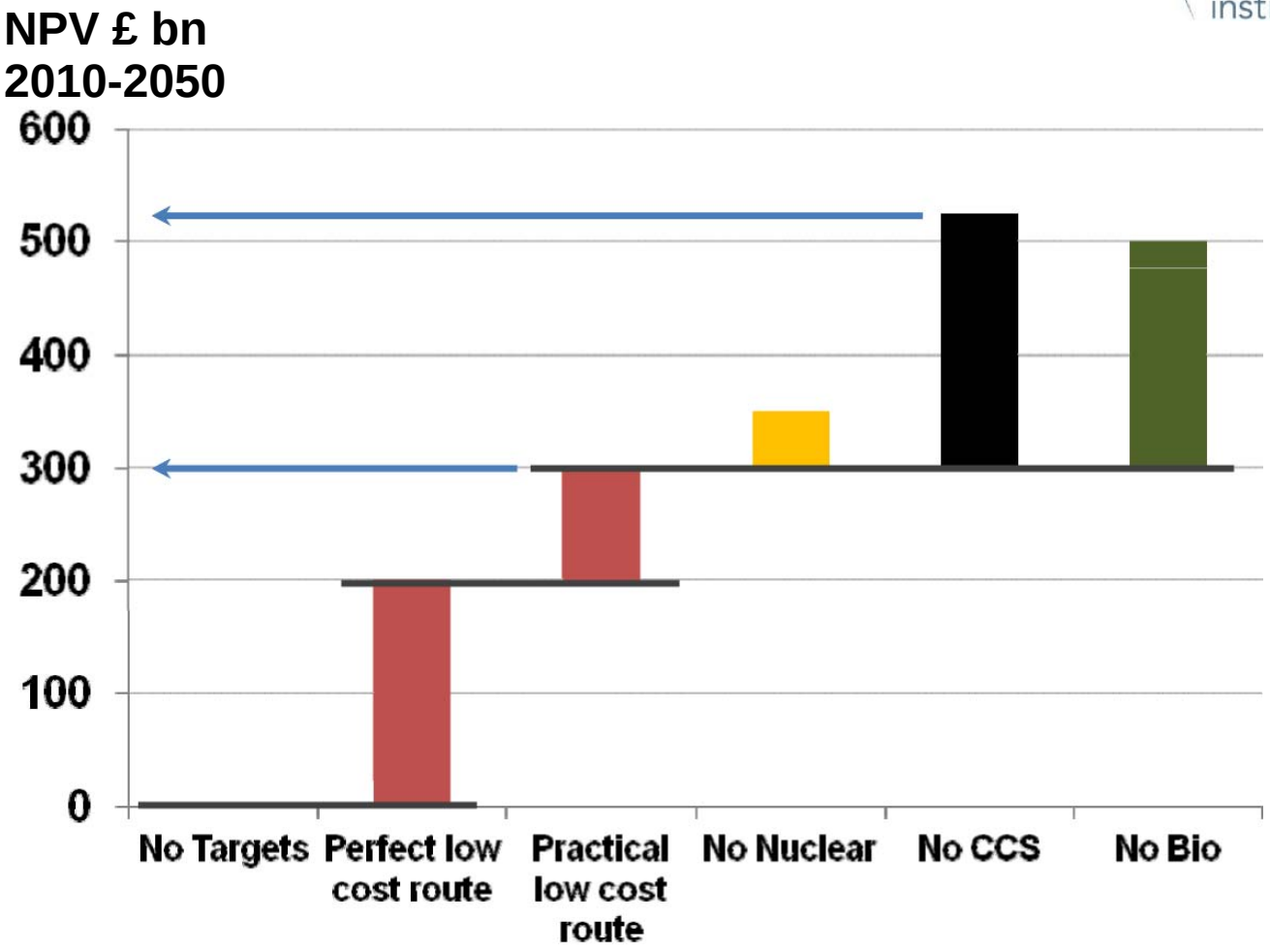


n[th]-of-a-kind levelised cost estimates of generation technologies for projects starting 2017

Central estimates of construction, operation, fuel and carbon costs. Levelised costs calculated using 10% discount rate. Data from PB Power (2011) and Arup (2011)

Cost of getting to 2050 without CCS – based on ESME Modelling

Incremental 2010-2050 cost of delivering national energy system which meets CO_2 targets



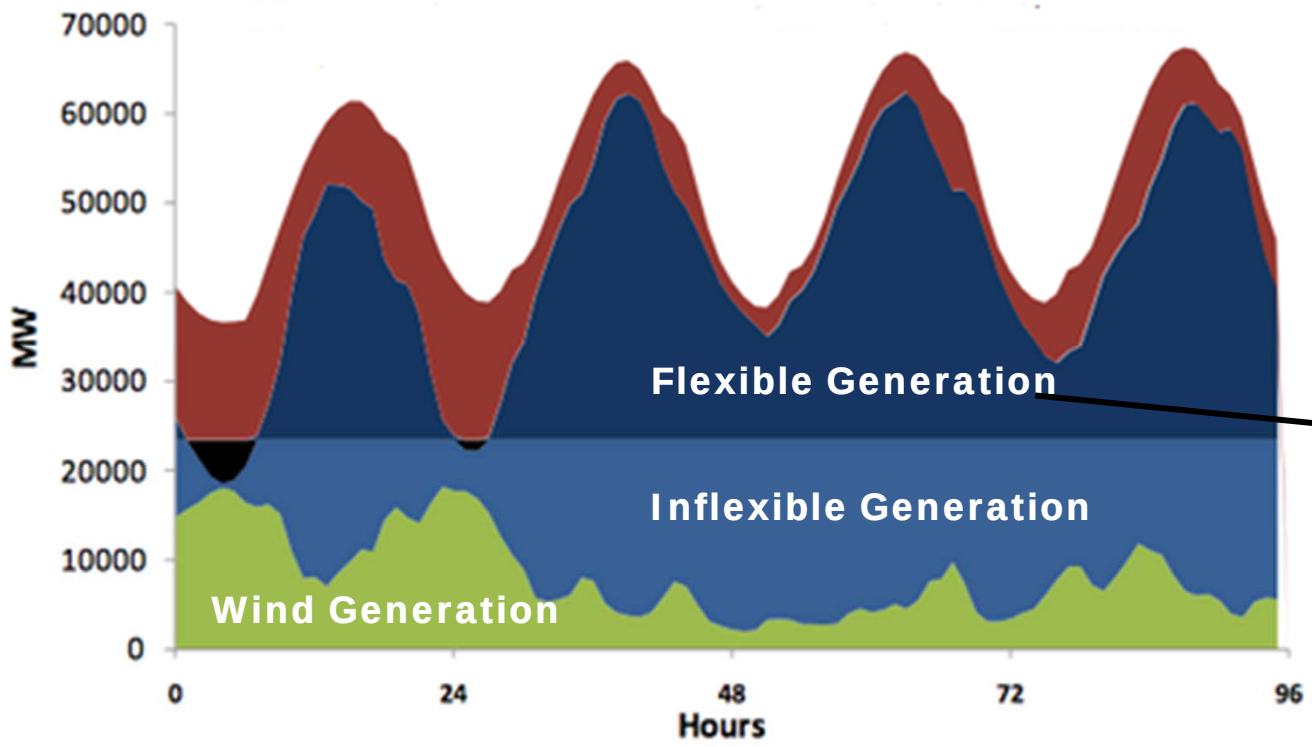
Societal level discount rate 3.5%

The UK Conclusion

- All technologies will be needed: a full portfolio approach
  - `Clean` Use of Fossil Fuel
  - `Economic` Renewable Energy
  - `Safe` Nuclear
- Substantial increase in take-up of energy efficiency
- **BUT** what balance will provide a viable electricity supply system?

ell cartoon showing deviated wellbore trajectory to the storage reservoir

Meeting Demand in the UK



Gas, Coal and Biomass Generation (with or without CCS) and Energy Storage

Combined Wind Power Output of Germany, Denmark and Spain
(4-26 January 2010)

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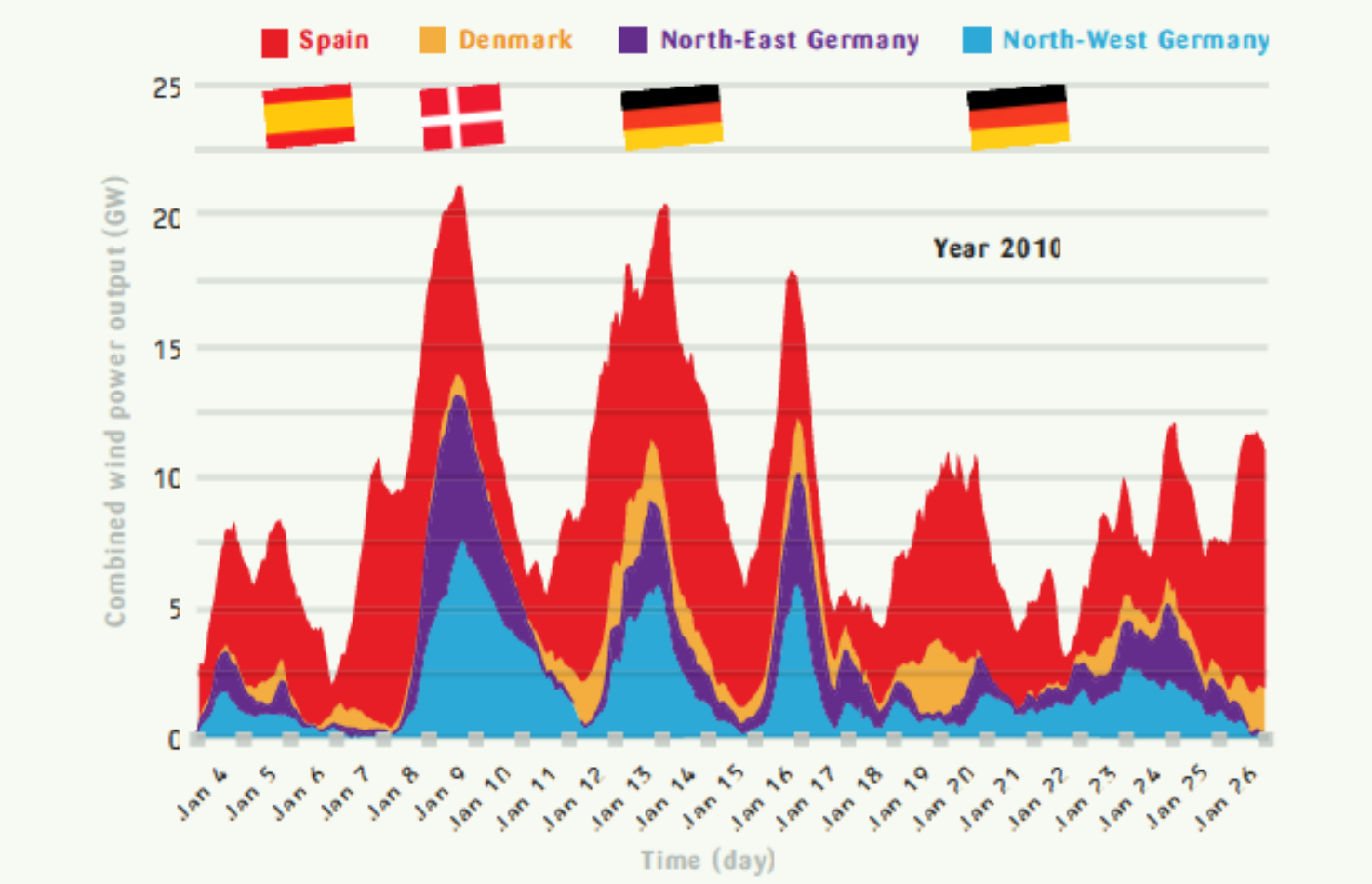

Smart Power Generation (2011)
 ISBN 978-951-692-846-6

Impact on Non-renewable Generation Costs

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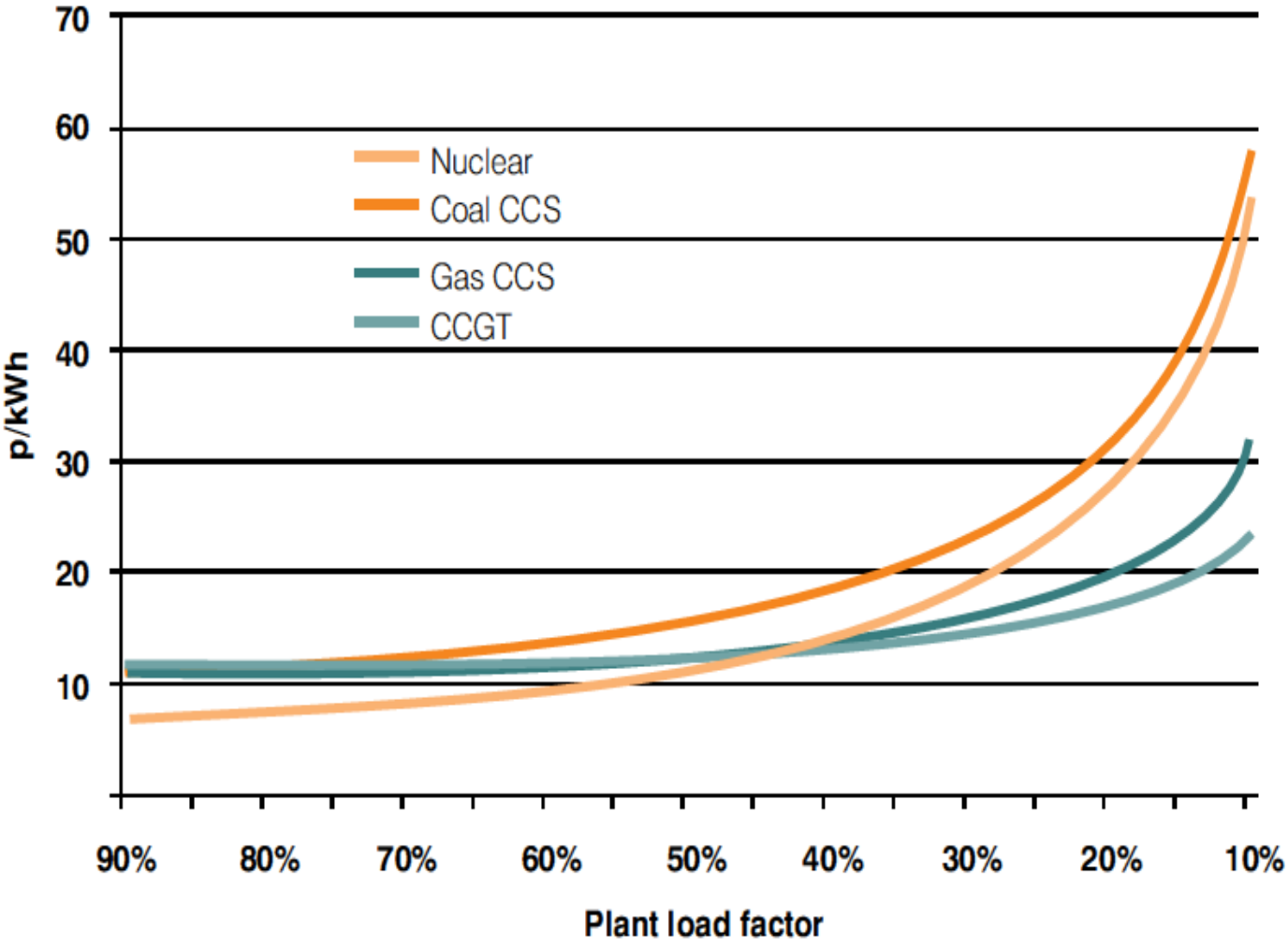

Figure 4 Estimated levelised cost of low-carbon technologies by load-factor in 2030. (Source: CCC calculations, based on Mott Macdonald (2010) UK Electricity Generation Costs Update)

Mat UK – Energy Materials WG (2006 – 2011)

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5 key technology scoping reports, the SRA (2010) and a report on the supply chain (2011)

Materials UK Energy Materials SRA R&D Focus

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The recommendations in the SRA have been distilled down into 3 key common themes where UK materials R&D should focus:-

- **Reducing time to market** and life cycle costs (e.g. solar, fuel cells, marine)
- **Higher performance in harsher environments** (e.g. carbon capture, co-firing, nuclear)
- **Improved life management and reliability** (e.g. offshore wind, nuclear)

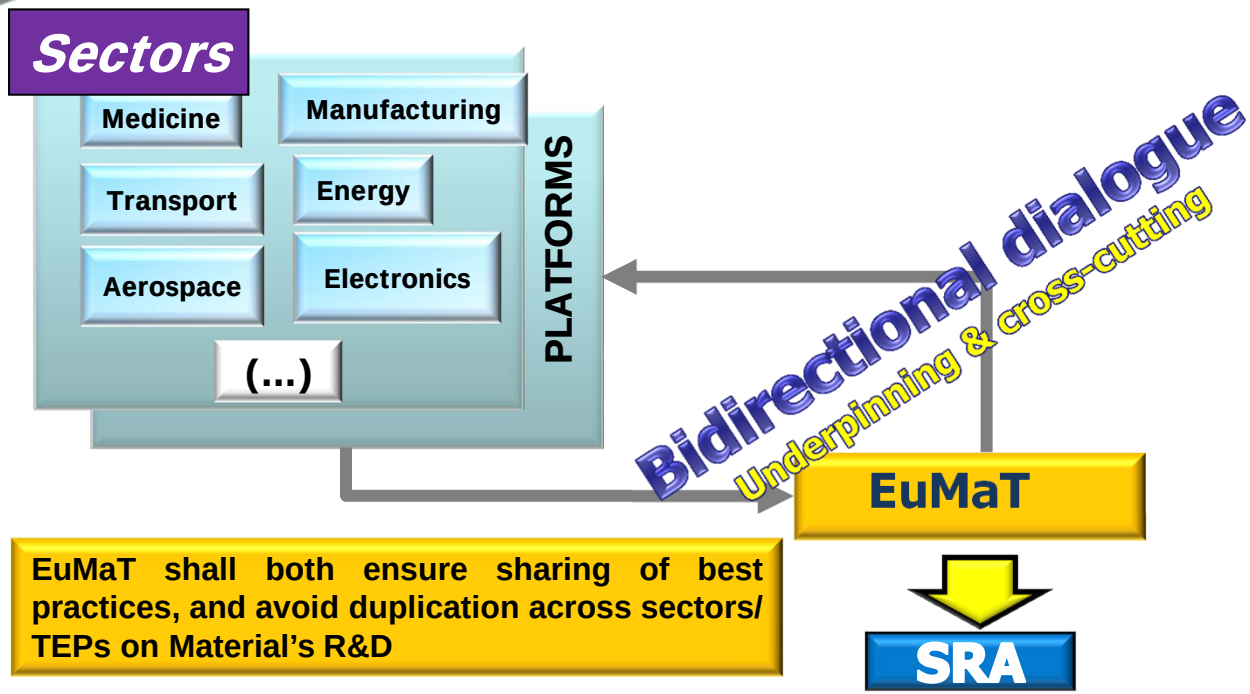
EuMaT – Steering Committee members

Official launch meeting, Brussels, 26 June 2006

Presently: more than 900 registered members

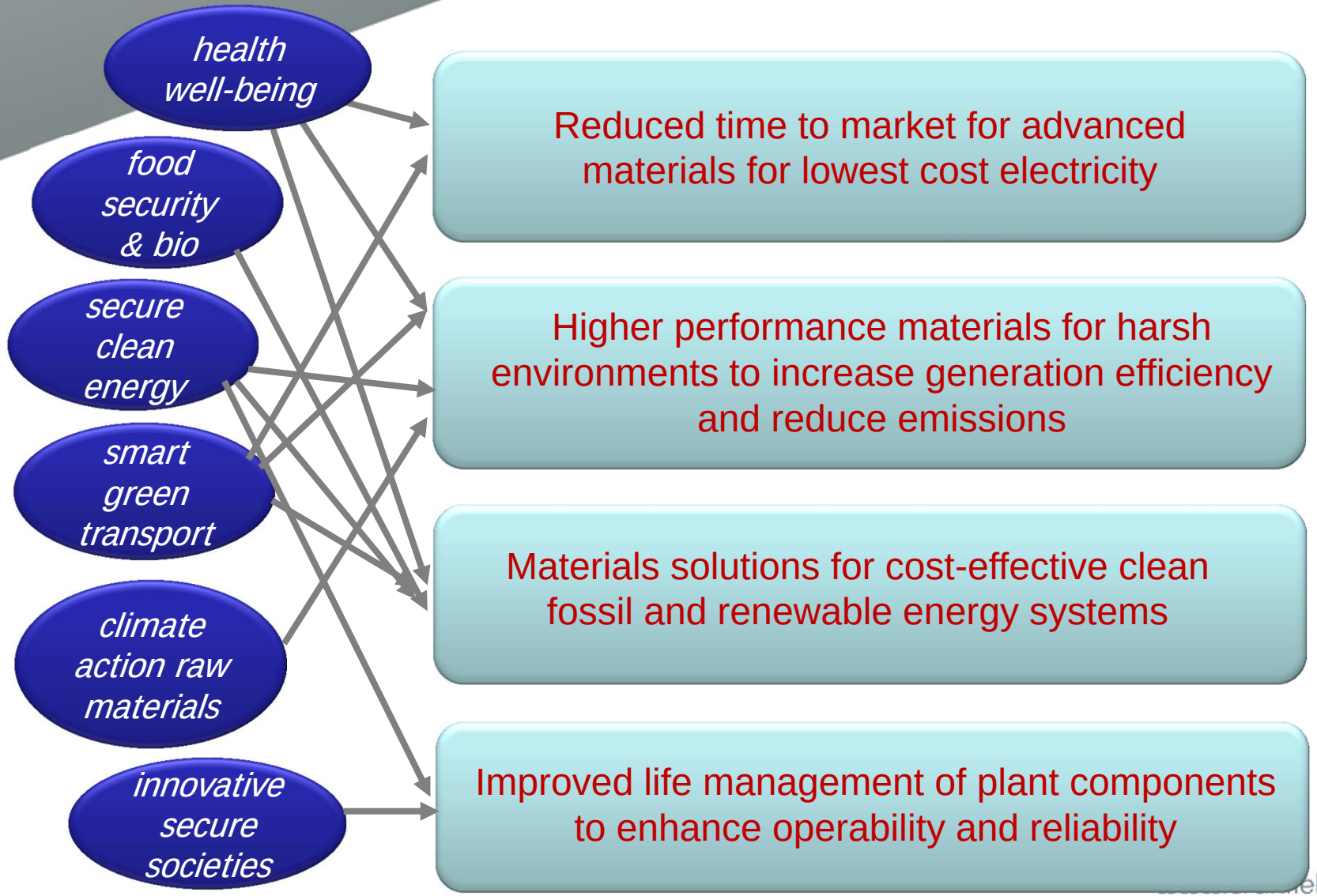
23% from industry

EuMaT – Strategic Research Agenda



WG1. Modelling and Multiscale
WG2. Materials for Energy
WG3. Nano and nano-assembled-materials for structural and multifunctional applications
WG4. Knowledge-based Structural and Functional Materials
WG5. Materials for Information and Communication Technologies (ICT)
WG6. Biomaterials
WG7. Lifecycle, Impacts, Risks

SRA – 2009, 2010 & 2014
Materials for Energy



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Community research

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Roadmap on Materials for the SET-Plan (2011-2012)

1. **Availability of suitable materials hampers breakthroughs in the development of more efficient and less costly energy technologies**
2. **Security of supply issues related with the manufacturing chain of low-carbon energy technologies**
3. **Material research is prioritised in all EIIs and EERA Work Plans**
4. **Political momentum:**

- **Europe 2020 Flagship on Resource Efficient Europe**
- **Highlight in the Innovation Union as a possible Innovation Partnership on non-energy raw materials**
- **Commission Raw Materials Initiative - COM(2008) 699**

A road mapping exercise on materials for the SET-Plan

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Technology Coverage

1. Wind energy
2. Solar energy (photovoltaic)
3. Solar energy (concentrating solar power) including heat
4. Storage
5. Electricity grid
6. Electrical storage
7. Bioenergy
8. Novel materials for the fossil energies sector, including carbon
9. Capture and storage and advanced fuels
10. Materials for the nuclear industry (fission)
11. Hydrogen and fuel cells
12. Energy efficient materials for Buildings

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Roadmaps on Materials for the SET-Plan

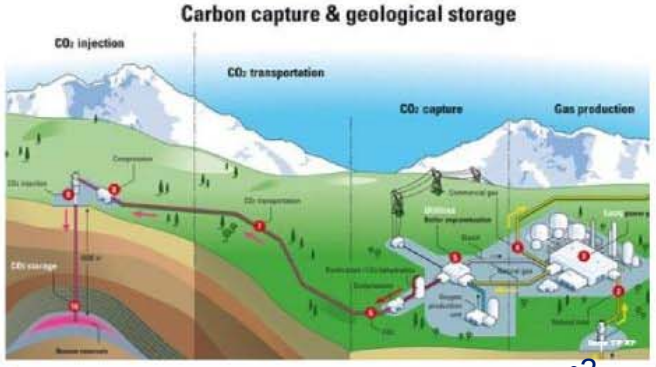
- **General objective** to contribute to make strategic decisions in materials research funding at the European level for the remaining years of FP7 and for the FP8 aligned with the priorities identified in the SET-Plan

- **Scope** proposals of critical R&D, D actions in the next 10 years with market implementation horizons for both 2020/2030 and 2050

- **Deliverables:** **Implementable roadmap (s) similar to the SETPlan Technology Roadmap that contains per priority, proposed key actions and Key Performance Indicators (KPIs), underpinned by a scientific assessment**

- **Release** **for the Polish SETPlan Conference End of 2011**

All of these applications and more are ***only*** possible thanks to ***advanced materials***

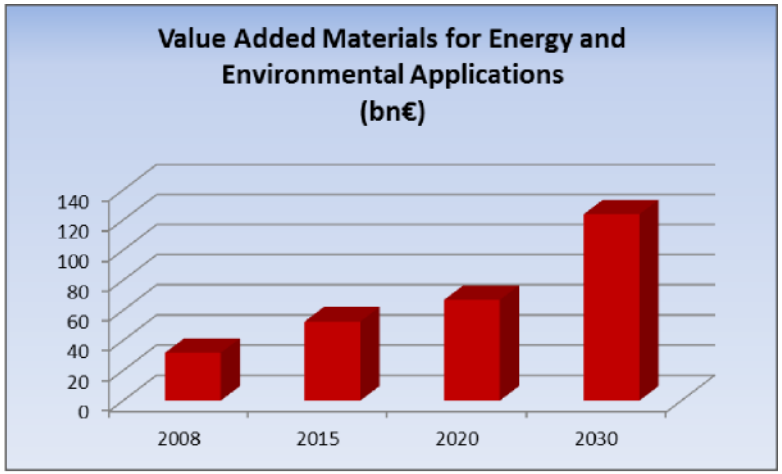


The importance of materials for the energy and the environment

Table 1: VAMs market share by sector

	2008	2015	2020	2030	2050
Energy	7,1	14,3	18,9	37,0	175,7
Transport	9,6	13,1	15,8	24,3	52,6
Environment	24,6	38,2	48,0	86,8	352,2
Health	27,0	32,1	37,4	55,0	115,2
ICT	29,6	38,8	46,6	70,7	152,2
Others / Cross-cutting	3,6	13,5	19,3	42,2	250,8
Total projected value of identified VAMs markets	**101,7**	**150,0**	**186,1**	**316,0**	**1098,6**

Source: Oxford Research AS. Unit: billion euro.



•Source:http://ec.europa.eu/research/industrial technologies/pdf/technology-market-perspective en.pdf

Energy and Environment represent the two key materials sectors forecast to be worth together circa 60 bn€/year by 2020 and growing on average 7% every year until 2050

ENERGY MATERIALS INDUSTRIAL RESEARCH INITIATIVE

EMIRI
Bridging the Innovation gap

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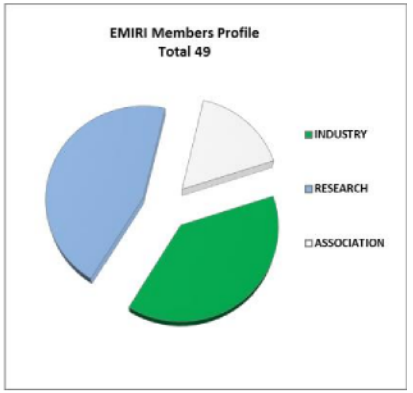
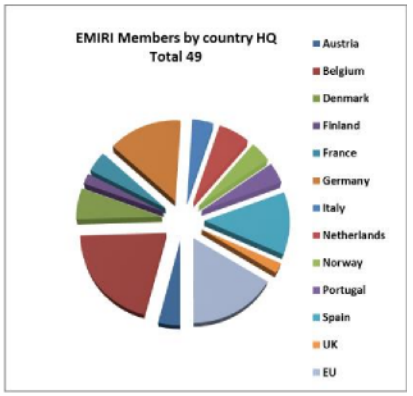
EMIRI aisbl established in 2012 / over 50 members

3M, AGC, ArcelorMittal, BEKAERT better together, BOSCH Invented for life, DOW CORNING, H.C.Starck, Heraeus, LABORELEC, PLANSEE, SAFT, SIEMENS, SOLVAY, umicore, voestalpine ONE STEP AHEAD.

cea, IK4 CIDETEC, Cranfield UNIVERSITY, 50, DTU, ECN, imec, itme MATERIALS TECHNOLOGY, JÜLICH, LEUVEN, Steinbeis Advanced Risk Technologies, SINTEF, tecnalia Inspiring Business, Tekniker, TNO, UNINOVA, VTT, Université de Liège

E-MRS, EBN, EUREC AGENCY, ESTEP





There are many synergies between applications for different materials. Organising materials research and development on a cross-cutting basis makes sense to be more effective and further enhance the level of excellence and strength of the sector.

	Wind energy	Photovoltaic	Concentrated Solar Power	Geothermal energy	Electricity storage	Electricity grids	Bioenergy	Carbon capture and storage	Hydrogen and fuel cells	Nuclear fission	Buildings
Structural materials											
Fibre reinforced materials	Y		Y			Y			Y	Y	
High temperature, low temperature and corrosion resistant materials	Y		Y	Y	Y		Y	Y	Y	Y	
Structural steel components and related joining techniques	Y		Y	Y	Y		Y	Y		Y	Y
Advanced concretes	Y			Y			Y			Y	Y
Functional materials											
Separation membranes				Y			Y	Y	Y		Y
Catalyst and electrolytes					Y		Y	Y	Y		
Solid catalyst, sorbents and O2 carriers					Y		Y	Y	Y		
High temperature superconducting materials	Y					Y					
High temperature heat storage materials			Y		Y				Y		
(High temperature) insulating materials			Y	Y		Y		Y		Y	Y
Materials for power electronics	Y	Y		Y		Y					
Heat transfer fluids			Y	Y						Y	
Manufacturing techniques											
Coatings and coating techniques	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
Condition monitoring techniques	Y	Y		Y	Y		Y	Y	Y	Y	

Source: SET Plan Materials Road Map, 2011

ENERGY MATERIALS INDUSTRIAL RESEARCH INITIATIVE

EMIRI
Bridging the Innovation gap

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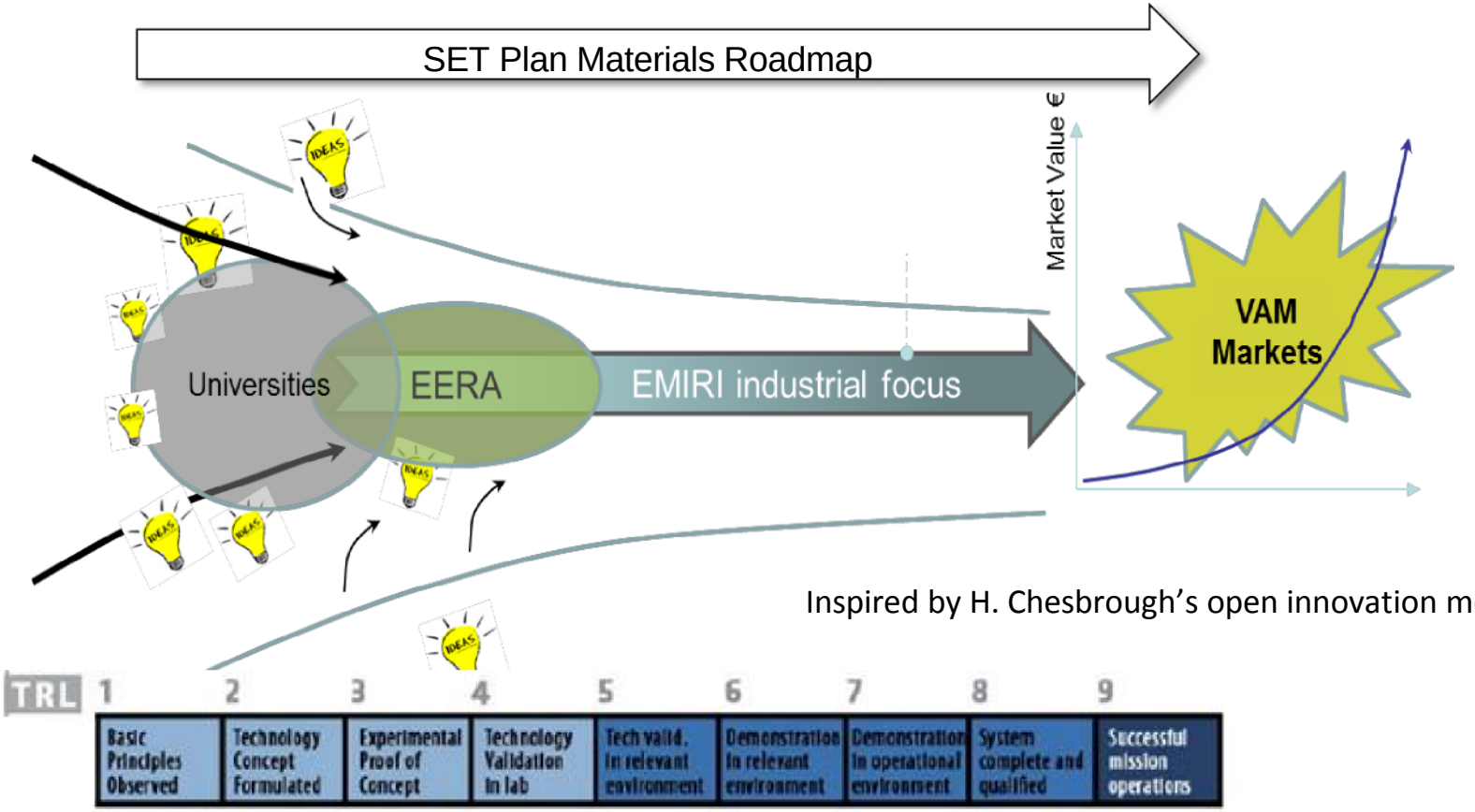
Building Industrial Leadership in Energy Materials - the Vision and the Actors



Inspired by H. Chesbrough's open innovation model

ENERGY **M**ATERIALS **I**NDUSTRIAL
RESEARCH **I**NITIATIVE

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Bridging the Innovation gap

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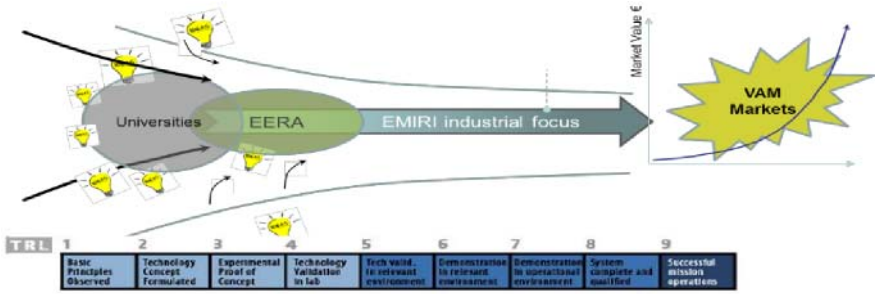

EMIRI is an industry driven grouping whose goal is:

- *To establish a strong and vibrant advanced materials sector for competitive low carbon energy inspired by the SET Plan goals and Materials Roadmap*

- *To bring together industry and research organisations for sustained strategic RESEARCH **and** INNOVATION programmes*

Conclusions

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1. Europe and the rest of the world face a major challenge in meeting energy demands while combstting climate change

2. A portfolio of energy technologies will be required and each of these depends on cost-effective and reliable materials and manufacturing technologies

3. European industry, institutions and governments have recognised that collaborative materials R&D represents the best way to meet the challenge

4. EMIRI is the latest in a series of initiatives aimed at developing collaborative energy materals projects – from concept to commercial deployment

Coming soon: Materials for Advanced Power Engineering Conference, Liege 14 - 17 September 2014

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Thank you for listening

Questions?

j.e.oakey@cranfield.ac.uk