

**MEETING DATE:** 19 July 2012

**LOCATION:** 170 Queens Gate, London, SW7 5HF

**ATTENDEES:**

Chair:	David MacKay	DECC
Members:	Martin Grant	Atkins
	Julian Allwood	Cambridge University
	Tom Delay	Carbon Trust
	David Clarke	ETI
	Duncan McLaren	Friends of the Earth UK
	Sue Ion	Royal Academy of Engineering
	Paul Lewis	Scottish Enterprise
	Neil Morgan	TSB
	Peter Bance	Octopus Investments
	Jill Duggan	Doosan Power Systems
	Peter Emery	Drax Power
	David Eyton	BP
	Neville Jackson	Ricardo
	John Loughhead	UKERC
	Ron Loveland	Welsh Government
	John Perkins	BIS
	Rod Smith	DfT
	Alison Wall	EPSRC
Non-members:	Rufus Ford	SSE
	Diego Villalobos	Ofgem
	Alexandra Elson	Shell
	Mike Thompson	CCC
	Ray Eaton	DECC
	Stephen Fleming	E.ON
	Adrian Gillespie	Scottish Enterprise
Secretariat:	Farida Isroliwala	DECC
	Ian Welch	National Grid
Analysis Team:	Jonathan Radcliffe	ERP Analysis Team
	Richard Heap	ERP Analysis Team
	Mark Workman	ERP Analysis Team
	Helen K Thomas	ERP Analysis Team

**1. Chair's introduction**

David MacKay welcomed Members and noted apologies from Nick Winser (National Grid); Jeremy Watson (DCLG); Ian Marchant (SSE, with Rufus Ford attending as alternate); Stephen Trotter (ABB); John Miles (Arup) and John MacArthur (Shell, with Alexandra Elson attending as alternate).

David highlighted some changes to ERP membership:

- **Jill Duggan**, replaces Mike Farley from Doosan Power Systems
- **John Perkins**, new BIS CSA

- **Rod Smith**, new DfT CSA
- **Sara Vaughan**, will be the new E.ON representative, with Stephen Fleming, attending July's meeting
- **John MacArthur** replaces Graeme Sweeney
- **Ceres** have withdrawn from ERP membership. The Co-chairs proposed that Peter Bance should continue to attend ERP meetings until a replacement company (SME) was found – Members approved this.

Other notices:

- DECC have appointed a new Head of Engineering – Craig Lucas, from PPA Energy

The minutes of the April 2012 meeting were approved.

David then outlined the main meeting objectives, which were:

1. To discuss and agree conclusions and recommendations from the draft Hydrogen report
2. Agree key messages and any additional follow-up work regarding the International Abatement project.
3. To discuss ERP's work plan for the coming 18 – 24 months, and agree initial priorities

## 2. Project reports

### 2.1 Hydrogen

Neville Jackson introduced the Hydrogen project and explained that ERP's previous report on Energy Storage had initiated a more in-depth focus on Hydrogen. He highlighted three key questions considered in the report:

- 1) What are the competitive advantages of Hydrogen?
- 2) How can Hydrogen be produced in a cost effective way?
- 3) How could Hydrogen be best utilised in the UK?

Richard Heap provided an overview of the report, presenting the key findings. Some initial points noted were:

- Fuel cells are currently the most promising technology in relation to Hydrogen. Historically they have been expensive to produce but extensive R&D programmes means they are now competing in niche markets (e.g. forklift trucks and uninterruptible power supplies).
- The cost of fuel cell systems (globally) is diminishing further due to an increase in global sales.
- There have been marked improvements in the performance of fuel cells, such that in 2009 car manufacturers announced that they intend to bring fuel cell vehicles to market by 2015.
- The UK has a number of established companies, such as Johnson Matthey and Ceres, several of which are university spin-outs. However, there is a lack of opportunities in the UK, meaning companies look abroad for greater support and product development.
- Most of the UK's RD&D funding is through the EPSRC Supergen programme, with additional money from TSB, DECC and European Programmes for demonstration projects.

Richard covered the advantages and disadvantages of Hydrogen as a technology and mentioned some potential uses. Points noted were:

- Producing and using hydrogen can be inefficient because of the number of conversion steps. But despite this, hydrogen systems could provide valuable, competitive energy services.
- Hydrogen can be produced locally or centrally, from a range of primary energy sources. Where fossil fuels are used, the question is how to decarbonise production, which is likely to depend on carbon capture and sequestration (CCS).
- A major advantage of Hydrogen is that it could be used for long-term, large-scale storage of energy for grid balancing / peak demands.
- It could be used to capture 'surplus' electricity from variable renewables. However, Hydrogen currently has a round-trip efficiency of 50% compared to pumped hydro which is about 80%.
- It could be used as an alternative to electric heating systems - although this posed questions of how such a network could develop and be low carbon.
- Hydrogen use in transport requires co-development of vehicles and infrastructure, which will be easier for depot-based fleets (such as HGVs and Buses) than for passenger cars requiring a widespread refuelling network.
- Hydrogen offers benefits over batteries (greater energy storage and quicker refuelling), which makes it attractive for transport. Although Hydrogen fuel cell vehicle unit costs are currently higher, the system cost may be lower. In technology terms they share key components so are likely to develop together.
- Hydrogen could help decarbonise the gas grid and a 10% mix is permissible; above 20% would require gas burners to be replaced. Decarbonisation with hydrogen is not linear, and would require a high percentage of hydrogen, but this would reduce the energy content.

In relation to the questions listed by Neville (above), Richard noted the following:

- Although Hydrogen is currently confined to niche markets, its potential use could be more widespread, but there is uncertainty about how it might develop – whether from local sources or a more planned infrastructure.
- A better understanding is needed of the potential for the different uses and production sources to interact and how markets might develop.
- Consideration is needed of the timeframes within which hydrogen services could be required and therefore the rate of technology development.
- Surplus Hydrogen from the current industry could be used to prime markets but these are from high carbon sources and will require decarbonisation.

Recommendations from the project were:

- There is the need for a more strategic approach to Hydrogen development in the UK, both in the short term for technology development and long-term for where the hydrogen will come from.
- A study is needed to understand the costs and benefits of the options and how they could be integrated.
- More support is needed for the UK's fledgling industry and for new entrants that will help bring costs down.
- Better coordination of pilot and demonstration projects is also required to improve utilisation and learning.

David Mackay prompted member feedback and discussion of the report and noted that hydrogen was attracting growing interest within DECC, particularly from an energy systems viewpoint.

In general, Members felt the report was timely as Hydrogen is returning to the political agenda. The focus on Energy Systems was welcomed and that it is not just an issue for transport. It was recognised that there is a growing appreciation (generally) around the complexity of Hydrogen, which goes beyond batteries versus fuel cells. Members felt that the report was useful in that it helped clarify and organise questions that the UK should be considering more closely, but hadn't necessarily been able to answer all the questions posed and more detail was needed on what an energy system approach would mean, for example for transport.

Members suggested that further work could include:

- A clearer perspective on what it would take to deliver the various options - how much would it cost and what are the timeframes for doing this? This should include a review of where technology is now and where it is going.
- Details on where Hydrogen use could be most valuable in the UK.
- More in-depth analysis regarding system costs and innovation (programmes in these areas already exist e.g. through the ETI).
- Identification of possible no-regrets opportunities, although it was recognised this would require further cost analysis.
- A closer look at decarbonising hydrogen and the variety of possible sources e.g. Biomass, Nuclear and underground coal gasification (although the latter is a topic on its own and closer to shale gas).
- Discussion of the different levels of purity of Hydrogen and therefore different uses.
- An additional section on Air Synthesis (combining hydrogen with ambient CO<sub>2</sub> to produce chemicals and fuels such as methane or ammonia).

It was cautioned that because Hydrogen is such a broad and complex technology area, expanding the scope could mean the report loses focus. It was therefore thought best to keep the report as simple as possible and concentrate on areas of possible commercial advantages.

The recommendation of a strategic approach to the decarbonisation of Hydrogen was welcomed but as there are still many uncertainties around actual figures for Hydrogen production; it was suggested that scenarios would be a more useful tool, compared to the recommendation for a roadmap.

It was questioned whether a low carbon Hydrogen option existed, (given the dependency on CCS), and if Hydrogen scenarios should even be considered? This opinion was met with the view that now is not the time to give up on Hydrogen options as it could help solve future intermittency issues.

Members supported the need for further studies into an integrated system approach and its costs and benefits, but were unsure who should carry out this work. Imperial College and other initiatives/programmes such as those by the ETI and EPSRC were mentioned.

It was emphasised that innovation should be around integration as well as cost reduction, noting projects in the recent TSB funding call that included SSE and Honda.

Some members were excited by Hydrogen as an 'enabler' and 'de-risk' technology that buys optionality particularly to decarbonised electricity. The 'unknowns' regarding the technology were viewed in some lights as a positive factor meaning more research is required, legitimising any initial investments. It was highlighted that more companies are becoming interested in the Hydrogen technology area.

Following the debate on how 'clean' Hydrogen technologies could be; David Mackay made the point that any further work should include recommendations for innovation support for making Hydrogen cleaner.

The report was recognised as having an important 'top-down' approach although it was mentioned that the entrepreneurial 'bottom-up' approach to developing the technology should not be overlooked in regards funding and investment. Case studies such as Ontario were referred to where Hydrogen is being developed to store energy from the extensive wind programme rather than having to pay to export it to New York.

Neville Jackson closed the discussion stating that members' comments echoed the steering group's initial concerns. He emphasised the point that support is needed for UK SMEs and entrepreneurs. UK based demonstration programmes would help them gain success in the international market.

David Mackay thanked members for their input and added that the position of hydrogen, along with other technologies, will need to be considered in relation to DECC's next bid under the CSR.

**Action:** Richard Heap to make amendments/carry out further analysis in response to member discussion with a view to finalising the Hydrogen report.

Members are invited to submit any detailed comments they have on the report to Richard Heap by Friday, 7<sup>th</sup> September.

The final draft of the report will be circulated to members for approval in due course.

## **2.2 International Emissions Abatement Opportunities – follow-up analysis**

Tom Delay reminded members of the original aim of the project and provided a brief update in response to requests for follow-up work at April's plenary meeting. Tom briefly summarised the high-level findings of the report and noted that countries' pathways did not always reflect 'least cost priorities' but a mixture of: Security of supply, low-carbon targets and economic opportunities.

Mark Workman went on to re-familiarise members with aims and key messages in more detail and drew attention to the overarching project insights.

Mark encouraged discussion on project recommendations and follow-up work and mentioned he would present on the additional power generation sector analysis if time allowed.

Members agreed it was important to understand how UK emissions abatement opportunities compare to other countries and how the UK can benefit by learning from and collaborating with others.

Members discussed possible amendments to the follow-up work. This was mainly focused around the colour coding utilised in the summary of collaboration opportunities and types of collaboration between the UK and other nations in the survey for specific abatement opportunity areas. Members felt some opportunities were stronger than had been portrayed (requiring a change in colour) and also requested further granularity for some categories e.g. 'Offshore renewables development' should be disaggregated into offshore wind and marine.

Members additionally felt it would be beneficial to differentiate between R&D, private sector and national deployment activities; the works focus on the latter should be clarified.

The following points were also made:

- A focus on *which* countries showed most opportunity or need for collaboration with the UK, based on abatement strategies, was welcomed.
- Some countries may appear not to support certain abatement options (e.g. Germany in relation to CCS storage); however the amount of R&D funding in these areas can actually be very high (relative to the UK).
- There are many existing MOUs in place with often with diplomatic intentions rather than scientific ones. Members agreed on the importance of making connections where actual value can be added and were keen to see comment on high quality collaborations that were certain to add value. This will be best undertaken in the International Engagement project into which this work will feed.
- Emissions abatement opportunities are often territorial and complex.
- The development of industrial strategy work is being undertaken in BIS at present.

Tom Delay encouraged members to provide comments on follow-up opportunities, taking into account whether undertaking more in-depth analysis would be of greater benefit when highlighting collaboration opportunities.

Mark Workman presented on some possible follow-up options available, which included:

- A policy briefing note to DECC/Government
- Work with academic groups to a make case for / set the agenda on Industrial Strategy / Policy
- Others?

It was concluded that the main International Emission Abatement Opportunity report containing follow-up analysis (including that requested at April's plenary meeting) would be circulated to members and that a brief policy note should be presented to DECC/BIS/Government.

Any follow-up academic work would be needed by September to feed into the BIS's work on Industrial Strategy / Policy. The type of input required would need clarification.

The overall recommendations from the project were approved.

**Actions:**

Members to feed-in any further amendments to the table of collaboration opportunities/needs, Mark to amend table with these and suggestions noted during the discussion.

Analysis Team to circulate the draft International Emissions Abatement Opportunities analysis report to members for review.

Mark Workman/ERP to develop a policy-briefing note to send to government and inquire as to how the work, or any follow-up activity, may be best fed into the BIS Industrial Strategy / Policy Work.

### 3. ERP Future work plan

Jonathan Radcliffe re-capped on ERP's existing, upcoming and possible future project opportunities. Members were reminded of the broad remit of ERP's work, which covers the full energy spectrum and innovation process.

Some general comments on the role of ERP were made:

- ERP still had value, but members felt that recent changes to the research landscape could potentially change its role. The benefits of seeking ERP 'customer's' views were reiterated.
- ERP's work should avoid overlapping with that carried out by bodies such as the ETI and the Low Carbon Innovation Coordination Group (LCICG). Therefore, it was suggested that a presentation by LCICG on the Technology Innovation Needs Assessments (TINAs) would be a valuable item at October 2012's plenary meeting. Another 4 TINAs are expected to be published very shortly.
- It may be that ERP's future work needs to have a greater system focus and less technology specific (given the work covered by TINAs and other such initiatives) and instead focus on broader or more controversial project topics.

Specific suggestions for ERP's future work over the next 18 months were discussed. Some specific points made were:

- Research by UKERC has shown that the public does not believe those responsible for the energy system.
- CCS is a crowded space in which to do more work.
- Development of CCS and Shale Gas were more dependent on policy than innovation.
- A report for the Research Councils on Fusion is due to be published by the end of the year, which could inform a discussion by ERP.

Areas with most support for work by ERP were:

- Buildings technologies
- Flexible generation
- Public engagement

Other areas with some support were:

- Innovation landscape
- Scenarios
- Unconventional fossil (Shale gas, underground coal gasification)
- Energy systems in communities / cities
- Fusion (subject to Research Council report)

Less well supported were: further analysis for the international abatements project; follow-up to work on SMEs; CCS; renewable technologies; enhanced oil recovery; and thorium.

**Actions**

Analysis Team and Secretariat to explore with LCICG to present at next plenary meeting

At the October meeting, ERP to discuss the scope of potential work in public engagement, flexible generation and buildings technologies.

Jonathan to engage with Members and wider stakeholders on ERP's future role over next 6 months.

**4. Any other business**

No other business was discussed and members joined the ERP drinks reception and dinner.

The next meeting will be 16 October, 10.00 – 12.00.