

**MEETING DATE:** 4<sup>th</sup> February 2010

**LOCATION:** Westminster Conference Centre, 1 Victoria St, London

**ATTENDEES:**

**Chair:**

David MacKay DECC

**Members:**

David Eyton	BP
David Clarke	ETI
Brian Collins	DfT/BIS
Tom Delay	Carbon Trust
Mike Farley	Doosan Power Systems
Sue Ion	Royal Academy of Engineering
John Loughhead	UKERC
Ian Marchant	SSE
John Miles	Arup
Graeme Sweeney	Shell
Alison Wall	EPSRC
Jeremy Watson	DCLG
Allan Jones	E.ON
Trevor Gregory	ABB
Julian Allwood	University of Cambridge
Peter Emery	Drax
Neil Morgan	TSB
Nick Winser	National Grid

**Non-Members:**

Richard Neale	Atkins
Jeanie Cruickshank	DECC
Kersti Berge	Ofgem
Samantha Riches	EPSRC
Jason Green	EPSRC

**Secretariat /Analysis Team:**

Ian Welch	National Grid
Farida Isroliwala	DECC
Rebecca Jeffree	DECC
Richard Heap	ERP Analysis Team
Jonathan Radcliffe	ERP Analysis Team
Ilaria Longo	ERP Analysis Team
Mark Workman	ERP Analysis Team

**Apologies/Not present:**

Paul Lewis	Scottish Enterprise
Ron Loveland	Welsh Assembly Government
Peter Bance	Ceres Power
Duncan McLaren	Friends of the Earth Scotland

## **1 Chair's introduction**

David MacKay welcomed new members to the ERP: Trevor Gregory from ABB, Julian Allwood from the University of Cambridge, Peter Emery from Drax, and Richard Neale (standing in for Keith Clarke) from Atkins. Apologies were noted from Ron Loveland, Peter Bance, Paul Lewis and a further new member, Duncan McLaren from Friends of the Earth Scotland.

The minutes of the previous meeting were approved.

David MacKay stated that the Consortium Agreement has yet to be finalised and will be circulated shortly for signature and then reminded members that the ERP Review had been published in November. DM then reported on the meeting that a group of members had with the DECC minister, Greg Barker on 30 November. The meeting included an overview of ERP's work from the past two years and plans for the future, then focused on a few examples including CCS, energy efficiency in domestic buildings and R&D in SMEs. The minister responded with some emphasis on the issues he would like to see addressed.

## **2 Draft Report on Energy Storage, John Miles/Jonathan Radcliffe**

DM introduced the item on the Energy Storage report saying that it is one of the crucial priorities for improvement in the 2050 pathways work.

John Miles opened the presentation by stating how the 80GW generation capacity could rise to 120GW in pathways to 2050, with an increase in electricity demand for heat pumps and Electric Vehicles (EVs). Energy storage is an important issue because of the difference between peak and the average demand, and the variation across days and seasons. Not only is there likely to be more demand on the system, but also the introduction of variable supply. If energy storage could be utilized effectively on the system it could reduce some of those peak requirements, which would be accentuated because of the variability of resources like wind.

JM noted that it is not a subject that has had a great amount of historic attention because the costs have been high and it has not been so necessary. Hence there are many possible opportunities to be explored. He then gave the floor to Jonathan Radcliffe to present the content of the draft report.

Jonathan Radcliffe starting by saying that the objective of the report was to provide a high-level overview of the technology area 'to guide public and private sector decision makers when considering the potential role of storage technologies in the future energy system, and therefore what needs to be done now to prepare.'

Energy storage is conceptually appealing, given its ability to 'time-shift' supply to times of demand to: reduce generation capacity especially at peak times; provide 'back-up' to intermittent generation; make most efficient use of infrastructure capacity; and respond quickly for power quality.

However, there are other means of meeting the same general and specific challenges: using flexible generation which is currently the most cost effective way of meeting extra demand; demand side response with smart meters deployed over the next decade; and increased interconnection providing additional capacity or load for the UK, but operated on merchant basis it is not solely for UK benefit.

The challenges facing the energy system at different timescales were outlined:

- The scale of seasonal heat demand in the UK is huge, currently at >100TWh (delivered heat). By 2030 heat from Heat Pumps (HPs) could deliver an average

12MWh a year in 7m households according to the Committee on Climate Change medium scenario. The goal isn't necessarily to supply the electricity to power heat pumps when they need it, but to provide the service of thermal comfort when people want it.

- Low wind periods of several days require of order 1TWh, or 10GW delivered over days, which is still beyond any foreseeable central electrical storage capacity. GW links to new Pumped Hydro Storage (PHS) in Norway may help, though UK will be in competition with other countries for that.
- Managing daily peaks is an area where there is greater prospect of energy storage making a real difference. Peak shaving/load levelling arbitrage over hours is already commercial with PHS, and potential from new technologies (such as compressed air and large battery stores). EVs and HPs with thermal storage could also offer flexibility for flattening demand. There is potential for distributed/domestic electrical storage, possibly using 'second life' EV batteries.
- As for short time scale response, National Grid forecast greater need for Short Term Operating Reserve Requirement (STORR) with increasing wind. Frequency response also likely to become more important with rapid ramping of renewables, and could limit the generation from wind on the system.

We can see where and how energy storage could help meet the challenges in principle, but we don't have the detailed analysis to show:

- Where energy storage devices should be placed in the system
- The characteristics of energy storage which are required at different locations
- The optimal mix of energy storage, generation and demand side technologies
- Where infrastructure need urgent strengthening or can be deferred.

Cost-optimised energy system modelling is limited in its ability to capture temporal or spatial regimes in which energy storage technologies operate. Power system modelling has been limited to static modelling for energy storage. At least 27GW new capacity needed 2021 – 2030 due to plant closures; the energy system is going to be dynamic over years → minutes. We need the tools for planning the transition to include energy storage.

Some analyses help define benefits:

- Cost savings from reducing peak generation capacity from DSR
- Temporal Market chooses 7 - 10 % demand as storage (mostly distributed)
- IEA analysis suggests 50 – 100 GW required in western Europe
- Analyses for CCC by Pöyry, and AEA/NERA, and for ENA by Redpoint on gas networks, all show some benefit
- Report for the Scottish Government concludes PHS best option in short term, but marginally more expensive than new generation.

Cost/technology maturity main barrier now, but some issues *may* act against deployment:

- Uncertain impact of EMR capacity mechanism, though designed to be technology neutral
- Energy storage not eligible for ROC/FiT incentives, though may offer emission reductions
- Regulation does not recognise energy storage as a separate asset class, cannot be owned by network operators who could be beneficiaries.

UK R&D on energy storage has been increasing and focused on specific areas where world-class capability exists, especially Li-ion batteries. There is variable funding from other sources: the Carbon Trust, TSB and ETI. There is activity in the private sector with several

small companies investigating battery and other technologies, and some interest from major industry. Especially interesting are the companies with novel solutions.

The central conclusion of the report is that there is a gap in understanding of the role for energy storage in pathways to a low-carbon economy. It is a complex field which needs detailed analysis to guide appropriate technology development and deployment measures. Without such analysis, there is a risk that opportunities to reduce economic and environmental costs of greater renewable generation and electrification of heat will be missed.

John Miles concluded by proposing that ERP should take the work forward by building a high-level roadmap for energy storage in the UK. This would encompass the development of technologies from research through to deployment, including an assessment of UK capabilities and the enabling regulation and policy to facilitate the steps.

### **Discussion**

Points raised in discussion included:

- There are a large number of degrees of freedom which makes progress difficult. Segmenting and defining the opportunities may be one approach. Another view was that the technical possibilities may be the main driver behind progress, with an opportunistic rather than planned development.
- Quantification of the potential for an increase in pumped hydro storage to cover low wind periods would be valuable
- The challenges described by the report show how effective fossil fuels are at meeting energy demands almost instantaneously. We should examine ways of continuing to use them efficiently whilst abating their emissions.
- The costs and cost-reduction potential of energy storage relative to the alternatives would be a useful comparison to make. Reductions in cost and scalability would make the technology a game-changer – what innovation support is required to make this happen? It was suggested that energy storage could be a focus for one of the Technology Innovation Centres (TICs) which are being established by the Technology Strategy Board.
- Providing domestic heat was a key challenge highlighted by the report, the magnitude of which may make stock replacement, retrofit passive houses or use of process heat, attractive options.
- It was questioned whether hydrogen should be looked at in more detail as a serious opportunity, particularly in combination with CCS generation.
- Without knowing what the regulations should have any specific aims to encourage energy storage makes it difficult for the Electricity Market Reform to deliver the right incentives. However, a short but urgent piece of thinking by ERP as input to the EMR consultation may be useful to ensure that the doors for storage are left open.
- Issues to be considered are not just technological - innovation will be required in systems architecture and consumer behaviour. Business models will also need to be considered, including who has an interest in deploying energy storage.
- Integrated assessment of energy storage needs were being assessed by an SSE study with Ofgem being initiated in Feb 2011 called the `Shetland Sandpit`.

There was support for ERP to continue the work so as to set out the UK's capabilities, and the steps which could be taken to enable regulation/policy to meet the challenges.

### **Actions**

The report will be finalized in the light of the discussion, and reviewed by the Energy Storage Steering Group before circulation to ERP Members for approval. The aim is to publish the report by April.

The Steering Group will also consider follow-on work from the project, including development of a high-level roadmap.

### **3 Research Councils Review of Energy, Jason Green EPSRC**

Jason Green reported on the RCUK Review of Energy, undertaken by an International Panel at the end of October 2010. The panel visited 30 universities and a number of other organisations to assess the quality of research funded through the RCUK Energy Programme and the impact the Programme has had in the UK and internationally. The draft report was presented to a Town Meeting in January.

The panel concluded that the RCUK Energy Research programme is delivering impact in the UK and worldwide, finding:

- On impact: On the whole, the academic community is very well regarded on the international scene for its excellence. However, in terms of impact on economic benefit, industry development and quality of life, there were concerns that much more could be done.
- On quality: There were many examples of impressive excellence, especially where there has been sustained focus. Again, the panel recommended improvements.
- The skills base: There was a good pipeline of doctoral students and post doctoral research associates. The availability of long term career paths thereafter was less than clear.

A number of specific findings of the panel were described, including:

- A focussed strategy and roadmap for energy research would benefit the UK economy and global competitiveness.
- The commitment to strategic research programs should exceed 10 years.
- An opportunity exists to accelerate deployment and fill the gap in TRLs 2 to 3. The balance between SME and large industry should be explored and the relationship between RCUK, TSB and ETI.
- There is a coherent energy research community and it was recommended to support cross-cutting networks at universities.
- No present shortage of doctoral or post-graduates, DTCs is part of the success story though Masters and undergraduate energy programmes need to be scaled up. Attracting overseas students is effective, but retention/integration appeared less successful. Attention and resources directed to career paths both in industry and academia for multidisciplinary work is required.
- Examples of international collaborations were evident, but not quantified. The UK should go beyond existing systems and develop new opportunities for working internationally, removing barriers toward increased international collaboration regarding the R&D funds, encouraging researchers to identify and engage with international collaborators in proposals for funding.

Assessments of specific disciplines were made by the panel:

Biomass and bioenergy has a place in the UK, international (US, Brazil) collaborations are essential.

CCS and coal –needs a clear UK vision and strategy for engagement.

Demand side and energy efficiency needs to be aggressively pursued in order to meet goals.

Pilot projects show promise in ground heat source.

A smart grid advisory panel should develop a vision to identify gaps for RCUK Nuclear fission research through KNOO and the DTCs are important to meet future capacity needs. Clear alignment priorities need to be made with industry.

Fusion research is world leading.

Benefits of working jointly with social scientists was clear.

Expertise in PV solar, networking should be built to strengthen long term research.

Future wind industry needs should be matched through supporting deployment research alongside offshore demonstrations and strengthen basic research

Structural issues within wave & tidal would improve national research collaboration and accelerate impact.

The panel's overall recommendations were for:

- A fully integrated “roadmap” for UK research targets
- A single, well defined, cross-Councils energy research budget to provide a common vision and strategy to the research community and to avoid conflicting priorities
- More transparent allocation process for strategic programmes to ensure better/optimal research community involvement, thereby secure deliverables
- There needs to be increased efforts to identify opportunities, provide funding and then promote, recognize and reward interdisciplinary R&D.
- More attention and resources directed to career paths both in industry and academia for multidisciplinary work
- R&D on demand reduction needs a higher profile in the R&D portfolio, and may warrant a dedicated programme.

The panel saw that the overall funding level was not competitive and critical targets may not be reached, noting that the UK spends less on energy research than peer countries.

### **Discussion**

In discussion the following points were made:

- ERP Members who had been involved in the Review observed that
  - General views reflected by the panel were that the UK was doing well in spite of the difficult environment.
  - The two key messages were: much clarity of vision would be gained from a roadmap, and there was lack of transparency of processes.
- Recommendations on demand side were welcomed, but developing the research world is difficult as it is hard to find partners for exploitation of the results. It is also politically quite difficult because demand is so visible.
- The innovation support landscape post Research Councils was noted as being complex. Given this, the UK had managed to achieve a remarkable amount of coherence in energy research. It is important to ensure that energy objectives across the landscape are strategic and aligned. It was proposed that the UK's performance could be improved if a 'project manager' was in place to drive the effort and take responsibility for a budget.
- It is important to put effort into:
  - achieving a good understanding of the UK energy system which will enable coherent decisions to be taken; and
  - More SME business creation

- The Review links to ERP's continuing international engagement work. One of the big issues is knowing what collaboration is happening – recording activity in the UKERC Research Atlas may address this.
- Demand side should be at the centre of a change in UK research priorities from RCs through to TSB.
- It was noted that there are only two universities offering courses in engineering and economics. The UK should encourage more interdisciplinary and interdepartmental collaboration.
- There was some questioning of UK funding levels for fusion, though the recent review of fusion research which recommended continued support was noted.<sup>1</sup>

Alison Wall commented that an action plan which responds to the recommendations of the international review will be made within about 3 months by the Research Councils.

#### **4 Changes in the Innovation Landscape, Neil Morgan, Technology Strategy Board**

Neil Morgan highlighted recent changes to the energy innovation landscape with the introduction of Technology Innovation Centres (TICs), and demise of RDAs, Business Link Offices and Regional Govt Offices (GOs). The Technology Strategy Board would be taking over grants for R&D from RDAs and establishing the Technology Innovation Centres.

Last year the Hauser Review recommended that “the UK Government should commit to a network of elite business-focused national Technology Innovations Centres (TICs) for UK economic benefit”. This has been accepted by Government, with the TICs focusing where there are large global market opportunities, where UK has technical leadership and where there is capacity to anchor significant part of value chain in UK.

A strategy and implementation plan about what the centres functions will be, which technology areas to focus on and how to manage them will be developed by April 2011, with three or four centres up and running by April 2012.

Neil explained that an ‘Energy Technology & Innovation Centre’ would have to be in an area with potential global market worth £bns and contain:

- Business-focused, world-leading technical capabilities
- Outreach into world-class science
- The capability to undertake collaborative R&D projects with business
- The capability to undertake contract research for business
- A professional delivery ethos
- A critical mass of activity to anchor globally mobile energy sector companies in the UK
- Skills development at all levels

Total revenue is expected to be £20-30m a year with £10-15m a year from business.

#### ***Discussion.***

In discussion the following points were made:

- The complexity of the landscape had been an issue in the previous discussion, and the role of the centres in relation to TICs was questioned.
- Existing facilities could be brigaded into a TIC instead of starting something from scratch, though it is not required to have an energy TIC if it is not required.

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<sup>1</sup> See <http://www.epsrc.ac.uk/newsevents/news/2010/Pages/energystrategy.aspx>.

- A stated criterion for success was a potential global market worth billions. This could exclude demand reduction, which is where most opportunities lie, and which might be a system change rather than a value added technology which might lead to business growth.
- A first step could be to look at the market, see what gaps are in it and how they potentially fill them. The demand issue appears to be a big gap though it is a complex landscape to tap into.

### **Actions**

Neil asked for input by 18<sup>th</sup> February about what energy TIC should do, technical areas & focus, operational issues & performance incentives and governance arrangements. Names for the centres could also be suggested.

## **5 ERP priorities for future work**

Richard Heap invited members to indicate priorities for ERP's future work. He noted that it has been the ambition for ERP to cover a wide spectrum of technologies and cross-cutting issues such that we have the appreciation of innovation across the energy system that allows us to provide guidance and advice to policy makers and funders.

The Milestones to 2050 report has been used to provide the basis for structuring and prioritising ERP's future work and the recent projects have come directly from this. Since July 2010, major technology projects have been undertaken on nuclear fission (published in September 2010), bioenergy (which will be publishing in March/April), energy storage (also publishing in March/April) and industrial efficiency (started in October 2010).

The Analysis Team is also engaged in following-up previous work including a nuclear roadmapping project co-funded by EPSRC, NDA, ETI and NNL.

There are several possible avenues for future work:

- the technology areas that will be most significant to the UK's energy system, which have not been covered by ERP, are
  - transport and
  - off-shore wind;
- two potential projects have come from the energy storage and bioenergy projects, respectively:
  - hydrogen, and
  - resource availability;
- from the meeting with Greg Barker, some issues were raised that could form short pieces of work:
  - assessing global market potential of technologies,
  - international comparison of abatement intervention opportunities, and
  - support for SMEs particularly in bringing forward 'disruptive' energy technologies to the market.

Expanding on the issues raised by Greg Barker, Mark Workman explained that current work in DECC is studying global markets, and that the Carbon Trust had recently studied support for SMEs. However, a critical analysis of abatement opportunities within a coherent framework between countries is not available. A high-level briefing note could describe the different pattern of abatement opportunities for a number of countries (possibly France, Germany, USA, Brazil and South Korea) by April, with a more comprehensive report by July.



## ***Discussion***

Members were asked for their views. In discussion the following points were made:

- The minister's suggestions should not be the only grounds to initiate projects.
- The International Energy Agency should be the first place to look regarding international comparisons.
- A very simple and light-touch briefing on international comparisons, with specific outputs on what could be learnt from other countries would be something to aim for. A comment was made that the focus should initially be restricted to EU as these countries had the same 2020 targets. The Minister could also be asked for his views.
- A quick review of support mechanisms, coherence and gaps in the innovation landscape might help understand where the TICs fit. However, it was noted that there had been a number of recent reviews undertaken on the innovation landscape (e.g. Climate Change Committee, National Audit Office, Public Accounts Committee) and that the benefits of undertaking another would be questionable.
- There was general interest in the Carbon Trust study on SMEs.

Jeanie Cruickshank stated that DECC would like to involve ERP as part of its Technology Innovation Needs Assessments (TINAs). A specific TINA could be brought to ERP for review.

Allan Jones indicated strong support for the international comparisons project and that E-ON would be keen to participate.

David MacKay apologized for the lack of time to discuss the item further, but encouraged members to read the paper and respond with their feedback off-line.

## **6 A.O.B.**

Graeme Sweeney noted that the deadline for submitting proposals to the competition for 300m New Entrant Reserve EU-ETS allowances (the 'NER300') would be on 9 February.<sup>2</sup> The competition presented a significant opportunity for the UK.

## **7 Chair's Closing Remarks**

David MacKay closed the meeting and announced that a post-plenary discussion would be led by Ofgem on "Sponsoring and stimulating innovation in regulated businesses and networks".

## **Date of next meeting**

The next meeting is on the 8th April, 10 a.m. – 12 noon, and will be held at ERP HQ, 58 Prince's Gate, London SW7 2PG.

Future meetings in 2011 will be on

- Thursday 7 July
- Thursday 6 October

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<sup>2</sup> See [http://ec.europa.eu/clima/funding/ner300/index\\_en.htm](http://ec.europa.eu/clima/funding/ner300/index_en.htm).