The 14th Annual APGTF Workshop: The Role of Fossil Fuel Power Plant in Providing Flexible Generation

Report of the Panel Discussion Sessions

Attendance Figures

There were 124 delegates across the two days (107 on day 1 and 90 on day 2, with 74 attending both days). The delegates comprised representatives of industry, commerce, academia, Government, funding agencies plus other stakeholders and interested persons.

Day 1 - Fossil Fuels – Balancing the Drivers for Flexibility and Lower Carbon

Panel Discussion

Panel Chair: Philip Sharman, APGTF
Panellists: James Watt (AMEC), Ricky Chaggar (SSE), Greg Kelsall (Alstom Power), Professor Goran Strbac (Imperial College).

The Chair opened the panel discussion by making the comment that flexibility is just one aspect of power plant operation. How can the need for generation flexibility be balanced with other operational parameters such as reliability, maintainability, efficiency, affordability, etc. and how these should be prioritised?

The panellists addressed this question from a number of perspectives:

- In acknowledging that a number of relevant parameters come into play, one panellist from academia (Imperial College) preferred to consider this issue from a whole systems perspective rather than focusing on individual parameters. He added that the key driver of overall value would be of primary importance before taking into account individual effects on maintainability, efficiency etc.
- From an equipment supplier's (Alstom) perspective, work was still needed into the implications of flexibility and it would be important to work with academia, research organisations and networks such as SUPERGEN consortia/hubs to gain greater understanding of flexibility issues.
- From a power generator's (SSE) perspective, it was acknowledged that with, e.g. Electricity Market Reform (EMR), the drivers for flexibility are becoming more important with increasing interaction with organisations interested in flexibility. However, there needs to be a greater understanding of the potential tension between flexibility and efficiency and its implications.
- An engineering company (AMEC) would usually focus on efficiency but would also work closely with clients to discuss other important aspects of operation. However, cost was also of prime importance and any discussions would need to be realistic in this respect.

The discussion was then opened up to the floor and the additional points that were made are listed below.

How flexible does the grid system need to be, how much flexible plant does it need and, indeed, how is flexibility defined?

- One panellist discussed flexibility in terms of ramp-up times for, e.g. gas turbines and coal-fired plant and also with reference to load-following characteristics.
- Another considered this to be the ability of a plant to respond to prevent the grid system failing.
- Another important aspect was considered to be the ability to respond to reduced demand, perhaps with ramp rates being a less significant issue (although 4h-2h would make a significant difference) compared to start-up times or stabilised operation. In this respect, curtailing wind or nuclear output was thought to be less advisable as both were expensive technologies and needed maximum utilisation.
- This led to some discussion of the implications of energy storage from wind turbines and the possibility of siting industrial users close to wind farms.

Can the panel comment on the ability of the integrated CCS chain to respond to changes in electricity demand and also the cost implications?

- Although it is wise to be considering the problem of flexibility with the CCS chain, renewable electricity sources could also make an important contribution by increasing their flexibility, e.g. through hydrogen production.
- Diversity in the electricity supply system would also bring some degree of flexibility.
- It would be better to apply a distributed model of CCS first and then consider hubs to develop more complex organisation of CCS.
- Some believed that now is the right time to consider flexibility issues of CCS.
- Increased flexibility of any energy generation technology would lead to a bigger role in future generation systems but it is unclear or perhaps doubtful whether the issue of flexibility needs to be addressed at this time (RC).
- The question was not about technical ability to increase flexibility (even of nuclear power generation) but more one of the costs involved. Cost would also be an important determinant in reaching the balance between the various energy forms (GS).

What is being done to identify the lowest cost energy system considering the discrepancy in strike prices between for example thermal CCS systems and offshore wind?

- No obvious winners have emerged and other (political) issues including energy security are likely to favour a portfolio of options (GS).
- Demand side management (DSM)/participation could also play a major role in providing a solution, e.g. with large users moving to off-peak electricity. In this case, flexible CCS may not be as necessary as one might think.

- It was acknowledged that DSM could play an important role in maintaining the integrity of future electricity supply systems and that this was still a largely untapped 'resource'. DSM education could also play an important role in this respect.
- However, to maximise the influence of DSM, a cultural shift would be required and a number of barriers need to be overcome, e.g. the limitations of electric cars in both range and infrastructure (RC).
- The application of DSM could lead to the production of large electricity users, e.g. the fertiliser industry, being interrupted. Effective DSM would also require a considerable cultural shift (JW).
- It is unwise to generalise when considering the trade-off between the level of integration of a CCS generation system and its flexibility. Cost is also an issue but this would depend, e.g. on the type of CCS and the level of integration involved.

Day 2 - Alternatives for Meeting the Flexibility Requirement

Panel Discussion

Panel Chair: Philip Sharman, APGTF
Panellists: Professor Jim Watson (UKERC), Professor Richard Green (Imperial College), Jo Coleman (ETI), Robin Irons (E.ON), Bill Livingston (Doosan Babcock)

The Chair opened the discussion by asking the panel what was the future role of biofuels in providing flexible power generation?

The main points discussed are below:

- Experience with co-firing, one of the major biofuels applications in the UK, has shown that this does not compromise the operation and flexibility of the plant. However, at this stage, less is known about the flexibility of dedicated biomass power generation plant (BL).
- Flexibility of biomass plant was not considered to be a particular problem, according to one panellist, particularly in the long term, where it was envisaged that biomass plant with CCS would operate at full load. Beyond that, the potential for the production of hydrogen would assist in increasing flexibility (JC).
- There appeared to be more concern about biomass supply issues and appropriate use of land than flexibility of power generation (RG). Indeed, the sustainability of biofuels was a concern that was voiced several times during Day 2 of the workshop.
- Flexibility issues of biomass utilisation would also depend on the pathway the market develops, e.g. the use of biofuels for heating would impact on flexibility (JW).

Can the panel comment on the role of energy storage in addressing the flexibility issue? What are the relative costs and what is the trade-off between flexibility, operability, ownership, etc?

- It was agreed that cost would be a major factor. The UK currently has (3-4GW) of storage but more still needs to be known about the relative costs of the various options (RG).

- Electric vehicles could provide a form of energy storage depending on the decision when to recharge batteries (RG). However, future prospects for electrification of heat and transport are still regarded as being uncertain (JW).
- With regard to energy storage, the hydrogen energy vector is currently the benchmark. As with other technologies there will be a cost curve for energy storage and, as yet, it is unclear how far the technology is along this cost curve.
- The picture is complicated when heat demand is also considered alongside electricity demand and its role in addressing flexibility issues.
- There is an enormous demand for heat which cannot be solved by electrification alone. Other options include heat pumps which operate all the time or through district heating. Solar panels have also proved very effective and can heat water during the day. They can provide an effective solution if people have the equipment (JC).
- The UK gas grid was also considered as a potential energy store.

The comment was made that, with the operational flexibility of combined cycle gas turbine power plants (CCGTs), energy storage is unnecessary, at least while natural gas is readily available. How did the panel view this?

- The point was made that although additional electricity storage may not be necessary at present, the 2050 target for carbon reductions would mean we should consider all options (JC).
- Maintenance issues associated with flexible operation of CCGTs would also be an issue together with the question of how CCGTs can be incentivised in the complex energy system of the future (JW).

But is energy storage an immediate priority?

- One panellist put forward the view that the market would always optimise depending on the baseline criteria it had to meet (RI).
- Discussion then centred on the concept of the 'carbon bubble'/'trillionth tonne' of carbon, beyond which average global warming would exceed 2°C and serious global climate change impacts would occur. It was questioned whether market forces alone would be effective in meeting this threat (JW). This was illustrated by reference to the location/geopolitics of the trillionth 'unburnable' tonne as no country had yet to identify its carbon as being unburnable.
- CCS was not considered to provide a complete solution as not all countries have CCS options and some countries would not consider CCS in any case.

When discussing extreme possible future scenarios a keynote presenter (JC) made the point that "we have a decade to prepare our options". Would it be the market alone that will decide?

- It will not be just one decision, and many important decisions will need to be made along the way. The development of appropriate business models alongside technical developments will be important. Much could be done to incentivise business including appropriate policies, EMR, carbon price, etc. Ten years is a long time to

develop policies and put these in place but this does need to happen in parallel with technical development and other measures (JC).

- We will need standards, development of carbon prices and transformation of 'technology-push' (RG).
- Cumulative emissions budgeting would also have a bearing on the decisions to be made under varying IPCC emissions scenarios. In this respect, CCS will not be fully dominant and we will also need to consider, e.g. methane emissions from fossil fuel production.

What is the cheapest levelised cost of electricity (LCoE) that would be low carbon when you compare the whole scenario, i.e. what is the cost of decarbonising electricity?

- The presentation from ETI addressed comparative costs of decarbonising electricity and identified the important role of CCS in reducing these costs (JC).
- Although CCS does relatively well on cost, it is still unclear what the cheapest option will be. However, we should not consider decarbonising electricity in isolation but decarbonisation of the entire energy system.
- It was also considered that CCS would be required elsewhere in the system and not just in power generation.

.