Minutes of ICARB Grid Carbon Intensity Workshop

Monday 13th June 2011, Heriot-Watt University

Present

Phil Banfill, *Heriot-Watt University*
Samuel Chapman, *Heriot-Watt University*
Mehreen Gul, *Heriot-Watt University*
Gareth Harrison, *University of Edinburgh (Guest speaker)*
Jim Hart, *Edinburgh Napier University*
Adam Hawkes, *AEA Technologies/Imperial College London (Guest speaker)*
Iain Hossack, *North Ayrshire Council*
Vicky Ingram, *Heriot-Watt University*
David Jenkins, *Heriot-Watt University (Chair)*
Ben Murray, *Blackwood Environmental Consultancy*
Sue Roaf, *Heriot-Watt University*
Camilla Thomson, *University of Edinburgh*

Presentations

- ***Introduction to topic***, Dr David Jenkins
- ***Estimating Marginal Emissions Rates for Electricity Systems*** – *Progress and Challenges*, Dr Adam Hawkes
- ***Carbon intensity of electricity: towards more realistic numbers***, Dr Gareth Harrison

All the above presentations are available at www.icarb.org/2011/06/28/grid-carbon-intensity-minutes/

Minutes

1. The discussion session was centred around (though not limited to) three broad questions:
    a. Are the official annual average grid carbon intensities indicative of the electrical energy that we use? Why, in previous years, have these figures varied so much?
    b. Do we need to think about how carbon intensity varies over the year, and throughout a given day, to understand the carbon impact of specific technologies?
    c. As we electrify both transport and energy use in buildings, what impact will this have on the electrical infrastructure of the UK and, in turn, the carbon intensity of electricity generation?

2. The presentations earlier in the day demonstrated the significant variation in grid carbon intensity (CI) figures that have been used in recent years, and the effect this can have on technology performance; examples of ground source heat pumps and combined heat and power were given to this effect.

3. The use of “marginal” CI can produce vastly different values than the “average” values often used, as demonstrated by the Imperial College study (AH). Marginal CI aims to represent the type of power plant that is likely to respond to any given change – as this is likely to be fossil-fuel based (weighted towards coal and gas), this value will be numerically higher than the national average. Using Elexon’s balance mechanism data, a value of 0.69kgCO_2/kWh was calculated. This is 60% higher than the marginal CI used in policy analysis, of 0.43kgCO_2/kWh (this smaller value assuming a response from CCGT).

4. A further complication relates to the “build margin”. An example of an electric car was given. A large number of electric cars might cause an extra power plant to be built, and each car is therefore partly responsible for that station being built – and this should somehow be reflected in our carbon assessment of that car. However, when the car is charged, it does not necessarily use the new power station to do so – in such a case, the marginal rate might be more appropriate, and this is the “operating margin”. The question was raised concerning how do we accommodate these two different sources of carbon emissions, both in some way resulting from the use of an electric car?

5. Grid CI, in reality, varies with start-up times of specific power plants. University of Edinburgh (GH) used real power plant data to demonstrate the effect of warm-up times on the CI of electricity production. This study included, for example, the significant drop in efficiency when part-loading CCGT and coal plants. The CI of a CCGT plant during “warm-up” (as the plant prepares to come online for a set time) could be as much as 0.8kgCO_2/kWh. For coal this can be 1.2-1.4khCO_2/kWh. This type of analysis demonstrates the detail that can be lost when using, for example, DECC CI estimates. The cycling of power plants is clearly important when estimating time-of-day CI.

6. Simple emission factors will not always be suitable for making the correct choices. Also, while we can have a suitable degree of certainty for historical CI (including marginal CI), predicting future CI for informing policy decisions far more complex. Large levels of uncertainty in future demand and future supply characteristics. Increased use of wind will change the cycling patterns of conventional power generation in a detrimental way, as well as putting greater requirements on reserve capacity. Overall grid CI would drop (if wind and other renewables reach higher penetration on the network), but average CI of thermal generation likely to rise.

7. The value of “0.43kgCO_2/kWh” is itself a marginal CI, so introduction of such values as the norm should not be an issue.

8. Electric cars were used several times as an example of the problem around ascribing current and future CI’s to technologies. Like heat pumps, electric cars are a suitable low-carbon technology providing we meet targets for renewable generation. There was a concern, more generally, over how we assess these technologies now. Even though their current carbon emissions might be significant (using either average or marginal CI’s), should we accept that their carbon emissions will reduce over time as the national grid becomes decarbonised (according to government targets)? This raises the prospect of justifying technologies for installation now based on future CI’s – how can this be legislated for?

9. A further uncertainty, in relation to electric cars, is the charging behaviour that would be adopted. Uncontrolled usage is likely to require an increase in power plant number to cope with peak demand (if electric cars achieve widespread penetration in the

market). However, could they be used as an effective “store”, thus allowing more flexibility in the network and (with improved load factors) produce lower CI? Perhaps this is possible but is it feasible to include this as a likely future scenario when estimating the future carbon impact of electric vehicles?

10. It should be remembered that, when forecasting future scenarios, a combination of different technologies are going to be in use. It is not sufficient, therefore, to talk about the effect of (for example) electric cars on grid profiles (and subsequently CI). There will be a selection of technologies with a combined effect on the grid, and a resulting CI that will reflect this. Again, this is non-trivial.

11. Following the work at Imperial, is it possible to imagine a combination of build and operating CI’s used in a standardised way (such as with building performance calculations)? It was generally agreed that this would be a suitable approach. Concern was expressed towards the level of complexity of such recommendations, and whether these could be disseminated towards policy makers. However, it was also pointed out that it was not necessary for users of this information to constantly refer back to the basic principles.

12. Some technologies will become less attractive, in terms of carbon performance, as the grid becomes decarbonised. Unabated gas CHP was put forward as one example of such a technology. However, unabated gas CHP could have a role as a “transitionary” technology – a solution for carbon reductions now that would have to be phased out in the future as the grid evolves.

13. Some technologies are not always fairly represented by official guidance. Heat pumps do not perform well with the Standard Assessment Procedure (SAP) for dwellings. This might change if CI is updated over time – but, again, the question of when we should install these technologies is raised. Should we simply wait until CI reaches a threshold where such technologies are a “no-brainer”, or will it be too late to achieve mass installation by that point?

14. Large-scale renewable are included in, for example, UKERC future scenarios of the national grid, but how can we account for more uncertain technologies? Is the potential domestic market around solar PV too uncertain for this to be included as a major future provider of technology? Returning to electric cars, domestic solar PV could change our assumptions on the effect of electric vehicles on build margin.

15. It was discussed whether a new approach is something that the Scottish Government could lead, perhaps reflecting the current and near future renewable generation in Scotland. This does not necessarily mean Scotland using different assumptions than south of the border but it could lead a different way of calculating and applying CI values.

16. In summary, it should be possible to improve, and clarify, the current CI values that are used in academia and industry. These can be disseminated in a relatively simple form, but still include more detailed calculations that are more indicative of the actual characteristics of large-scale electricity production. The problem is projecting this for future scenarios, and making choices of technologies now (particularly in the building sector), which will only reach their optimum carbon performance in a future national grid.