NOTES ON “ENERGY” LECTURE

For Bath Royal Literary and Scientific Institution

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FAIRNESS, PHYSICS AND SUSTAINABILITY

Grown-up energy strategies for the UK in the 21st century.

I don’t mean ‘a bit more sustainable here and there’, I mean whatever it takes.

“Whatever it takes” is determined mostly by physics, not by politics, so there’s not a lot of debate needed about the conditions we have to satisfy. As Canute the Great is said to have demonstrated a thousand year ago, it is foolish to argue with Nature.

Underneath, it’s all rather simple. We face a lot of big sustainability problems, but the over-riding one is Climate Change. We all agreed this was a big deal in 1992, when we signed the UNFCCC and undertook to take all necessary steps to ‘avoid dangerous climate change’.

So it’s official. What then *is* ‘dangerous climate change’? The contemporary standard is a 2°C rise in global average temperature. Beyond that it’s *very dangerous*, and beyond that *extremely* *dangerous*. We don’t want to go there.

How do we keep things below 2°C? By limiting GHGE to less than 800 GtCO2e from now on. That’s the world budget, give or take 100 Gt or so, calculated by climate scientists. Who else are we going to ask? Nigel Lawson?

The world doesn’t work as a single polity, but in nation states. Only a nation can sign up to a budget. How should budgets be allocated? Obviously the sum of all national budgets must be <800 Gt, but how does this get divvied up? The most basic idea is that 800 GtCO2e should be allocated on an equal per capita basis. That would give 115 tonnes each person, to cover the period between now and (say) 2100. That would be about 1.34 tonnes per year.

How does this apply to the UK? 115 t each for each of 63 million gives us 7.25 GtCO2e. That’s our apparent fair shares budget. How does this match up with the UK’s emissions? If we know this, we can see how it matches up with UK policy, and start to identify which changes might be necessary.

What are the UK’s emissions? Unfortunately there are several ways of working these out, which give different results (in very round figures; there is no point in spurious precision here):

Territorial Environmental Accounts Consumption Indirect Land Use

600 650 900 1000

Perhaps we should take a vote on which of these best represents the UK’s responsibilities?

The UK government likes the lowest one, and its policy is to reduce it to 80% of the 1990 value, that is to159 MtCO2e a year, by 2050, via a series of intermediate steps. We can look at the published steps to 2028 and calculate what this means in terms of an accumulated ‘budget’ to 2050. The answer is about 16 Gt, more than twice our fair shares allowance.

Either this is not sustainable or it’s not fair. If it’s not sustainable we are failing in our responsibility to posterity. If it’s not fair it means that others are unlikely to cooperate with us, and the whole thing only works if everybody is on board. So in this context fairness is an unavoidable part of sustainability.

We should not be too hard on the UK government. Like any government in this situation, it cannot tell the plain truth because the general public don’t like the consequences and have not been prepared to deal with the situation in a grown-up way. In many respects we are all like little kids and think in magical, fairy-tale terms: something will turn up; the Lord will provide; or Mum will read the riot act, clear up the mess, and all we need to do is say sorry. Infantile.

What would be a non-infantile approach?

It must mean getting the physics right first, *then* working out how to adapt the politics, economics, technology, standards of living, diplomacy etc etc. Not the other way round. Anybody want to argue the toss? That we can decide climate policy on the basis of political expediency and expect that Nature will somehow come quietly? Of course not, so isn’t it amazing that the political class, the business community and virtually the entire economics profession insist on putting the politics first and Physics second. Infantile. But pragmatic.

OK, so if we take the budget of 7Gt literally (and it may be less, but let’s go with this for now) where is this coming from? We can now easily calculate that getting not to 20% but *zero* by 2050, would give us 10.5 GtCO2e: too much. We’d need to get to zero by 2038. At least 80% is energy-related CO2, so this is the lion’s share. And some parts of the economy cannot have zero emissions, so energy has to work extra hard.

What would a near-zero-emission energy system look like? There are lots of ways to do it. David Mackay thought of several back in 2009. There are plenty more, including much bigger demand side measures and massive life-style changes.

One problem is that all energy technologies have their enemies, and it is impossible to design an operational energy system that everyone likes. Again we have to be grown up about this. Everything’s got to be on the table. No ‘acquired phobias’, whether it’s nukes or windmills. In making this omelette, some eggs are going to be broken.

Consider two extremes. A fairly conventional “base-load” approach, and a lifestyle/renewables approach. Baseload still has large RE component, but probably not enough demand side. Carbon Capture and Storage (CCS) is so far not 100%, so we would not get to zero; would need some Biomass with CCS (BECCS): so there would be land use implications. Probably gas CCS is better: more research needed, as always. The nuclear bit is helpful and substantial, but assumes success of the mitigation programme. If mitigation fails, an ‘adaptation world’ is unstable, and arguably no place for active nuclear power. So, better to do without it if possible. Nevertheless nuclear could play a part in a transition, and could easily be phased out after (say) 2050.

Large demand reduction, partly through major lifestyle changes, has been argued, and the numbers quite clearly stack up. It is a bit like living in the 50s, since when there has been no increase in reported happiness. 50s levels of supply with some of the clever tricks we have learned since, would suit me perfectly.

But I have to admit this might be breaking too many eggs, and if we can devise a system that delivers a closer approximation to modern life, we should go for that. At CAT we worked out a credible system for doing just this. It’s mostly wind, because we know we have wind and it won’t run out, mostly offshore. Plus the standard Mackay package of other renewables, heat pumps etc. It could have nukes, but we decided to see if we could make the model work without them because we were looking for a system that was robust against failure, *i.e*., one that would operate well in an adaptation world, as well as one where mitigation has been successful. As it happened we found we could make it work as a viable energy system without any ‘baseload’ capacity at all, something of a heresy, although we do need an awful lot of backup capacity.

Do I hear an elephant trumpeting at the back of the room? Yes, what about the fabled intermittency of renewables and especially wind, of which the scenario has such a large slice? Fatal, surely?

We did start sceptically, and identified several concatenations of weather conditions in the last few years that would have caused severe problems. But basically we found ways to provide backup for these occasional awkwardnesses, using a combination of expected surplus electrolytic hydrogen, biomass and waste CO2. We modelled all manner of conditions and real ones every half hour for 12 years. The lights stayed on.

Yes, it’s expensive, but not cripplingly so. What else could you do? Once you stop cheating by ignoring climate costs, energy is going to be expensive anyway. But by historical standards it’s still incredibly cheap. A person working manually for a 40-hour week would deliver about 2kWh of energy, at a cost of (say) £300 but we can buy this much as electricity for about 30p, only 1000th as much; even if it cost thrice this, it would still be a fantastic bargain. Even if energy took up 8% of our household expenditure rather than the present 4%, we’d adjust and probably not use so much so badly. Collapse of civilisation it’s not.

We know how to do it, and there are quite a few alternative choices. We just have to stop being infantile and living in a fantasy world where everything is perfect. Some eggs must be broken, and we need to have a good grown-up discussion about which, in the full knowledge that none of us can have everything we want.

And you greenies too, don’t think you’re going to have it all your own way!