Dear Sir or Madam,

Sometime ago I emailed a civil servant who was working in a team concerned with energy storage, with a suggestion for a possible energy storage solution.
She has asked me to contact yourselves through the consultation system hence this email.

Regards

Keith Ions FRCS

Although Scotland has areas suitable for pumped storage, England does not. It occurred to me that a bank of flywheels might store a useful amount of energy. I made a small spread-sheet (attached), which calculates the theoretical energy storage of a flywheel using the mass at the rim, ignoring the extra energy stored in the rest of the wheel.

I then went on the internet to see if I could find numbers for the energy storage capacity of pumped storage. These are not easy to come by as most sites merely quote the power output capability. I did find one site suggesting that the storage capacity of pumped storage sites is between 0.5 and 20 GWh.

I then did what I should have done first, - I looked up flywheel energy storage! This is well documented. It seems though, that the engineers have largely done the obvious thing and chased ways of increasing the angular velocity. (This is because the energy stored is proportional to the square of the angular velocity). This leads them to more advanced solutions using stronger materials, magnetic or air bearings, vacuum chambers, and rotational speeds of up to 100,000 rpm. These systems are apparently capable of very high power output almost instantaneously, but not for long.

I wonder whether the sort of storage you are looking for, off peak energy stored and returned over a longer time period, might be better attained with the relatively low tech, older type of flywheels, at much lower angular velocities?

I have done some calculations and made the spread-sheet attached. The spread-sheet gives you an idea of the possible energy storage dependent on the number and size of fly wheels deployed. You can alter the numbers that are in red as you wish and see the output in black below them. I would suggest not going much above 3000 rpm as steel can breakup at very high rpm, and wobble is a definite problem. The ‘Material density’ indicated on the spread sheet is an average steel density, but this can be changed for other materials. The main variables to play with are the flywheel dimensions and the number of wheels. You will see that the sheet as you receive it has 100 wheels, I think that would be a very modest number for a factory sized storage unit, yet we obtain from this very slightly over 0.3 GWH storage. Please note that there would need to be a clutch mechanism between the wheels. It would not be possible to run up 100 flywheels from a standing start using a generator/motor. The generator/motor would be used to take spare capacity from the grid, run up a flywheel, then the next one (via the clutch mechanisms) and so on, until all the flywheels were up to speed. In times of increased demand to the grid the fly wheels would then be able to turn the generator/motor to return power to the grid.
These installations could be sited anywhere, and could vary significantly in size. Old industrial sites might be ideal.

At these speeds, (about 3000 rpm), I expect conventional bearings would be fine, and no vacuum environment would be required. What I am suggesting is, that it might be useful for some engineers to look at what would be considered a low-tech fly wheel energy storage system. They could use the best standard bearings, manufacturing techniques, electronic controls etc, but go for a low angular velocity solution. This will not be the most exciting engineering for them, but it may be a useful contribution to our current energy storage problem. One problem, probably among many, would be protecting against failure. If a flywheel broke up, or came off it's bearings or similar while running, (ie containing a large amount of kinetic energy) it would cause considerable havoc. This would be another engineering problem to be dealt with.

I have no idea what this would all cost. The only cost I could find for a pumped storage system was £130m. I would guess that a similar capacity flywheel system could be done for a good bit less than that, but that is only a guess.

Unless you have found something better that can be used in England, this might be worth a look.

Best wishes

Keith Ions

PS all systems have energy losses (~20% in pumped storage is quoted) I have not made any guess for what the losses in a flywheel system might be.

The 'workings' of the spread-sheet are on the right in grey. Just change the font colour back to black if you want to poke around in the calculations.