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# The Soluble Lead Flow Battery: Medium term storage of energy

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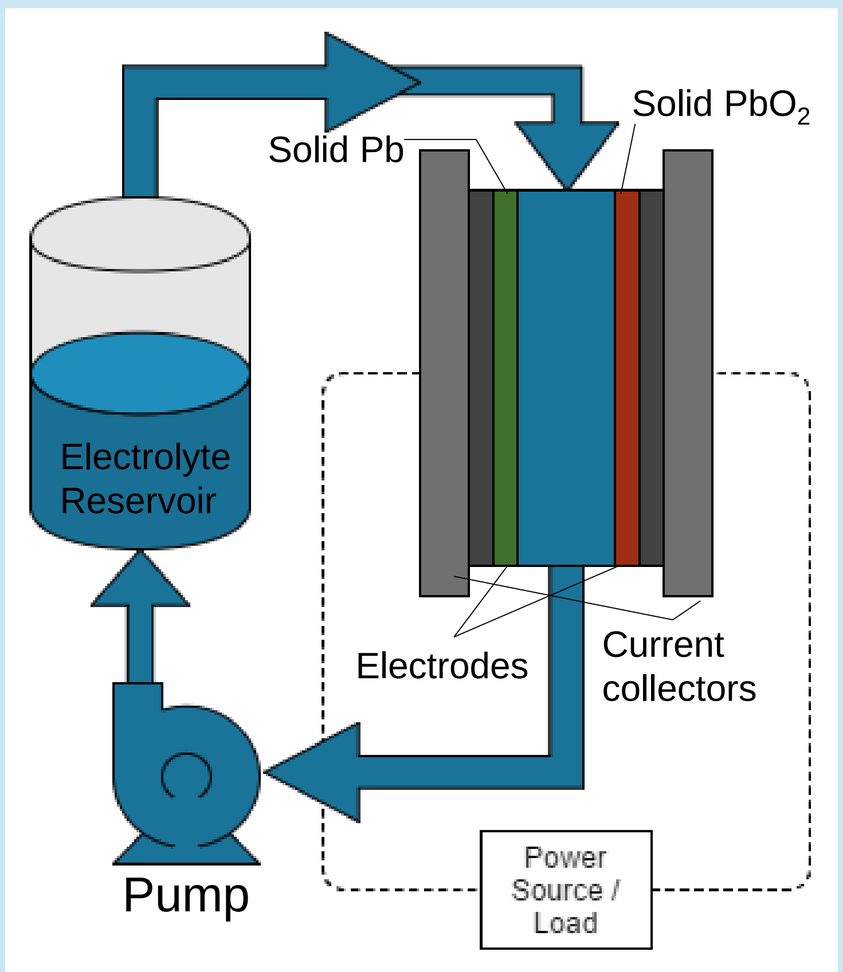
## Introduction



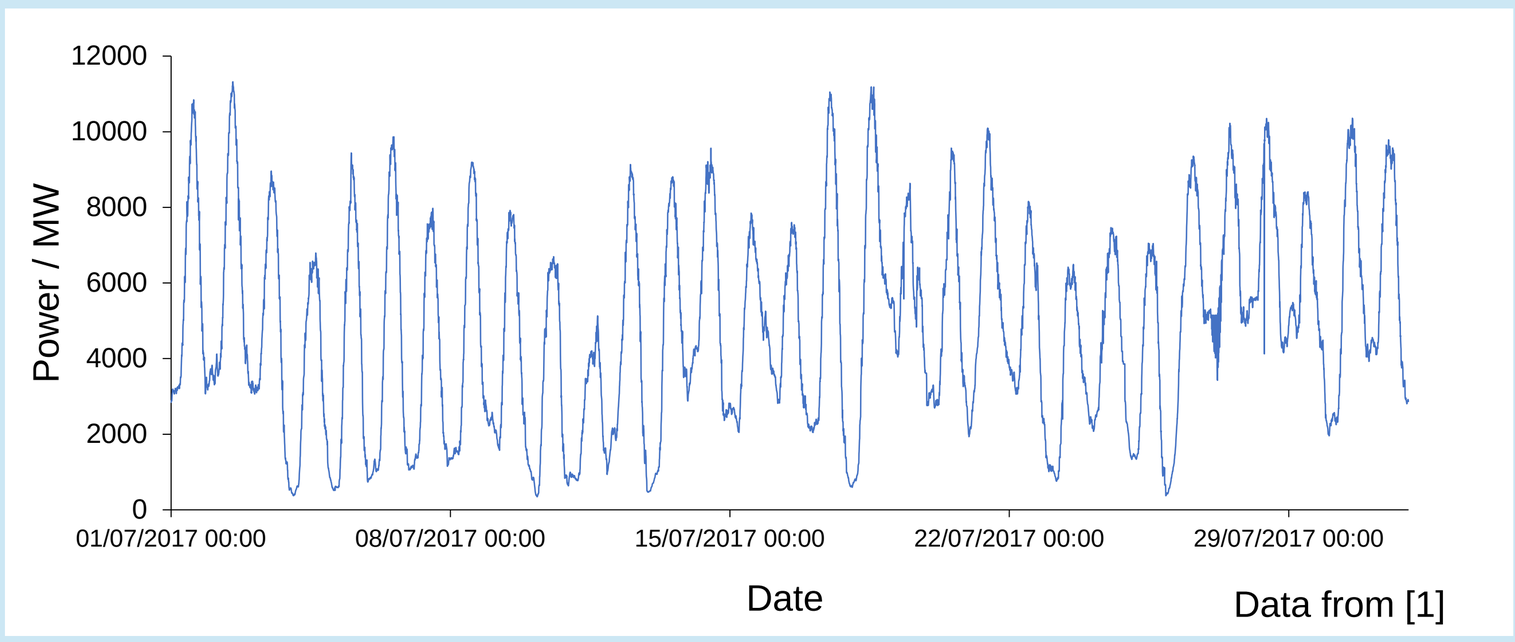

Redox flow batteries (RFBs) are devices that show promise for storing energy in grid scale applications when the charging and discharging period is over a number of hours.
Typically, RFBs require two separate electrolytes, two sets of pumps and reservoirs and an ion exchange membrane to separate each half of each cell.
The soluble lead flow battery (SLFB) has just one electrolyte, due to $Pb^{2+}$ being common to both redox couples. So, it requires just one pump, one reservoir and it does not require a membrane. These simplifications can lead to significant cost reductions of the system.

$$Positive \quad Pb^{2+} + 2H_2O \leftrightarrow PbO_2 + 4H^+ + 2e^- \quad E^0 = +1.46\,V\ vs\ SHE$$

$$Negative \quad Pb^{2+} + 2e^- \leftrightarrow Pb \quad E^0 = -0.13\,V\ vs\ SHE$$

$$Cell \quad 2Pb^{2+} + 2H_2O \leftrightarrow Pb + PbO_2 + 4H^+ \quad E^0_{cell} = +1.59\,V$$

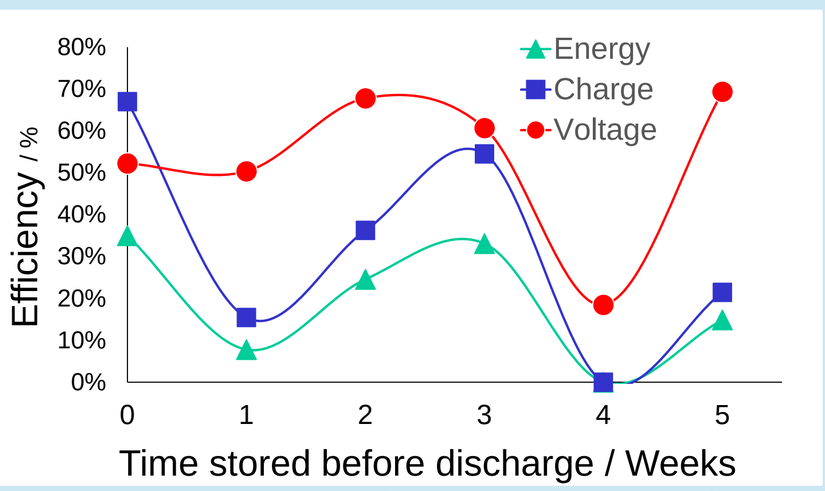
Demand for storage technologies does not always require continuous operation. Generation from hydropower, wind and solar, combined is shown over the month of July 2017. There are obvious peaks and troughs in generation each day but there are also fluctuations between each day.

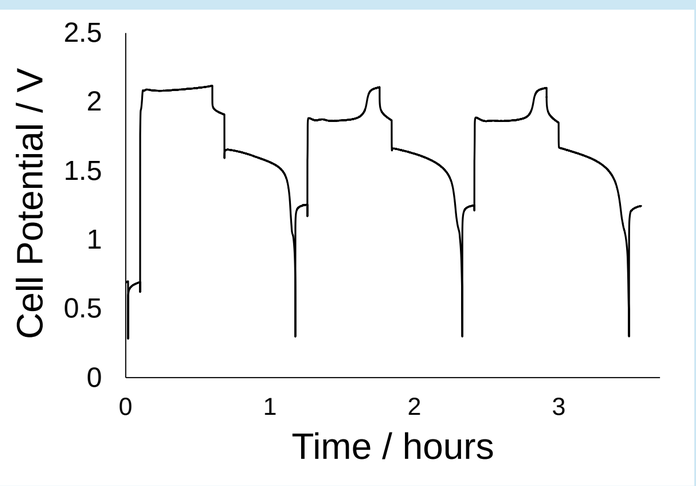



Data from [1]

## Results


Static electrolyte cells were produced so they could be inverted storing the electrolyte separately from the electrodes.




Inconsistent results over a number of weeks suggest unreliable cells. However, the cell performs well again upon subsequent cycling, even in the cell which completely failed to discharge.

## Conclusions

- Self discharge rate is still unknown.
- However, even after complete failure during storage (no discharge current at all) the cell recovers with subsequent cycling.

## Further Work

- A more consistent static cell and testing conditions to achieve consistent results is being developed.
- Better electrodes, shorter charge times and cycling the cell before storage will be incorporated.
- Use the process on a flow battery

**References**

[1] “G.B. National Grid Status” Available: http://www.gridwatch.templar.co.uk/