

Energy Storage in Remote Australia: conniptions and kerfuffles

Phil Maker <philip.maker@gmail.com>

ACEP/Powerwater Remote Operations

March 2014

Abstract

A review of energy storage in hybrid systems in Remote Australia including the messy bits (well a wee bit at least).



Where: Australia



*"I keep six honest serving men,
They taught me all I knew,
Their names are What and
Why and When And How and
Where and Who." – Kipling*



Where: Australia



*"I keep six honest serving men,
They taught me all I knew,
Their names are What and
Why and When And How and
Where and Who." – Kipling*

- ▶ *Energy storage in
NT/WA.*



Where: Australia



*"I keep six honest serving men,
They taught me all I knew,
Their names are What and
Why and When And How and
Where and Who." – Kipling*

- ▶ *Energy storage in NT/WA.*
- ▶ *And the conniptions and kerfuffles (see handbook).*



Where: Australia

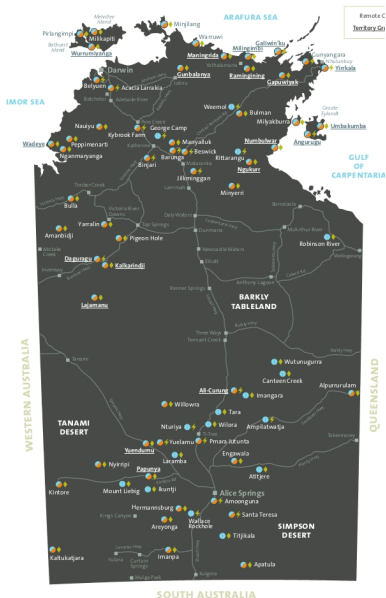


*"I keep six honest serving men,
They taught me all I knew,
Their names are What and
Why and When And How and
Where and Who." – Kipling*

- ▶ *Energy storage in NT/WA.*
- ▶ *And the conniptions and kerfuffles (see handbook).*
- ▶ *Feel free to interrupt or redirect me.*



Northern Territory/Powerwater



- ▶ Early **SMA** systems for delaying gen switch up (20y lifetime).
- ▶ Small ($\approx 50\text{kW}$) PV/Wind systems.
- ▶ Concentrated PV with limited smoothing.
- ▶ Ti Tree, Kalkarindji and Lake Nash ($\approx 1\text{MW}$ total PV, 80% peak penetration).
- ▶ ASIM and Solar Diesel Handbook.
- ▶ Medium Pen Rollout.
- ▶ High Pen Diesel off systems.



Western Australia/Horizon Power, Verve Energy

In the past:



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.
- ▶ Flywheel Energy Storage: 18MWs at 500kW so 36s at rated which is enough to start and synchronise a diesel.



In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.
- ▶ Flywheel Energy Storage: 18MWs at 500kW so 36s at rated which is enough to start and synchronise a diesel.



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.
- ▶ Flywheel Energy Storage: 18MWs at 500kW so 36s at rated which is enough to start and synchronise a diesel.

Currently:

- PV with hosting capacity limits and mandatory battery smoothing.



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.
- ▶ Flywheel Energy Storage: 18MWs at 500kW so 36s at rated which is enough to start and synchronise a diesel.

Currently:

- ▶ PV with hosting capacity limits and mandatory battery smoothing.
- ▶ Its very hard to get some of them away from Low Load diesels :-).



Western Australia/Horizon Power, Verve Energy

In the past:

- ▶ Wind Diesel systems using Enercon, Vestas and Vergnet WTGS.
- ▶ Low Load Diesels: 12L/hr at 7% load for 320kW generator which gives us 280kW of spinning reserve and 190kW of step load.
- ▶ Flywheel Energy Storage: 18MWs at 500kW so 36s at rated which is enough to start and synchronise a diesel.

Currently:

- ▶ PV with hosting capacity limits and mandatory battery smoothing.
- ▶ Its very hard to get some of them away from Low Load diesels :-).
- ▶ But I'm sure something will happen.



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.

Complete piffle: just resize your PV array by 30kW (<10%) and have a a brandy, its not the standby loss, its the CAPEX/Engineering



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.
Complete piffle: just resize your PV array by 30kW (<10%) and have a a brandy, its not the standby loss, its the CAPEX/Engineering
- ▶ Round trip efficiency is important.



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.
Complete piffle: just resize your PV array by 30kW (<10%) and have a a brandy, its not the standby loss, its the CAPEX/Engineering
- ▶ Round trip efficiency is important. Well perhaps but if you can give me a cheap 500kW solution with 50% round trip efficiency I'm going to buy it.



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.
Complete piffle: just resize your PV array by 30kW (<10%) and have a a brandy, its not the standby loss, its the CAPEX/Engineering
- ▶ Round trip efficiency is important. Well perhaps but if you can give me a cheap 500kW solution with 50% round trip efficiency I'm going to buy it.
- ▶ Its about energy and load shifting.



Some obvious facts?

- ▶ A standby loss of $x > k$ kW is a show stopper!
For example a 500kW for 36s flywheel is useless because its standby losses might be 15kW.
Complete piffle: just resize your PV array by 30kW (<10%) and have a a brandy, its not the standby loss, its the CAPEX/Engineering
- ▶ Round trip efficiency is important.Well perhaps but if you can give me a cheap 500kW solution with 50% round trip efficiency I'm going to buy it.
- ▶ Its about energy and load shifting.A bit, it turns out that most of our NT work will be power limited using East/West arrays (or tracking).



Our Past Mistakes

So what have your mob got wrong:



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.

Well we do not use the diesel spinning reserve as a resource.



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.
Well we do not use the diesel spinning reserve as a resource.
- ▶ Concentrated Solar that is not intergrated in the power system.



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.

Well we do not use the diesel spinning reserve as a resource.

- ▶ Concentrated Solar that is not intergrated in the power system.
- ▶ No Low Load Diesels.



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.

Well we do not use the diesel spinning reserve as a resource.

- ▶ Concentrated Solar that is not intergrated in the power system.
- ▶ No Low Load Diesels.
Note that running diesels at low load is impossible and anyone who suggests it is a liar and a coward.



Our Past Mistakes

So what have your mob got wrong:

- ▶ TKLN - an award winning design that flogs batteries for no real reason.

Well we do not use the diesel spinning reserve as a resource.

- ▶ Concentrated Solar that is not intergrated in the power system.
- ▶ No Low Load Diesels.
Note that running diesels at low load is impossible and anyone who suggests it is a liar and a coward.
- ▶ And difficulties in sizing sets for loads.



Our Future Mistakes

So our cunning plans are:

- ▶ We've done a few design studies and a wee bit of modelling.
- ▶ Expecting to use a 30m..2h Li Ion battery system with diesel off capability.



Our Future Mistakes

So our cunning plans are:

- ▶ We've done a few design studies and a wee bit of modelling.
- ▶ Expecting to use a 30m..2h Li Ion battery system with diesel off capability. That is we need a power battery, we are not doing load shifting.



Our Future Mistakes

So our cunning plans are:

- ▶ We've done a few design studies and a wee bit of modelling.
- ▶ Expecting to use a 30m..2h Li Ion battery system with diesel off capability. That is we need a power battery, we are not doing load shifting.
- ▶ Roll out medium penetration first and prove to our operations people that high penetration can work.
- ▶ Continue working on a variety of projects in order to improve system performance.



So what!

- ▶ Share our lessons learnt in a frank fashion.



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.
- ▶ Its not just the technology.



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.
- ▶ Its not just the technology.
- ▶ Don't look at the problem just from your interests, e.g. in my case control systems.



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.
- ▶ Its not just the technology.
- ▶ Don't look at the problem just from your interests, e.g. in my case control systems.
- ▶ Try to replicate projects/share risks,



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.
- ▶ Its not just the technology.
- ▶ Don't look at the problem just from your interests, e.g. in my case control systems.
- ▶ Try to replicate projects/share risks, particularly with remote battery chemistry.

"Learning is not compulsory..."



So what!

- ▶ Share our lessons learnt in a frank fashion.
- ▶ Chemistry is difficult.
- ▶ Its not just the technology.
- ▶ Don't look at the problem just from your interests, e.g. in my case control systems.
- ▶ Try to replicate projects/share risks, particularly with remote battery chemistry.

*"Learning is not compulsory...
neither is survival" – W. Edwards Deming*

