Executive Summary

HydroSun, a renewable energy company, has developed a reliable and secure energy storage device with the capability of being a controlled generation system that can be scheduled to provide guaranteed generation at times of high demand on an electricity grid.

Each such installation will be connected to the distribution network segment of the NEM related grid and capable of delivering a scheduled amount of generation. The proposed energy storage system using PV solar and/or off-peak grid charging is effectively a 'peak shaving' or load levelling device which can be used, together with and assisting, the existing controlled and reliable generation that supplies electricity to the customer.

The benefits that follow from this approach include:

a) the ability for 'shaving' the peak demands on the NEM, thereby reducing the demand on the aging 'main stream' transmission connected generation;
b) reduction in the 'peak/trough' ratio characteristic of the NEM demand thus creating a reduction in the extremity in variation as seen by the transmission generators and allowing improved generation planning and opportunity for extending the life of the aging generation plant; and
c) reduction in the electrical power transported through the transmission network which will reduce the network losses and hence reduce greenhouse gas emissions.

The results of the technical analysis on the beneficial impact that a battery storage would provide across the NEM are detailed in the body of this report, however, in summary such a storage system for the 3 options considered would lead to:

Option 1: 12 GW system capable of delivering 12 GWh of energy;

a) enable a reduction of main system generation in the order of 9%, and
b) enable a reduction of energy delivered across the NEM in the order of 2% as the storage system is located close to the customer load,

Option 2: 12 GW system capable of delivering 60 GWh of energy;

a) enable a reduction of main system generation in the order of 22%, and
b) enable a reduction of energy delivered across the NEM in the order of 9%.

Option 3: 24 GW system capable of delivering 120 GWh of energy;

a) enable a reduction of main system generation in the order of 32%, and
b) enable a reduction of energy delivered across the NEM in the order of 18%.

For comparison, the option of just having 12 GW of solar and without any form of battery storage was considered. Assuming the perfect day it could deliver a maximum of 114 GWh of energy, but this is totally dependent on the environment such as cloud cover. Given the perfect day the best this installation system would deliver is:

Option 4: 12 GW of solar with zero energy storage

a) enable a reduction of main system generation in the order of 35%, but at a time not coincident with the actual peak demand, and

b) enable a reduction of energy delivered across the NEM in the order of 17%.

Observations that can be made from the overall analysis are:

1) The advantage of the HydroSun proposal (either of Options 1,2, or 3) is that the generation installations are connected in the vicinity of the actual NEM load and hence serve to reduce not only the output from the main transmission generation but also the network losses created by the power delivered by the main transmission generation;

2) Note that for Option 3 (24 GW of storage providing 120 GWh of energy) one issue that needs to be considered is that the actual operating hours to deliver all the stored energy may have to be restricted to allow time to rejuvenate the storage system ready for the next day energy delivery.

3) For Option 4 (i.e., using solar only as a generation source) two drawbacks are identified:
   (a) maximum generation output most likely will not be coincident with the peak demand of the NEM and therefore optimising the reduction in main transmission generation would be restricted; and
   (b) being solar only the additional output available is limited by the environmental impacts such as cloud cover.

Power Grid Obligation:

Power production scheduling forms the basis for a reliable and secure electricity supply. The reliable and secure nature of the main transmission generation (eg coal and gas) allows this to be scheduled. The variability of wind and solar means renewable energy is unreliable and therefore cannot be factored into the power production schedule. It is only by using an energy storage system that the renewable energy can provide a secure and reliable power source that will allow renewable energy to be scheduled and offset the energy supplied from the main transmission generation.

Community Impact:

Today more than ever the consumer is dependent upon and demands a reliable and secure supply. Also there is community pressure to enhance more renewable energy and reduce the coal fired plant. It is obvious then that subject to economic feasibility, then the way forward is to use renewable energy storage systems that are able to meet both the customer supply and community environmental expectations.

1 NEM future demand

Using the NEM load data available on the AEMO website refer [Ref. 1], analysis has been carried out to determine the expected future demand within the NEM for the year 2030. Analysis shows that the 10% PoE (Probability of Exceedance) summer growth rate as predicted by AEMO [Ref. 2] will be around 0% for the summer. Demand Growth calculations have been carried out to extrapolate the demand for 2030. Analysis shows that the 10% PoE summer growth rate as predicted by AEMO [Ref. 2] will be around 0% for the summer 2016-2030 period.

As the demand in 2030 is similar to the 2016-17, therefore the available NEM data for 2016-17 [Ref 1] has been used without modification as the basis of the graphs in demonstrating the effect that battery storage would have in 2030. The results of this analysis are shown in Table 1.

Table 1 Extrapolated demand growth rate for 2030 using Ref [1] as base data

Maximum demand for summer and winter 10% PoE (GW)

State	2016-17		2021-22		2026-27		2035-36		Summer Growth Rate	Winter Growth Rate	2030	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter			Summer	Winter
NSW	14.2	12.3	14.1	12.5	14.0	12.8	14.1	13.2	-0.04%	0.37%	14.1	13.0
QLD	9.6	8.5	10.0	9.2	10.3	9.7	10.6	10.5	0.52%	1.12%	10.3	9.9
SA	3.1	2.5	2.8	2.5	2.6	2.5	2.6	2.5	-0.92%	0.00%	2.7	2.5
TAS	1.5	1.8	1.5	1.8	1.5	1.8	1.5	1.9	0.00%	0.28%	1.5	1.9
VIC	9.9	7.9	9.7	8.2	9.5	8.4	9.4	8.7	-0.27%	0.51%	9.5	8.5
NEM	38.3	33.0	38.1	34.2	37.9	35.2	38.2	36.8	-0.01%	0.58%	38.2	35.8