

# To Store or Not to Store

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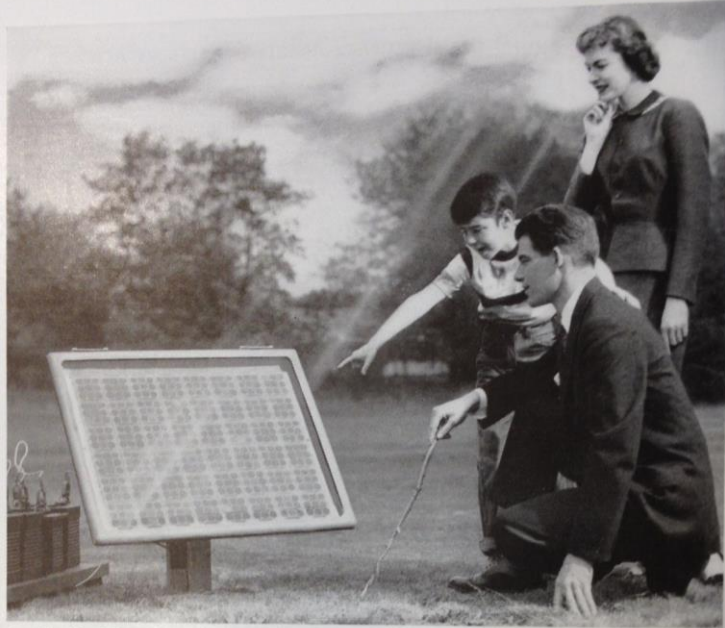
# What is storage?

- ▶ Storage is a means of storing surplus energy and being able to use it later.
- ▶ It may also be a case of putting energy into a storage medium to be used at a time where energy costs more.
- ▶ It can also be used to supply base load with renewable energy sources that tend to have unpredictable energy deliver patterns such as wind or solar generation.

# Forms of Energy Storage

- ▶ Storage of power can be done in several ways.
- ▶ 1. Hydro
- ▶ 2. CSP Concentrated Solar power usually using salt.
- ▶ 3. Thermally (stored as heated water)
- ▶ 4. Geothermal
- ▶ 5. Batteries

# Latest Technology



**Something New Under the Sun.** It's the Bell Solar Battery, made of thin discs of specially treated silicon, an ingredient of common sand. It converts the sun's rays directly into usable amounts of electricity. Simple and trouble-free. (The storage batteries beside the solar battery store up its electricity for night use.)

## **Bell System Solar Battery Converts Sun's Rays into Electricity!**

*Bell Telephone Laboratories invention has great possibilities for telephone service and for all mankind*

Ever since Archimedes, men have been searching for the secret of the sun.

For it is known that the same kindly rays that help the flowers and the grains and the fruits to grow also send us almost limitless power. It is nearly as much every three days as in all known reserves of coal, oil and uranium.

If this energy could be put to use — there would be enough to turn every wheel and light every lamp that mankind would ever need.

The dream of ages has been brought closer by the Bell System Solar Battery. It was invented at the Bell Telephone Laboratories after

long research and first announced in 1954. Since then its efficiency has been doubled and its usefulness extended.

There's still much to be done before the battery's possibilities in telephony and for other uses are fully developed. But a good and pioneering start has been made.

The progress so far is like the opening of a door through which we can glimpse exciting new things for the future. Great benefits for telephone users and for all mankind may come from this forward step in putting the energy of the sun to practical use.

**BELL TELEPHONE SYSTEM**



# Why use batteries

- ▶ They use a chemical reaction to store and release electrons.
- ▶ Batteries are not new we have been using them every day for about one hundred years.
- ▶ They are relatively compact.
- ▶ No Battery is perfect each, technology has trade off's.
- ▶ Not every battery is suited to every application.

# Types of batteries commercially available

- ▶ Lead and improved lead.
- ▶ Nickel Iron NiFe
- ▶ Lithium and varieties
- ▶ Flow Batteries inc Aqueous Hybrid Ion. (AHI)
- ▶ Sodium Nickel or molten salt (Sonick) also known as Zebra battery



# Lead based batteries.

Lead is the most common type of battery

## ▶ Disadvantages

- ▶ 1. Flooded cells emit explosive hydrogen.
- ▶ 2. Large and Heavy.
- ▶ 3. Contain lead a substance known to cause diseases
- ▶ 4. Low DOD (Depth of Discharge) about 30-40% to give long life
- ▶ 5. Require maintenance periodic water topped up
- ▶ 6. Cant easily add additional capacity after 2 years

## ▶ Advantages

- ▶ 1. Cheap
- ▶ 2. Proven technology.
- ▶ 3. Recyclable but not 100% practice of recycling questionable

# Lead based batteries and “improved Lead”

Broad range available including sealed, GEL, Lead Carbon and Lead Crystal.

## ▶ Disadvantages

- ▶ 1. Large and Heavy.
- ▶ 2. Contain lead a substance known to cause deceases
- ▶ 3. May not be recyclable depending on doping of lead plates.
- ▶ 4. Cant easily add additional capacity after 2 years

## ▶ Advantages

- ▶ 1. Fairly good DOD and life about 50%
- ▶ 2. No to very little explosive gases
- ▶ 3. Not as Cheap as previous option
- ▶ 4. Proven technology.
- ▶ 5. Recyclable but not 100%, practice of recycling questionable
- ▶ 6. No Maintenance

# Nickel iron Ni Fe flooded batteries.

## Also known as Eddison battery

### ▶ Disadvantages

- ▶ 1. Large and Heavy.
- ▶ 2. More cells needed for equivalent output.
- ▶ 3. Require maintenance periodic water topped up.
- ▶ 4. Not all chargers capable of charging.

### ▶ Advantages

- ▶ 1. Very good DOD 50% and extremely long life, about 40 years.
- ▶ 1. No to very little explosive gases
- ▶ 2. Not as Cheap as previous option mainly due to additional cell required.
- ▶ 3. Proven technology.
- ▶ 4. Fully recyclable.
- ▶ 5. No Dangerous metals
- ▶ 6. Can easily add additional capacity

# Lithium and varieties

## ▶ Disadvantages

- ▶ 1. Expensive.
- ▶ 2. Unproven as large scale storage.
- ▶ 3. Not recyclable
- ▶ 4. Very poor operating temperature range 0 to 40 degrees C
- ▶ 5. Cant be transported by plane as to dangerous.

## ▶ Advantages

- ▶ 1. Very good DOD 80% and good life.
- ▶ 2. No explosive gases
- ▶ 3. Compact
- ▶ 4. Light weight for same power output compared with most batteries.

# Flow batteries.

Sealed system with flowing electrolyte  
Also include Aqueous Hybrid Ion (AHI)

- ▶ Disadvantages

- ▶ 1. Expensive.
- ▶ 2. Extremely large and heavy
- ▶ 3. Some have mechanical element ,pump etc

- ▶ Advantages

- ▶ 1. Very good DOD 100% and good life.
- ▶ 2. No explosive gases
- ▶ 3. Will store energy indefinitely when flow stopped (except AHI)
- ▶ 4. Replaceable cell (Except AHI)
- ▶ 5. Can easily add additional capacity

# Sodium Nickel or Molten salt battery

- ▶ Disadvantages

- ▶ 1. Expensive.

- ▶ Advantages

- ▶ 1. Very good DOD 80% and good life.
- ▶ 2. No explosive gases
- ▶ 3. Compact
- ▶ 4. Light weight for same power output compared with most batteries.
- ▶ 5. Fully recyclable
- ▶ 6. Best operating temperature of all batteries -20 to 50 degrees C
- ▶ 7. Extremely safe by design
- ▶ 5. Can easily add additional capacity

# Motivations for Storing power

- ▶ 1. To supply constant reliable power
- ▶ 2. To become resilient in emergencies
- ▶ 3. To shift solar generation for maximum financial return
- ▶ 4. To become self sufficient
- ▶ 5. To stick it up the power companies
- ▶ 6. No Power available
- ▶ 7. Can not function with out power UPS
- ▶ 8. To Guarantee reliable clean power
- ▶ 9. For cost mitigation

# Applications for storage

- ▶ 1. Telco's
- ▶ 2. Banking and internet providers
- ▶ 3. Emergency services and Medical
- ▶ 4. Government and Security services
- ▶ 5. Business's
- ▶ 6. Domestic homes
- ▶ 7. Remote communities including mining.

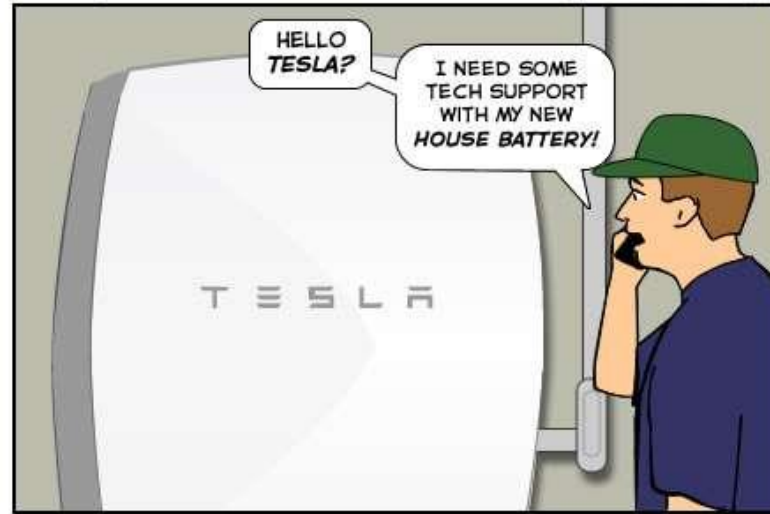


# Costs of storage and Return on investment ROI

- ▶ The cost of storage is dropping fast, as the cost of power increases the gap between stored and peak purchased power reduces. For a lot of customers the price is already comparable and in some cases less.
- ▶ EG: A remote community that uses diesel generation all the time may be able to run the generator one third of the time thereby reducing wear and tear, maintenance and fuel costs (which include very high freight costs). Also reducing Green house emissions. (Ironically the fuel is subsidised by the diesel fuel rebate at about 38 cents per litre).
- ▶ EG 2: A solar customer exports 50 % of the solar power in summer @ 5 cents per kilowatt (as of Jan 1st 2016) only to come home and pay 35 cents per kilowatt.

# Cheapest form of home based battery storage

- ▶ A Hybrid or Grid support system is the cheapest form of battery storage for business and homes, these systems may use any of the commercially available batteries.
- ▶ It is not essential to have solar in order to install a Battery System.
- ▶ Not all of these systems work in the same way, the cheaper commercially available systems do not supply power if the Grid power is removed.
- ▶ Solar if installed, may not be able to contribute to the power on all systems.
- ▶ The ultimate system to support full redundancy, will also employ a generator, automated to start when and if the power goes out, or the batteries are being depleted, and no other form of power is available.



# Basic Types of systems “Solar Battery”

## Battery add on to Existing solar inverter

- ▶ Add on high voltage battery bank to existing solar connected inverter.
- ▶ Disadvantages
  - ▶ 1. No power when grid gone
  - ▶ 2. Not able to support large loads in most houses
  - ▶ 3. Can only be added to some Grid connected Solar inverters
- ▶ Advantages
  - ▶ 1. Cheap
  - ▶ 2. Saves some money by shifting some stored renewable energy
  - ▶ 3. Wall mountable, assuming very strong wall.

# Grid Support system “Grid Hybrid”

- ▶ Add on inverter/charger and battery bank to home may be added to existing solar connected inverter.
- ▶ Disadvantages
  - ▶ 1. More expensive than previous option
  - ▶ 2. Requires more space than previous option.
- ▶ Advantages
  - ▶ 1. Power when grid gone
  - ▶ 2. Able to support most loads (depending on size)
  - ▶ 3. Saves money by shifting some stored energy
  - ▶ 4. Solar if fitted may be able to be used when grid gone.
  - ▶ 5. Generally safer battery voltages and chemistry
  - ▶ 6. Able to support diversion loads

# Full Grid support “Grid Hybrid/Off Grid”

- ▶ Add on inverter/Charger and battery bank to home may be added to existing solar connected inverter, full power with solar and option for generator support
- ▶ Disadvantages
  - ▶ 1. More expensive than previous option
  - ▶ 2. Requires more space than previous option.
- ▶ Advantages
  - ▶ 1. Power when grid gone, ongoing support with optional generator
  - ▶ 2. Able to support all loads (depending on size)
  - ▶ 3. Saves money by shifting stored energy
  - ▶ 4. Solar if fitted will be able to be used when grid gone.
  - ▶ 5. Safer battery voltages and Chemistry.
  - ▶ 6. Able to support diversion loads.
  - ▶ 7. Full resilience

# Costs of systems

## Costs include installation

- ▶ Solar Battery or High Voltage battery system start from \$10,000
- ▶ Grid Hybrid support systems around \$10,000 to \$20,000
- ▶ Full Grid support/ Off Grid system from \$18,000 depending on days of storage (autonomy) and integration/supply of generator
  
- ▶ NB: costs are guide lines only and each location/house wiring would need to be assessed
- ▶ NBB: Off grid systems design should be based on daily load, multiply by \$2,500 per kilowatt consumption then add cost of generator.

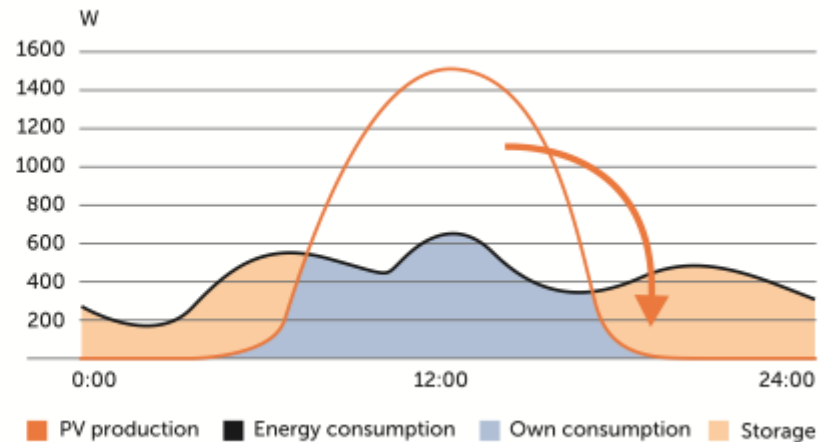
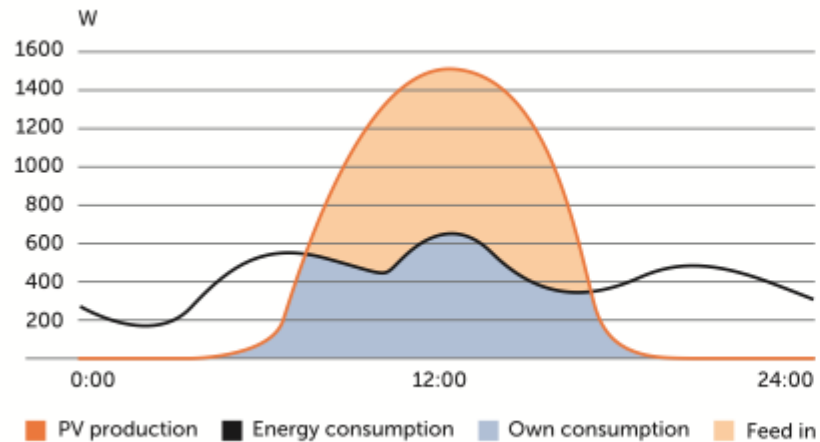
# Return on investment

- ▶ The advantage of storing free energy from solar into storage is that it can be used in a time of need as apposed to sending it to the grid for the current feed in tariff 5 cents.
- ▶ It is anticipated that the Victorian feed-in tariff will follow most other states and become zero in the next couple of years
- ▶ We also have the current interim feed-in tariff of 30 odd cents to end in 2016, about half of installed domestic systems were installed under this tariff, and when this ends, these customers will default to the feed-in tariff at the time.
- ▶ Note: groups like Solar citizens and the Australian Solar Council are very active in trying to improve conditions and returns for solar owners.



# How can the battery storage save money

## Solar generation and battery storage



# Batteries "aint batteries"

- ▶ “All back-up systems are different and their effectiveness depends on how much power your home requires. According to a [recent article in Wired](#), a 7kWh battery system would power an average home for 5.6 hours, assuming it is fully charged when the power outage occurs. The practical runtime of the battery system was estimated at 3 hours.”
- ▶ “Bloomberg News, [explores the output of a home battery system](#). The 10kWh system puts out just 2 kilowatts of continuous power, which could be maxed out by a single vacuum cleaner, hair dryer, microwave or clothes iron. The battery isn't powerful enough to operate a pair of space heaters; an entire home facing a winter power outage would need much more”.

# What type of storage system should I have?

- ▶ I have solar fitted and I am on a Premium solar tariff of about 60 cents.  
A: You might be best to leave the system as it is. You could consider a Hybrid storage system for black out protection. Or a system that time shifts to maximise the export of the solar system.
- ▶ I have solar fitted and I don't know what solar tariff I have and I don't see any credits on my bill.  
A: The solar system is not exporting any spare energy, you would get benefit from storage and by adding additional panels, and for black out protection.
- ▶ I have solar fitted and I see lots of solar credits on my bill, but we don't get much for it. Or I currently receive the interim tariff about 30cents but I will loose it in 2016.  
A:A storage system would be ideal as you can store the access power instead of exporting it, if grid outage is of no concern then a basic Solar battery system may suffice.

# Emergency Power

## What type of storage system should I have? I can go without power for a couple of hours

- ▶ Only Hybrid or off grid systems can supply power in a grid outage situation.
- ▶ How long the batteries last will last is a direct relationship between the size of the battery storage and how much is being used by the house or load.
- ▶ You may only need a relatively small battery

What type of storage system should I have? I can not go without power at all, I have to have power all the time. The power sometimes goes out for days.

- ▶ Only Hybrid or off grid systems can supply power in a grid outage situation.
- ▶ How long the batteries last will last is a direct relationship between the size of the battery storage and how much is being used by the house or load.
- ▶ It will also be important to have any solar contributing when the grid is down
- ▶ You will need a large battery system, these batteries may have to last several days with out the grid or any solar working.
- ▶ You must have a generator and available fuel source.



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