

Economics of tCell[®] Based Grids

Competitive renewable electricity

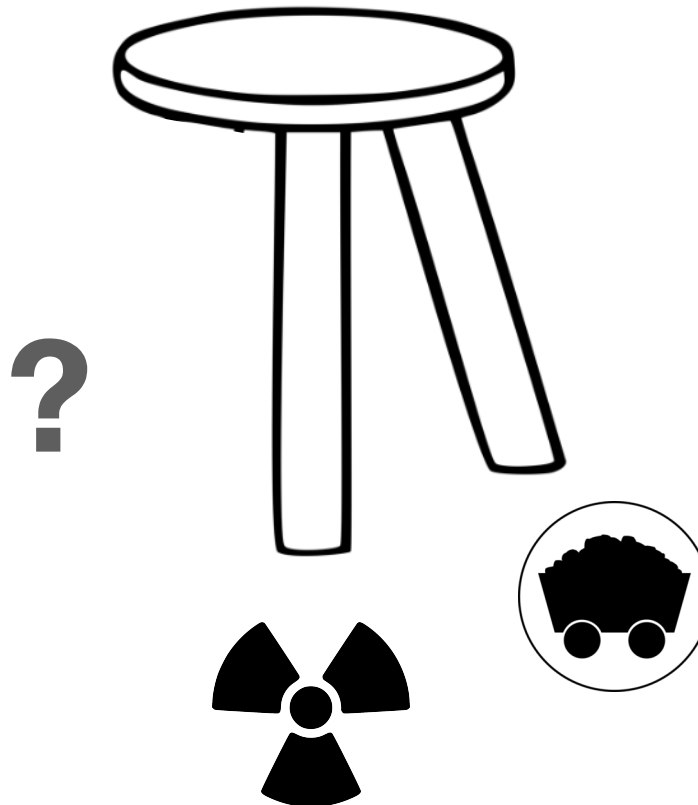
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HOMER International
MICROGRID Conference | 8th Annual | #HIMC2020



the electricity Problem

USD0.15 / kWh (nominal)



Answer is  **tCell**[®]

Long life  **tCell**[®]

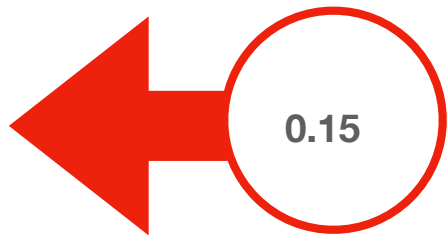
tCell[®] ?

- 20000 charge cycle, lithium titanate (LTO) energy storage
- Modular, scalable
- Integrated BMS : standalone or Can bus connected.
- Regional Australia upstart

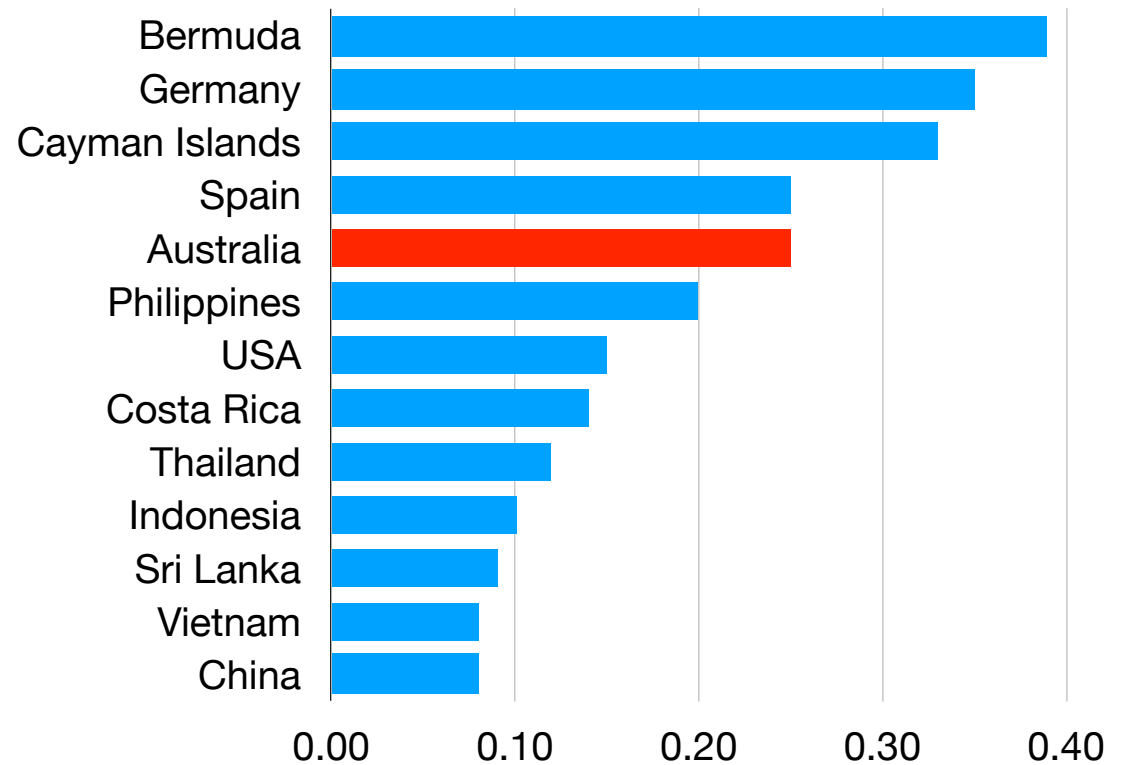


The ideal kWh rate ?

- People talk in \$ / kWh
- USD0.15 / kWh



Residential rate USD/kWh Dec 2019

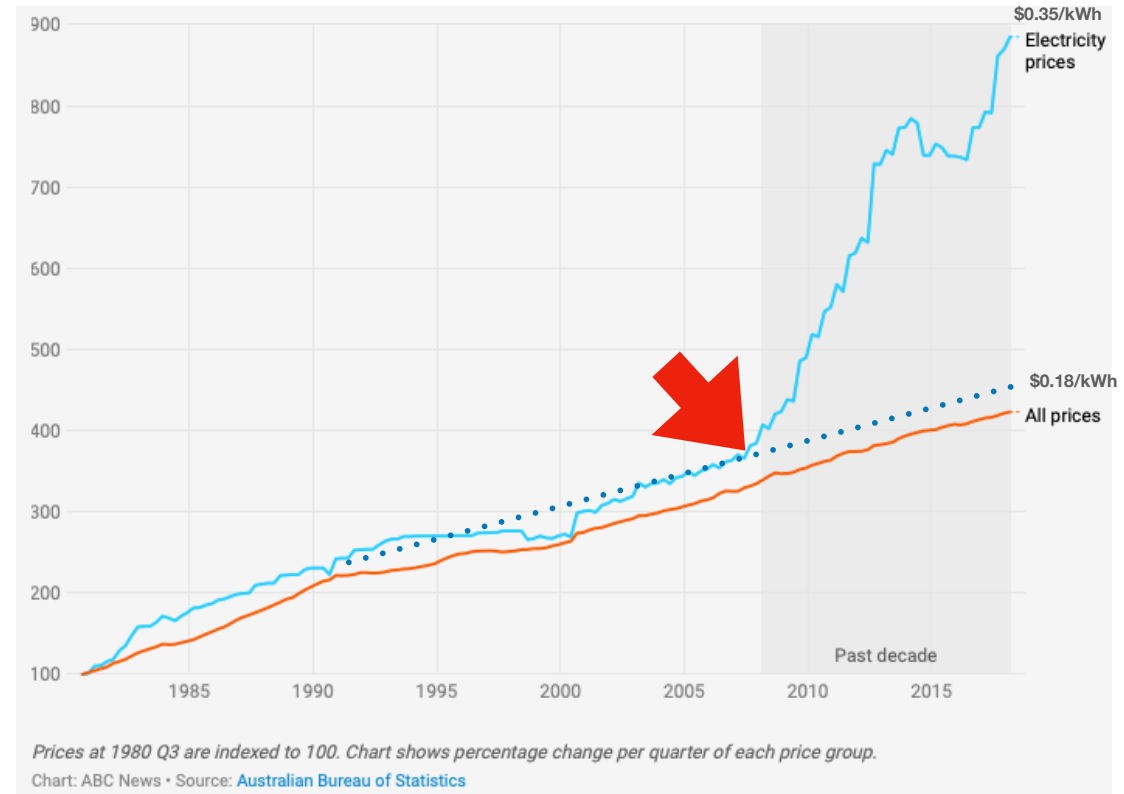


Source: https://www.globalpetrolprices.com/electricity_prices/

Australian electricity rates

Rampant energy inflation

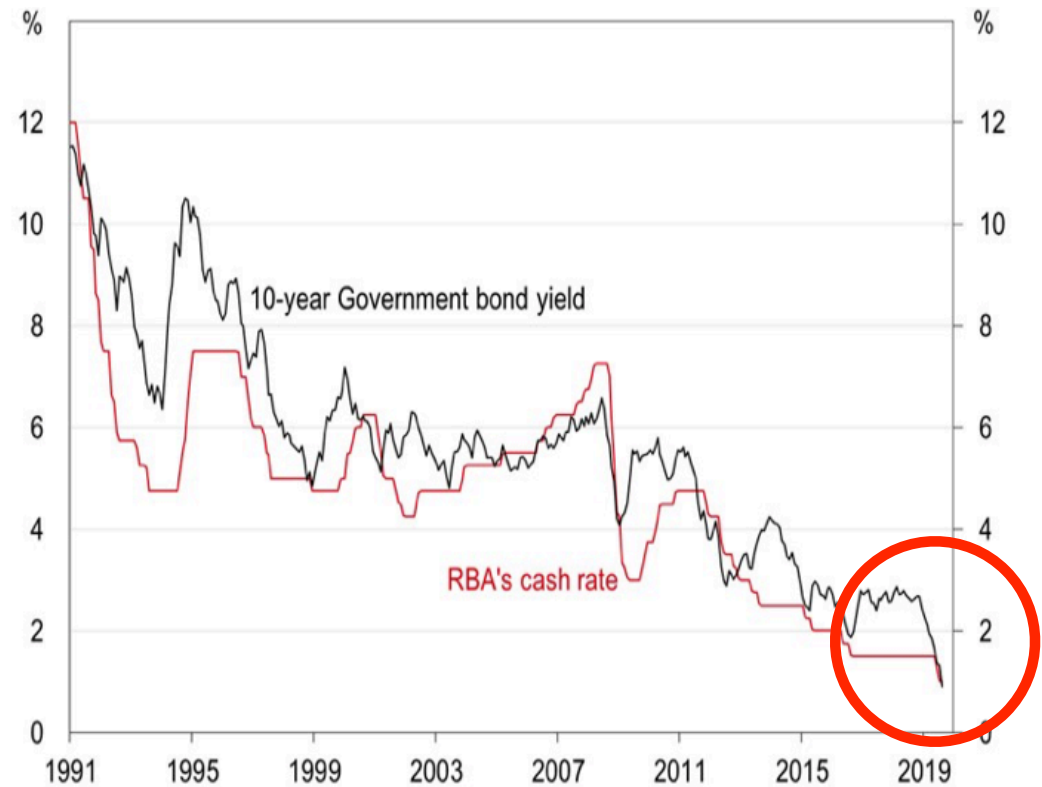
- Typical residential rate is now AUD0.35/ kWh (\approx USD0.25 kWh at FX AUD/USD=0.7000)
 - 8% energy inflation (last decade) vs 2.2% general
- Rates despite very high solar uptake (wholesale & residential)
- Rate would be AUD0.18/kWh (USD 0.13) if electricity had continued to track general inflation post 2010.



Source: <https://www.abc.net.au/news/2018-07-18/electricity-price-rises-chart-of-the-day/9985300?nw=0>

Money inversion

- Real interest rates now negative in Australia
 - Nominal rates maybe soon
- 0.5% discount rate assumed for low risk energy projects



Source: <https://www.abc.net.au/news/2019-08-27/graph-australian-interest-rates-2019/11450982?nw=0>

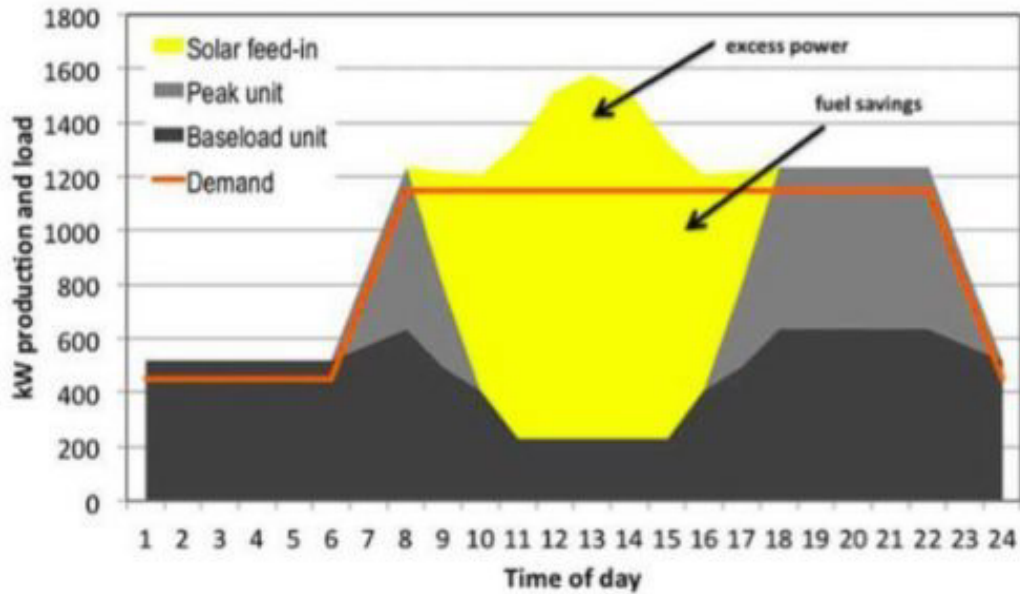
Grid electricity apocalypse

10X increase in forward rates in 10 years

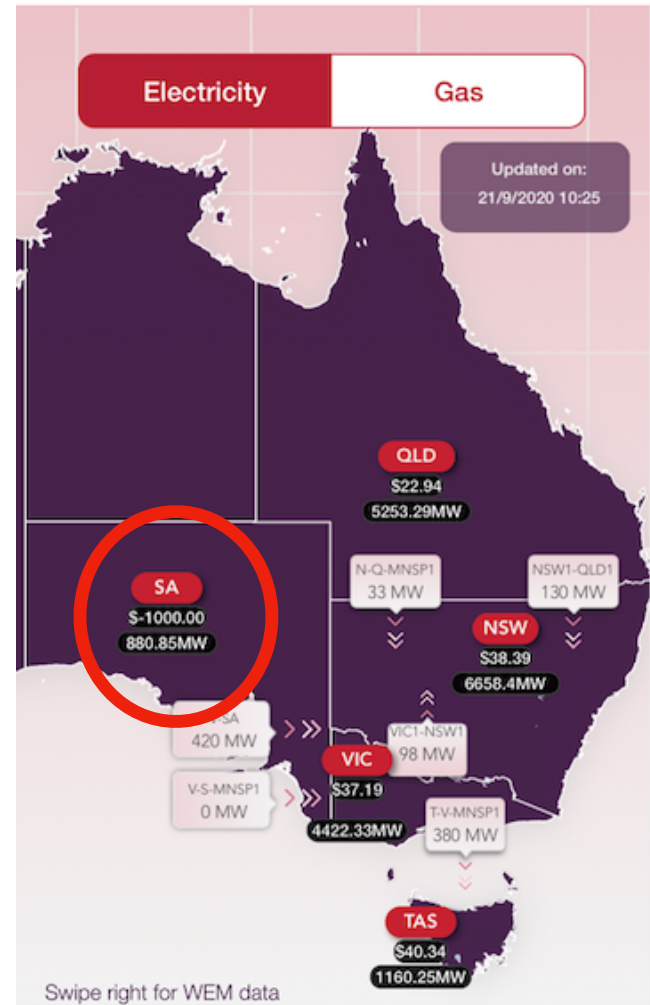
	2010	Grid Now	Now + Solar
Rate	0.14	0.35	0.35
Discount Rate	6%	0.5%	0.5%
Grid Inflation	2%	8%	5%
FWD RATE	0.09	0.94	0.32
USD FWD	0.06	0.65	0.22

- Homer with 20kWh / Day demand, 5kW PV

Too much solar



Source: <https://reneweconomy.com.au/norfolk-island-has-too-much-solar-now-it-wants-storage-58159/>



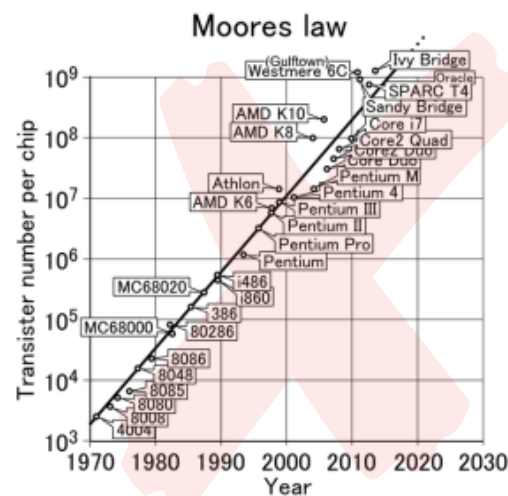
Grid electricity apocalypse

10X increase in forward rates in 10 years

	2010	Grid Now	Now + Solar	Future ?
Rate	0.14	0.35	0.35	0.35
Discount Rate	6%	0.15	0.5%	0.5%
Grid Inflation	2%	5%	5%	5%
FWD RATE	0.09	0.94	0.32	0.62
USD FWD	0.06	0.65	0.22	0.43

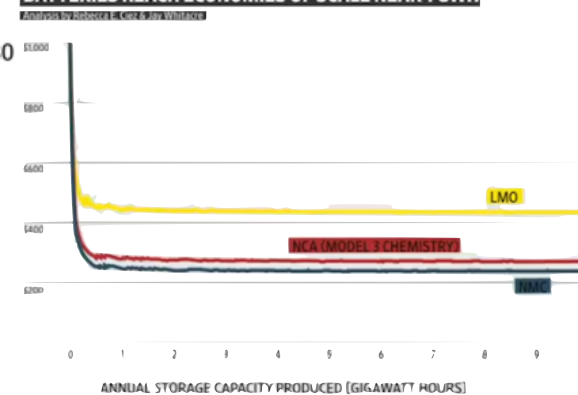
Most Batteries can't achieve USD0.15

- there is no Moore's law for batteries
- Batteries just follow the commodity costs at scale.. plateauing after 1GWh. We are already asymptote bound
- Worse, their lifecycles do not match duration needed for long term stationary storage



	Cycles
NCA	500
NMC	1000-2000
LFP	2000
MILLION MILE	4000

BATTERIES REACH ECONOMIES OF SCALE NEAR 1 GWH

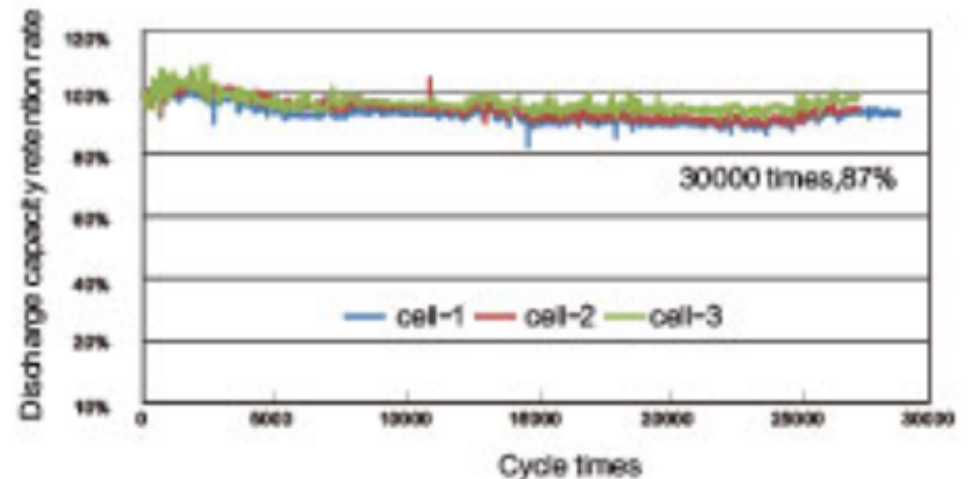


Sources:

1. https://batteryuniversity.com/learn/article/types_of_lithium_ion
2. <https://strathmore.energy>
3. <https://thedriven.io/2020/05/15/tesla-battery-day-update-flags-launch-of-million-mile-battery-in-china-first/>
4. Source: https://www.youtube.com/watch?v=We3JAj_rWAo&feature=youtu.be
5. <https://www.cringely.com/2013/10/15/breaking-moores-law/>

But tCell[®] can

- A 20000 charge cycle
- leverages lithium ion production at scale
- Can achieve USD0.15kWh total cost of ownership in many case

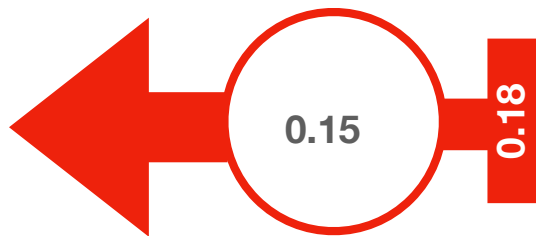


	Cycles
NCA	500
NMC	1000-2000
LFP	2000
MILLION MILE ?	4000
tCell [®]	20000

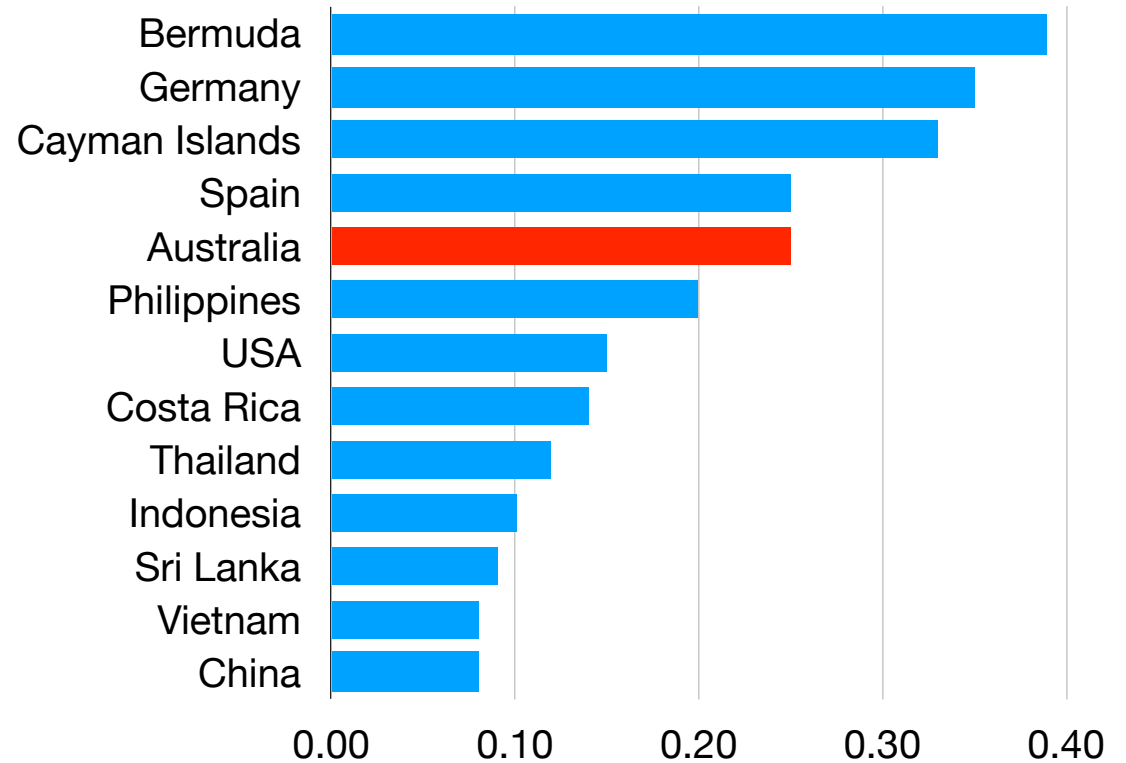
Source <http://www.zhyle.com/en/industry.html>

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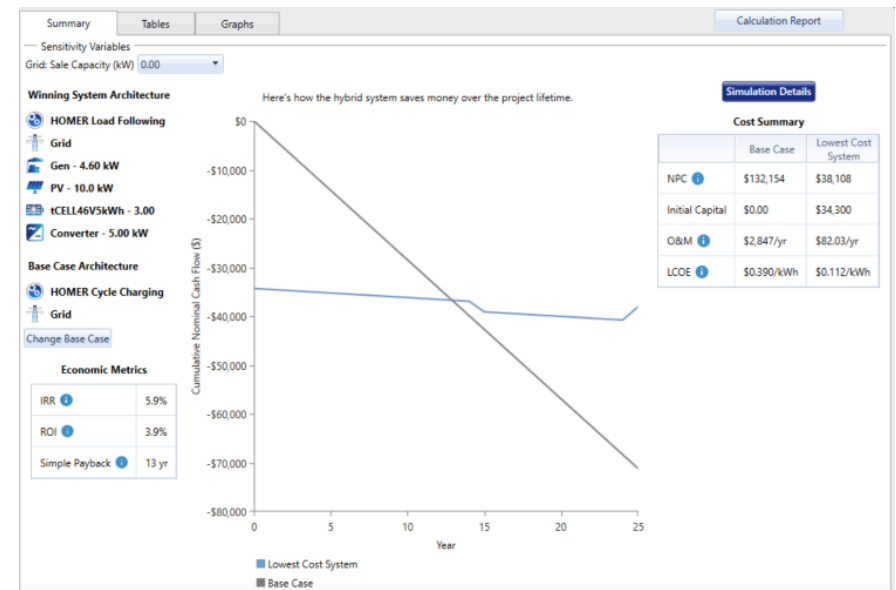
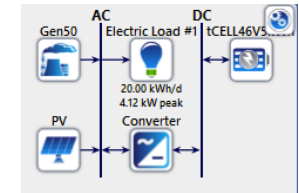
Validated with Homer 😊

20kWh/Day Typical Residence

- 25 Yr NPC= AUD45K
- FWD kWh rate = AUD0.25 , **USD0.17**



- Homer Model parameters
 - 15kWh tCell @ USD1050 / kWh
 - 10kW PV @ \$560 / kW
 - 5kW Converter @ \$300 / kW
 - -33.1,149 GPS (Molong)
 - No grid, 5kW generic genset @ USD350/kW
 - 0.5% disc, 5% inflation



Global try-for-fit : 20kWh Day , 15kWh tCell®

Latitude & clearness

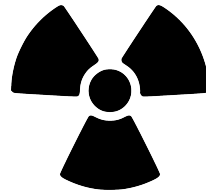
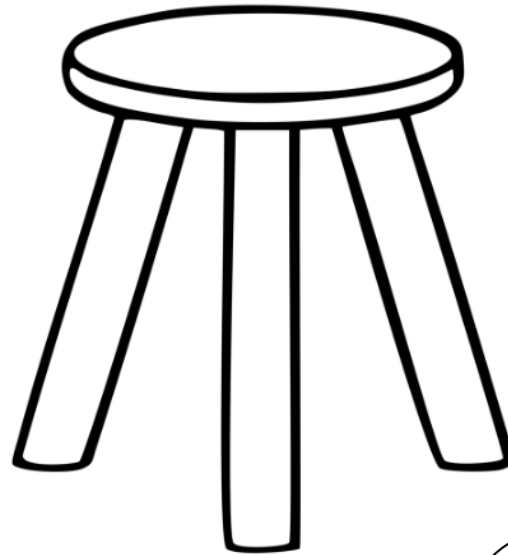
Molong	0.17	Santiago	0.15	Bangkok	0.18	Cape Town	0.15
San Diego	0.18	Juneau	0.40	Jakarta	0.19	Nairobi	0.16
San Francisco	0.16	Hawai	0.17	Ho Chi Minh	0.19	Rome	0.24
Mexico City	0.20	Manilla	0.17	New Caledonia	0.16	Budapest	0.33
San Juan	0.17	Mumbai	0.15	Madagascar	0.16	Ankara	0.25



Constant model: excludes local taxes, regulatory , freight and installation

Conclusion

USD0.15 / kWh



Disclaimer

- Presentation may contain errors or omissions. No warranty offered or implied. Conduct your own independent due diligence. Use at your own risk.