Modeling Case Study:

A Financial Comparison Between Lithium Ion and Flow Batteries in a Utility Scale Storage

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A simulated project is used to compare the economics between a Lithium-Ion and a Flow Battery-type Battery Energy Storage System (BESS) in a utility application .

ASSOCIATED ENERGY DEVELOPERS

5 Aldrin Road, Suite 2
Plymouth, MA 02360
www.AssocEnergy.com

By: **Brian D. Kuhn,** C.E.O., Founder
Associated Energy Developers, LLC

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Comparing Lithium Ion and Flow Battery Economics

The growing supply of intermittent renewable energies such as solar and wind power on the electric grid causes both momentary instabilities and a mismatch between hourly and daily supply and demand curves. Battery Electric Storage Systems (BESS) can provide inertia to the grid to 'smooth out' both sub-second fluctuations (voltage and frequency control) as well as shifting energy supplies over time to meet demand (peak shifting). Both of these functions result in an economic opportunity for the owner/provider of the BESS in the form of Ancillary Service Revenue and the arbitrage of energy between high and low priced periods of power. Many types of batteries are becoming available for this task. While Lithium-Ion chemistries have dominated the BESS landscape to date and seem to have achieved a temporary 'market lock', other types of batteries known as 'Flow Batteries' are competing for adoption. This study compares both of these types of batteries in a common use case to determine which exhibits better economics.

By: Brian D. Kuhn, C.E.O., Founder, Associated Energy Developers, Plymouth, MA

This study compares two battery systems - Lithium-Ion and Flow Batteries – in order to determine which offers the best economics. The economic metric to be used for comparison is the Internal Rate of Return (25 year, unlevered) for the BESS system over time.

The primary questions to be answered center around two of the basic differences of the BESS systems. Flow Batteries will typically operate at a lower 'Round Trip Efficiencies' than a Li-Ion Battery (75% vs 90+%), while Li-Ion batteries will degrade faster than Flow Batteries, requiring them to undergo costly 'Augmentation' (the replacement of a significant portion of their storage cells) every few years. Given all of the other operating conditions between the two types of systems, we wish to determine if there is a significant difference in economic returns between one over the other.

A BESS system typically consists of an interconnection to the grid, transformers and switchgear to handle voltage and amperage requirements, the Batteries themselves, and a Battery Management System (BMS) which is sometimes referred to as an Energy Management System (EMS). The Battery itself can be viewed as being 'dumb' and simply charges and discharges electrons. It is the BMS that contains the brains of the system and oversees things like battery temperature and environmental controls, as well as charge and discharge rates based on pricing signals from the grid. A large number of strategies may be used in the BMS, such as Peak Shaving, Load Management, Standby Use, or Pricing Arbitrage, depending on the business use case for the BESS in that location. Some strategies may be used in combination. Therefore, the BMS and the strategy employed greatly influence the economics of the system.

The purpose of this study was to compare the types of batteries in an Arbitrage use case, to see which type of system would have the best economics when 'buying low and selling high'. A project scenario was developed for the simulations which allowed an 'apples-to-apples' computer comparison. The process included the creation of a test set of 15-minute 'Settlement Prices' over the course of a year. This same set of data was used in all simulations. The system size was changed between simulation runs to see the effects of scaling, both in terms of Power (kW) and Energy (kWhrs). The same logic strategy was employed in all runs which simulated the actions of a BMS. The costs of the BESS were broken out on a $/kW basis where possible to allow system sizes to change as part of the study. Some cost elements were fixed regardless of scale, reflecting the reality of site development. The resulting economics are presented from the point of view of a 'Special Purpose' company ("DevCo") which owns and operates the BESS project and sells this electricity to the grid operator.

The end result of the modeling effort is the production of a 25 year Proforma income statement using AED's proprietary *FOCUS©* financial modeling software, which calculates all of the revenues and expenses of the BESS' operations when charging and discharging. It measures this operation in 15 minute intervals over each of 20 years, to produce the system's unleveraged (unfinanced) Internal Rate of Return as an investment ranking.

The Base Case for Modeling:

The following describes the scenario and assumptions that were used to create the base case simulations:

1. The project developer ("DevCo") has leased land and has interconnected to the electric grid at some node "X", which is defined only by the settlement pricing characteristics shown below. No specific geographic node has been assigned. A lease cost for the land has been assigned to the project, as has an annual PILOT (Payment in Lieu of Taxes) for real estate tax purposes.
2. Two different types of Batteries have been considered, at prices quoted to AED from manufacturers as of January of 2024. A Lithium Ion Phosphate (LFP) and an Iron Flow Battery are simulated. Due to Non-Disclosure Agreements the names of the manufacturers of the batteries have been redacted, and only the generic type of battery is referenced in the report.
3. The size of each of the BESS has been allowed to vary for each comparison computer simulation. Sizes of between 4MWhrs to 16 MWhrs were analyzed.
4. All of the simulations utilize the same BMS to control the rate and logic as to when the batteries will charge and discharge. The BMS logic is driven by 'Settlement Prices' which occur every 15 minutes of the year. The logic for the BMS can be regulated so that 'Buys' and 'Sells' occur at 3 specified price range 'spreads'.
5. A Settlement Price curve was developed for the simulations. The Settlement Prices are based on a daily cycle containing one peak period and one off-peak period. The cycle simulates a sine wave over the 24 hour cycle, with prices rising and falling according to the time of day. The mean (average) price of the Settlement Prices over the year is $.10 USD/kWhr for all simulations in this report. The Settlement Prices can be varied by changing the Amplitude of the Sine Wave which allows an examination of how the economics of the BESS will respond to different price 'spreads'. Each BESS was simulated at 3 different pricing spreads to see the effects of pricing on the economics:
    a. Buy at <$.04/kWhr/Sell>$.16/kWhr,
    b. Buy at <$.05/kWhr/Sell>$.15/kWhr, and
    c. Buy at <$.06/kWhr/Sell>$.14/kWhr.

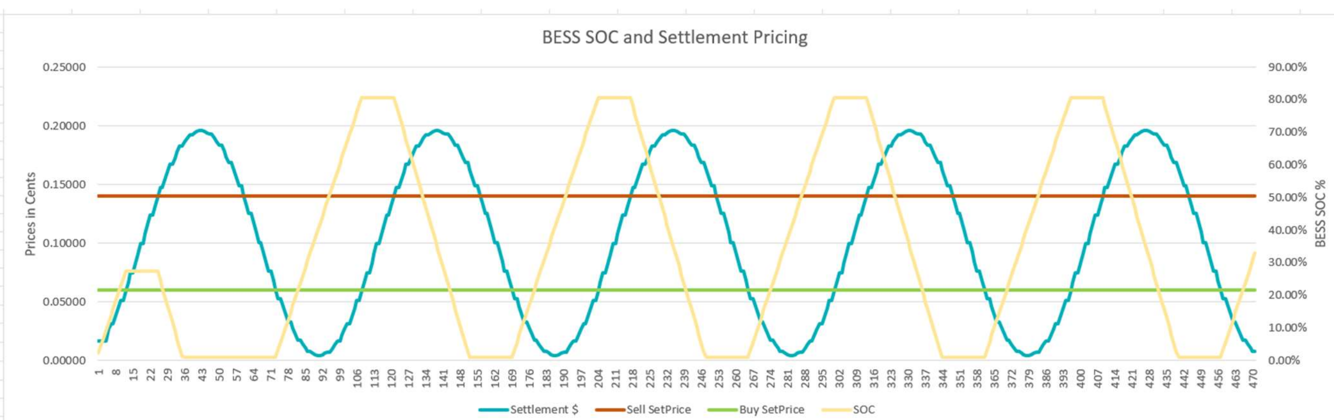


Figure 1 - The Settlement Price curve (blue) simulates node pricing cycling once a day. Mean values ($.10/kWhr) as well as Buy (green) and Sell (red) prices can be specified. The yellow line shows the State of Charge of the BESS. The units of the X-axis are 15 minute intervals, with 5 days shown.

6. A portion of each battery may be 'Set Aside' for purposes of performing Ancillary Service Revenues (ASR). A value of $100,000 per MW-year is used for all BESS. Of note is the fact that there appears to be some disagreement within the industry as to whether Flow Batteries can take advantage of ASR due to pump

reaction speeds, etc. The two manufacturers interviewed for the study claim that their products can react within 200ms and are currently performing ASR. Therefore both BESS participate in ASR.

7. Project costs were assigned on a $/kW or $/kWhr basis to allow for scaling of the BESS size. Some cost elements, such as Permitting, were fixed regardless of size. The costs used are considered typical within the nascent storage industry, and a Bill of Materials (BOM) is included for reference in the Appendix.
8. The costs of maintaining the different types of BESS were included in either an annual O&M cost or as part of an Augmentation program plus O&M in order to replenish the BESS through the 25 year life of the proforma. In this manner no complete replacement of the BESS was required.
9. Where appropriate the Investment Tax Credit and a depreciation expense were taken against the project and added to the Proforma income statement for Devco. A combined tax bracket of 26% was assumed (State and Federal).
10. The metric used to measure the results and compare system performance was the 25 year Internal Rate of Return of the project, on an unlevered basis.

Assumptions:

A number of other assumptions are used to simulate the projects as found in Table 1 below.

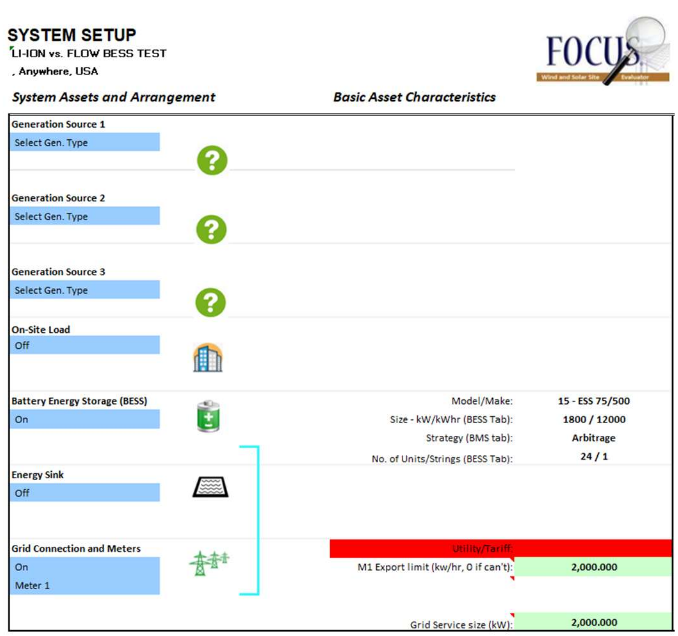
Item	Value
Round Trip Efficiencies (Li-Ion / FB)	90%/76%
ITC value	30%
Cost of Site (Land Lease + PILOT)	$20,000/$10,000, increased for FB due to larger footprint
Augmentation for Li-Ion	15% every 3 years
Devco Combined Tax Bracket	28%
Augmentation of Flow Batteries	Built into O&M per manufacturer's warranty
Insurance Costs	See Appendix
O&M costs	See Appendix
Cycling	Both systems cycled approximately once/day

Table 1 - Various assumptions used in the model.

Methodology:

FOCUS© financial modeling software for Microgrids (www.AssocEnergy.com/Focus) was used to model the BESS performance and business profitability. FOCUS© was used to set up a microgrid topology for the BESS and all associated costs and revenues incurred in servicing one of the grid's nodes, represented by the derived Settlement Pricing curve.

FOCUS© then simulated the operation of the system using data from the Settlement data in 15 minute increments to analyze how the BESS charges, discharges and makes money according to the logic of the BMS. The business has been modeled from the point of view of DevCo, which owns the BESS as a business unit. The power and energy from the BESS is sold for both Arbitrage against the daily fluctuating curve, with a set aside reserve of 20% of the BESS which is used for ASR.



The costs associated with the business unit include all costs of Capital, Financing, Operations, Labor and O&M placed upon the business unit as can be seen in the Appendix exhibits. Where possible known values were used in these calculations. Otherwise industry averages were used. Costs were determined to be either fixed, per kW or a per kWhr basis, depending on the type of cost. This allowed for the project sizes to be scaled.

Once the Settlement Prices were loaded the characteristics of each BESS to be studied were input. These characteristics appear in the Exhibits. The program was then used to simulate the operation of each BESS every 15 minutes of the year, repeating the process until it scaled through 7 different size configurations. This was done for each of the BESS at 3 different 'buy/sell' price points on the Settlement Pricing curve in order to study the effects of the price spread on the IRRs.

FOCUS© then generated a 25 year proforma income statement and the 25 IRR for each of the 21 simulations.

A few notations are made concerning the comparison of Li-Ion to Flow Batteries due to the differences in technology.

1. In general today's Flow Batteries are only about 15-25% as energy 'dense' as Li-Ion batteries. Although this is reflected in the CapEx price/unit power or energy, the Flow Batteries have a larger footprint and will consume more real estate. Therefore, the lease and the PILOT (real estate tax) costs of the Flow Battery simulation were increased.
2. Lithium-Ion chemistry requires those batteries to be 'Augmented' every few years in order to replace overused or worn-down cells and keep the overall battery running at factory specifications for the warranty. In contrast, Flow Batteries require an occasional replenishment of electrolytic fluid, which is much less expensive. The FOCUS program accommodates for both of these differences in both the O&M and 'Augmentation' expense columns of the Proforma Income Statements. Manufacturers values for O&M and Augmentation were used in the simulation.
3. The 'Round Trip Efficiency' of the BESS (kHrs Delivered/kWhrs Charged) is different between the two types of batteries, with flow batteries exhibiting a lower RTE. This characteristic is included in the calculations performed by the FOCUS program.

Results:

The Li-Ion BESS: The LFP BESS was simulated in FOCUS first, according to the assumptions listed previously and shown in the Exhibits. As the project was scaled through 7 different sizes (from roughly 2MWhr to 16 MWhr) the IRR of each size was calculated. Figure 2 below shows the result of those simulations at each of the Settlement Price pricing spreads.

Figure 2 - The Internal Rates of Return of the Li-Ion BESS at different sizes and at 3 different pricing spreads.

As can be seen, the larger the pricing spread between the Buy and Sell prices, the higher the rate of return on the investment will be at given sizes. This is as expected.

In addition, a 'sweet spot' in system size develops for the BESS for each of the pricing spreads. For any pricing spread there is an optimum (maximum) IRR that occurs. System sizes to the left or right of this optimum show decreasing IRRs, as the system size and operating revenue is either too small to overcome fixed and minimum operating expenses, or the system is too large and wastes Power or Energy capacity for the number of arbitrage occurrences over the year.

This analysis underscores the fact that a BESS system should be designed to the Settlement Pricing data for the intended grid node in order to achieve optimum economics.

A Proforma income statement for this BESS system at the 12,000 kWhr size and for the mid-range pricing spread is shown in the Appendix.

The Flow Battery BESS: The Flow Battery BESS was then substituted for the Li-Ion BESS and the simulations were rerun. Only a few modifications mentioned above were made (Augmentation, RTE, etc.), and all other variables were held constant. As the project was scaled through 7 different sizes (from roughly 2MWhr to 16 MWhr) the IRR of each size was calculated. Figure 2 below shows the result of those simulations at each of the Settlement Price pricing spreads.

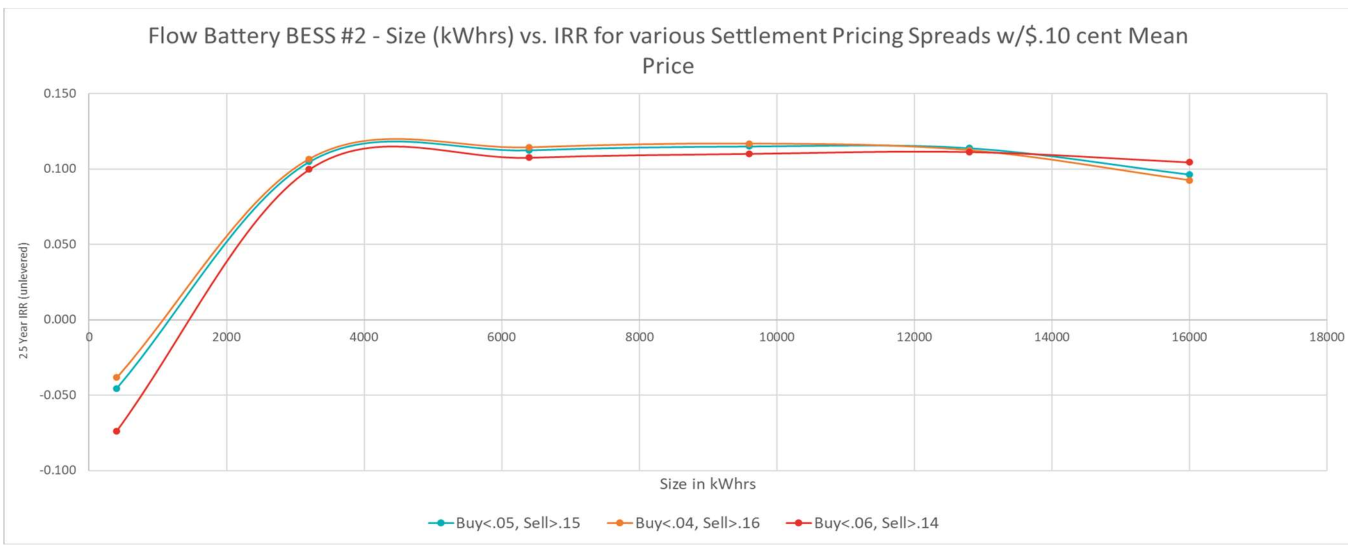


Figure 3 - The flow Battery simulations at 3 different pricing spreads. Note that IRR is less affected by the size of the units.

This type of BESS appears to achieve a slightly higher IRR across more sizes than the Lithium chemistry. And it appears to hold that return across a broader range of sizes, making the sizing of these units appear more 'forgiving'.

Once again, we see that sizes below 3-4 MWhrs achieve inferior economics, while sizes above 16mWhrs start to drop off. And again, these IRR values must be taken in context with the Settlement Prices from that node, and the strategy/logic of the BMS system.

Side-by-side Comparison: A side-by-side comparison of the two BESS types at the middle pricing spread are shown below in Figure 4. The 'bump' in IRR at the 4,000 kWhr mark in the Flow Battery curve should be ignored, as it is the result of the data being smoothed between data points.

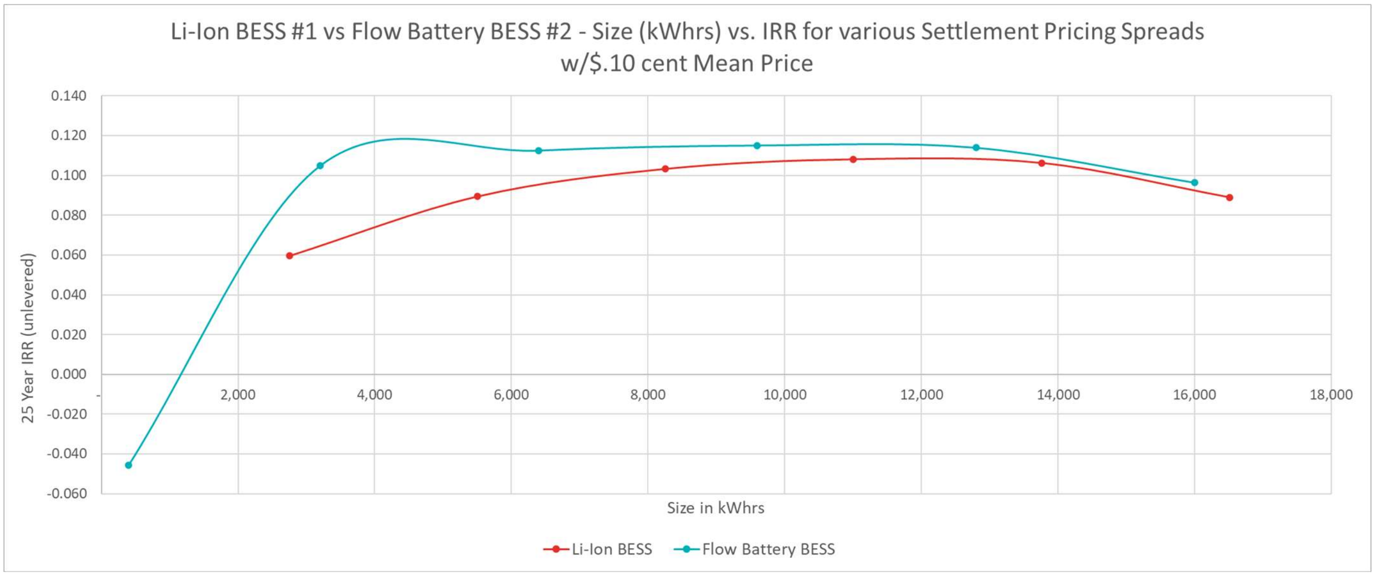


Figure 4 - The Flow Battery BESS and the Li-Ion BESS across similar size ranges for the middle pricing spread (Buy<$.05, Sell> $.15)

As can be seen the Flow Battery actually exceeds the IRR of the Lithium BESS for all sizes at this pricing spread. In actual business practice this should be examined at any anticipated node, and it should be kept in mind that this small difference may be mitigated simply by a better quotation on pricing, or future pricing trends (see conclusion). But in general, this exercise shows that the RTE and Augmentation result in similar economics between the two BESS system types.

Reserve for Ancillary Services Revenue:

As was noted, each simulation was done with 20% of the BESS size 'reserved' for bidding into Ancillary Services such as voltage and frequency support. At the start of the exercise, it was thought that the Flow Batteries could not provide the rapid response needed to provide these services and that this revenue should be ignored in those simulations. Interviews with two Flow Battery manufacturers during the work have revealed that the Flow Batteries can react within 200ms, which should allow participation in at least some support services. Each manufacturer confirmed that they have product in the field that is successfully bidding AS revenues. Therefore this set-aside was included for both types of BESS.

For the Flow Battery, at the 12,000 Gross kWhr size and at the middle price spread of $.05/$.15, the 20% set aside for Ancillary Service Revenues produced 36.1% of the total *energy* revenues, or 24.4% of all 'revenues' *including* ITC and tax considerations.

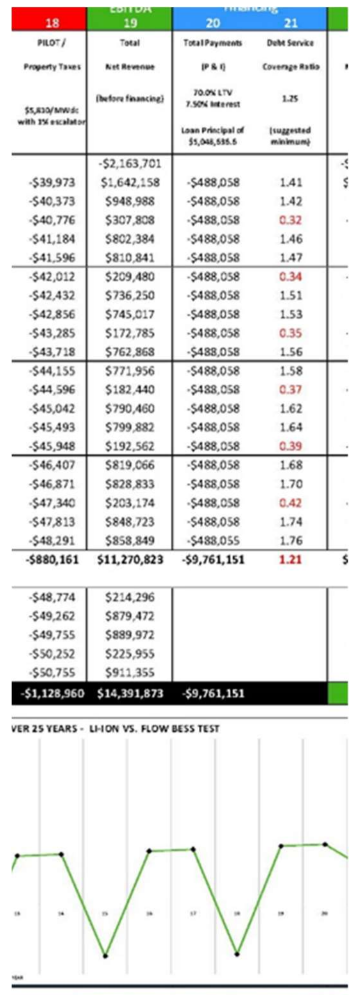
A Proforma was run for this simulation and appears in the Appendix. As can be seen, the inclusion of the AS revenue increased the IRR from 9.4% without the ASR set aside to 11.5% with the ASR.

For the Li-Ion BESS, at the 13,760 Gross kWhr size, and at the middle price spread of $.05/$.15, the 20% set aside for Ancillary Service Revenues produced 25.2% of the total *energy* revenues, or 23.4% of all 'revenues' *including* ITC and tax considerations.

A Proforma was also run for this simulation and appears in the Appendix. As can be seen, the inclusion of the AS revenue increased the IRR from 8.9% without the ASR set aside to 10.8% with the ASR.

Conclusions:

1. The Flow Battery appears to enjoy a slight increase in IRR across all size of projects studied, although the difference at many sizes is less than 1% IRR, and this is likely with the margin of error of this exercise.
2. The lower Round Trip Efficiency of the flow battery and the increased Augmentation costs of the LFP appear to counteract each other, resulting in similar cost effectiveness for each system.
3. The Augmentation costs of the LFP really hurts its economic performance. Although the practice is to only replace a certain percentage of cells every few years, the end result is the entire replacement (plus some) of the battery within 25 years.
4. As well as affecting overall economic returns (IRR), this Augmentation cost replacement presents an additional concern with the financing of the project. As can be seen on the Proforma Income Statements (snippet on right), the volatility of the Augmentation expense raises havoc on the cash flow in replacement years, which also affects the Debt Service Coverage Ratio (DSCR) for financing. Lenders who insist that EVERY year maintain a certain DSCR may decline to finance the project for that reason.
5. The 'shape' of the Settlement curve in Arbitrage situations – how it changes from hour-to-hour and day-to-day – is most important. The BESS needs to be optimized against this curve for best performance. In fact, the analysis of this data is at the very heart of the BESS sizing proposition.
6. The logic and strategies of the BMS system are very important to the financial success of the project. Understanding the logic, setpoints, communication protocols and other details of the BMS interface between the BESS and the grid operator is paramount.
7. It goes without saying that the Pricing obtained for the BESS is paramount and will have a great influence on the IRR. This is an issue at the heart of the rapidly growing storage industry, which is promising many new technologies and price reductions for the near future.
8. Due to the lower energy density of the Flow Batteries, a larger real estate footprint will be required. This should especially be considered for small sites.
9. This study only examined one type of Flow Battery chemistry – that of Iron and a salt electrolyte. Other chemistries may have slightly different results.
10. As this report shows, a simulation of economic forecasting or backcasting with actual historic data should be undertaken as part of the economic due diligence. Such a report should list all variables considered and the methodology of the analysis performed. Such an analysis should include FULLY LOADED project costs, including land costs, taxes, O&M, Augmentation and fees paid to all participants.



18	19	20	21
PILOT / Property Taxes $5,830/MWdc with 1% escalator	Total Net Revenue (before financing)	Total Payments (P & I) 70.0% LTV 7.50% Interest Loan Principal of $5,048,585.6	Debt Service Coverage Ratio 1.25 (suggested minimum)
	-$2,163,701		
-$39,973	$1,642,158	-$488,058	1.41
-$40,373	$948,988	-$488,058	1.42
-$40,776	$307,808	-$488,058	0.32
-$41,184	$802,384	-$488,058	1.46
-$41,596	$810,841	-$488,058	1.47
-$42,012	$209,480	-$488,058	0.34
-$42,432	$736,250	-$488,058	1.51
-$42,856	$745,017	-$488,058	1.53
-$43,285	$172,785	-$488,058	0.35
-$43,718	$762,868	-$488,058	1.56
-$44,155	$771,956	-$488,058	1.58
-$44,596	$182,440	-$488,058	0.37
-$45,042	$790,460	-$488,058	1.62
-$45,493	$799,882	-$488,058	1.64
-$45,948	$192,562	-$488,058	0.39
-$46,407	$819,066	-$488,058	1.68
-$46,871	$828,833	-$488,058	1.70
-$47,340	$203,174	-$488,058	0.42
-$47,813	$848,723	-$488,058	1.74
-$48,291	$858,849	-$488,055	1.76
-$880,161	**$11,270,823**	**-$9,761,151**	**1.21**
-$48,774	$214,296		
-$49,262	$879,472		
-$49,755	$889,972		
-$50,252	$225,955		
-$50,755	$911,355		
-$1,128,960	**$14,391,873**	**-$9,761,151**	

Figure 5 - The Augmentation costs greatly affect the DSCRs.

Appendices:

The following Exhibits are enclosed:

1. Proforma Income Statement of 12,000kWhr Flow Battery BESS at mid-range pricing spreads w/20% ASR.
2. Proforma Income Statement of 12,000kWhr Flow Battery BESS at mid-range pricing spreads w/out 20% ASR.
3. Bill of Materials comprising the 12,000kWhr BESS installation used in the simulations.
4. Details of Expenses shown on Proforma for the 12,000 kWhr simulation.

5. Proforma Income Statement of 12,000kWhr Li-Ion BESS at mid-range pricing spreads w/20% ASR.
6. Proforma Income Statement of 12,000kWhr Li-Ion BESS at mid-range pricing spreads w/out 20% ASR.
7. Bill of Materials comprising the 12,000kWhr BESS installation used in the simulations.
8. Details of Expenses shown on Proforma for the 12,000 kWhr simulation.

1. Proforma FB with 20% ASR set aside.

25-YEAR FINANCIAL PROFORMA : LI-ION vs. FLOW BESS TEST - , Anywhere, USA

Notes: **Flow Battery BESS - with 20% ASR setaside. 12,000kWhr Gross Energy Storage**

Prepared For:

Prepared By: Brian Kuhn, Founder, CEO

Contact Info: 1(888) 800-2381 | Brian.Kuhn@AssocEnergy.com

Report Date: 1/25/2024 10:15

	Source 1	Source 2	Source 3	Energy Storage	Ancillary Svc.	Totals
Generation Type:				Energy Storage System	N/A	
Size (dc):				1,800.000 kWdc		1,800.000 kWdc
Size (ac):				1,800.000 kWac		1,800.000 kWac
Net Output:				N/A		0 kWh
Cost ($):				$6,664,130.00		$6,664,130.00
Cost ($/W):				$3.702 /Wdc		$3.702 /Wdc
Tax Ineligibles:				$0.00		$0.00
Investment Tax Credit:				$1,999,239.00		$1,999,239.00
Depreciation Cash Value:				$1,472,772.73		$1,472,772.73

Revenue (Cash Basis)									Gross	Operating Expenses								EBITDA	Financing		Results	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Year					Additional Revenue BESS kWhrs Exports - 3,027,813	BESS Anc. Svcs. Revenue BESS AS Reserve of 20.0% and AS Rate of $100,000 / MW		Depreciation and Fed ITC Depreciation at 26.0% Tax Rate ITC Shown as Revenue (Year 1)	Gross Revenue	Site Lease / Site Purchase	Insurance Coverage $17.50/kWdc with 1% escalator	Operations & Maintenance	Miscellaneous Expenses BESS kWhrs Imports - 3,964,254	Anc. Pumping Costs	Other Costs	Down Payment / Interest Reserve 30.0% Down Payment	PILOT / Property Taxes $11,620/MWdc with 1% escalator	Total Net Revenue (before financing)	Total Payments (P & I) 70.0% LTV 7.50% Interest Loan Principal of $4,664,891.	Debt Service Coverage Ratio 1.25 (suggested minimum)	Annual Net Cash Flow	Cumulative Net Cash Flow
0																-$1,999,239		-$1,999,239			-$1,999,239	-$1,999,239
1					$558,075	$192,000		$883,664	$1,633,738	-$20,000	-$31,500	-$92,160	$62,219	-$1,982			-$20,916	$1,401,961	-$450,961	1.16	$954,001	-$1,045,238
2					$563,655	$194,880		$235,644	$994,179	-$20,000	-$31,815	-$93,082	$62,841	-$1,972			-$21,125	$763,344	-$450,961	1.17	$312,384	-$732,854
3					$569,292	$197,803		$141,386	$908,481	-$20,000	-$32,133	-$94,012	-$63,469	-$1,962			-$21,336	$675,567	-$450,961	1.18	$224,607	-$508,248
4					$574,985	$200,770		$84,832	$860,587	-$20,000	-$32,454	-$94,953	-$64,101	-$1,953			-$21,550	$625,573	-$450,961	1.20	$174,613	-$333,635
5					$580,735	$203,782		$84,832	$869,348	-$20,000	-$32,779	-$95,902	-$64,745	-$1,943			-$21,765	$632,214	-$450,961	1.21	$181,254	-$152,381
6					$586,542	$206,839		$42,416	$835,797	-$20,000	-$33,107	-$96,861	-$65,393	-$1,933			-$21,983	$596,521	-$450,961	1.23	$145,560	-$6,821
7					$592,408	$209,941			$802,349	-$20,000	-$33,438	-$97,830	-$66,046	-$1,923			-$22,203	$560,908	-$450,961	1.24	$109,948	$103,127
8					$598,332	$213,090			$811,422	-$20,000	-$33,772	-$98,808	-$66,707	-$1,914			-$22,425	$567,796	-$450,961	1.26	$116,835	$219,962
9					$604,315	$216,287			$820,602	-$20,000	-$34,110	-$99,796	-$67,374	-$1,904			-$22,649	$574,769	-$450,961	1.27	$123,808	$343,770
10					$610,358	$219,531			$829,889	-$20,000	-$34,451	-$100,794	-$68,048	-$1,895			-$22,876	$581,826	-$450,961	1.29	$130,865	$474,635
11					$616,462	$222,824			$839,286	-$20,000	-$34,796	-$101,802	-$68,728	-$1,885			-$23,104	$588,970	-$450,961	1.31	$138,010	$612,645
12					$622,626	$226,166			$848,792	-$20,000	-$35,144	-$102,820	-$69,416	-$1,876			-$23,335	$596,202	-$450,961	1.32	$145,242	$757,887
13					$628,853	$229,559			$858,412	-$20,000	-$35,495	-$103,848	-$70,110	-$1,866			-$23,569	$603,524	-$450,961	1.34	$152,563	$910,450
14					$635,141	$233,002			$868,143	-$20,000	-$35,850	-$104,887	-$70,811	-$1,857			-$23,804	$610,934	-$450,961	1.35	$159,974	$1,070,424
15					$641,492	$236,497			$877,989	-$20,000	-$36,208	-$105,936	-$71,519	-$1,848			-$24,042	$618,436	-$450,961	1.37	$167,476	$1,237,899
16					$647,907	$240,045			$887,952	-$20,000	-$36,571	-$106,995	-$72,234	-$1,839			-$24,283	$626,032	-$450,961	1.39	$175,071	$1,412,970
17					$654,386	$243,645			$898,031	-$20,000	-$36,936	-$108,065	-$72,956	-$1,829			-$24,526	$633,719	-$450,961	1.41	$182,758	$1,595,729
18					$660,930	$247,300			$908,230	-$20,000	-$37,306	-$109,145	-$73,686	-$1,820			-$24,771	$641,502	-$450,961	1.42	$190,542	$1,786,270
19					$667,540	$251,009			$918,549	-$20,000	-$37,679	-$110,237	-$74,423	-$1,811			-$25,019	$649,380	-$450,961	1.44	$198,420	$1,984,690
20					$674,215	$254,775			$928,990	-$20,000	-$38,055	-$111,339	-$75,167	-$1,802			-$25,269	$657,357	-$450,958	1.46	$206,400	$2,191,090
Subtotals:					**$12,288,249**	**$4,439,745**		**$1,472,773**	**$18,200,767**	**-$400,000**	**-$693,599**	**-$2,029,271**	**-$1,369,995**	**-$37,815**		**-$1,999,239**	**-$460,549**	**$11,210,298**	**-$9,019,208**	**1.30**	**$2,191,090**	**$2,191,090**
											Additional Years' Performance											
21					$680,957	$258,596			$939,553	-$20,000	-$38,436	-$112,453	-$75,919	-$1,775			-$25,521	$665,449			$665,449	$2,856,539
22					$687,767	$262,475			$950,242	$20,000	$38,820	$113,577	-$76,678	$1,766			$25,777	$673,623			$673,623	$3,530,162
23					$694,644	$266,412			$961,056	$20,000	$39,209	$114,713	-$77,445	$1,757			$26,034	$681,898			$681,898	$4,212,061
24					$701,591	$270,108			$971,999	-$20,000	-$39,601	-$115,860	-$78,219	-$46,691			-$26,295	$645,333			$645,333	$4,857,394
25					$708,607	$274,165			$983,072	-$20,000	-$39,997	-$117,019	$79,001				-$26,558	$700,497			$700,497	$5,557,891
Totals:					**$15,761,815**	**$5,772,101**		**$1,472,773**	**$23,006,689**	**-$500,000**	**-$889,651**	**-$2,602,893**	**-$1,757,257**	**-$89,805**		**-$1,999,239**	**-$590,735**	**$14,577,099**	**-$9,019,208**			**$5,557,891**

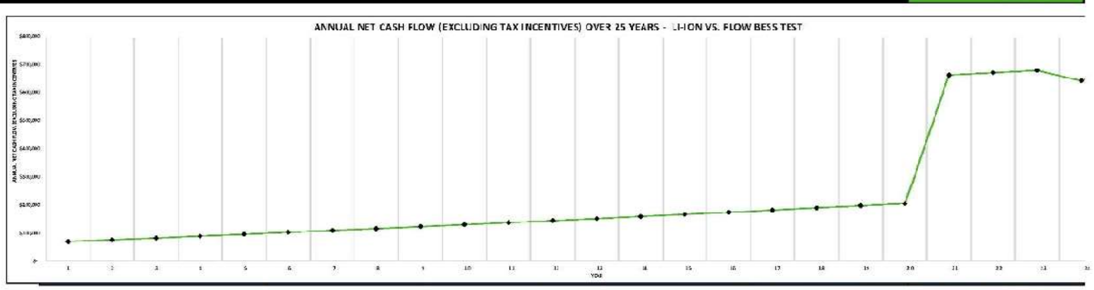
Key Financial Metrics

Internal Rate of Return (IRR)

20-Year Unlevered IRR:	*8.40%*
25-Year Unlevered IRR:	*11.51%*

Project Notes

- Depreciation modeled at 25% Tax Bracket. Year One Tax Benefit ROIC of 44.2%.



2. Proforma FB w/out 20% ASR set aside.

ASSOCIATED ENERGY DEVELOPERS

FOCUS

25-YEAR FINANCIAL PROFORMA : LI-ION vs. FLOW BESS TEST - , Anywhere, USA

Notes: Flow Battery BESS - withOUT 20% ASR setaside. 12,000kWhr Gross Energy Storage

Prepared For:

Prepared By: Brian Kuhn, Founder, CEO

Contact Info: 1(888) 800-2381 | Brian.Kuhn@AssocEnergy.com

Report Date: 1/25/2024 10:16

	Source 1	Source 2	Source 3	Energy Storage	Ancillary Svc.	Totals
Generation Type:				Energy Storage System	N/A	
Size (dc):				1,800.000 kWdc		1,800.000 kWdc
Size (ac):				1,800.000 kWac		1,800.000 kWac
Net Output:				N/A		0 kWh
Cost ($):				$6,664,130.00		$6,664,130.00
Cost ($/W):				$3.702 /Wdc		$3.702 /Wdc
Tax Ineligibles:				$0.00		$0.00
Investment Tax Credit:				$1,999,239.00		$1,999,239.00
Depreciation Cash Value:				$1,472,772.73		$1,472,772.73

Revenue (Cash Basis)									Gross	Operating Expenses								EBITDA	Financing		Results	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Year					Additional Revenue BESS kWhrs Exports - 3,765,277			Depreciation and Fed ITC Depreciation at 26.0% Tax Rate ITC Shown as Revenue (Year 1)	Gross Revenue	Site Lease / Site Purchase	Insurance Coverage $17.50/kWdc with 1% escalator	Operations & Maintenance	Miscellaneous Expenses BESS kWhrs Imports - 4,027,500	Anc. Pumping Costs	Other Costs	Down Payment / Interest Reserve 30.0% Down Payment	PILOT / Property Taxes $11,620/MWdc with 1% escalator	Total Net Revenue (before financing)	Total Payments (P & I) 75.0% LTV 4.50% interest Loan Principal of $4,664,891.	Debt Service Coverage Ratio 1.25 (suggested minimum)	Annual Net Cash Flow	Cumulative Net Cash Flow
0																-$1,999,239		-$1,999,239			-$1,999,239	-$1,999,239
1					$691,083			$883,664	$1,574,752	-$20,000	-$31,500	-$92,100	-$93,632	-$2,464			-$20,916	$1,314,030	-$450,961	0.95	$863,120	-$1,136,119
2					$697,999			$235,644	$933,643	-$20,000	-$31,815	-$93,082	-$94,568	-$2,451			-$21,125	$670,601	-$450,961	0.96	$219,541	-$915,478
3					$704,979			$141,386	$846,365	$20,000	$32,133	$94,012	-$95,514	$2,439			$21,336	$580,930	$450,961	0.97	$129,970	$785,509
4					$712,029			$84,832	$796,861	-$20,000	-$32,454	-$94,953	$96,469	-$2,427			-$21,550	$529,008	-$450,961	0.98	$78,047	-$708,461
5					$719,149			$84,832	$803,981	-$20,000	-$32,779	-$95,902	-$97,434	-$2,415			-$21,765	$533,686	-$450,961	1.00	$82,725	-$625,736
6					$726,341			$42,416	$768,757	-$20,000	-$33,107	-$96,861	-$98,408	-$2,403			-$21,983	$495,995	-$450,961	1.01	$45,034	-$580,701
7					$733,604				$733,604	-$20,000	-$33,438	-$97,830	-$99,392	-$2,391			-$22,203	$458,351	-$450,961	1.02	$7,390	-$573,311
8					$740,940				$740,940	-$20,000	-$33,772	-$98,808	-$100,386	-$2,379			-$22,425	$463,170	-$450,961	1.03	$12,210	-$561,101
9					$748,350				$748,350	-$20,000	-$34,110	-$99,796	-$101,390	-$2,367			-$22,649	$468,038	-$450,961	1.04	$17,077	-$544,024
10					$755,833				$755,833	-$20,000	-$34,451	-$100,794	-$102,404	-$2,355			-$22,876	$472,954	-$450,961	1.05	$21,993	-$522,031
11					$763,391				$763,391	-$20,000	-$34,796	-$101,802	-$103,428	-$2,343			-$23,104	$477,918	-$450,961	1.06	$26,958	-$495,073
12					$771,025				$771,025	$20,000	$35,144	$102,820	-$104,462	$2,332			$23,335	$482,933	$450,961	1.07	$31,972	$463,101
13					$778,736				$778,736	-$20,000	-$35,495	-$103,848	$105,507	-$2,320			-$23,569	$487,997	-$450,961	1.08	$37,036	-$426,065
14					$786,523				$786,523	-$20,000	-$35,850	-$104,887	-$106,562	-$2,308			-$23,804	$493,112	-$450,961	1.09	$42,151	-$383,913
15					$794,388				$794,388	-$20,000	-$36,208	-$105,936	-$107,627	-$2,297			-$24,042	$498,278	-$450,961	1.10	$47,317	-$335,596
16					$802,332				$802,332	-$20,000	-$36,571	-$106,995	-$108,704	-$2,285			-$24,283	$503,495	-$450,961	1.12	$52,534	-$284,062
17					$810,355				$810,355	-$20,000	-$36,936	-$108,065	-$109,791	-$2,274			-$24,526	$508,764	-$450,961	1.13	$57,803	-$226,259
18					$818,459				$818,459	-$20,000	-$37,306	-$109,145	-$110,889	-$2,263			-$24,771	$514,086	-$450,961	1.14	$63,125	-$163,134
19					$826,644				$826,644	-$20,000	-$37,679	-$110,237	-$111,998	-$2,251			-$25,019	$519,461	-$450,961	1.15	$68,500	-$94,634
20					$834,910				$834,910	-$20,000	-$38,055	-$111,339	-$113,118	-$2,240			-$25,269	$524,889	-$450,958	1.16	$73,931	-$20,702
Subtotals:					$15,217,076			$1,472,773	$16,689,849	-$400,000	-$693,599	-$2,029,271	-$2,061,682	-$47,003		-$1,999,239	-$460,549	$8,998,505	-$9,019,208	1.06	-$20,702	-$20,702
										Additional Years' Performance												
21					$843,259				$843,259	-$20,000	-$38,136	-$112,453	$114,249	-$2,207			-$25,521	$530,394			$530,394	$509,691
22					$851,692				$851,692	-$20,000	-$38,820	-$113,577	-$115,391	-$2,195			-$25,777	$535,931			$535,931	$1,045,622
23					$860,209				$860,209	-$20,000	-$39,209	-$114,713	-$116,545	-$2,184			-$26,034	$541,523			$541,523	$1,587,145
24					$868,811				$868,811	-$20,000	-$39,601	-$115,860	-$117,711	-$58,036			-$26,295	$491,308			$491,308	$2,078,453
25					$877,499				$877,499	-$20,000	-$39,997	-$117,019	-$118,888				-$26,558	$555,038			$555,038	$2,633,491
Totals:					$19,518,545			$1,472,773	$20,991,317	-$500,000	-$889,661	-$2,602,893	-$2,644,465	-$111,626		-$1,999,239	-$590,735	$11,652,699	-$9,019,208		$2,633,491	

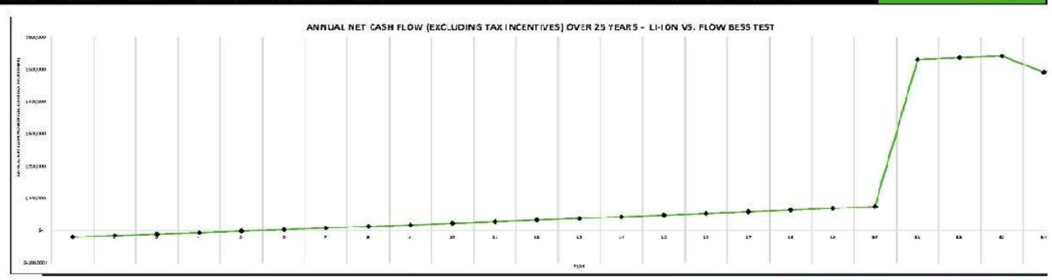
Key Financial Metrics

Internal Rate of Return (IRR)

20-Year Unlevered IRR:	*5.97%*
25-Year Unlevered IRR:	*9.38%*

Project Notes

- Depreciation modeled at 26% Tax Bracket. Year One Tax Benefit ROIC of 41.2%.



3. FB CapEx BOM

ASSOCIATED ENERGY DEVELOPERS

FOCUS

BESS Component Budget	BESS Model:		1/25/2024
Project:		**LI-ION vs. FLOW BESS TEST -, Anywhere, USA**	
A. Development and Permitting		**Cost ($)**	**Cost ($/Watt)**
Site Visit:			$ -
Feasibility Study:		$ 20,000.00	$ 0.011 /W
Site Plans:		$ 25,000.00	$ 0.014 /W
Soil Geotechnic Study:		$ -	$ -
Interconnection Studies:		$ -	$ -
Interconnection Application:		$ -	$ -
Electrical Engineering:		$ 5,000.00	$ 0.003 /W
Environmental Studies:		$ 5,000.00	$ 0.003 /W
Structural Engineering:		$ -	$ -
Legal (ALTA, Title, Project Co., Legal Review):		$ 5,000.00	$ 0.003 /W
Town Permits:		$ 10,000.00	$ 0.006 /W
Total Development & Permitting		$ 70,000.00	$ 0.039 /W
B. Balance of Plant		**Cost ($)**	**Cost ($/Watt)**
B1. BESS Equipment Costs			
Battery Cost		$ 4,950,000.00	$ 2.7500 /W
BESS Shipping:		$ 180,000.00	$ 0.100 /W
Duties and Fees:		$ 3,600.00	$ 0.002 /W
BMS/EMS:		$ 72,000.00	$ 0.040 /W
Transformer:		$ 45,000.00	$ 0.025 /W
Inverters:		$ -	$ -
Electrical BOS:		$ -	$ -
DAS / SCADA:		$ 18,000.00	$ 0.010 /W
Other Components :		$ -	$ -
Total BESS Equipment Costs		$ 5,268,600.00	$ 2.927 /W
B2. BESS Equipment Installation			
BESS Installation:		$ 144,000.00	$ 0.080 /W
BMS Installation:		$ 36,000.00	$ 0.020 /W
Wiring to Meter:		$ -	$ -
Wiring to Grid:		$ -	$ -
Total BESS Equipment Installation Costs		$ 180,000.00	$ 0.100 /W
B3. Site Work & Other Project Costs			
Rental Equipment:		$ -	$ -
Grading:		$ -	$ -
Landscaping:		$ -	$ -
Crane/Lift Costs:		$ -	$ -
Interconnection Fees:	1.59%	$ 90,000.00	$ 0.050 /W
Other:		$ -	$ -
EPC Contingency:		$ -	$ -
EPC Project Fees:		$ 63,000.00	$ 0.035 /W
Total Site Work & Other Project Costs		$ 153,000.00	$ 0.085 /W
Total Balance of Plant		$ 5,601,600.00	$ 3.112 /W
C. General & Administrative Costs		**Cost ($)**	**Cost ($/Watt)**
Sales Tax:		$ -	$ -
Miscellaneous:	2.00%	$ 113,432.00	$ 0.063 /W
Offtaker Acquisition Fees:		$ -	$ -
Soft Costs - Third Party Developer Fees:	2.00%	$ 113,432.00	$ 0.063 /W
Soft Costs - Developer Fees:	12.00%	$ 680,592.00	$ 0.378 /W
Soft Costs - Site Host Developer Fees:		$ -	$ -
Soft Costs - Financing Fees:	1.50%	$ 85,074.00	$ 0.047 /W
Total G&A Expenses	17.50%	$ 992,530.00	$ 0.551 /W
Total Installed Price		**$ 6,664,130.00**	**$ 3.702 /W**

4. FB Proforma Annual Expenses

Expense Calculations

	Insurance	O&M	Decommissioning	Miscellaneous	Asset Management	Augmentation	PILOT/Taxes
In Use:	Yes	Yes	No	No	Yes	Yes	Yes
Start Year:	1	1	1	1	1	1	1
End Year:	25	25	25	25	25	25	25
Select Rate:	$/kWdc	$/kWdc	$	$/kWh	$/kWh	$	$/kWdc
$ Rate:	$150,000.00	$66,641.30	$5,000.00	$5,000.00	$5,000.00	$0.00	$10,000.00
$/kWdc Rate:	$17.50 /kWdc	$51.20 /kWdc	$3.00 /kWdc	$3.00 /kWdc	$3.00 /kWdc	0.00% of BESS CapEx/yr.	$11.62 /kWdc
$/kWac Rate:	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	Every 3 Years	$3.00 /kWac
$/kWh Rate:	$0.01600 /kWh	$3.65000 /kWh	$0.00500 /kWh	$0.00050 /kWh	$0.00050 /kWh		$0.00500 /kWh
Escalator:	1.00%	1.00%	2.50%	2.50%	2.50%	1.00%	1.00%
Year							
1	$ 31,500.00	$ 92,160.00	$ -	$ -	$ 2,463.75	$ -	$ 20,916.00
2	$ 31,815.00	$ 93,081.60	$ -	$ -	$ 2,451.43	$ -	$ 21,125.16
3	$ 32,133.15	$ 94,012.42	$ -	$ -	$ 2,439.17	$ -	$ 21,336.41
4	$ 32,454.48	$ 94,952.54	$ -	$ -	$ 2,426.98	$ -	$ 21,549.78
5	$ 32,779.03	$ 95,902.07	$ -	$ -	$ 2,414.84	$ -	$ 21,765.27
6	$ 33,106.82	$ 96,861.09	$ -	$ -	$ 2,402.77	$ -	$ 21,982.93
7	$ 33,437.88	$ 97,829.70	$ -	$ -	$ 2,390.76	$ -	$ 22,202.76
8	$ 33,772.26	$ 98,807.99	$ -	$ -	$ 2,378.80	$ -	$ 22,424.78
9	$ 34,109.99	$ 99,796.07	$ -	$ -	$ 2,366.91	$ -	$ 22,649.03
10	$ 34,451.09	$ 100,794.03	$ -	$ -	$ 2,355.07	$ -	$ 22,875.52
11	$ 34,795.60	$ 101,801.98	$ -	$ -	$ 2,343.30	$ -	$ 23,104.28
12	$ 35,143.55	$ 102,819.99	$ -	$ -	$ 2,331.58	$ -	$ 23,335.32
13	$ 35,494.99	$ 103,848.19	$ -	$ -	$ 2,319.92	$ -	$ 23,568.67
14	$ 35,849.94	$ 104,886.68	$ -	$ -	$ 2,308.32	$ -	$ 23,804.36
15	$ 36,208.44	$ 105,935.54	$ -	$ -	$ 2,296.78	$ -	$ 24,042.40
16	$ 36,570.52	$ 106,994.90	$ -	$ -	$ 2,285.30	$ -	$ 24,282.83
17	$ 36,936.23	$ 108,064.85	$ -	$ -	$ 2,273.87	$ -	$ 24,525.65
18	$ 37,305.59	$ 109,145.50	$ -	$ -	$ 2,262.50	$ -	$ 24,770.91
19	$ 37,678.65	$ 110,236.95	$ -	$ -	$ 2,251.19	$ -	$ 25,018.62
20	$ 38,055.43	$ 111,339.32	$ -	$ -	$ 2,239.93	$ -	$ 25,268.81
21	$ 38,435.99	$ 112,452.71	$ -	$ -	$ 2,228.73	$ -	$ 25,521.49
22	$ 38,820.35	$ 113,577.24	$ -	$ -	$ 2,217.59	$ -	$ 25,776.71
23	$ 39,208.55	$ 114,713.01	$ -	$ -	$ 2,206.50	$ -	$ 26,034.48
24	$ 39,600.64	$ 115,860.14	$ -	$ -	$ 2,195.47	$ -	$ 26,294.82
25	$ 39,996.64	$ 117,018.75	$ -	$ -	$ 2,184.49	$ -	$ 26,557.77
Totals:	$ 889,660.78	$ 2,602,893.27	$ -	$ -	$ 58,035.98	$ -	$ 590,734.76

5. Proforma Li-Ion with 20% ASR set aside.

ASSOCIATED ENERGY DEVELOPERS

25-YEAR FINANCIAL PROFORMA : LI-ION vs. FLOW BESS TEST - , Anywhere, USA

FOCUS

Notes: **Li-Ion BESS with 20% ASR set aside**

Prepared For:
Prepared By: Brian Kuhn, Founder, CEO
Contact Info: 1(888) 800-2381 | Brian.Kuhn@AssocEnergy.com

Report Date: 1/25/2024 11 10

	Source 1	Source 2	Source 3	Energy Storage	Ancillary Svc.	Totals
Generation Type:				Energy Storage System	N/A	
Size (dc):				6,880.000 kWdc		6,880.000 kWdc
Size (ac):				6,880.000 kWac		6,880.000 kWac
Net Output:				N/A		0 kWh
Cost ($):				$7,212,338.00		$7,212,338.00
Cost ($/W):				$1.048 /Wdc		$1.048 /Wdc
Tax Ineligibles:				$0.00		$0.00
Investment Tax Credit:				$2,163,701.40		$2,163,701.40
Depreciation Cash Value:				$1,593,926.70		$1,593,926.70

Revenue (Cash Basis)									Gross	Operating Expenses								EBITDA	Financing		Results	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Year					Additional Revenue BESS kWhrs Exports - 3,764,713	BESS Anc. Svcs Revenue BESS AS Reserve of 20.0% and AS Rate of $100,000 /MW		Depreciation and Fed ITC Depreciation at 26.0% Tax Rate ITC Shown as Revenue (Year 1)	Gross Revenue	Site Lease / Site Purchase	Insurance Coverage $8.75/kWdc with 3% escalator	Operations & Maintenance	Miscellaneous Expenses BESS kWhrs Imports - 4,182,043	Asset Management	Other Costs BESS Augmentation at 15.0% of BESS CapEx Every 3 years and 1.0% Esc./yr.	Down Payment / Interest Reserve 30.0% Down Payment	PILOT / Property Taxes $5,810/MWdc with 1% escalator	Total Net Revenue (before financing)	Total Payments (P & I) 70.0% LTV 7.50% Interest Loan Principal of $5,048,636.6	Debt Service Coverage Ratio 1.25 (suggested minimum)	Annual Net Cash Flow	Cumulative Net Cash Flow
0																$2,163,701		$2,163,701			$2,163,701	$2,163,701
1					$694,156	$220,160		$956,356	$1,870,672	$20,000	$60,200	$43,000	-$65,341				$39,973	$1,642,158	$488,058	1.41	$1,154,100	$1,009,601
2					$701,098	$223,462		$255,028	$1,179,588	-$20,000	-$60,802	-$43,430	-$65,995				-$40,373	$948,988	-$488,058	1.42	$460,931	-$548,671
3					$708,109	$226,814		$153,017	$1,087,940	-$20,000	-$61,410	-$43,864	$66,655		-$547,426		-$40,776	$307,808	-$488,058	0.32	-$180,250	-$728,921
4					$715,190	$230,217		$91,810	$1,037,217	-$20,000	-$62,024	-$44,303	$67,321				-$41,184	$802,384	-$488,058	1.46	$314,327	-$414,594
5					$722,342	$233,670		$91,810	$1,047,822	-$20,000	-$62,644	-$44,746	-$67,995				-$41,596	$810,841	-$488,058	1.47	$322,783	-$91,811
6					$729,565	$237,175		$45,905	$1,012,645	-$20,000	-$63,271	-$45,193	-$68,675		-$564,014		-$42,012	$209,480	-$488,058	0.34	-$278,577	-$370,388
7					$736,861	$240,732			$977,593	-$20,000	-$63,904	-$45,645	-$69,361				-$42,452	$736,250	-$488,058	1.51	$248,193	-$122,195
8					$744,229	$244,343			$988,572	-$20,000	-$64,543	-$46,102	-$70,055				-$42,856	$745,017	-$488,058	1.53	$256,959	$134,764
9					$751,671	$248,009			$999,680	-$20,000	-$65,188	-$46,563	-$70,755		-$581,104		-$43,285	$172,785	-$488,058	0.35	-$315,272	-$180,509
10					$759,188	$251,729			$1,010,917	-$20,000	-$65,840	-$47,028	-$71,463				-$43,718	$762,868	-$488,058	1.56	$274,811	$94,302
11					$766,780	$255,505			$1,022,285	-$20,000	-$66,498	-$47,499	-$72,178				-$44,155	$771,956	-$488,058	1.58	$283,898	$378,200
12					$774,448	$259,337			$1,033,785	-$20,000	-$67,163	-$47,974	-$72,899		-$598,712		-$44,596	$182,440	-$488,058	0.37	-$305,618	$72,582
13					$782,192	$263,227			$1,045,419	-$20,000	-$67,835	-$48,453	-$73,628				-$45,042	$790,460	-$488,058	1.62	$302,403	$374,985
14					$790,014	$267,176			$1,057,190	-$20,000	-$68,513	-$48,938	-$74,365				-$45,493	$799,882	-$488,058	1.64	$311,824	$686,809
15					$797,914	$271,183			$1,069,097	-$20,000	-$69,198	-$49,427	-$75,108		-$616,854		-$45,948	$192,562	-$488,058	0.39	-$295,496	$391,313
16					$805,894	$275,251			$1,081,145	-$20,000	-$69,890	-$49,922	-$75,859				-$46,407	$819,066	-$488,058	1.68	$331,008	$722,321
17					$813,953	$279,380			$1,093,333	-$20,000	-$70,589	-$50,421	-$76,618				-$46,871	$828,833	-$488,058	1.70	$340,775	$1,063,097
18					$822,092	$283,571			$1,105,663	-$20,000	-$71,295	-$50,925	-$77,384		-$635,545		-$47,340	$203,174	-$488,058	0.42	-$284,884	$778,212
19					$830,313	$287,824			$1,118,137	-$20,000	-$72,008	-$51,434	-$78,158				-$47,813	$848,723	-$488,058	1.74	$360,665	$1,138,878
20					$838,616	$292,141			$1,130,757	-$20,000	-$72,728	-$51,949	-$78,940				-$48,291	$858,849	-$488,055	1.76	$370,794	$1,509,672
Subtotals:					$15,284,624	$5,090,906		$1,593,927	$21,969,457	-$400,000	-$1,325,544	-$946,817	-$1,438,754		-$3,543,656	-$2,163,701	-$380,161	$11,270,823	-$9,761,151	1.21	$1,509,672	$1,509,672
Additional Years Performance																						
21					$847,002	$296,524			$1,143,526	-$20,000	-$73,455	-$52,408	-$79,729		-$654,803		-$48,774	$214,290			$214,290	$1,723,969
22					$855,472	$300,971			$1,156,443	-$20,000	-$74,190	-$52,993	-$80,526				-$49,262	$879,472			$879,472	$2,603,440
23					$864,027	$305,486			$1,169,513	-$20,000	-$74,932	-$53,523	-$81,332				-$49,755	$889,972			$889,972	$3,493,412
24					$872,667	$310,068			$1,182,735	$20,000	$75,681	$54,058	-$82,145		$674,644		$50,252	$225,955			$225,955	$3,719,367
25					$881,394	$314,719			$1,196,113	$20,000	$76,438	$54,599	-$82,966				$50,755	$911,355			$911,355	$4,630,722
Totals:					$19,605,187	$6,518,674		$1,593,927	$27,817,788	-$500,000	-$1,700,241	-$1,214,458	-$1,845,452		-$4,873,103	-$2,163,701	-$1,128,960	$14,391,873	-$9,761,151			$4,630,722

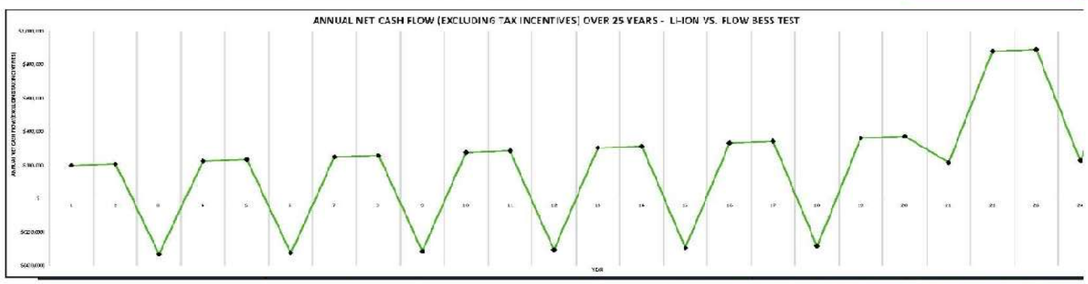
Key Financial Metrics

Internal Rate of Return (IRR)

20-Year Unlevered IRR:	7.58%
25-Year Unlevered IRR:	10.80%

Project Notes

- Depreciation modeled at 26% Tax Bracket. Year One Tax Benefit ROIC of 44.2%.



6. Proforma Li-Ion w/out 20% ASR set aside.

ASSOCIATED ENERGY DEVELOPERS

25-YEAR FINANCIAL PROFORMA : LI-ION vs. FLOW BESS TEST - , Anywhere, USA

FOCUS

Notes:	Li-Ion BESS withOUT 20% ASR set aside
Prepared For:	
Prepared By:	Brian Kuhn, Founder, CEO
Contact Info:	1(888) 800-2381 | Brian.Kuhn@AssocEnergy.com
Report Date:	1/25/2024 11:13

	Source 1	Source 2	Source 3	Energy Storage	Ancillary Svc.	Totals
Generation Type:				Energy Storage System	N/A	
Size (dc):				6,880.000 kWdc		6,880.000 kWdc
Size (ac):				6,880.000 kWac		6,880.000 kWac
Net Output:				N/A		0 kWh
Cost ($):				$7,212,338.00		$7,212,338.00
Cost ($/W):				$1.048 /Wdc		$1.048 /Wdc
Tax Ineligibles:				$0.00		$0.00
Investment Tax Credit:				$2,163,701.40		$2,163,701.40
Depreciation Cash Value:				$1,593,926.70		$1,593,926.70

Revenue (Cash Basis)									Gross	Operating Expenses								EBITDA	Financing		Results	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Year					Additional Revenue BESS kWhrs Exports - 4,708,982			Depreciation and Fed ITC Depreciation at 25.0% Tax Rate ITC Shown as Revenue (Year 1)	Gross Revenue	Site Lease / Site Purchase	Insurance Coverage $8.75/kWdc with 1% escalator	Operations & Maintenance	Miscellaneous Expenses BESS kWhrs Imports - 5,228,354	Asset Management	Other Costs BESS Augmentation at 15.0% of BESS CapEx Every 3 years and 1.0%Esc./yr.	Down Payment / Interest Reserve 30.0% Down Payment	PILOT / Property Taxes $5,800/MWdc with 1% escalator	Total Net Revenue (before financing)	Total Payments IP & II 70.0% LTV 7.50% Interest Loan Principal of $5,048,636.6	Debt Service Coverage Ratio 1.35 (suggested minimum)	Annual Net Cash Flow	Cumulative Net Cash Flow
0																-$2,163,701		-$2,163,701			-$2,163,701	-$2,163,701
1					$861,775			$956,356	$1,818,131	-$20,000	-$60,200	-$43,000	-$93,412				-$39,973	$1,561,546	-$488,058	1.24	$1,073,489	-$1,090,213
2					$870,393			$255,028	$1,125,421	-$20,000	-$60,802	-$43,430	-$94,346				-$40,375	$866,471	-$488,058	1.25	$378,413	-$711,800
3					$879,097			$153,017	$1,032,114	-$20,000	-$61,410	-$43,864	-$95,290		-$547,426		-$40,776	$223,347	-$488,058	0.14	-$264,711	-$976,510
4					$887,888			$91,810	$979,698	-$20,000	-$62,024	-$44,303	-$96,243				-$41,184	$715,944	-$488,058	1.28	$227,887	-$748,624
5					$896,767			$91,810	$988,577	-$20,000	-$62,644	-$44,746	-$97,205				-$41,596	$722,386	-$488,058	1.29	$234,328	-$514,296
6					$905,734			$45,905	$951,639	-$20,000	-$63,271	-$45,193	-$98,177		-$564,014		-$42,012	$118,972	-$488,058	0.15	-$369,085	-$883,381
7					$914,792				$914,792	-$20,000	-$63,904	-$45,645	-$99,159				-$42,432	$643,652	-$488,058	1.32	$155,594	-$727,785
8					$923,940				$923,940	-$20,000	-$64,543	-$46,102	-$100,150				-$42,856	$650,289	-$488,058	1.33	$162,231	-$565,555
9					$933,179				$933,179	-$20,000	-$65,188	-$46,563	-$101,152		-$581,104		-$43,285	$75,887	-$488,058	0.16	-$412,170	-$977,726
10					$942,511				$942,511	-$20,000	-$65,840	-$47,028	-$102,163				-$43,718	$663,761	-$488,058	1.36	$175,704	-$802,022
11					$951,936				$951,936	-$20,000	-$66,498	-$47,499	-$103,185				-$44,155	$670,599	-$488,058	1.37	$182,541	-$619,481
12					$961,455				$961,455	-$20,000	-$67,163	-$47,974	-$104,217		-$598,712		-$44,596	$78,793	-$488,058	0.16	-$409,265	-$1,028,745
13					$971,070				$971,070	-$20,000	-$67,835	-$48,453	-$105,259				-$45,042	$684,480	-$488,058	1.40	$196,422	-$832,323
14					$980,781				$980,781	$20,000	$68,513	$48,938	-$106,312				$45,496	$691,525	$488,058	1.42	$203,467	$628,855
15					$990,588				$990,588	$20,000	$69,198	$49,427	-$107,375		$616,854		$45,948	$81,786	$488,058	0.17	$406,271	$1,035,127
16					$1,000,494				$1,000,494	-$20,000	-$69,890	-$49,922	$108,448				-$46,407	$705,827	-$488,058	1.45	$217,769	-$817,358
17					$1,010,499				$1,010,499	-$20,000	-$70,589	-$50,421	-$109,533				-$46,871	$713,085	-$488,058	1.46	$225,027	-$592,331
18					$1,020,604				$1,020,604	-$20,000	-$71,295	-$50,925	-$110,628		-$635,545		-$47,340	$84,871	-$488,058	0.17	-$403,187	-$995,518
19					$1,030,810				$1,030,810	-$20,000	-$72,008	-$51,434	-$111,735				-$47,815	$727,820	-$488,058	1.49	$239,762	-$755,756
20					$1,041,118				$1,041,118	-$20,000	-$72,728	-$51,949	-$112,852				-$48,291	$735,298	-$488,055	1.51	$247,243	-$508,513
Subtotals:					$18,975,431			$1,593,927	$20,569,358	-$400,000	-$1,325,544	-$946,817	-$2,056,840		-$3,543,656	-$2,163,701	-$880,161	$9,252,638	-$9,761,151	1.01	-$508,513	-$508,513
Additional Years' Performance																						
21					$1,051,530				$1,051,530	-$20,000	-$73,455	-$52,468	-$113,980		-$654,803		-$48,774	$83,048			$88,048	-$420,465
22					$1,062,045				$1,062,045	-$20,000	-$74,190	-$52,993	-$115,120				-$49,262	$750,480			$750,480	$330,015
23					$1,072,665				$1,072,665	-$20,000	-$74,932	-$53,523	-$116,271				-$49,755	$758,184			$758,184	$1,088,199
24					$1,083,392				$1,083,392	-$20,000	-$75,681	-$54,058	-$117,434		-$674,644		-$50,252	$91,322			$91,322	$1,179,521
25					$1,094,226				$1,094,226	-$20,000	-$76,438	-$54,599	-$118,609				-$50,755	$773,826			$773,826	$1,953,347
Totals:					$24,339,289			$1,593,927	$25,933,215	-$500,000	-$1,700,241	-$1,214,458	-$2,638,255		-$4,873,103	-$2,163,701	-$1,128,960	$11,714,498	-$9,761,151			$1,953,347

Key Financial Metrics

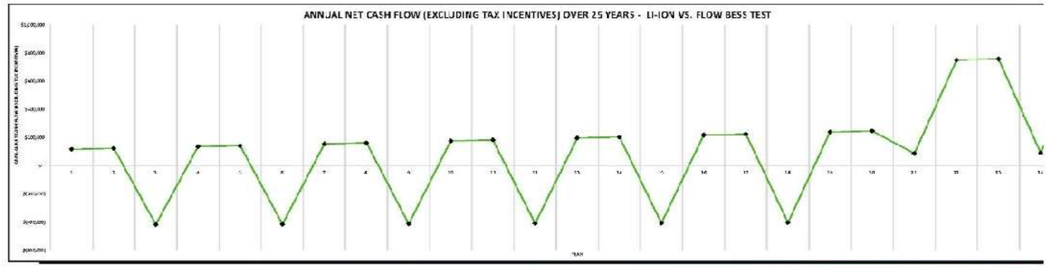
Internal Rate of Return (IRR)

20-Year Unlevered IRR:	*5.45%*
25-Year Unlevered IRR:	*8.93%*

Project Notes

- Depreciation modeled at 26% Tax Bracket. Year One Tax Benefit ROIC of 14.2%.

ANNUAL NET CASH FLOW (EXCLUDING TAX INCENTIVES) OVER 25 YEARS - LI-ION VS. FLOW BESS TEST



7. Li-Ion CapEx BOM

ASSOCIATED ENERGY DEVELOPERS

FOCUS

BESS Component Budget	BESS Model:		1/25/2024
Project:	LI-ION vs. FLOW BESS TEST - , Anywhere, USA		
A. Development and Permitting		**Cost ($)**	**Cost ($/Watt)**
Site Visit:			$ -
Feasibility Study:		$ 20,000.00	$ 0.003 /W
Site Plans:		$ 25,000.00	$ 0.004 /W
Soil Geotechnic Study:		$ -	$ -
Interconnection Studies:		$ -	$ -
Interconnection Application:		$ -	$ -
Electrical Engineering:		$ 5,000.00	$ 0.001 /W
Environmental Studies:		$ 5,000.00	$ 0.001 /W
Structural Engineering:		$ -	$ -
Legal (ALTA, Title, Project Co., Legal Review):		$ 5,000.00	$ 0.001 /W
Town Permits:		$ 10,000.00	$ 0.001 /W
Total Development & Permitting		$ 70,000.00	$ 0.010 /W
B. Balance of Plant		**Cost ($)**	**Cost ($/Watt)**
B1. BESS Equipment Costs			
Battery Cost		$ 3,577,600.00	$ 0.5200 /W
BESS Shipping:		$ 688,000.00	$ 0.100 /W
Duties and Fees:		$ 13,760.00	$ 0.002 /W
BMS/EMS:		$ 275,200.00	$ 0.040 /W
Transformer:		$ 172,000.00	$ 0.025 /W
Inverters:		$ -	$ -
Electrical BOS:		$ -	$ -
DAS / SCADA:		$ 68,800.00	$ 0.010 /W
Other Components :		$ -	$ -
Total BESS Equipment Costs		$ 4,795,360.00	$ 0.697 /W
B2. BESS Equipment Installation			
BESS Installation:		$ 550,400.00	$ 0.080 /W
BMS Installation:		$ 137,600.00	$ 0.020 /W
Wiring to Meter:		$ -	$ -
Wiring to Grid:		$ -	$ -
Total BESS Equipment Installation Costs		$ 688,000.00	$ 0.100 /W
B3. Site Work & Other Project Costs			
Rental Equipment:		$ -	$ -
Grading:		$ -	$ -
Landscaping:		$ -	$ -
Crane/Lift Costs:		$ -	$ -
Interconnection Fees:	5.60%	$ 344,000.00	$ 0.050 /W
Other:		$ -	$ -
EPC Contingency:		$ -	$ -
EPC Project Fees:		$ 240,800.00	$ 0.035 /W
Total Site Work & Other Project Costs		$ 584,800.00	$ 0.085 /W
Total Balance of Plant		$ 6,068,160.00	$ 0.882 /W
C. General & Administrative Costs		**Cost ($)**	**Cost ($/Watt)**
Sales Tax:		$ -	$ -
Miscellaneous:	2.00%	$ 122,763.20	$ 0.018 /W
Offtaker Acquisition Fees:		$ -	$ -
Soft Costs - Third Party Developer Fees:	2.00%	$ 122,763.20	$ 0.018 /W
Soft Costs - Developer Fees:	12.00%	$ 736,579.20	$ 0.107 /W
Soft Costs - Site Host Developer Fees:		$ -	$ -
Soft Costs - Financing Fees:	1.50%	$ 92,072.40	$ 0.013 /W
Total G&A Expenses	17.50%	$ 1,074,178.00	$ 0.156 /W
Total Installed Price		**$ 7,212,338.00**	**$ 1.048 /W**

8. Li-Ion Proforma Annual Expenses

Expense Calculations

	Insurance	O&M	Decommissioning	Miscellaneous	Asset Management	Augmentation	PILOT/Taxes
In Use:	Yes	Yes	No	No	No	Yes	Yes
Start Year:	1	1	1	1	1	1	1
End Year:	25	25	25	25	25	25	25
Select Rate:	$/kWdc	$/kWdc	$	$	$	$	$/kWdc
$ Rate:	$150,000.00	$72,123.38	$5,000.00	$5,000.00	$5,000.00	$536,640.00	$10,000.00
$/kWdc Rate:	$8.75 /kWdc	$6.25 /kWdc	$3.00 /kWdc	$3.00 /kWdc	$3.00 /kWdc	15.00% of BESS CapEx/yr.	$5.81 /kWdc
$/kWac Rate:	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	$3.00 /kWac	Every 3 Years	$3.00 /kWac
$/kWh Rate:	$0.01600 /kWh	$0.01710 /kWh	$0.00500 /kWh	$0.00500 /kWh	$0.00500 /kWh		$0.00500 /kWh
Escalator:	1.00%	1.00%	2.50%	2.50%	2.50%	1.00%	1.00%
Year							
1	$ 60,200.00	$ 43,000.00	$ -	$ -	$ -	$ -	$ 39,972.80
2	$ 60,802.00	$ 43,430.00	$ -	$ -	$ -	$ -	$ 40,372.53
3	$ 61,410.02	$ 43,864.30	$ -	$ -	$ -	$ 547,426.46	$ 40,776.25
4	$ 62,024.12	$ 44,302.94	$ -	$ -	$ -	$ -	$ 41,184.02
5	$ 62,644.36	$ 44,745.97	$ -	$ -	$ -	$ -	$ 41,595.86
6	$ 63,270.81	$ 45,193.43	$ -	$ -	$ -	$ 564,014.03	$ 42,011.81
7	$ 63,903.51	$ 45,645.37	$ -	$ -	$ -	$ -	$ 42,431.93
8	$ 64,542.55	$ 46,101.82	$ -	$ -	$ -	$ -	$ 42,856.25
9	$ 65,187.97	$ 46,562.84	$ -	$ -	$ -	$ 581,104.22	$ 43,284.81
10	$ 65,839.85	$ 47,028.47	$ -	$ -	$ -	$ -	$ 43,717.66
11	$ 66,498.25	$ 47,498.75	$ -	$ -	$ -	$ -	$ 44,154.84
12	$ 67,163.23	$ 47,973.74	$ -	$ -	$ -	$ 598,712.26	$ 44,596.39
13	$ 67,834.87	$ 48,453.48	$ -	$ -	$ -	$ -	$ 45,042.35
14	$ 68,513.22	$ 48,938.01	$ -	$ -	$ -	$ -	$ 45,492.78
15	$ 69,198.35	$ 49,427.39	$ -	$ -	$ -	$ 616,853.84	$ 45,947.70
16	$ 69,890.33	$ 49,921.67	$ -	$ -	$ -	$ -	$ 46,407.18
17	$ 70,589.23	$ 50,420.88	$ -	$ -	$ -	$ -	$ 46,871.25
18	$ 71,295.13	$ 50,925.09	$ -	$ -	$ -	$ 635,545.13	$ 47,339.96
19	$ 72,008.08	$ 51,434.34	$ -	$ -	$ -	$ -	$ 47,813.36
20	$ 72,728.16	$ 51,948.68	$ -	$ -	$ -	$ -	$ 48,291.50
21	$ 73,455.44	$ 52,468.17	$ -	$ -	$ -	$ 654,802.78	$ 48,774.41
22	$ 74,189.99	$ 52,992.85	$ -	$ -	$ -	$ -	$ 49,262.16
23	$ 74,931.89	$ 53,522.78	$ -	$ -	$ -	$ -	$ 49,754.78
24	$ 75,681.21	$ 54,058.01	$ -	$ -	$ -	$ 674,643.96	$ 50,252.33
25	$ 76,438.03	$ 54,598.59	$ -	$ -	$ -	$ -	$ 50,754.85
Totals:	$ 1,700,240.61	$ 1,214,457.58	$ -	$ -	$ -	$ 4,873,102.70	$ 1,128,959.77

About the FOCUS Software:

The FOCUS software used to simulate the systems in this exercise has been developed over the past 12 years for use in depicting the financial performance of various kinds of renewable energy and microgrid systems, including combinations of solar, wind, CHP, energy storage, natural gas gensets, and other resources within a microgrid environment. It has been used by developers, investors and financial institutions to model the financial performance of over 1000 energy systems around the world.

About the Author

Brian D. Kuhn is the Founder and a Principal of both Associated Energy Developers *and* Aeronautica Windpower *of Plymouth, MA, and a 40 year veteran of the Renewable Energy industry. Associated Energy Developers is a renewable energy project analysis and development company specializing in solar and wind systems for clients in the Commercial and Industrial as well as Utility scale markets. Brian may be reached at* Brian.Kuhn@AssocEnergy.com*, or 508-364-9489.*