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ESS Comparison Worksheet

LCOS Algorithm Worksheet for Computing and Comparing the Levelized Cost of Storing Wind Electricity at two ESS
for *A Financial Algorithm for Computing the levelized Cost of Storing Wind Electricity (LCOS)*
WindEurope Conference 2018, 25-28 September, Hamburg Germany

Excel Worksheet | COLOR CODE: Entry, Result, Side Column Result, Transfer Result, Check Values | US$ to € Converter: US$ $100, € € 86

				Excel Worksheet			COLOR CODE			US$ to € Converter				b-a	(b-a)/a
FX	Enter		US$/€ exchange rate	$1.15771	m/d/y 06/21/18		Entry / Result			US$ $100	€ € 86				
				Original ESS a			Side Column Result / Transfer Result	Second ESS b							
	ESS Plant CapEx			EOS Aurora®	kW ↓	MWh:MW ratio	Check Values in €	Tesla Powerpack®	kW ↓	MWh:MW ratio				Δ	Δ %
1	Enter	Spec	ESS Plant-Power Output-MW	1	1,000			1	1,000					0	0.0%
2	Enter	Spec	ESS Daily Energy Storage Capacity-MWh/day	4	4,000	4.0		4	4,000	4.0				0	0.0%
A	Computed	Value	ESS Yearly Energy Storage Capacity-MWh/yr	1,460	US$/MWh ↓	€/kWh ↓	€/MWh ↓	1,460	US$/MWh ↓	€/kWh ↓	€/MWh ↓			0	0.0%
3	Enter	Spec	ESS Plant CapEx-US$/kWh (US$/MWh)	$160	$160,000	€ 138	€ 138,204	$100	$100,000	€ 86.38	€ 86,377			($60)	-37.5%
B	Computed	Value	Total Plant CapEx-US$/ESS Plant	$640,000			€ 552,815	$400,000			€ 345,510			($240,000)	-37.5%
	Cost of the Wind Electricity						€/ESS Plant↑				€/ESS Plant↑				
4	Enter	Spec	Round Trip Efficiency-η-%	80%	US¢/kWh ↓	€/MWh↓	€¢/kWh↓	75%	US¢/kWh ↓	€/MWh↓	€¢/kWh↓			-5%	-6.3%
5	Enter	Spec	Cost of the Wind Electricity to be Stored-COE-US$/MWh	$50.16	5.02	€ 43.33	€ 4.33	$50.16	5.02	€ 43.33	€ 4.33			$0.00	0.0%
C	Computed	Value	Cost of the Stored Wind Electricity-COSE-US$/MWh	$62.70	6.27	€ 54.16	€ 5.42	$66.88	6.69	€ 57.77	€ 5.78			$4.18	6.7%
D	Computed	Value	Extra Cost (COSE-COE) of the Stored Wind Electricity-US$/MWh	$12.54	1.25	€ 10.83	€ 1.08	$16.72	1.67	€ 14.44	€ 1.44			$4.18	33.3%
E	Computed	Value	% Increase in the Cost of the Stored Wind Electricity	25%				33%						8%	33.3%
	ESS OpEx and Capital Costs														
6	Enter	Spec	Annual Fixed O&M Cost-% Total Plant Capex, Line B	0.50%	€/yr ↓			0.50%	€/yr ↓					0%	0.0%
F	Computed	Value	Annual Fixed O&M Cost-US$/yr	$3,200	€ 2,764	€/MWh ↓	€¢/kWh ↓	$2,000	€ 1,728	€/MWh ↓	€¢/kWh ↓			($1,200)	-37.5%
7	Enter	Spec	Variable O & M Cost-US$/MWh	$1.00	0.10	€ 0.86	€ 0.09	$1.00	$0.10	€ 0.86	€ 0.09			$0.00	0.0%
8	Enter	Spec	Physical Life of Cabin Creek-Years	20	US¢/kWh ↑			20	US¢/kWh ↑					0	0.0%
9	Enter	Spec	Interest/ROE Rate-%	8.0%				8.00%						0%	0.0%
G	Computed	Value	Capital Amortization Factor-CAF	0.1019	€/yr↓			0.1019	€/yr↓					0.0000	0.0%
H	Computed	Value	Annual Capital Amortization-ACA-US$/yr	$65,185	€ 56,305			$40,741	€ 35,191					($24,445)	-37.5%
	Computation of the Levelized Cost of the Stored Wind Electricity-US$/MWh-LCOS			US$/MWh↓	US¢/kWh ↓	%	€/MWh↓	US$/MWh↓	US¢/kWh ↓	%	€/MWh↓				
I	Computed	Value	Annual Capital Amortization-ACA-US$/MWh	$44.65	4.46	40.4%	€ 38.57	$27.90	2.79	28.7%	€ 24.10			($16.74)	-37.5%
J	Computed	Value	Fixed O&M Cost-US$/MWh	$2.19	0.22	2.0%	€ 1.89	$1.37	0.14	1.4%	€ 1.18			($0.82)	-37.5%
K	Transferred	Value	Variable O&M Cost-from Line 7 above-US$/MWh	$1.00	0.10	0.9%	€ 0.86	$1.00	0.10	1.0%	€ 0.86			$0.00	0.0%
L	Transferred	Value	Cost of the Stored Wind Electricity-COSE- from Line C above-US$/MWh	$62.70	6.27	56.7%	€ 54.16	$66.88	6.69	68.8%	€ 57.77			$4.18	6.7%
M	Computed	Value	Levelized Cost of the Stored Wind Electricity-LCOS-US$/MWh	$110.54	11.05	100.0%	€ 95.48	$97.15	$9.72	100.0%	€ 83.92			($13.38)	-12.1%
	Levelized Extra Cost of the Stored Wind Electricity-US$/MWh--LECOS			US$/MWh↓	US¢/kWh ↓		€/MWh↓	US$/MWh↓	US¢/kWh ↓		€/MWh↓				
N	Computed	Value	Levelized Extra Cost (LECOS) of the Stored Wind Electricity-US$/MWh	$60.38	6.04		€ 52.15	$46.99	4.70		€ 40.59			($13.38)	-22.2%
O	Computed	Value	% Increase in the Levelized Cost of the Stored Wind Electricity	120%			120%	94%			94%			-27%	-22.2%
	Second Computation of the Levelized Extra Cost of the Stored Wind Electricity-LECOS-US$/MWh			US$/MWh↓	US¢/kWh ↓	%	€/MWh↓	US$/MWh↓	US¢/kWh ↓	%	€/MWh↓				
I	Computed	Value	Annual Capital Amortization-ACA-US$/MWh	$44.65	4.46	73.9%	€ 38.57	$27.90	2.79	59.4%	€ 24.10			($16.74)	-37.5%
J	Computed	Value	Fixed O&M Cost-US$/MWh	$2.19	0.22	3.6%	€ 1.89	$1.37	0.14	2.9%	€ 1.18			($0.82)	-37.5%
K	Transferred	Value	Variable O&M Cost-from Line 7 above-US$/MWh	$1.00	0.10	1.7%	€ 0.86	$1.00	0.10	2.1%	€ 0.86			$0.00	0.0%
L	Transferred	Value	Cost of the Stored Wind Electricity-COSE- from Line D above-US$/MWh	$12.54	1.25	20.8%	€ 10.83	$16.72	1.67	35.6%	€ 14.44			$4.18	33.3%
N	Computed	Value	Levelized Extra Cost of the Stored Wind Electricity-LECOS-US$/MWh	$60.38	6.04	100.0%	€ 52.15	$46.99	4.70	100.0%	€ 40.59			($13.38)	-22.2%
	Bonus-Check Value--Total Annual O&M				€/yr ↓				€/yr ↓						
F	Transferred	Value	Annual Fixed O&M Cost-from Line F above-US$/yr	$3,200	€ 2,764			$2,000	€ 1,728					($1,200)	-37.5%
P	Computed	Value	Annual Variable O&M Cost-US$/yr	$1,460	€ 1,261			$1,460	€ 1,261					$0	0.0%
Q	Computed	Value	check value--Total O &M US$/yr	$4,660	€ 4,025			$3,460	€ 2,989					($1,200)	-25.8%

Instructions
1. This is Comparison Case Worksheet for use with my Wind Power 2018 Paper, *A Financial Algorithm for Computing the levelized Cost of Storing Wind El* ectricity (LCOS)
2. The nine EES specs in Columns a and b as well as the FX US$/€ exchange rate can be changed
3. The worksheet is presented with the Eos Aurora® (original) ESS spec values compared with the Tesla Power Pack® (second) ESS spec values that are presented on Page 8-9, Section VIII, The Effect on the LCOS From Changing one or two ESS Spec Values While Keeping the Other ESS Spec Values the Same.
4. You can replace these ESS spec values with ESS spec values from Section VIII, IX, X or use your own ESS spec values
5. Print a copy of this worksheet so that you have the original values

Basic energy storage facts
a. Wind electricity is energy and is measured in MWh
b. WindPower is measured in MW
c. Energy storage capacity is measured in MWh
d. Energy storage power output is measured in MW
e. Energy storage capacity can also be measured in duration (output hours at full power).

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Excel Worksheet

This complimentary copy given to
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