Moon energy systems lift capacity in Falcon Heavy units and dollar equivalents

Systems	Comment	Energy System Surface kg	Energy System LO/L1 kg	Energy System LEO kg	Energy System GEO kg	Required Storage on Surface	Surface Only FH	LO/L1 FH	LEO FH	GEO FH	Tot FH with EP	Tot FH without EP	Tot FH $ with EP	Tot FH $ without EP
Store - Flywheel - ISRU	**requires lunar production**						0.00	0.00	0.00	0.00	0.00	0.00	$0.00	$0.00
Store - Thermal - Al - ISRU	**requires lunar production**						0.00	0.00	0.00	0.00	0.00	0.00	$0.00	$0.00
Store - Thermal - Fe - ISRU	**requires lunar production**						0.00	0.00	0.00	0.00	0.00	0.00	$0.00	$0.00
Store - Chemical - monthly - H2+ ISRU O2 (RFC mass not included)	**requires lunar production** - Chemical energy storage system for 17 days of lunar darkness - H2 only recharged monthly from Earth - O2 produced by ISRU					306	0.05	0.00	0.00	0.00	0.02	0.05	$1,432,080.00	$3,391,310.41
ELEOLS	Beamed energy from Earth to a DS constellation in LEO	625		1,860		240	0.15	0.00	0.04	0.00	0.11	0.19	$6,949,800.00	$11,818,547.40
LOPMLS (SP)	LO Polar Multiple satellite LS - SP-powered	50	2,409			240	0.05	0.14	0.00	0.00	0.08	0.19	$5,115,240.00	$12,113,406.13
EGEOLS	Beamed energy from Earth to DS at GEO	625			1,000	240	0.15	0.00	0.00	0.05	0.09	0.20	$5,608,200.00	$12,586,547.40
LEOLS (SP)	Low Earth Orbit LS - SP-powered	625		2,812		240	0.15	0.00	0.05	0.00	0.13	0.20	$8,434,920.00	$12,960,947.40
L1LS (SP)	L1 based LS - SP-powered	63	2,600			240	0.05	0.15	0.00	0.00	0.09	0.20	$5,474,040.00	$12,963,080.86
LEOLS (PV)	Low Earth Orbit LS - PV-powered	625		3,202		240	0.15	0.00	0.06	0.00	0.14	0.21	$9,043,320.00	$13,428,947.40
LOPMLS (PV)	LO Polar Multiple satellite LS - PV-powered	50	2,799			240	0.05	0.16	0.00	0.00	0.09	0.21	$5,723,640.00	$13,554,158.92
LOPCLS (SP)	LO Polar Constellation satellite LS - SP-powered	50	2,889			240	0.05	0.17	0.00	0.00	0.09	0.22	$5,864,040.00	$13,886,640.33
L1LS (PV)	L1 based LS - PV-powered	183	3,520				0.03	0.20	0.00	0.00	0.10	0.24	$6,347,640.00	$15,031,854.09
LOPCLS (PV)	LO Polar Constellation satellite LS - PV-powered	50	3,279			240	0.05	0.19	0.00	0.00	0.10	0.24	$6,472,440.00	$15,327,393.12
L1LS (PV)	L1 based LS - PV-powered	63	3520			240	0.05	0.20	0.00	0.00	0.11	0.26	$6,909,240.00	$16,361,779.74
LOPPVLS (PV)	LO Polar single satellite LS - PV powered	50	2,799			510	0.10	0.16	0.00	0.00	0.11	0.26	$6,987,240.00	$16,546,491.64
LOEPVLS (PV)	LO Equator single satellite LS - PV powered	50	3,360			510	0.10	0.20	0.00	0.00	0.12	0.29	$7,862,400.00	$18,618,959.11
L5LS (SP)	L4 or L5 based LS - SP-powered	625		16,221		240	0.15	0.00	0.31	0.00	0.46	0.46	$29,352,960.00	$29,051,747.40
L5LS (PV)	L4 or L5 based LS - PV-powered	625		17,391		240	0.15	0.00	0.33	0.00	0.49	0.48	$31,178,160.00	$30,455,747.40
LPSMS (PV)	Lunar Polar Surface-Mounted System - PV-powered	2,380				1,320	0.64	0.00	0.00	0.00	0.27	0.64	$17,316,000.00	$41,006,040.89
LOSPLS (SP)	LO SP-powered LS	110	2,520			3,870	0.69	0.15	0.00	0.00	0.35	0.84	$22,557,600.00	$53,418,680.30
LOPVLS (PV)	LO PV-powered LS	110	3,000			3,870	0.69	0.17	0.00	0.00	0.37	0.87	$23,306,400.00	$55,191,914.50
Store - Chemical - monthly - H2 + O2 + RFC (RFC mass not included)	**requires lunar production** - Chemical energy storage system for 17 days/month without solar energy - H2 & O2 recharged monthly from Earth					5,204	0.91	0.00	0.00	0.00	0.38	0.91	$24,354,720.00	$57,674,442.38
CRFC*	Cryogenic storage Regenerating Fuel Cell system - *Applicable to all systems requiring energy storage if practical	920				4,285	0.91	0.00	0.00	0.00	0.38	0.91	$24,359,400.00	$57,685,525.09
Store - Li/S Battery	Lithium sulfer battery energy storage system for 17 days lunar dark - assumed 500 Wh/kg.					12,000	2.09	0.00	0.00	0.00	0.88	2.09	$56,160,000.00	$132,992,565.06
FOLS	Fixed Orbit Laser System - PV-powered - 2009 NASA concept study	4,116	3,000			7,875	2.09	0.17	0.00	0.00	0.96	2.26	$60,797,880.00	$143,975,534.39
LNSMS (PV)	Lunar Non-polar Surface Mounted System - PV-powered	1,095				12,240	2.32	0.00	0.00	0.00	0.98	2.32	$62,407,800.00	$147,787,987.92
Store - Flywheel	Flywheel energy storage system for 17 days/month without solar energy					27,513	4.79	0.00	0.00	0.00	2.02	4.79	$128,760,840.00	$304,918,703.53
Store - Li Battery	Lithium battery energy storage system for 17 days of lunar darkness - measured in Tesla Model S batteries (100 Wh/kg)					60,000	10.45	0.00	0.00	0.00	4.42	10.46	$280,800,000.00	$664,962,825.28
SYLLABUS														
Systems	The various systems analyzed for creating and storing useful energy on the lunar surface													
EP	Electronic Propulsion (EP) to power a system from Low Earth Orbit (LEO) to another destination													
Surface kg	The total mass in kg on the lunar surface for a system receiving either laser energy or solar energy for conversion purposes													
LO/L1 kg	The total mass in kg either in Lunar Orbit (LO) or at L1 receiving either laser energy or solar energy for conversion purposes													
LEO kg	The total mass in kg at LEO receiving either laser energy or solar energy for conversion purposes													
Required Storage on Surface (RFC)	The total mass in required energy storage on lunar surface as measured in Regenerated Fuel Cell mass (RFC)													
Required Storage in Space (RFC)	The total mass in required energy storage in space as measured in Regenerated Fuel Cell mass (RFC)													
Surface FH	Portion of system launched directly from the Earth's surface to the lunar surface - Lift Capacity (LC) measured in Falcon Heavy units (FH)													
LO/L1 FH	Portion of system launched directly from the Earth's surface to either LO or L1 - LC measured in FH													
LEO FH	Portion of system launched directly from the Earth's surface to LEO - LC measured in FH													
GEO FH	Portion of system launched directly from the Earth's surface to GEO - LC measured in FH													
Tot Surface FH with EP	The total mass of the system as measured in FH launched from the Earth's surface to LEO and then moved with EP to LO, and from LO to the lunar surface													
Tot LO/L1 FH with EP	The total mass of the system as measured in FH launched from the Earth's surface to LEO and then moved with EP to LO or L1													
Tot FH without EP	The total mass of the system as measured in FH launched directly from the Earth's surface to a combination of GEO, LEO, LO, L1, or the lunar surface - LC measured in FH													
Tot FH with EP	The total mass of the system as measured in FH launched from the Earth's surface to LEO and then moved with EP to GEO, LO, or L1 - LC measured in FH													
ISRU	In Situ Resource Utilization													
DS	Deflecting System satellite; used to alter the path of an LS													
GEO	Geostationary Earth Orbit													
L1	Solar insolation captured by a solar-powered laser system at Earth-Moon Lagrande Point 1 (L1)													
LS	Laser System													
LO	Lunar Orbiting													
PV	PhotoVoltaic system													
SP	Solar Pumped													
RFC	Regenerated Fuel Cell													
CRFC	Cryogenic storage Regenerating Fuel Cell. From 2009 NASA concept study													
FOLS	Fixed Orbit Laser System. From 2009 NASA concept study													
EGEOLS	Beamed energy from Earth to Geostationary Earth Orbit													
ELEOLS	Beamed energy from Earth to a DS constellation in LEO													
L1LS (PV)	L1-based LS - PV-powered													
L1LS (SP)	L1-based LS - SP-powered													
LEOLS (PV)	Low Earth Orbit LS - PV-powered													
LEOLS (SP)	Low Earth Orbit LS - SP-powered													
LOELS (PV)	LO Equator single satellite LS - PV powered													
LOPLS (PV)	LO Polar single satellite LS - PV powered													
LOPVLS (PV)	LO PV-powered LS													
LOSPLS (SP)	LO SP-powered LS													
LOPCLS (PV)	LO Polar Constellation satellite LS - PV-powered													
LOPCLS (SP)	LO Polar Constellation satellite LS - SP-powered													
LOPMLS (PV)	LO Polar Multiple satellite LS - PV-powered													
LOPMLS (SP)	LO Polar Multiple satellite LS - SP-powered													
LPSMS (PV)	Lunar Pole Surface-Mounted System - PV-powered													
LSMS (PV)	Non-polar Lunar Surface Mounted System - PV-powered													
Store - Li Battery	Lithium battery energy storage system for 17 days of lunar darkness - measured in Tesla Model S batteries (100 Wh/kg)													
Store - Li/S Battery	Lithium sulfer battery energy storage system for 17 days lunar dark - assumed 500 Wh/kg.													
Store - Chemical - monthly - H2+O2	Chemical energy storage system for 17 days/month without solar energy - H2 & O2 recharged monthly from Earth													
Store - Chemical - monthly - H2	Chemical energy storage system for 17 days of lunar darkness - H2 only recharged monthly from Earth - O2 produced by ISRU													
Store - Chemical - recycled H2O	Chemical energy storage system for 17 days/month without solar energy - H2 & O2 produced by ISRU													
Store - Flywheel	Flywheel energy storage system for 17 days/month without solar energy													
Store - Flywheel - ISRU	Flywheel energy storage system for 17 days/month without solar energy - ISRU													
Store - Thermal - Fe - ISRU	Battery energy storage system for 17 days/month without solar energy - stored in molten iron (Fe) - ISRU													
Store - Thermal - Al - ISRU	Battery energy storage system for 17 days/month without solar energy - stored in molten aluminum (Al) - ISRU													