

## Appendix A - Calculations

For this project, the total energy supplied by the existing batteries and any new possible batteries needed to be calculated. The following are the equations used to determine the amp hours and watt hours for this project, with the calculations for the stock batteries.

$$\text{(Watt-Hours)} / \text{(volts)} = \text{AH}$$

$$(23 * 10^3) / (312) = 73.7 \text{ AH}$$

$$\text{AH} * \text{Volts (total)} = \text{Watt-Hours}$$

$$(73.7) * (312) = 23 * 10^3$$

## Appendix B – Goals and Constraints

<b>Constraint</b>	<b>Score</b>
Voltage	7
Current	7
Size	6
Budget	9

<b>Goals</b>	<b>Score</b>
Provide comparable range	8
Limit required modifications	7

The scores are based on a scale of 1-10, 1 being not important, and 10 being critical. The scores were tabulated by taking a poll within the group and deciding which constraint or goal was most important.

## Appendix C - (Battery Specifications)

### Current Battery

- Model BXE-202
- 8 Volt
- 70 Amp-hour rating per individual battery
- 23 kWh rating for the pack
- 39 individual batteries
- 15.25" L x 4.5" W x 6.625" H
- Total weight = 2000 lbs.

### 8V Replacement Battery

- Exide Golf Cart Battery: E-4800 8V
- 40.9 AH
- 10.375" L x 7.1875" W x 11.4375" H3

### 4V Replacement Battery

- Sealed Lead Acid 4V Battery
- 9 AH
- 3.98" L x 1.73" W x 3.74" H

### 12V Replacement

- Optima d31a Deep cycle Battery
- 12V
- 75 AH
- 12.81" L X 6.50" W X 9.31" H

The 8V batteries are too big (and could provide a power concern), while the 4V batteries aren't powerful enough.

## Appendix D – (BatteryMD contact information)

### Battery MD

- [www.batterymd.com](http://www.batterymd.com)
- Contact: Kitty Rodden at [batterymd@aol.com](mailto:batterymd@aol.com) or 916-641-1807
- Official remanufacturer of all Ford EV battery packs
- Individual batteries not available
- Offer qualified used “refurbished” battery pack purchased with trade-in of your existing battery pack for approximately \$4000 (quoted as \$3928.56). This includes parts and labor, and they will perform a complete diagnostic test of your vehicle. Price does not include transporting your vehicle to and from there Sacramento offices

Pack is only guaranteed to have a range of 30 miles when it leaves their facility, as compared to the original 50 mile range from the factory. The pack is not warranted. There is no guarantee on how long the new pack will last.

## Appendix E – (Morphological Chart)

Subfunction	Concept Number			
	1	2	3	4
1.0 Store Energy				
1.1 Electric	Deep Cycle	Standard Automotive		
1.2 Kinetic	Flywheel	Gyro		
2.0 Deliver Energy				
2.1 Power Transformation	Transformer			
	Equivalent Amp			
2.2 Provide Adequate Duration	Hours			
3.0 Provide Housing and Support				
3.1 Protect Batteries		Provided by On-Board computer system		
3.1.1 Overcharge Protection	Provided by battery			
3.1.2 Provide Thermal Control				
3.1.2.1 Cooling	Air	Liquid		
3.1.2.2 Heating	Electrical	Insulation		
3.1.3 Resist Impact	Shock Absorbers	Resistant Case	Integrated Skid Plate	
3.2 Provide Structure				
3.2.1 Chemical Resistant	Case Material	Case Coating	Sacrificial Material	
			Increase the number of mount points	
3.2.2 Low Flex	Internal framing	Rigid Material		
	Sliding Battery			
3.3 Access to all Batteries	Trays	Minimize Stacking of batteries	brackets	
4.0 Provide User Interface				
4.1 Fastening Hardware	Base Clamps	Tie Straps	Pressure Fit	
4.2 Provide Connections				
4.2.1 Battery Connections	Alligator Clip	Clamp On	Push On	Hardwire
4.2.2 Wires	Silver	Lead	Gold	Silver
4.3 Allow for Easy Maintenance				
4.3.1 Top Case Easily Removable	Top Case Sectioned	Solid Top Case		
4.3.2 Contaminant Infiltration	Weather Stripping	Silicon		