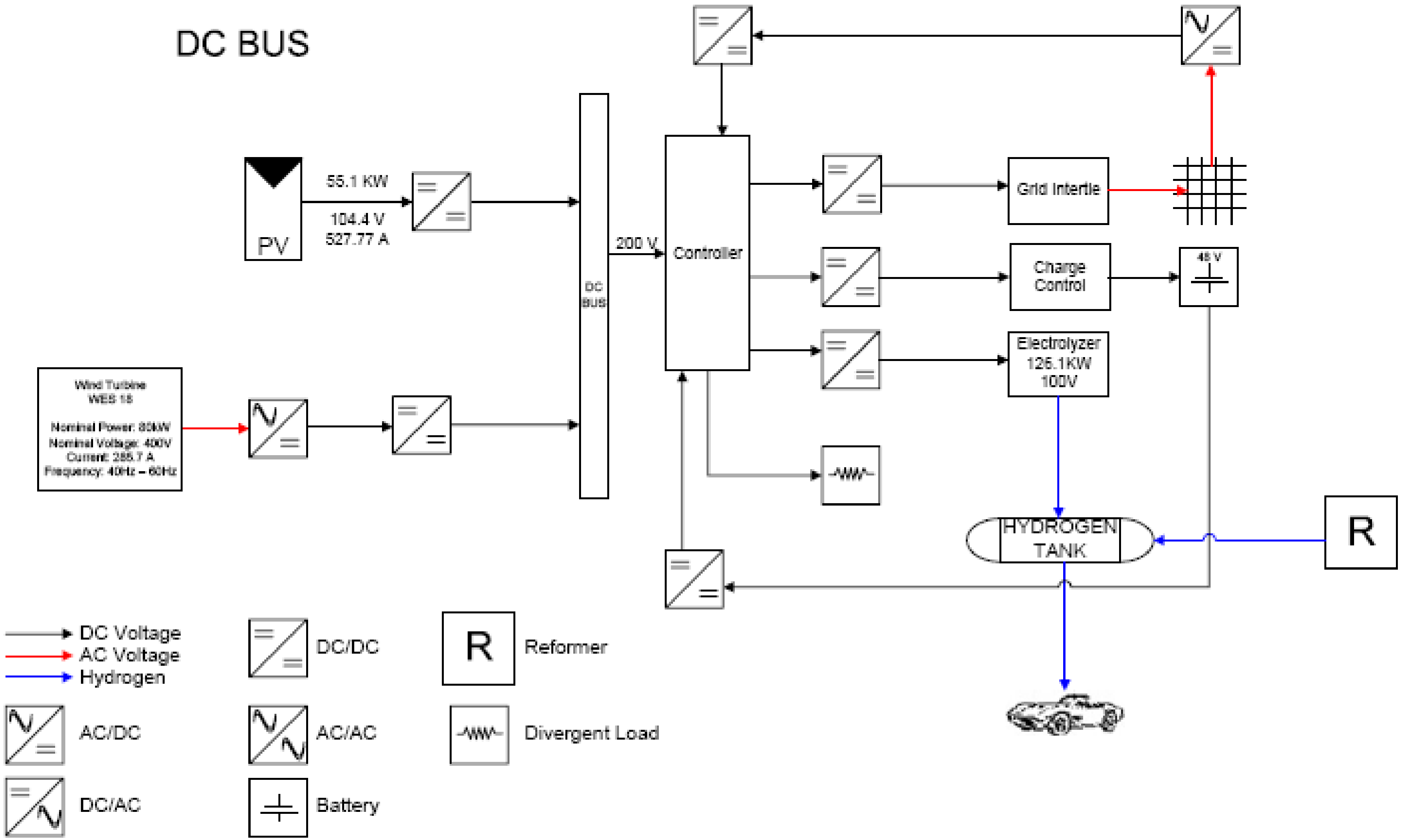
IPRO 301 Fall 2005
Hydrogen Fueling Station

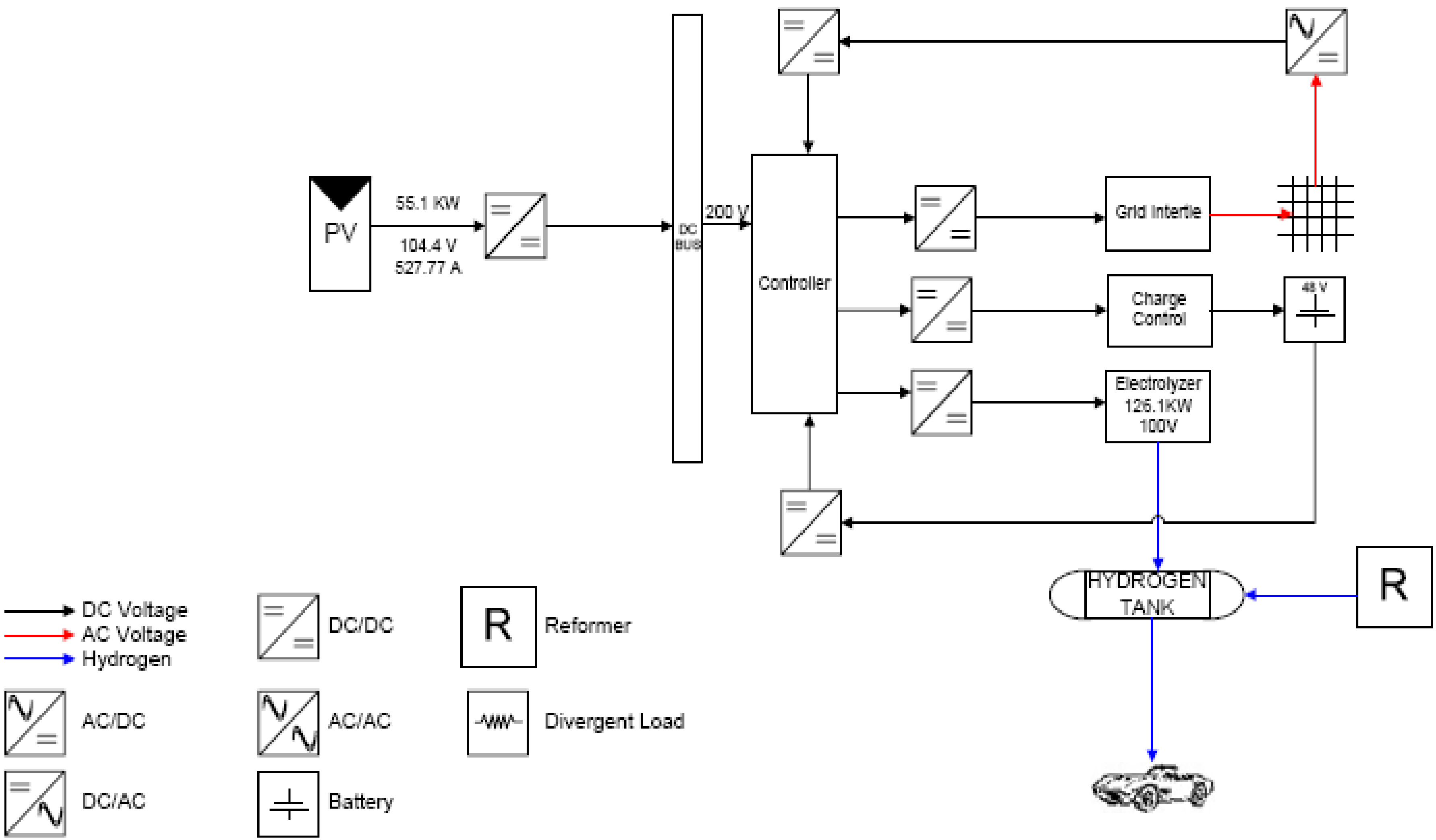
Design 1

DC BUS

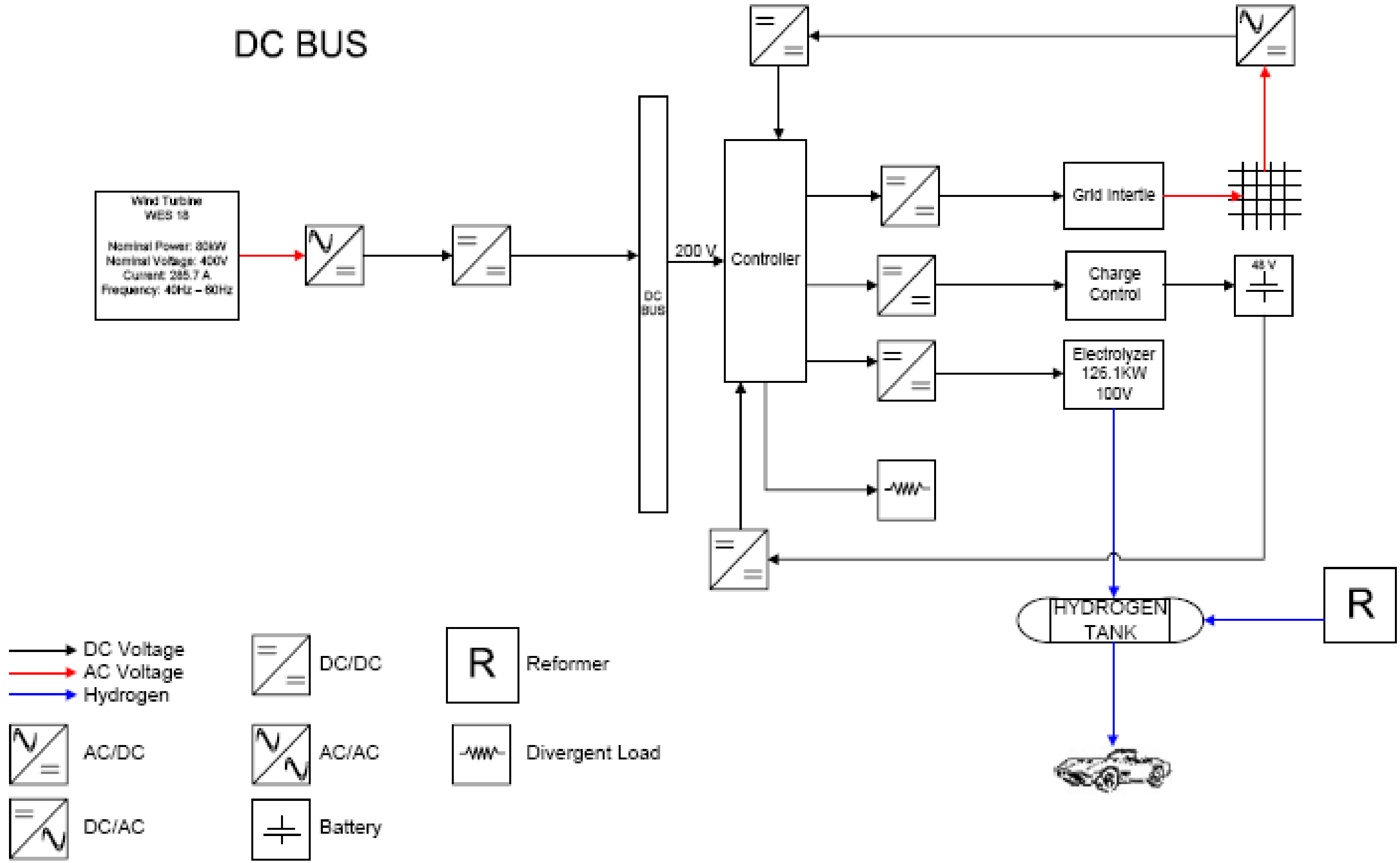


Design 2

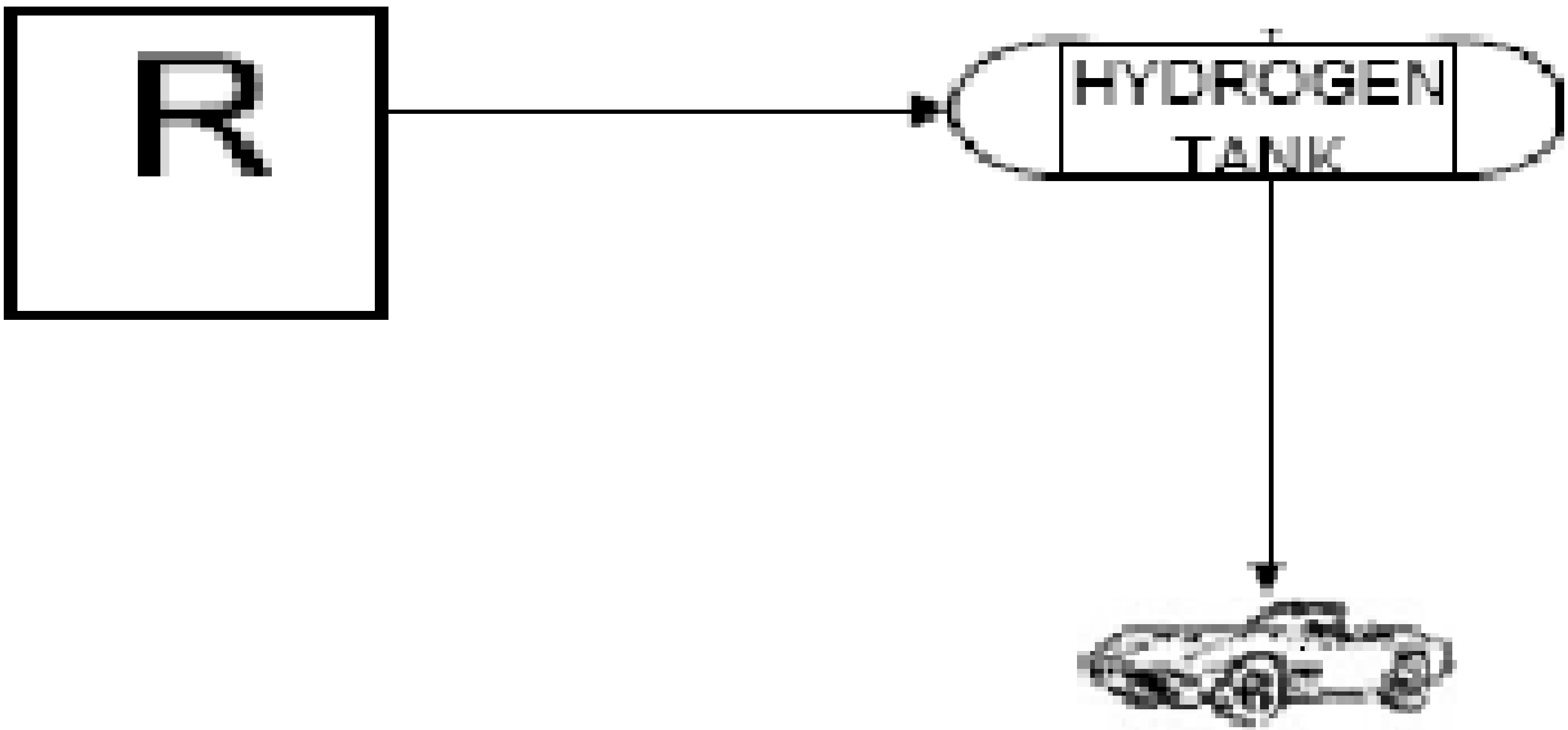
DC BUS



Design 3


DC BUS
Wind Turbine
WES 18
Nominal Power: 80kW
Nominal Voltage: 400V
Current: 285.7 A
Frequency: 40Hz – 60Hz
DC BUS
200 V
Controller
Grid Intertie
Charge Control
48 V
Electrolyzer
126.1KW
100V
HYDROGEN TANK
R
DC Voltage
AC Voltage
Hydrogen
DC/DC
Reformer
AC/DC
AC/AC
Divergent Load
DC/AC
Battery

Design 4



Components

- **PV arrays:** Kyocera KC190GT is the model used. It has a maximum output of 190watts and efficiency of 16%.
- **Wind Turbine:** The WE18 is the model used. It reaches its maximum output of 80KW at a wind speed of 20m/s.
- **Electrolyzer:** The Hylyzer 65 model form Hydrogenics was used. It produces Hydrogen at a power consumption rate of 50.44 kWh/kg. It can produce 2.5Kg/hr, therefore its energy consumption rate is 125KW.
- **Reformer:** The Reformer is produced by Virent Technology. For every 10Kg of 50% sorbitol solution it intakes it produces 1Kg of Hydrogen (10:1 ratio).

Components (cont'd)

- **Grid Intertie:** The SW5548E model was used from Xantrex Sinewave Power. Input: 44-66Vdc, 150Adc.
- **Charge Controller:** The model used is the TRISTAR-60. 44 units are needed for the battery bank.
- **Battery Bank:** The model used is the 12-CS-11PS from Surrette. The batteries are made from flooded lead Acid. Power Ratings: 12Vdc, 357AmpHr, 4.284KWh.
- **Diversion Load:** The FSE-1500 model is used. It has a power rating of 1.5KW each. 54 of these is used in the system.

Initial Costs

Components	Design 1	Design 2	Design 3	Design 4
Sorbital	$34,000	$34,000	$34,000	$50,000
Reformer	$400,000	$400,000	$400,000	$400,000
Electrolyzer	$1,200,000	$1,200,000	$1,200,000	X
Wind turbine	$260,000	X	$260,000	X
PV Panels	$152,000	$1,078,300	X	X
Electrical	$783,200	$712,400	$757,600	$102,000
Hydrogen Dispensing System	$40,600	$40,600	$40,600	$40,600
Sorbitol storage tank	$10,000	$10,000	$10,000	$10,000
Wiring	$14,000	$14,000	$14,000	$14,000
Total	**$2,893,800**	**$3,489,300**	**$2,716,200**	**$616,600**

Annual Cost

Components	Design 1	Design 2	Design 3	Design 4
Sorbitol	$34,000	$34,000	$34,000	$50,000
Reformer Maintenance	$10,000	$10,000	$10,000	$10,000
Electrolyzer Maintenance	$11,700	$11,700	$11,700	X
Wind Turbine Maintenance	$3,000	X	$3,000	X
PV Maintenance	$1,300	$1,300	X	X
Electrical Maintenance	$19,600	$17,800	$18,900	2,600
Dispensing System Maintenance	$1,000	$1,000	$1,000	$1,000
Sorbitol Storage Tank Maintenance	$300	$300	$300	$300
New Wiring	$400	$400	%400	$400
Energy Sales to Grid	-$9,600	-$14,200	-$5,600	$0
Total	**$71,700**	**$62,300**	**$73,700**	**$64,300**

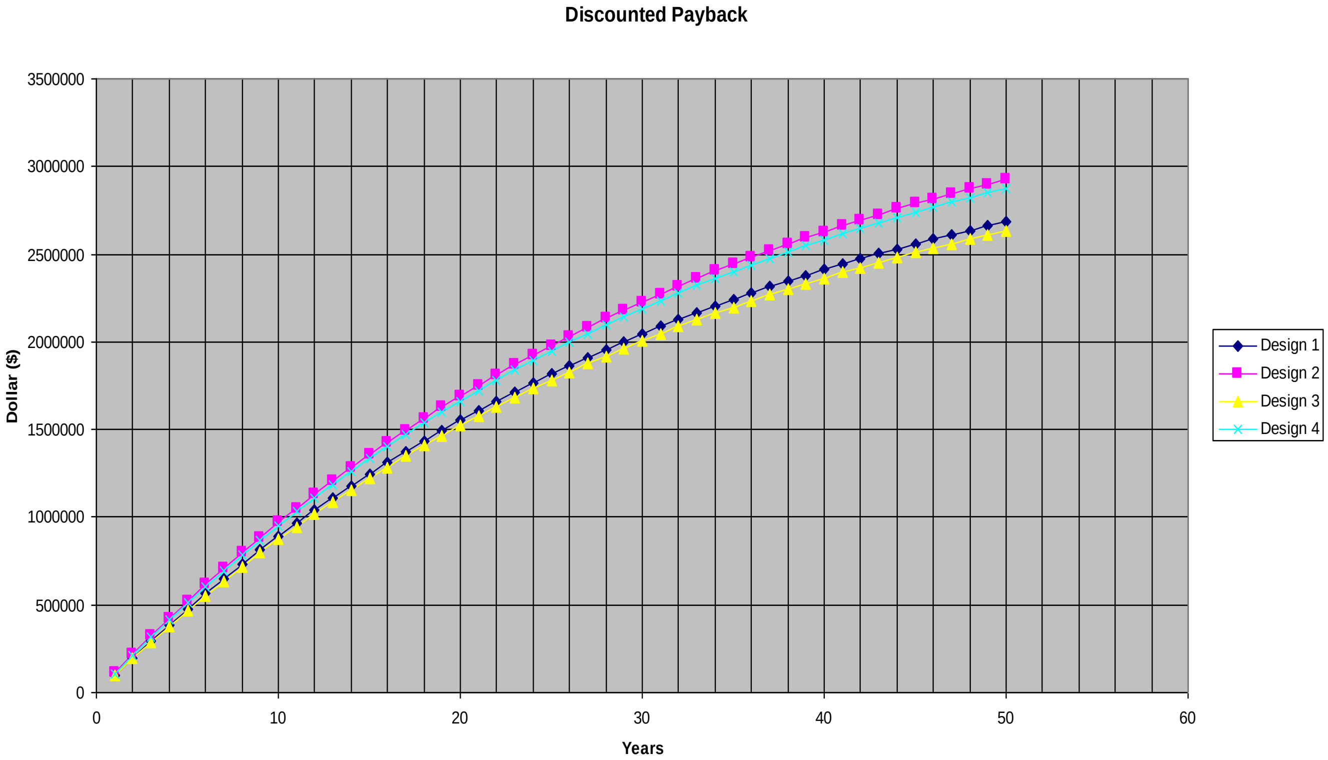
SPB Values

	Simple Payback (years)	Life Time Profitable (years)
Design 1	27.7449	28
Design 2	30.6886	31
Design 3	26.5513	27
Design 4	5.5201	6

- With the expected lifespan of the Hydrogen Fueling station of 35 years all four designs would be according to the SPB method profitable.

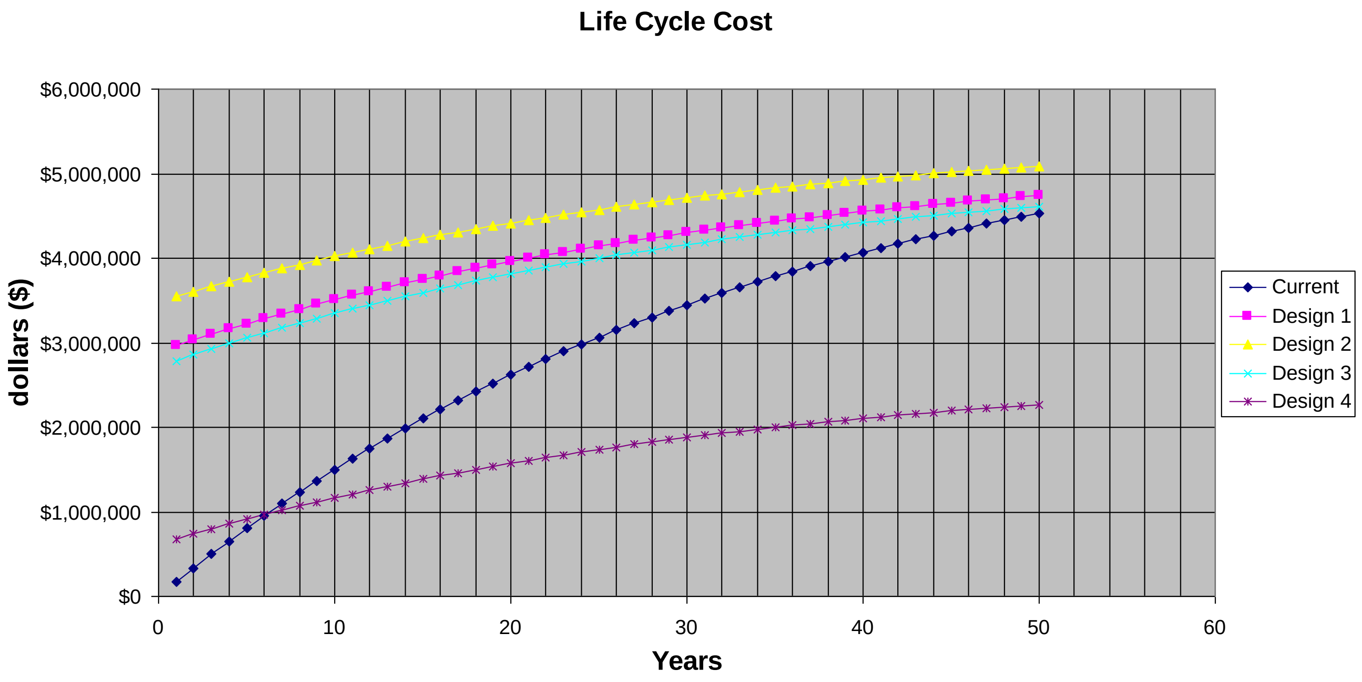
- The Life span of the project would need to be at least 31 years for all of the designs to be economically profitable under the Simple Payback method.

DPB Graph



- With the expected lifespan of the Hydrogen Fueling station of 35 years Only design 4 would be profitable.
- As you can see, even after fifty years Designs one, two, and three do not repaying their initial cost.

LCC Graph



- As you can see the LCC cost of the current system is less than that of each of the designs through fifty years except for design 4.
- Design 4 becomes profitable according to the LCC method well before 25 years.
- Because it is unlikely that the project lifespan would be greater then 50, we can predict that designs one, two, and three will not be economically profitable.

Recommendations

- According to all three methods of economic analysis used by the economic analysis team design four seems to be the most economically efficient design. In all three methods used design four was either the only design to be profitable or was the most profitable out of all designs. However because economics was not the only deciding factor in making our recommendation we took into account other issues such as renewable energy usage as well as promotional values of the design.

- With all of these in mind the economic analysis team is recommending that design one should be utilized. Although design four is far less expensive then design one, it utilizes not methods of renewable energy such as wind or solar. Designs two and three only utilize one renewable energy component, ether PV panels or wind turbine. In Chicago wind becomes insignificant during the summer months while sunlight is diminutive during the winter. Using design two or three would limit the amount of power the system would be able to produce year round. The economic analysis team feels that by not utilizing these renewable energy sources the project would suffer huge losses as far as project promotional value.

- Design one uses all of the different components to some extent which has a large promotion value and would allow the system to produce enough energy year round. Design one is also less expensive then design two and close to the same cost of design three. For these reasons we are recommending design one to be utilized for the project.