

COLUMBIA and the 3 E'S

ECONOMY

Intelligent management in the expenditure or consumption of money, materials and resources.

ENERGY

Any source of usable power, as fossil fuel, electricity, or solar radiation.

ENVIRONMENT

The air, water, minerals, organisms, and all other external factors surrounding and affecting a given organism at any time.

Low Speed Electric Vehicles

An Intelligent
Transportation Solution.

Economy

Electric vehicles provide a Low Cost form of transportation for the frequent user. In most of the examples below, electric vehicles are Cheaper to Operate than gas counterparts, even with the cost of batteries included. The estimated cost of operation for an electric vehicle is \$0.02 per mile. The estimated cost of operation for a gas vehicle is between \$0.10 & \$0.14 per mile.

US Average of January 12, 2014

Costs Incurred for 1 Year with a Gas Vehicle			
Miles/Day	Miles/Year	Gal. Used (30 MPG)	\$3.35/Gal.
5*	1825	60.80	203.68
7	2555	85.20	285.42
10	3650	121.70	407.70
15	5475	182.50	611.38
20	7300	243.30	815.06

Costs Incurred for a Gas Vehicle After Number of Years						
Miles /Day	2 Years	3 Years	4 Years	4 yrs w/btty(s)**	5 Years	5 yrs w/btty(s)**
5*	407.36	611.04	814.72	904.72	1,018.40	1,108.40
7	570.84	856.26	1,141.68	1,231.68	1,427.10	1,517.10
10	815.39	1,223.09	1,630.78	1,720.78	2,038.48	2,128.48
15	1,222.75	1,834.13	2,445.50	2,535.50	3,056.88	3,146.88
20	1,630.11	2,445.17	3,260.22	3,350.22	4,075.28	4,165.28

Costs Incurred for 1 Year with an Electric Vehicle		
Miles/Day	Miles/Year	\$0.02/Mile
5*	1825	36.50
7	2555	51.10
10	3650	73.00
15	5475	109.50
20	7300	146.00

Costs Incurred for an Electric Vehicle After Number of Years						
Miles /Day	2 Years	3 Years	4 Years	4 yrs w/btty(s)**	5 Years	5 yrs w/btty(s)**
5*	73.00	109.50	146.00	1,146.00	182.50	1,182.50
7	102.20	153.30	204.00	1,204.40	255.50	1,255.50
10	146.00	219.00	292.00	1,292.00	365.00	1,365.00
15	219.00	328.50	438.00	1,438.00	547.50	1,547.50
20	292.00	438.00	584.00	1,584.00	730.00	1,730.00

* equal to 1 round of golf

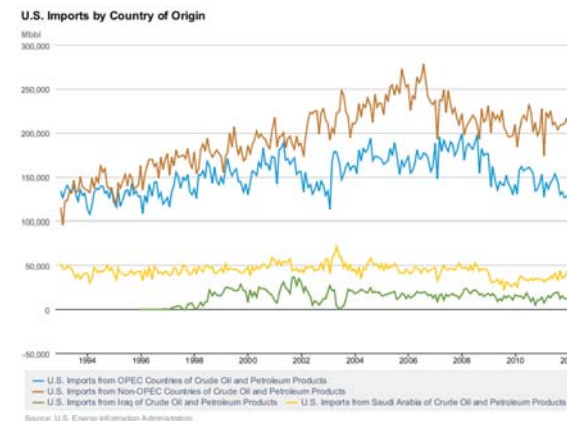
**January, 2014 Pricing of Batteries from Columbia ParCar Arizona

Energy

Electric vehicles promote U.S. Energy Production and Reduce Dependence on Foreign Oil.

The graph below shows the number of barrels Imported from OPEC Nations (blue), Non-OPEC Nations (brown), Saudi Arabia (yellow), and Iraq (green) in each month over the past 12 years.

Electric vehicles move the U. S. closer to Energy Independence.



Environment

Electric vehicles use Clean, Renewable Energy reducing the amount of greenhouse gases produced. A Princeton University study, presented in this pamphlet, concluded that the operation of ONE Gas golf car creates FOUR times as much Nitrous Oxide and EIGHT times as much Carbon Monoxide as ONE Ford Taurus.



COLUMBIA ParCar ARIZONA



Sun City West Sales & Service

Safeway Shopping Center
13525 W. Camino Del Sol
Sun City West, AZ 85375

Phone: 623-974-4584

E-mail: questions@parcar.com

Web: www.columbiaparcaraz.com

Hours of Operation:

Monday thru Friday
8:00 a.m. to 4:30 p.m.

Saturday

10:00 a.m. to 2:00 p.m. (sales only)

Sunday

Closed

Objective

In 2004, Princeton University's Environmental Oversight Committee considered the impact their gasoline golf car vehicles and automobiles were having on the environment. Their primary objective was to reduce the amount of gas emissions from the University fleet. In an effort to make a decision on whether to go to electric automobiles from gasoline power, it was decided they would study the effects gasoline golf cars had on the environment versus electric. The following includes their findings.

Problem¹

"Examine the possibility and feasibility of reducing the amount of harmful gas emissions of the University fleet by improving their fuel economy through alternate fuel usage and methods. Although we examined all of the vehicles in the fleet (see graphs below) we found that the Club Cars® on campus provide the largest disproportionate amount of harmful emissions. This report, although mentioning general limiting of gas emissions by the entire fleet, focuses on the availability of switching the gas carts used on campus over to hybrid/fully electric vehicles. If this first large step is successful, the results can then be extrapolated out to include the entire fleet, rather than just the carts. The carts represent 92 vehicles out of a total of around 440 vehicles that we can do something with. This is encouraging for the future. The gas carts emit carbon monoxide, nitrous oxide, hydrocarbons, and carbon dioxide. This report uses numbers provided by the cart manufacturer (below matrix) on their engines with the exception of the CO₂, which was taken from the average emissions of CO₂ emitted in gasoline."

Measured were;

HC or Hydrocarbons – Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. It is our most widespread and intractable urban air pollution problem. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer. (US EPA)

NO_x or Mono-Nitrogen Oxides NO (nitric oxide) and NO₂ (Nitrogen Dioxide) – NO_x are a family of (7) air polluting chemical compounds. Automobiles and other mobile sources contribute about half of the NO_x that is emitted. NO_x creates ground level ozone, which is the primary constituent of smog. NO_x also causes nutrient enrichment problems in bodies of water, which result in oxygen depletion causing marine life death. (EPA)

CO or Carbon Monoxide – Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death. (EPA) In the United States, most carbon monoxide pollution comes from vehicles and other machinery that burn gasoline. In high concentrations, carbon monoxide can harm human health by reducing oxygen to the heart and brain. Carbon monoxide is also one of the chemicals that create ozone pollution and urban smog. (NASA)

CO₂ or Carbon Dioxide – Transportation makes up 31% of US Carbon Dioxide emissions. Carbon pollution stays in the atmosphere and contributes to climate change, which is a threat to public health and the environment for current and future generations. Unchecked greenhouse gas pollution threatens Americans' health and welfare by leading to long-lasting changes in our climate. The health risks from climate change are especially serious for children, the elderly, and those with heart and respiratory problems. (EPA)

Gas Golf Cart Findings - Emission rates²:

Element(s)	Hrs/Wk		Wks/Yr		HP		Lb/HpHr		Lbs/Yr		Ton/2000lbs		Tons/Yr/Cart		Qty		Tons/Yr
HC & NO _x	2.5	x	52	x	10.5	x	0.011	=	1/2000	x	1/2000	=	0.008	x	90	~	0.7 NO _x Fleet
CO	2.5	x	52	x	10.5	x	0.439	=	1/2000	x	1/2000	=	0.3	x	90	~	27 CO Fleet
CO ₂	2.5	x	52	x	10.5	x	1.08	=	1/2000	x	1/2000	=	0.7371	x	90	=	66 Tons/Yr Fleet

Princeton's Engineering Department then compared these results with other areas of the University;

Location	NO _x Tons/Yr		CO Tons/Yr		CO ₂ Tons/Yr	
	PP	CF	PP	CF	PP	CF
Power Plant (PP) vs. Cart Fleet (CF)	79	0.7	92	27	90,000	66
	FT	SC	FT	SC	FT	SC
Ford Taurus (FT) vs. Single Cart (SC)	0.002	0.008	0.032	0.3	2.21 ³	0.7371

From the data, you can extrapolate the following emission measurements:

NO_x: (4) Ford Taurus Vehicles equals (1) gas golf cart

CO: (10) Ford Taurus Vehicles equals (1) gas golf cart

CO₂: The Ford Taurus has more horsepower, so naturally it would have more CO₂ emissions

They then replaced their gasoline golf carts with Low Speed Electric Vehicles as they changed out their golf cart fleet thereby eliminating the harmful toxic fumes the gasoline golf carts were emitting into our atmosphere.

Princeton cited the following electric golf cart advantages;

- The Low Speed Electric Vehicles fully charged within six to eight hours by simply plugging in to a standard 110-volt outlet and would travel up to 35 miles at speeds approximately 25 miles an hour.

~ Columbia Low Speed Electric Vehicles have been tested to complete up to 80 miles per charge ~

- Because of the battery power, electric golf carts emit NO direct greenhouse gases; The electrical generating plants for the batteries do emit CO₂. However, these plants are much more efficient than golf cart engines, minimizing CO₂ production (per unit of energy). Electric golf cart technology has become highly efficient utilizing "regenerative braking", As traveling on downward slopes with brakes in use transfers some of the gravitational energy produced by the vehicle back into the batteries.
- Low Speed Electric Vehicles are built to NHTSA (National Highway Traffic Safety Administration) regulations. Safety standards required include four wheel hydraulic brakes, independent front suspension, windshields, windshield wipers, head, tail, brake light, turn signals and emergency flashers, seat belts, horn, side view mirrors, rear view mirror and more.

~ Columbia offers many additional options for Low Speed Electric Vehicles including all-weather enclosures, chrome rim tires, white rim tires, multiple passenger seating, range extending solar panels, heater, defrosting fan, hard doors, lockable trunk space and much more. ~

- Low Speed Electric Vehicles run more quietly than gasoline vehicles and therefore do not disturb neighbors, golfers and others in the environment around us. To address concerns about catching pedestrians and other operators unaware, Low Speed Electric Vehicles are standardly equipped with a horn for drivers to alert them of the traveling vehicle's presence.

- Maintenance costs for electric vehicles are a great deal lower than gasoline golf carts.³

~ Following standard periodic maintenance schedules provided in the Columbia Operators Manual, the lifespan of the batteries Columbia vehicles utilize, depending on care, is three to five years. ~

- Princeton garage personnel supplied figures showing the average oil filter change, oil tune-up, and general repairs for the average gas car is around \$90. If the cart is repaired bi-annually, it equates to around \$180 in minimal repairs for one car during a year. As the fleet of carts Princeton inventoried was currently around 100 golf carts, that's almost \$18,000 in repairs EACH YEAR.

- Immediate starting of the vehicle with the turn of a key – no priming or choking of the system to have the vehicle start.

Princeton cites the following electric golf cart disadvantages;

- Comparison of Costs – Short Term vs. Long Term – While Low Speed Electric Vehicles are relatively affordable, the short term costs to switch a gasoline fleet or vehicle over to electric can be high.

~ Columbia Low Speed Electric Vehicles start as low as \$7,999 and fully loaded vehicles range from \$11,000 to \$12,000 depending on the model. Consider the purchase of an Low Speed Electric Vehicle includes batteries which supply 3 to 5 years of fuel less the nominal expense to charge the vehicle. The purchase of a gas golf car includes no more than 5 gallons of fuel or roughly \$16.75 of additional value. ~

"Not only does the cart start saving immediately with its impact on the environment in terms of lowering of gas emissions, but also noise pollution; while the long term savings of maintenance and upkeep are positive ones as well. Although the short term costs of replacing the fleet will be on the high side, as would be any transition – these expenditures are the same if not less that is already being spent on the gas carts currently. The long term effects of the replacement are limitlessly positive and ones that should be further examined and put into place immediately."

Result Summary:

Princeton University found there would be immediate savings for their budget, as well as on the economy by switching to Low Speed Electric Vehicles from gasoline golf carts. In addition, through their own research, they found utilizing Low Speed Electric Vehicles is more environmentally friendly and more energy saving than gasoline golf carts.

¹Princeton University Environmental Oversight Committee, Meeting Minutes, Wednesday, April 14, 2004, Attachment A – Hallett Johnson PEOC: Fleet Emissions Report 15, April 2004 web.princeton.edu/sites/peoc/apr142004minutes.htm . Princeton University is located in Princeton, NJ USA.

²Calculations are based on averages for each cart. It was estimated that each cart was used on average for 2.5 hours each week.

³Reference Exhibit C reproduced from materials made available from Princeton University. Reference footnote 1.

"NASA - National Aeronautics and Space Administration." NASA. National A., 15 Feb. 2013. Web. 18 Feb. 2013. <http://www.nasa.gov>

"US Environmental Protection Agency." EPA. Environmental Protection Agency, 15 Feb. 2013. Web. 18 Feb. 2013. <http://www.epa.gov>

*Club Car is a registered trademark of Club Car, Inc. CORPORATION GEORGIA P.O. Box 204658 Augusta GEORGIA 30917