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Under Review: Build Your Own Electric Vehicle by S. Leitman and B. Brandt

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Build Your Own Electric Vehicle
By Seth Leitman and Bob Brandt
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In their book *Build Your Own Electric Vehicle* Seth Leitman and Bob Brandt provide interesting bits of electric automotive history and it could not come at a better time. A sample of the history provided by the authors was Henry Ford's motor company that manufactured over 15 million Model T automobiles between 1908 and 1927 (Henry Ford, n.d.). These vehicles were noisy and powered by a small, internal combustion (IC) engine. Interestingly, his wife, Clara Bryant Ford, was the owner of a 1915 Detroit Electric vehicle powered by a quiet electric motor that managed 25 miles per hour with a range of 80 miles per charge.

The crux of this book is not about building an electric vehicle (EV) from scratch, rather it's about converting a used pickup or a small economy car with an (IC) engine to a plug-in EV. The result of this conversion would be a vehicle that would get you around town and home again with zero emissions. The authors provide several illustrations of vehicles that have been converted, these include: a 959 Porsche, a GMC van, a Chevy S-10 pickup, and even a Rolls Royce. The authors stated that the prime candidate for this type of conversion is a short wheel base pickup truck that can handle the added battery weight needed by an EV.

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Overview

In Chapter 1, entitled *Why Electric Vehicles are Still Right for Today!* the authors dispel some myths about the shortcomings of an EV. A primary concern for anyone who owns a EV is the range. General Motors conducted a study in the early 90's that indicated that 8 percent of all trips driven are 25 miles or less. A federal government report indicted that the average daily commuter trip was only 10 miles. Leitman and Brandt stated that many of today's 120-volt electric vehicle conversions will go 75 miles or more before charging is required.

Why should you convert an IC vehicle to electric? According to the authors, EVs are cleaner, more efficient, and a very effective form of transportation. The first chapter also provides an interesting comparison of the operating costs of an EV versus an IC. There are several variables to consider when making a comparison, IC mpg, price per gallon of gasoline and monthly consumables for repair and maintenance. An important variable for the EV is the cost of kilowatt-hours (kwh). The authors compare an IC vehicle that averages 20 mpg at $4.50 per gallon to an EV that uses $.165 kwh (the rate for New York) multiplied by .44kwh (the mileage for a converted Ford Ranger pickup). At these rates, the EV wins hands down at 7.3 cents per mile to 27 cents per mile. This includes the addition of consumables like oil and filters plus periodic costs for maintenance at 4.2 cents per mile, based on $500 per year at 12,000 miles for both vehicles. For this example, the IC is favored slightly because the EV will have lower maintenance costs due to not requiring oil changes, filters, etc. In any event, energy efficiency is a critical component of this argument. If you change the gas price to the current cost in the Midwest ($2.25) and increase the gas mileage based upon a good hybrid gas-electric (40 mpg) the

economy of the IC changes significantly to about 9.8 cents per mile including consumables.

Going Green

The green effects of an EV are highlighted in Chapter 2, *Electric Vehicles Save the Environment,* especially when compared to an IC. This chapter includes many concerns regarding ICs, including dependence on foreign oil, the greenhouse effect, toxic air pollution, and wasted heat. What would be the effect of thousands (or maybe millions) of electric vehicles on the roads? A shift to large numbers of electric vehicles does demand more from coal-fired generating plants. However these coal generation stations have advantages in that they can be controlled more than internal combustion vehicles. An interesting note about this chapter is the author's argument that conversion to EVs will provide an economic benefit to our electric utilities because it will represent a new market for electricity sales.

A Rich History

The story of the electric vehicle during the 20th century could be described to a certain extent, as on again and then off again, at least in terms of normal passenger vehicles. Chapter 3, *Electric Vehicle History* is packed with interesting facts and figures regarding all types of EVs. For example, "Electric vehicles enjoyed rapid growth and popularity until about 1910, then a slow decline until their brief resurgence in the 1990s" (p34). The authors show four waves of EV development in the United States, Europe, and Japan. The first wave came in the 1960s, the second after 1973, the third after 1979 and the fourth in the 1990s. Great Britain led EV development with electric milk trucks totaling more than "100,000" vehicles

(p44). In the 1970s the United States Postal Service made use of "350" electric vans purchased from AMC General Corp. (p48). Have you ever run across a Dodge Omni that was converted to an EV? If so, this conversion was completed by Jet Industries of Austin, Texas in the 1980s. These vehicles "are prized possessions among Electric Auto Association members today, attesting to their outstanding quality and durability" (p. 52). In the 1990s, General Motors gave us the famous, or maybe, infamous EV1. This vehicle, which was the subject of a documentary (*Who Killed the Electric Car?),* is an example of Detroit mentality that was two steps forward and three steps backward. They built 50 of these vehicles which had to be returned to the dealers after being leased to customers. Ultimately, GM crushed them in the Arizona Desert for a number of reasons explained in the film. Ironically, this vehicle had an impressive set of stats including "a 0.19 coefficient of drag (still the most aerodynamic production car ever made)," a "50 to 70 mile range" that could be extended to "120-140 miles" with nickel metal hydride (NiMH) batteries, "a 0-to-60 time under 8 seconds" and an "80-mph freeway capability" (p.62).

The Nuts and Bolts of a Conversion

The remainder of this book is essentially the details about how to go about a conversion and your best choice in components and batteries. If for example, you take an early 90s Toyota Celica and want to convert it to an EV, you will need a vehicle that has a manual transmission. Manual transmissions are preferred and explained in Chapter 5, *Chassis and Design.* The best choice in electric motors are detailed in Chapter 6 which provides a range of alternatives. The authors say "the series DC motor is unquestionably the best for today's first-time EV converter," however, "Improvements in solid-

state AC controller technology clearly put AC motors on the fast track for EV conversions of the future" (p. 155).

Another essential component is the motor controller which is covered in Chapter 7. Controller efficiency includes building or buying the best controllers on the market. The heart of an EV conversion is in the batteries which are covered in Chapter 8. The authors detail batteries in regard to how they work, charging considerations, and vanities. According to the authors, the Trojan battery company of Santa Fe Springs, California, provides the best performance as well as cost in lead-acid deep cycle batteries.

Chapter 9 covers the charging and electrical systems, as well as details on step by step conversion of an IC vehicle. Chapter 11 provides the particular skills needed to drive an EV vehicle, licensing, insurance and car care. Finally, Chapter 12 provides a number of vendors that supply the best products and prices.

Conclusion

The authors provide a cost list to make an EV conversion that provides several different scenarios for the buyer. Using an economy car with a combination of new and used components, the total cost is estimated at $5,200. This is a rock bottom cost for a do-it-yourself project. Obviously, using a newer vehicle with new components and having it converted by someone else will increase the cost of such a project. At the high end, the estimate can reach $17,500. In any event, this type of conversion project makes sense, especially for a second vehicle that is used around town. Moreover, the conversion of an IC vehicle to an EV is a move towards more appropriate technology, technology that is environmentally as well as user friendly. Is such a conversion project beyond the scope of a high school or post-secondary

technology education program? Some schools have done it as demonstrated by the Technology Studies Department at Fort Hays State University in Kansas. They have their own EV pickup that was converted by faculty and students 9 years ago. The expenses for this conversion were supported by a Department of Transportation *Clean Cities* grant.

Build Your Own Electric by Seth Leithman and Bob Brandt is an excellent guide and starting point for such a project.

References

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