The selection of economic car

Course Title: Engineering Economics Analysis

Course Number: ETM 535

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Term: Fall

Year: 2011

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Report No.:

Type: Student Project

Note:

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Abstract

The motivation of this project is to fulfill a typical consumer's economic dilemma in the decision process for an optimal automobile purchase. The purpose of this research paper is to investigate a group of different economic analysis methods at a simple level with only the fundamental scope in mind such that a reasonable decision selection can be concluded. Our first approach is to determine the Annual Worth for each of a set of mutually exclusive alternatives on a 5 and 10 year useful life. This entails making some reasonable estimate assumptions, considering the total operation cost for the life cycle of the car. Included in our analysis will be a section to determine the optimal useful life for a subset of the alternatives based on the EUAC. The result that we determine through the different economic analysis methods will be that the efficient (modern) regular gasoline combustion engine type car gets the consumer the most "bang for the buck" and also we will show approximately what would need to take place to change this result. In conclusion, we learned that multiple advanced economics analysis methods should be involved to resolve a deeper insight over the different aspects of a single complicated mathematical problem. There are hard and soft considerations and these are some things that make different consumers opinions different enough such that they may weigh the attributes of the alternatives differently than how we conducted our research.

Introduction

The year is 2012 and a consumer needs an automobile and wants to make a selection based on the criteria presented in a typical Engineering Economic study. However, there are a multitude of principles and methods that aid Engineers in making Engineering Economic decisions. Furthermore, there are even combinations and variations of the principles and methods that allow different analysis perspectives to be considered which may lead to different conclusions. The purpose of this research paper is to investigate a group of different methods at a simple level with only the fundamental scope in mind such that a reasonable selection can be concluded. Furthermore a deeper understanding of the economic principles and methods that are considered will be met.

Problem Statement

Conduct an Economic Analysis for a set of efficient automobiles for a consumer. The set of alternatives will be made up of 4 subcategories of 2012 sedan type cars being:

1.) Hybrid
    a. Toyota Prius
    b. Ford Fusion
    c. Honda Civic
2.) Turbo diesel
    a. Volkswagen TDI Jetta
    b. Volkswagen TDI Passat
    c. Volkswagen TDI Golf
3.) High Efficiency Regular Gas Combustion
    a. Ford Fiesta
    b. Hyundai Elantra
    c. Chevrolet Cruze
4.) Electric Vehicle (EV)
    a. Nissan Leaf
    b. Mitubishi I-MiEV

The main objective is to determine which of the alternatives cost the least on an annual worth method. The AW will also be the EUAC for this study as the alternatives have no revenue generating qualities and will be only cost-cash flows.

Methodology

The Economic study period will be from 2012 to 2022 and will follow the typical algorithm of searching for a solution:

1.) Plan
    a. Choose a valid model to follow with consistent metrics to compare alternatives such that the resources are reputable, and the assumptions can be backed up.
    b. Choose all the terms of the economic problem on a consistent level such as a reasonable MARR to apply with the time-value conversions, the useful life of the investment and the salvage value-depreciation.
    c. Choose a collection of analysis methods that will allow a broad enough understanding of the factors to make a useful conclusion.
2.) Execute
    a. Make the calculations.
3.) Measure
    a. Interpret the results of the calculations.
    b. Make comparisons of the useful information that the different methods resolve.
4.) Correct
    a. Take the basic information from the measurement level and determine where adjustments that will matter should be made.
5.) Repeat to the plan stage if major adjustments are required. Otherwise make the conclusion with the best information available. This may be if time passes and, or new information is revealed to be incorporated into the model.

Plan

The initial plan is to determine the most economic efficient alternative in each subcategory and then make a comparison between the winners of the subcategories. The consumer requirement is 15,000 miles per year based on a 50 mile round trip, daily commute for 6 days a week with a 45% highway and 55% city type driving condition.

For all the subcategories, we determined the efficient alternative based on their fuel consumption (miles per gallon, MPG) and their performances, like passenger volume in cubic feet for each of the sub categories. The best of each sub-category are Ford Fiesta (Regular Gas Combustion), Mitsubishi MiEV (EV), Toyota Prius (Hybrid), and Volkswagen Jetta (diesel) to be candidates for further comparison analysis.

Economic analysis Methods

Based on the situation and objectives, we conduct five different types of economic analysis methods to give the consumer deep insight in several important areas.

1.) The AW (Annual worth) method is conducted to compare the total costs of different cars with 5 and 10 years useful life.

2.) To see the change of each car's annual cost through its entire life cycle, we incorporated the EUAC (Equivalent Uniform Annual Cost) method to show these tendencies and also for helping to determine optimal useful lives for each of the selected alternatives.
3.) Incremental analysis is also utilized to show further information about economic efficiency for each type of car.
4.) Conduct Breakeven analysis to show the detailed relationship between each type of car and fuel cost.
5.) At last, we use Sensitivity analysis to examine the weight impacts of fuel price, initial cost, maintenance cost and MARR, over the annual cost of each car.

Costs

Assumptions for estimating the major costs:

1. Tire cost:
   We used the annual American Automotive Association's (AAA) 2011 report to get average operating tire cost per mile for each vehicle type [1]. The cost per mile is dependent on the vehicle type that is being selected in ranking of size in terms of small and medium sedan. For this cost, we decided to use the curb weight of the specific car compared to the cars used in the AAA report. With this information, we are able to found the cost per mile that the tires add to the total operating cost per mile. In addition, the calculations consider these costs as the annual cost and no time value, inflation corrections are made for the future annual costs.

2. Insurance:
   The Insurance costs come from the newcar.com website which gives consumers a detailed breakdown of the insurance cost [2]. The consumers can calculate their annual insurance cost by following this method. The calculation is based on driving 15,000 miles annually.

3. Maintenance:
   For the maintenance costs part, we include variables from part cost, labor cost and state fees to make our simulation as close to reality as we can. We collect data only from sources which are conducted by government or academic organizations or considered to be reliable by industry standards. One important data source we used in the project calculations is the Edmunds Inc. website [3]. The Edmunds Inc. publications are considered a reputable source from many people in the automotive industry.

4. Depreciation:
   The depreciation method used for the automobiles was decided to be one out of the IRS publication 946 which is the MACRS – GDS 5-year depreciation method. This was an arbitrary decision, and typically in the real world, cars get some salvage value when sold even after 20 years. This means clearly the MACRS – GDS 5 year depreciation system has a difference compared to reality. Moreover,

we found there is no uniform depreciation way that fit reality well, because the depreciation speed vary among different cars. For this reason, we decided to use an academic way (GDS 5-year) to depreciate our cars.

Year k	Depreciation proportion on k year
1	0.2000
2	0.3200
3	0.1920
4	0.1152
5	0.1152
6	0.0576

Table 1: depreciation method in MACRS – GDS 5 year system

5. Initial cost:

   The Initial cost of the selected automobiles comes from the official manufacturers' websites [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14]. The standard, stock, least expensive version of the automobiles was used for the comparisons. The EV charging station cost is also included in the initial investment [13], [14].

6. Environmental costs:

   Except the EV cars, all other cars like gasoline, diesel, and hybrid cars emit carbon dioxide. The emission of carbon dioxide can be seen as a social cost [15]. From the study of the Economics for Equity and the Environment Network (E3 network), the "Social Cost of Carbon Emission" is $21 per ton of CO2, or roughly 20 cents per gallon of gasoline in 2010 [16]. We used this estimation for the carbon footprint cost for combustion, diesel, and hybrid vehicles.

7. Fuel:

   The fuel cost growth rate was determined from the Energy Information Administration (EIA) data [17]. The target rate used for the project analysis was specifically for the years from 2000 to 2008 to give a reasonable rate at 13%. The reason to use this time span was to get what appeared to be a meaningful growth rate such that it is between a conservative rate of 6.6 percent considering the last 21 years of data and the more extreme rate of 21% that resulted from the years 2002 to 2008. The 13% rate is also a good middle road growth rate as the average of 21% and 6% is about 13.5%.

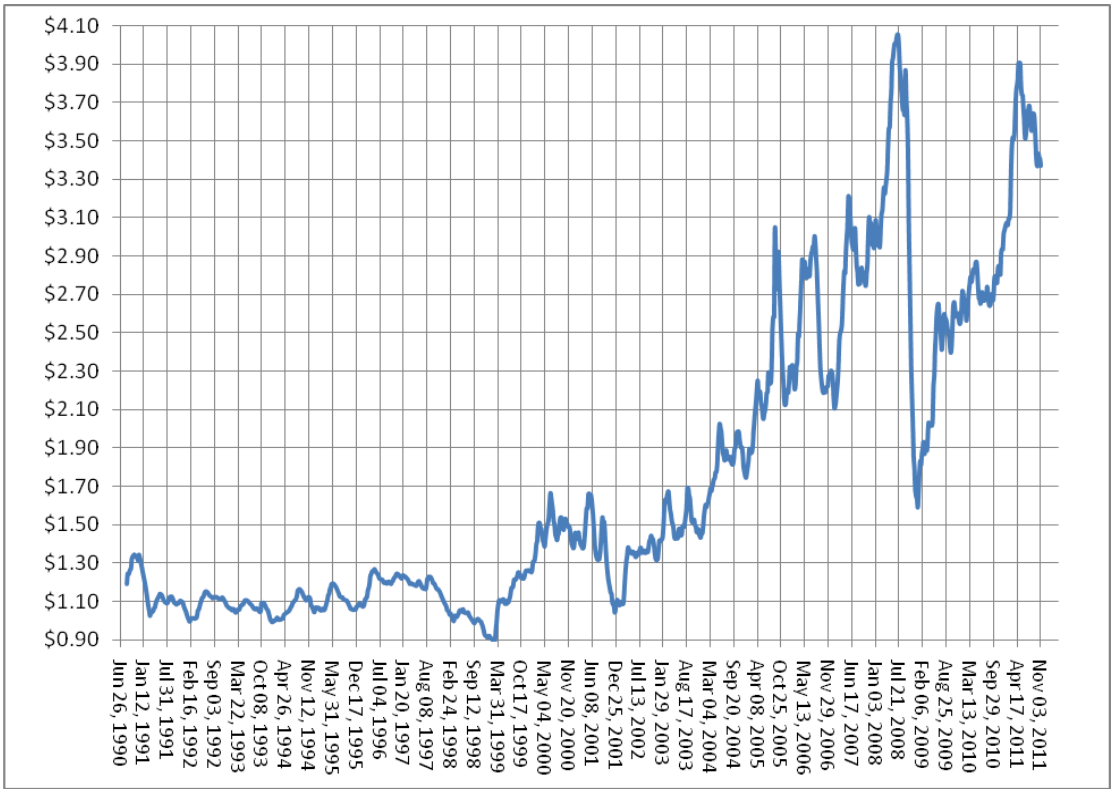


Figure 1: Historical of 21 years US Retailed Unlead

We decided to treat the cost of electricity used for the EV on a gasoline base. The government resource bases this on an observation that there is about 33.7 kW-Hr (115,000-BTU) of energy in a gallon of regular unleaded gasoline [18]. This amount of energy is also relevant to the horse power, Voltage-Amp, and efficiency rating of the electric motors for the respective EV. With the 33.7 kW-Hr per gallon conversion, the Nissan Leaf gets about $1.05 per 25 miles and the Mitubishi I-MiEV gets about $0.9 per 25 miles both on a $0.12 per kW-Hr rate.

We made an assumption that the growth of the gasoline prices would be the same for the electric prices. It should be noted that this was a much larger growth rate than the 21-year average growth rate for Oregon residential electricity rates which is about 3.19% [19].

Using a 13% growth rate for the price of electricity in our modeling is a pessimistic outlook. We decided that taking this approach was worthy since there are unknown factors that are associated with this new technology. And also there are potential negative impacts on the Electric distribution-transmission systems that could be passed on to the rate payers.

8. Battery

The battery replacement costs and up front warranties used for this project were determined by contacting the respective dealership service departments. The values ranged from $3,000 to $9,000 to as much as half of the car's value.

Today, for the Mitubishi I-MiEV the replacement cost for the battery is as much as half of the value of the car which is about $14,500. But, from observations of the hybrid trends from 2000-2011, we expect the cost of the EV batteries will be reduced to as much as a fifth of today's car price, approximately $6000 [20].

Execute & Measure Economic Analysis Methods

Annual Worth (AW) Analysis

The 5-year and 10-year useful life AW analysis:

Category	Combustion	Electric Vehicle	Hybrid	Diesel
Vehicle	Ford Fiesta	Mitsubishi MiEV	Toyota Prius	Volkswagen Jetta
AW (5-years)	7584.337534	11638.61116	9195.603701	10471.93481
AW (10-years)	7072.778096	8661.33404	7878.652886	9447.748291

Table 2: The 5 years and 10 years annual worth for all types of cars

The EV's AWs for the 5 and 10-years useful life bases are greater than the other alternatives. This is because the initial cost of the EV which includes the charge station cost as well, is much larger than the others; and the rate of fuel for our study horizon is not yet great enough at the base year to make enough difference. The combustion cars' AWs were found to be the lowest with this method. In addition, the EV and Hybrid cars have extra costs associated with the batteries such that the hybrid battery and the EV battery replacement costs can be considered major future repairs that we added into the AW.

Table 3 shows the AW percent change for a useful life of 5 to 10 years:

	Combustion	Electric Vehicle	Hybrid	Diesel
	Ford Fiesta	Mitsubishi I-MiEV	Toyota Prius	Volkswagen Jetta
AW % change from 5 year to 10 year	6.7%	25.6%	14.3%	9.7%

Table 3: The 5 years and 10 years annual worth percent change for all types of cars

The calculation is: Percent change = $\frac{AW_{5year} - AW_{10year}}{AW_{5year}}$

From table 3, we know the electric vehicle has the highest percent change. That is because the electric vehicle has the best fuel efficiency, as the mileage accumulates. For the same reason, because the combustion car has the lowest fuel efficiency, likewise, the combustion car has the lowest percent change. Furthermore, the EV appears to be a good alternative for an even longer term ownership than the 10 year period considered.

EUAC to determine the Useful Life

The Equivalent Uniform Annual Cost (EUAC) method is used to determine the useful life and also to compare the trends of annual cost for all types of cars. Since the car useful life is limited, we just do up to a 17 year EUAC analysis.

EUAC of k years	Ford Fiesta	Mitsubishi MiEV	Toyota Prius	Volkswagen Jetta
1	7745.64	12908.61	9917.85	10991.43
2	8538.96	14671.14	11137.00	12239.12
3	8183.37	13567.16	10442.95	11646.38
4	7787.05	12462.09	9671.12	10906.07
5	7584.33	11638.61	9195.60	10471.93
6	7370.48	10801.97	8706.46	10035.45
7	7178.89	9973.45	8605.51	10010.54
8	7081.35	9386.45	8269.18	9732.86
9	7052.99	8996.74	8029.82	9550.30
10	7072.77	8661.33	7878.65	9447.74
11	7135.00	8400.73	7777.96	9410.52
12	7227.48	8202.21	7723.51	9421.88
13	7344.43	8043.16	7706.08	9478.48
14	7487.43	7950.73	7719.14	9562.23
15	7650.85	7862.40	7757.96	9672.04
16	7843.40	7800.76	7819.02	9808.03
17	8042.00	7758.79	7899.71	9965.94
18	8259.75	7736.24	7998.02	10143.79
19	8492.82	7726.31	8112.42	10340.01
20	8740.85	7744.74	8241.72	10553.42

Table 4: Useful Life for four types cars

According to table 4, the best useful life of Ford Fiesta is the shortest (9 years) among all alternatives. Because the Mitsubishi MiEV (EV) is very energy efficiency, the EUAC of the EV has the longest useful life at about 19 years. So the EUAC analysis above indicates that the longer you utilize the EV, compared with the other alternatives, the more money you can save.

In addition, if the desired useful life is less than 15 years, the combustion vehicle has the most favorable EUAC such that the respective EUAC is smaller than other alternatives. But by the 16 year useful life case, the Mitsubishi I MiEV has the smallest EUAC among all alternatives.

The EUAC analysis here is based on the stated project assumptions and indicates that the Ford Fiesta is the best choice for the car owner with a 10 year useful life.

Incremental Analysis

We also conduct Incremental Analysis to compare the efficiencies for each type of cars. The useful life for all cars is 10 years and the MARR we use is 10%. Because the way we depreciate our cars, the savage values at the end of 10 years are zero. We first use Combustion car which has least initial capital cost as the basis to compare with the other cars. Then we make the second column use the Hybrid car's initial cost and annual expense minus Combustion car's. The result for Δ IRR is -3% and Δ PW is -$4,951.75 which means that the hybrid alternative is not economic justified. So we keep Combustion alternative as basis to go on and test the Diesel alternative. The results in table 5 show that this alternative is not acceptable, either. And actually, we can see that all the values in the third column are negative. This is the reason we cannot calculate the Δ IRR for this alternative. And the same conclusion can be drawn for the EV alternative. Although the Δ annual total expense is positive and it is growing very fast year by year, the Δ IRR and Δ PW are still negative. As a result, the EV alternative is not economic justified, either.

	Combustion	Hybrid-Com	Diesel-Com	EV-Com
Δ capital investment	-$14,500.00	-$9,020.00	-$9,100.00	-$20,625.00
Δ total expense 1	-$3,395.65	$533.79	-$515.78	$1,024.54
Δ total expense 2	-$3,611.61	$541.55	-$559.98	$1,051.67
Δ total expense 3	-$3,881.97	$687.06	-$731.19	$1,295.01
Δ total expense 4	-$4,256.05	$782.03	-$556.12	$875.50
Δ total expense 5	-$4,628.50	$976.41	-$500.63	$1,847.21
Δ total expense 6	-$5,015.58	$1,084.21	-$593.30	$2,057.61
Δ total expense 7	-$5,552.91	-$2,195.77	-$746.24	$2,611.29
Δ total expense 8	-$6,063.40	$1,304.08	-$771.64	$2,802.84
Δ total expense 9	-$6,696.26	$1,677.47	-$557.50	$2,601.84
Δ total expense 10	-$7,368.27	$1,747.71	-$547.63	$3,717.10
Δ market value	0	0	0	0
Δ IRR	N/A	-3%	#NUM!	-4%
Δ PW	($43,459.16)	($4,951.75)	($12,797.11)	($9,760.99)

Table 5: Incremental Analysis

As a conclusion, we can see, based on the current level of fuel prices (2011) and a 10 year research period, the regular combustion alternative is the most efficient choice for the costumer. But the calculation trend also shows that the EV is annual expense efficient compared to the Combustion car, if we conduct a further research based on a research period like 15 or 20 years, the EV will eventually exceed the Combustion car in efficiency of annual total cost.

Breakeven Cost Analysis

From the sensitivity analysis, the fuel cost is considered to have the greatest impacts on the economic efficiency of automobiles. So based on the varied fuel price, we conduct a Breakeven Analysis for each type of the cars to identify their fuel sensitivity. The range of fuel cost varies from 1 dollar to 10 dollars per gallon. And the information in table 6 is the EUAC of the best of each category with a 10-year useful life.

price of fuel	Ford Fiesta	Mitsubishi I-MiEV	Toyota Prius	Volkswagen Jetta
$1	4754.52762	7978.278096	6348.607572	6885.575033
$2	5642.066087	8239.784966	6934.38296	7720.703214
$3	6529.604554	8501.291835	7520.158349	8555.831394
$4	7417.143021	8762.798705	8105.933737	9390.959574
$5	8304.681488	9024.305575	8691.709125	10226.08775
$6	9192.219955	9285.812445	9277.484514	11061.21594
$7	10079.75842	9547.319314	9863.259902	11896.34412
$8	10967.29689	9808.826184	10449.03529	12731.4723
$9	11854.83536	10070.33305	11034.81068	13566.60048
$10	12742.37382	10331.83992	11620.58607	14401.72866

Table 6: Breakeven Analysis four types cars

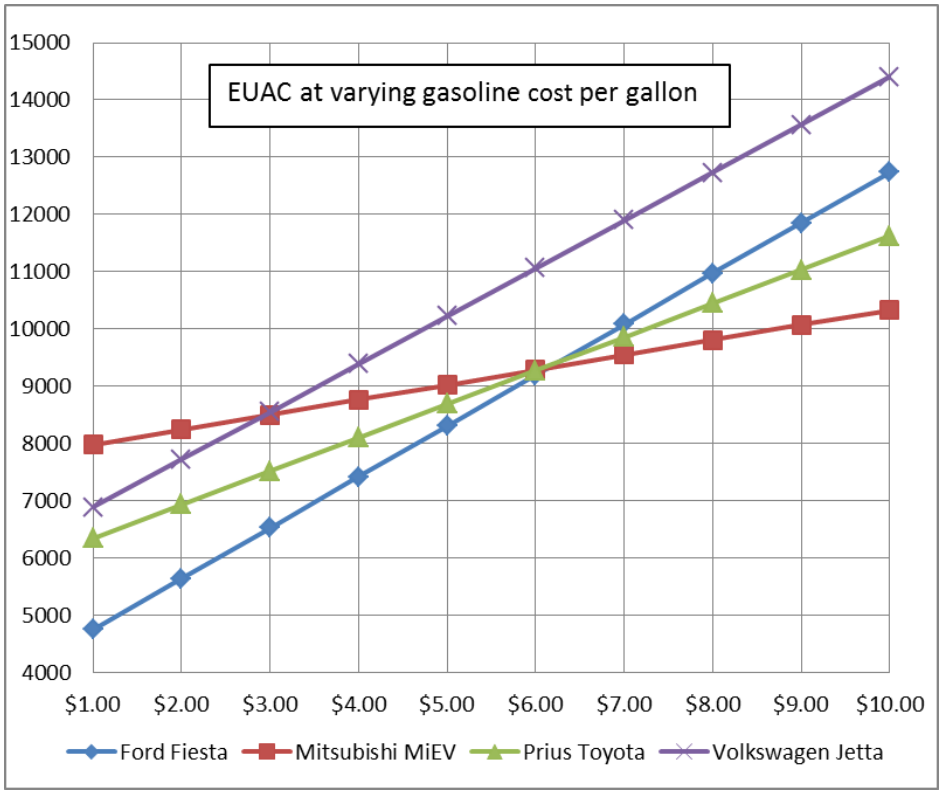


Figure 2: EUAC varying gasoline cost per gallon for all types of cars

Figure 2 shows that combustion and diesel cars are more sensitive to fuel price. Because the increase rate of gasoline and diesel price is almost the same, and also with similar maintenance schedules, the lines for diesel and combustion cars are parallel. The gap between two cars is due to the initial cost and fuel price difference between the two types.

For the combustion automobile, we can see that when the fuel price is lower than $6 per gallon, its annual cost is lower than the other cars. And when the fuel price is more than $6 per gallon, the EV, which has the best fuel efficiency, has a lower EUAC than the other cars. For diesel cars, if the diesel price is more than $3 per gallon, it will have the highest EUAC.

Also we can see that the combustion, EV and Hybrid cars have pretty similar Annual cost (around $9,200) at the point of 6 dollars per gallon. Interestingly, because the hybrid characteristic is to perform as a cross between an EV and a combustion car, it will have a similar value at the point where the EV and the combustion cars EUAC lines intersect.

Sensitivity Analysis

Ford Fiesta

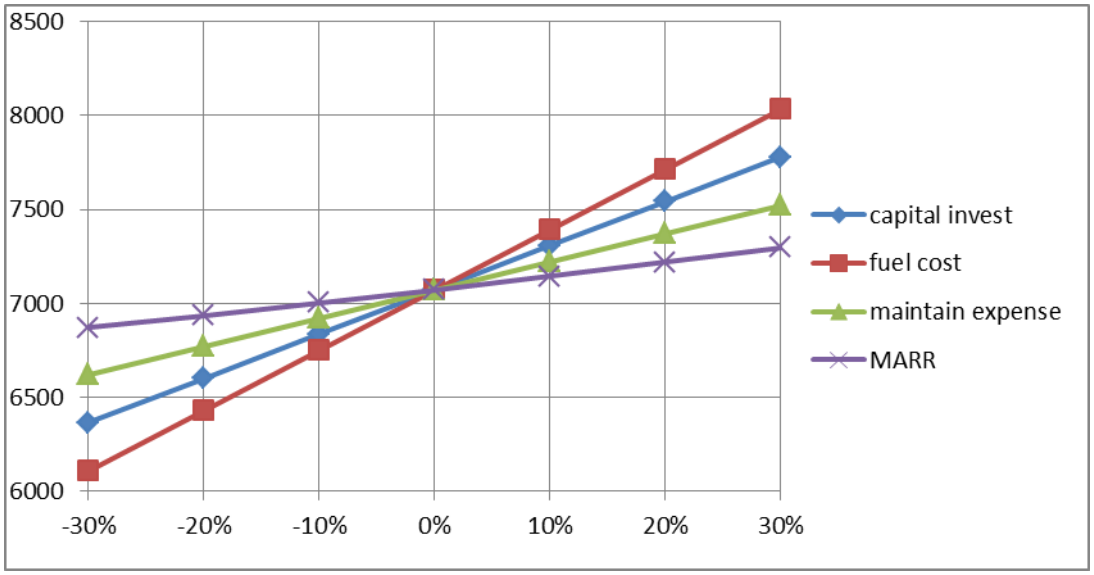


Figure 3: sensitivity analysis for Ford Fiesta

Figure 3 indicates that the regular combustion car is very sensitive to fuel costs. This means when the fuel price rises, this type of cost will impact combustion cars' annual cost heavily. Also for the combustion car, the next most heavily weighted factor to impact the annual cost is the capital investment cost and then the maintenance expenses.

Mitsubishi MiEV

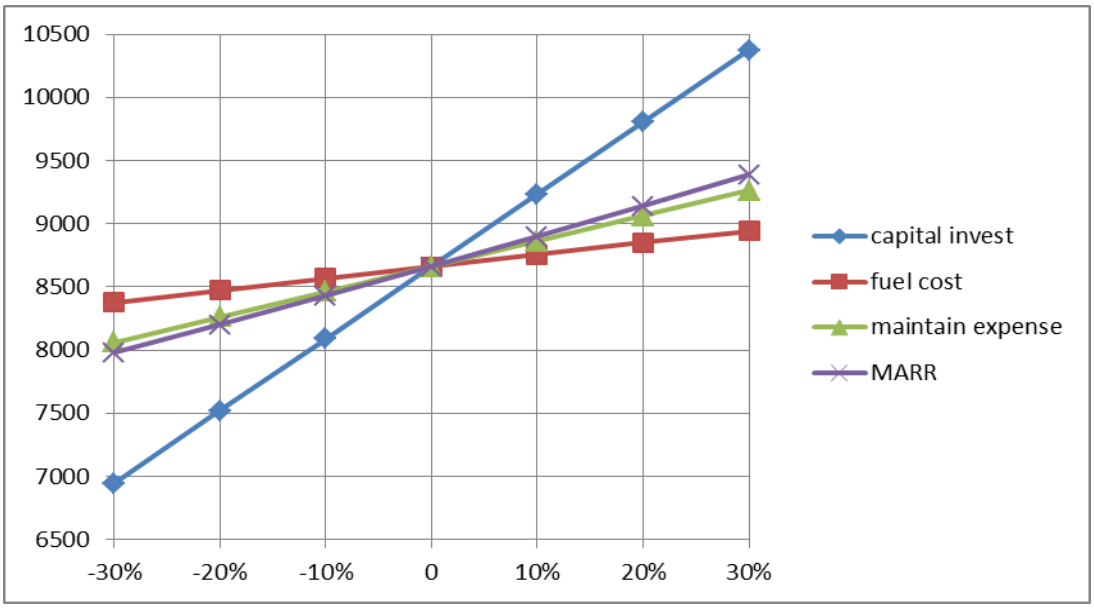


Figure 4: sensitivity analysis for Mitsubishi MiEV

Figure 4 indicates that EV is very sensitive to initial cost comparing to other costs, like capital investment, fuel cost and MARR. Like what we see in other analysis methods, the EV has the largest capital investment. And we can also see that, comparing to other cars, the EV has the lowest sensitivity to fuel cost. This is also a consistent conclusion with the other analysis methods results that EV is the most efficient in energy consumption.

Toyota Prius

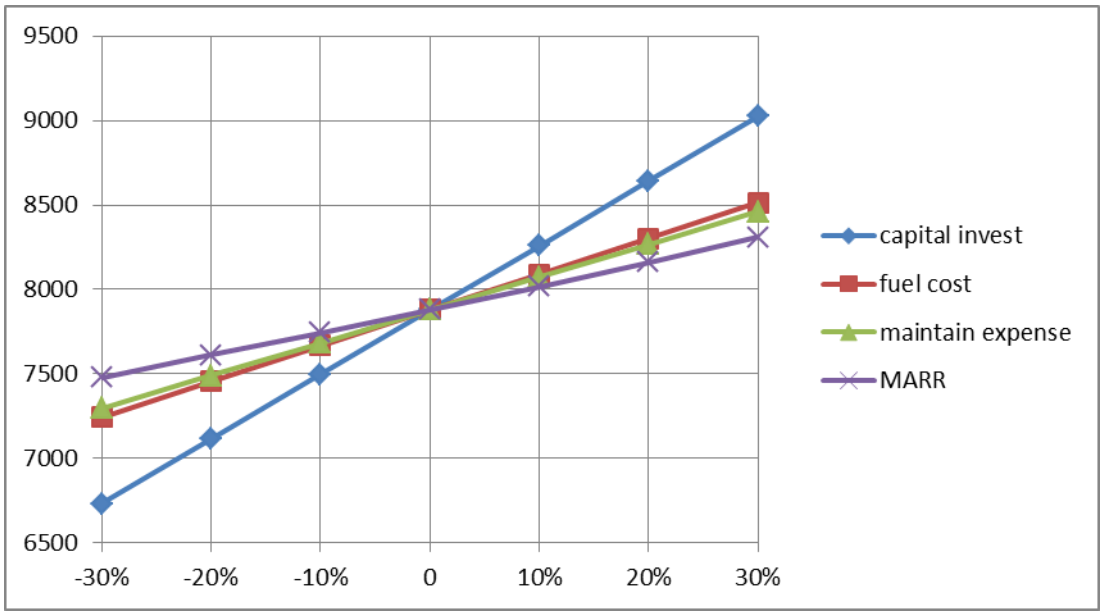


Figure 5: sensitivity analysis for Toyota Prius

Figure 5 show that hybrid car is sensitive to initial cost most, but not up to EV's level. And its sensitivity to fuel cost is lower than combustion cars, but much more sensitive than EV. In this way, we can see that the hybrid car is, as its definition, a moderate choice between combustion car and EV.

Volkswagen Jetta

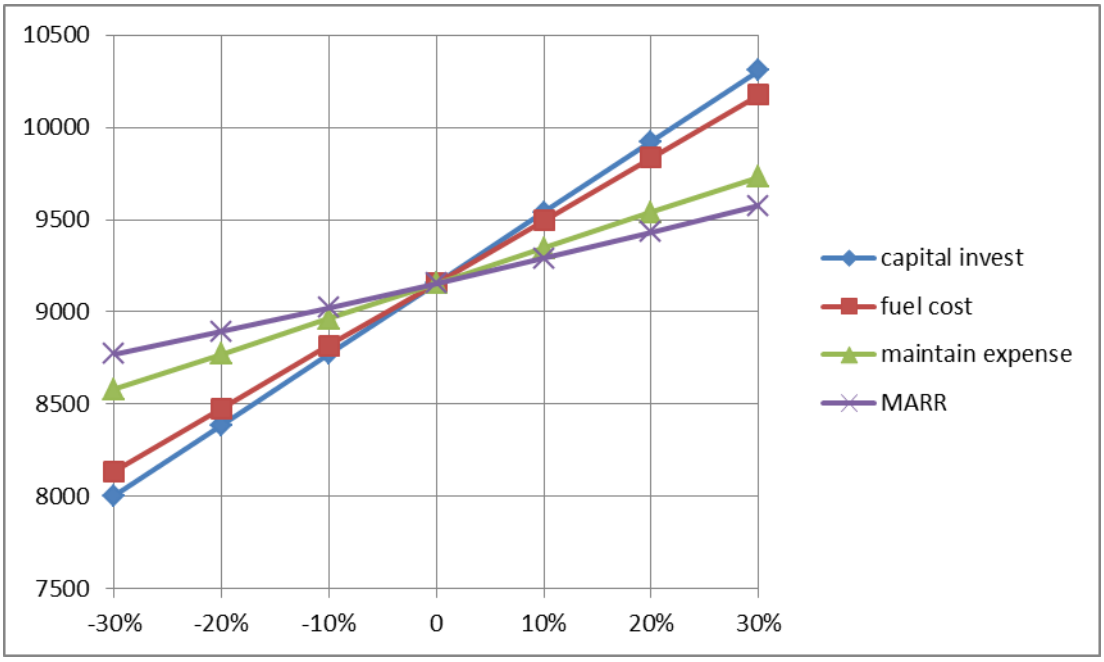


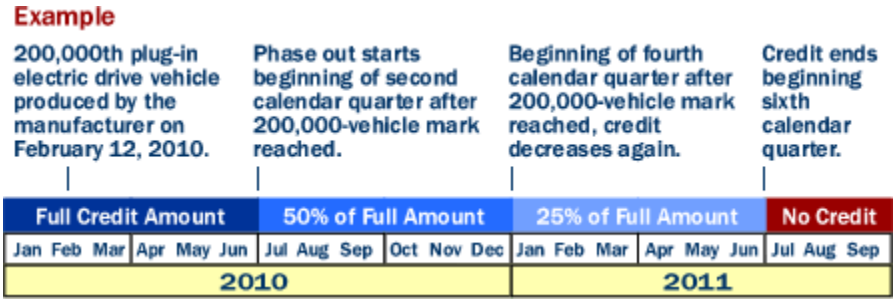
Figure 6: sensitivity analysis Volkswagen Jetta

And finally, for diesel car, it can be observed that it is sensitive to initial capital investments. This is because of its second largest initial cost among all the cars. And diesel car is also sensitive to fuel cost partly because the growth rates of regular gasoline and diesel are almost the same (both around 13% annually).

Conclusion

EV

The EV has the highest initial capital investment compared the other alternatives, and this is one of the major disadvantages to this alternative. There is a 2010 Federal Tax Credit which depending on the phase out production number and some other factors can be as much as $7,500. The basic structure is to begin a phase out after the 200,000th eligible EV is manufactured, and then there is a reduction of the credit that follows the example below [18]:



The EV is not as gasoline fuel sensitive as the other alternatives. However, if for some reason the cost of electricity increased more than was assumed, this would impact this conclusion.

Another point that makes the EV a less appealing alternative in the forefront of such a technology is that the single charge distance range can be as little as 60 miles. Also, a major disadvantage with the current battery technology is that after so many charge-discharge cycles, the range of the car is expected to be noticeably decreased[25].

Other EV inconveniences:

a. Due to the current technology, the design constraints have limited Passenger space.
b. Charging time durations can be a problem.
    - 22 hours for type 1 charge stations
    - 7 hours for type 2 charge stations
    - 30 minutes for a type 3 charge stations
c. Type 3 charging from a 3 phase 440 Volt station can degrade the life of batteries.

EV advantages:

a. Best Carbon Dioxide emission rating compared to the other alternatives.
b. Currently, most of the highway tax is paid at the pump so this would be a savings compared to the other alternatives.
c. If we add the $7,500 Federal tax credit with the Oregon state $750 tax credit, this will decrease the initial capital investment. Likewise, the 10 year EUAC will decrease greatly so that the breakeven point would improve from $6 to $4. The difference can be seen in the plot below:

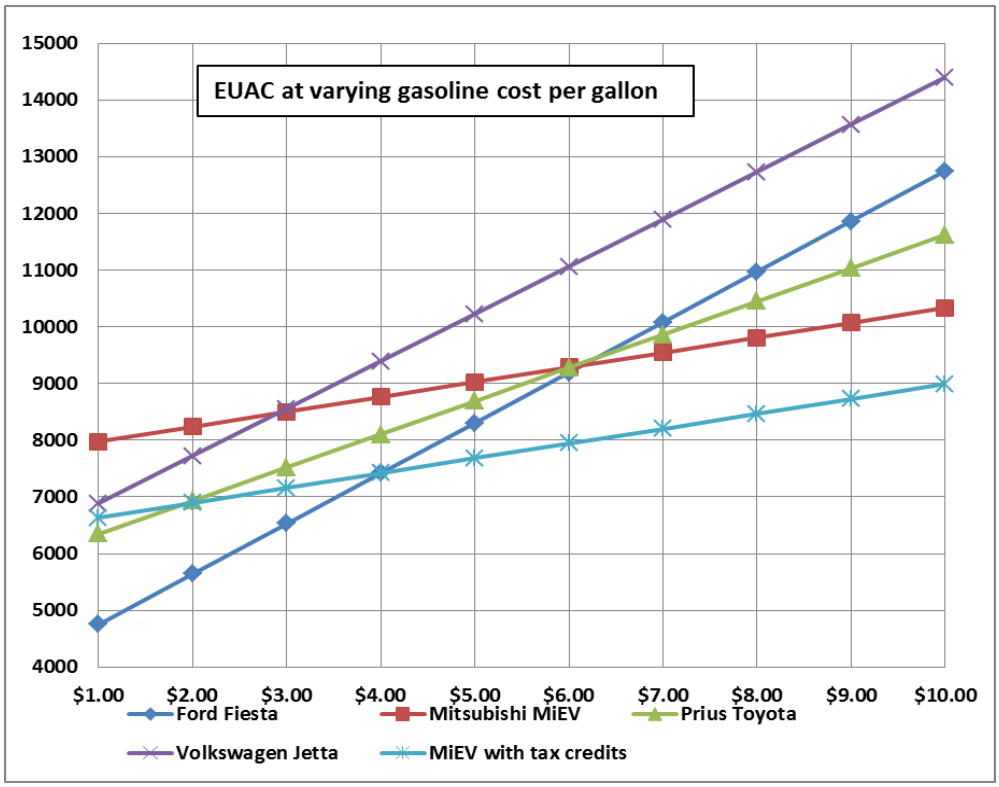


Figure 7: EUAC varying gasoline cost per gallon in four types of car

Diesel

The diesel car has second highest initial capital cost and fuel cost among all types of cars. This reduces the performance of diesel car in the calculation. The initial cost of this car is pretty similar to hybrid cars, which means also higher than combustion cars and lower than EV. And according to analysis, diesel cars are as sensitive in fuel cost as combustion cars.

Also, diesel vehicle requires less engine maintenance compare with conventional gasoline engines, because diesel engines do not have an ignition system so the consumers don't have to do the tune up. And also Diesel car has no sparking so that there is no spark plug or spark wire with fuel auto-ignites. This will lower the maintenance cost [21].

In addition, the fuel cost per kilowatt of diesel engines is thirty to fifty percent lower than the conventional gasoline engines [21].

There is also, a federal tax credit which list in Edmunds website can be applied for buyer of diesel car for the first time. According to this website, for purchasing Volkswagen Jetta Diesel 2010 before July 1, 2010, the customer will get a federal tax credit of $1300 [22].

Hybrid

Among all alternatives, the hybrid vehicle has the best range capability because the hybrid vehicle is more fuel efficient than the combustion and the diesel cars. Also, compared with the EV, even though the EV on the market can reach almost 100 MPG, its duration distance is about 60~90 miles per charge.

Also, the initial cost of the hybrid car is moderate among all alternatives, so that's why in the sensitivity analysis, the capital investment slope rate of hybrid car is moderate compared the other alternatives.

In addition, because the hybrid vehicle's fuel consumption rate is between the EV and the traditional car (combustion and diesel cars), the hybrid car's performances in the breakeven analysis will neither the best nor the worst.

And comparing to the EV's battery replacement cost ($10,000 ~ $15,000), hybrid car's replacement cost ($3000 ~ $4000) is much cheaper. Hybrid vehicle would be more economical if $3,400 federal tax credit (end in December 31, 2010) or $750 (end in January 1, 2010) state credit was available [23], [24].

Regular

Combustion cars are the most familiar type of automobile to our life. Instead something like EV, which is still at radical innovation stage and going on need further improvements, regular combustion car market has been a commodity one for a long time. Technologies and maintenance services are pretty mature. Many companies can offer a good performance product and reliable after-sell service and at the same time maintain an acceptable initial price. This is also why combustion car in the analysis has so much advantage in initial capital investment.

For costumers with this type of choice, the most concern usually is gasoline price. Comparing EV's impressive energy efficiency, fuel cost is always the big part of expense for combustion car. Even a slight increase of gasoline price could have heavy impacts on its annual expense. But as the fossil fuel reserves runs lower and lower, the gasoline price will eventually exceed what combustion car users can bear. As a result, combustion automobiles with its high fuel-price-sensitivity will be obsolete, instead by either EV or another type of energy efficient way of transportation.

Summary

After applying all these analysis methods, the determination is that based on a 10 years' time frame (2012-2022) and current 2011 fuel prices, that the regular combustion car (Ford Fiesta) is the most economic efficient one among all alternatives. But as the fuel price grows, eventually the gasoline price will reach 6 dollars per gallon sometime in the future. By then the EV (Mitubishi I-MiEV) instead of the combustion car will be the most efficient option. The Hybrid car (Toyota Prius) as its definition has a performance that is always in between the combustion car and the electric vehicle both by the meaning of initial capital cost and sensitivity of fuel cost. It could be a good option as a transitional product between these two types of cars while the EV range distance and time to recharge improve with technology improvement trends. Finally, the Diesel car (Volkswagen TDI Jetta) is moderate in initial cost as the hybrid car, but sensitive to fuel prices at the same level with the regular gasoline combustion car.

In the process of this research project, the different results indicate that the EV has great advantage in the long-term period. If we conduct more research on the time frame of 15 or 20 years, the results have great potential to change between the conventional combustion type vehicle and the EV.

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