The Prius$_{eqv}$ Proposal

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Introduction

U.S. automakers have tried but been unsuccessful over the last thirty years in developing new powertrain technologies that significantly improve miles per gallon (MPG) or reduce CO2 emissions. These unsuccessful technologies include fuel cell vehicles (FCVs), diesel hybrid technology (Partnership for a New Generation of Vehicles), Battery Electric Vehicles (BEVs), and Plug-in Hybrid Electric Vehicles (PHEVs). The only new technology that has improved MPG (and reduced CO_2 emissions) significantly has been the Hybrid Electric Vehicle (HEV), first developed in Japan in the late 1990s by Toyota (Prius) and Honda (Insight). The most successful HEV has been the Toyota Prius; 50% of hybrid shipments have been this single model. Most of the 38 different HEVs available or discontinued offer only marginally better MPG compared to their equivalent conventional models with the exception of Toyota and Honda. The fuel economy improvement for the best HEVs is in the range of 30-40%.

Rather than continue looking for some new future technical breakthrough, particularly through vehicle electrification via plug-in battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), the nation would be wise to commit to the HEV as the best alternative to conventional powertrains and do whatever it takes to make this the future standard powertrain technology for most cars. This powertrain technology can also be utilized in smaller lighter cars so as to couple the fuel economy improvement from the hybrid technology with fuel savings from “downsizing” our cars.

At the time of writing this in April, 2012, more and more media reports have begun to question the concept of the plug-in car, either pure battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV). [1] [2] [3] The technical reasons have been described in detail in other white papers on this site. The deliberate “hyping” of battery cars by the EPA and DOE using data that ignores the energy cost of making electricity when computing MPG has been described. The first year sales of plug-ins compared to HEVs have been disappointing. This is to some extent a repeat of the late 1990s and early 2000s when the success of the Prius and the Insight led to the demise of the first generation plug-ins such as the GM EV1.

MPG performance for cars has been increasing at the rate of 1-2% per year for many decades. Such improvements will continue, using mechanisms such as start-stop capability, smaller more efficient engines, turbo charging, lighter materials, and other technologies. But hybrid technology is a major change, a new powertrain architecture that provides a sizable “step function” from the normal historical improvement. It is a new higher base from which to improve MPG at the traditional rate. It behooves us to embrace the HEV technology and make it the standard powertrain for the near future.

HEV History – Shipments Update

In a previous white paper, I showed the U.S. hybrid shipment history from the initial deliveries in 1999 through the year 2010. [4] [5] Table 1 adds the 2011 sales of HEVs as well as the MPG for each car.[6]

HEV Electric Vehicle (HEV) Sales by Model								
Vehicle		**1999/**	**2003/**	**2005/**	**2007**	**2009/**		**Total**
		2002	**2004**	**2006**	**2008**	**2010**	**2011**	
Honda Insight-42mpg		10,747	1,783	1,388	0	41,534	15,549	71,001
Toyota Prius-50mpg		**41,237**	**78,591**	**214,868**	**339,795**	**280,610**	**136,463**	**1,091,564**
Honda Civic-44mpg		13,700	47,371	57,115	63,872	22,455	4,703	209,216
Ford Escape-32mpg			2,993	38,946	38,559	25,969	10,089	116,556
Toyota Highlndr.-28mpg				49,474	41,493	18,542	4,549	114,058
Lexus RX400/450-30mpg				42,619	34,814	30,357	10,723	118,513
Toyota Camry-41mpg				31,341	100,749	37,474	9,241	178,805
Nissan Altima-33mpg					17,207	16,067	3,236	36,510
Lexus LS600hL-20mpg					1,844	387	84	2,315
Chevy Tahoe-21mpg					3,745	4,726	519	8,990
GMC Yukon-21mpg					1,610	3,154	598	5,362
Cadillac Escalade-21mpg					801	3,168	819	4,788
Ford Fusion-39mpg						36,370	11,286	47,656
Lexus HS 250h-35mpg						17,362	2,864	20,226
Sierra/Silverado-21mpg						3,991	1,165	5,156
BMW ActiveHEV7-20mpg						102	338	440
BMW X6-18mpg						205	43	248
Ford Lincoln MKZ-39mpg						1,192	5,739	6,931
Honda CR-Z-35mpg						5,249	11,330	16,579
Mazda Tribute-32mpg						570	484	1,054
Mercedes S400-21mpg						801	309	1,110
Porsche Cayenne-21mpg						206	1,571	1,777
Buick Lacrosse-19mpg							1,801	1,801
Hyundai Sonata-37mpg							19,673	19,673
Lexus CT 200h-42mpg							14,381	14,381
Buick Regal-29mpg							123	123
Infinti M35h-29mpg							378	378
porsche pnamera-25mpg							52	52
Vw Toureg Hybrid-21mpg							390	390
Honda Accord-28mp			1,061	22,424	3,601	0	0	27,086
Mercury Mariner-27mp				4,172	6,051	2,583	0	12,806
Saturn Vue-26mp					7,323	2,706	0	10,029
Saturn Aura-27mp					1,057	581	0	1,638
Chevy Malibu-27mp					2,093	4,567	0	6,660
Chrysler Aspen-21mp					46	33	0	79
Dodge Durango-21mp						9	0	9
Mercury Milan-39mp						2,884	0	2,884
Mercedes ML450-22mp						627	1	628
Total		65,684	131,799	462,347	664,660	564,481	268,501	2,157,472

Table 1: U.S. Hybrid Sales 1999-2011

Fifty one percent of all hybrid cars sold in 2011 were Priuses. Toyota's total hybrid sales (all hybrid models including the Prius) garnered 66% of sales for 2011. Of the 38 models listed in Table 1, only five had a fuel economy above 40 MPG.

Status Report – Prius and Toyota in 2012

Yoshi Inaba, President of Toyota North America, spoke to the Economic Club of Chicago in February, 2012.[7] He announced that Toyota will launch 19 new or updated products this year under Toyota, Scion, and Lexus brands and that nearly half will be hybrids or electric vehicles. Inaba said that the company's current product line began a decade and a half ago when the Prius was introduced to the United States. At that time some people thought a car with both an electric motor and gas engine was a silly idea. Today hybrids are mainstream products; the company now offers nine different Toyota and Lexus hybrids. Recently the one millionth Prius in the U.S was sold and there are more than three million hybrid vehicles on the road worldwide. Inaba said that if one sees a hybrid car on the streets of a city like Chicago today, chances are one in two that it's a Prius and seven in ten that it's a Toyota or Lexus. He further noted that Toyota hybrids get about twice as many miles per gallon (MPG) as conventional cars.

Inaba then discussed some of the newest products including the Prius Plug-in, which is expected to achieve an estimated 95 MPGe in combined driving. He described the new Prius c as a small, sporty, fun-to-drive hybrid with the highest city miles per gallon (53 MPG) and the lowest price for any hybrid (less than $20,000). Two battery electric vehicles (BEVs) are to be added to the companies' product line, the first an all-electric version of the popular RAV4 and the second a Scion iQ EV, a micro car aimed at short-range urban driving and car-sharing programs.

Inaba emphasized that hybrids will remain the core technology powertrain for Toyota's future vehicles and that they can easily be adapted to other kinds of fuels. He noted that Toyota currently builds its Camry hybrid at its Georgetown, Kentucky factory and will build the Highlander SUV hybrid at its plant in Princeton, Indiana. He acknowledged that car companies are forming alliances and partnerships. Toyota forged an alliance with Tesla to rapidly bring to market the electric RAV4 and has teamed with Ford to develop hybrid systems for pick-ups and large SUVs. [8] He predicted more automotive alliances. Toyota and Ford had previously swapped patents on hybrid powertrains. [9]

In the same month, Toyota Group Vice President and General Manager Bob Carter, along with Prius c Chief Engineer Satoshi Ogiso and car expert Dave Lee of the University of Toyota [10] (a training school for Toyota employees) gave a series of talks on the Prius family including specific information on the new Prius c.[11] [12] Carter pointed out that 8,399 Prius v's were sold in the first ten weeks it was on the market, which was about the same as the number of Volts sold for all of 2011. He projected 220,000 sales of all Prius models in 2012, up from 136,000 in 2011. The mix is expected to be roughly 75% Liftbacks, the new brand name for the conventional Prius. Prius c and Prius v sales are estimated to be 33,000-44,000 (15-20% of sales). The Prius Plug-in sales are estimated at about 11,000, or around 5% of the mix.

Toyota has recovered from the Japanese earthquake and tidal wave that occurred on March 11, 2011. Their new hybrid announcements are impressive and their commitment to fuel saving hybrids remains strong. The company will also compete for PHEVs and BEVs business, but acknowledge that the powertrain of the future is the conventional hybrid. I believe that Toyota hybrid models will increasingly cut into the sales of plug-ins.

New Metrics for Plug-ins

More fuel economy information is now available from the experience of a full year (2011) of plug-in sales. There are three sources of this information, which I will cover in this section. First, some new information is available from the EPA fueleconomy.gov website, which is still not complete when it comes to MPGe (equivalent). Secondly, the EPA publishes a yearly summary of changes for light duty vehicles and the most recent one contains useful information. Finally, a recent lifecycle report from Carnegie Mellon provides a good summary of the economics of plug-ins compared to conventional and hybrid cars.

EPA fueleconomy.gov – The fueleconomy.gov website now includes an Energy and Environmental section, described in detail in my previous white paper "Reviewing EPA's Fueleconomy.gov Plug-In Emissions". [13] This website provides some limited capability to compare CO_2 emissions. The grams per mile for the Prius are 178, for the Leaf 239, and for the Volt 260. It would be useful if this functionality was made easier to use and more comprehensive in providing the information for all plug-in cars.

EPA Light-Duty Vehicle Trends – The EPA publishes a yearly summary of trends in technology, CO_2 emissions, and fuel economy. [14] The most recent report shows characteristics of seven model years of U.S. cars and light trucks which are detailed in Table 2. The Prius CO_2 emissions of 178 grams/mile are less than half of the 391 grams/mile of the 2011 U.S. car and light truck fleet. There was a significant reduction in the twelve year period from 1975 to 1987, a decrease in CO_2 emissions of 40%. In the twenty four year period from 1987 to 2011, CO_2 emissions declined only about 3.0%, showing the decreasing concern with fuel economy in recent decades.

Light Duty Vehicle Characteristics for Seven Model Years

	1975	1987	2004	2008	2009	2010	2011
Adjusted CO_2 Emissions (g/mi)	681	405	461	424	397	394	391
Adjusted Fuel Economy (MPG)	13.1	22.0	19.3	21.0	22.4	22.6	22.8

Table 2: MPG and CO_2 for U.S. Cars 1975-2011

Lifecycle Report – Table 3 summarizes a recent lifecycle analysis report that compares total costs to build and operate conventional vehicles (CV), hybrid electric vehicles (HEV), a PHEV with an electric only range of 20 kilometers, a PHEV with an electric only range of 60 kilometers, and a BEV with no range given.[15] A PHEV20 is equivalent to a car that can go 12.5 miles on a charge and a PHEV60 is equivalent to a car that can go 37.5 miles on a charge. The electric only range of the new Prius Plug-in is 11 miles and the electric only range of the Volt is 35 miles.

	CV	HEV	PHEV20	PHEV60	BEV
Base vehicle cost	23,019	24,800	25,666	25,729	20,497
Initial battery cost	0	2,068	2,632	8,730	31,953
Battery replacement cost	0	0	0	0	0
Gasoline cost	12,386	8,847	7,189	6,226	0
Electricity cost	0	0	788	2,314	5,282
Scheduled maint.	4,380	3,962	3,235	3,235	2,232
Charger/instl.	0	0	1,200	2,400	2,400
Net cost	39,786	39,677	40,709	48,635	62,364

Table 3: Cost Analysis for Different Powertrains

This table illustrates the very high costs of long range plug-ins and BEVs. Note that the Base Vehicle Cost (row 1) is relatively close for all models. As the battery increases in size, the Initial Battery Cost (row 2) increases. For the BEV in this example, the battery cost is half the total car cost. It is this factor that calls into question the viability of high range cars like the PHEV60 and the BEV. The better options are the HEV and a small improvement like the PHEV20 that adds a relatively small cost.

Embodied Energy Considerations

Some believe that a new high MPG car purchase should be avoided because it will take many years of driving it to save enough energy to make up for the energy expended in its manufacture. But the fact of the matter is that new cars are made and bought every year. Since much more efficient ones can be made, that is what we should focus on. Most older cars, even ones made a short time ago, are energy inefficient. Thus if one chooses to keep inefficient cars on the basis that they are saving the making of a new car, then one is choosing to maintain the existing unsustainable rate of CO_2 generation. The idea is economically and ecologically unsound.

It would help if consumers became aware of Lifecycle Assessment (LCA) or Lifecycle Energy Consumption. The EPA defines lifecycle assessment[16] as follows:

> Lifecycle assessment is a “cradle-to-grave” approach for assessing industrial systems. “Cradle-to-grave” begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. LCA evaluates all stages of a product’s life from the perspective that they are interdependent, meaning that one operation leads to the next. LCA enables the estimation of the cumulative environmental impacts resulting from all stages in the product lifecycle, often including impacts not considered in more traditional analyses (e.g., raw material extraction, material transportation, ultimate product disposal, etc.). By including the impacts throughout the product lifecycle, LCA provides a comprehensive view of the environmental aspects of the product or process and a more accurate picture of the true environmental trade-offs in product and process selection.

The most important thing about LCA in the case of cars is that it covers both the amount of energy required to build a car and the amount of energy required to operate the car. Figure 1 shows that 85% of the energy consumed over the lifetime of a car is for the gasoline or diesel fuel that is consumed.[17]

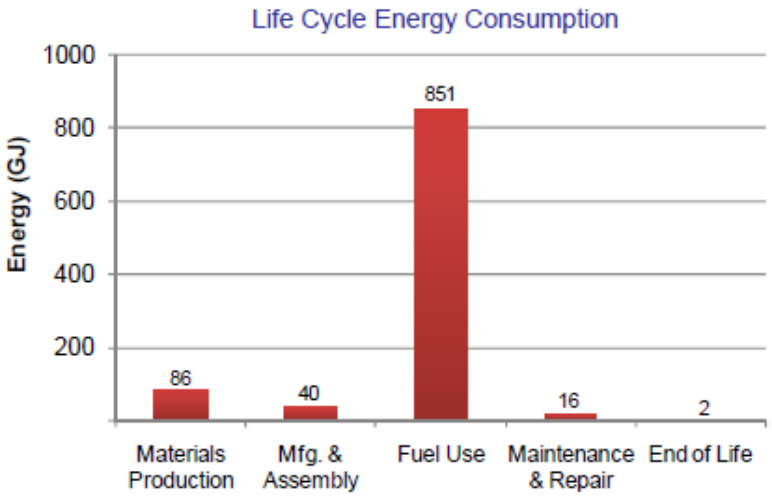

Figure 1: Lifecycle Energy Analysis for Cars

As cars become more efficient, the percentage distribution of manufacturing energy (embodied energy) and operating energy changes. The more fuel economical the car the higher the percentage of total energy used to build the car. Nonetheless, the total energy used decreases over its lifetime.

It is also important to consider the changes in consumer behavior relative to how long they keep a car. Figure 2 shows that the number of months new and used buyers keep their cars has increased over the years. [18]

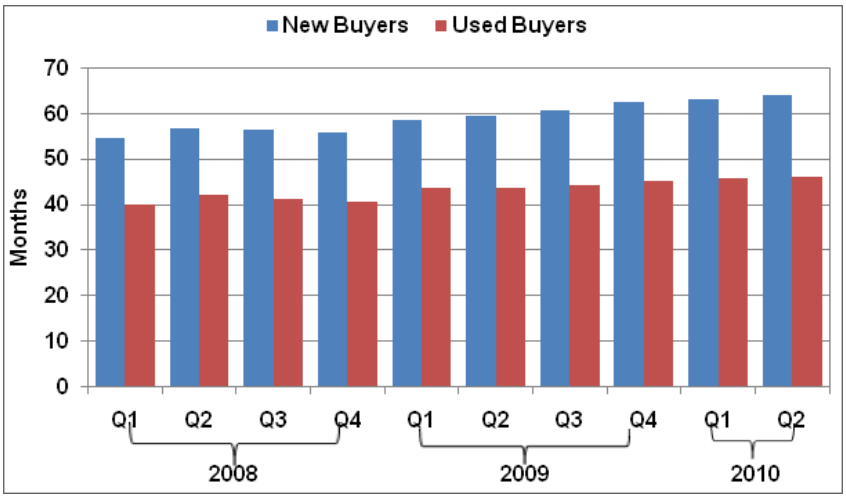

Figure 2: Average Length of Vehicle Ownership by Quarter 2008-2010

The length of time a consumer keeps a new vehicle has increased each quarter since 2008 to an average of 64 months in the 2nd quarter of 2010, a little over 5 years. For

used vehicles, the average length is 46 months. The most recent data suggests that new cars are kept 71.4 months and used cars 49.9 months. [19]

A Moment of Insight

The main obstacles to major change are cultural. The consumer paradigm underlying our society is focused on bigger, faster, and more wasteful products with continuous unnecessary style and fashion changes. Today our cultural values of success are measured by how much we consume, not the energy we use and the CO_2 we emit.

But I am writing from a different perspective, one that says we must curtail our energy use drastically. And it has become clear to me that the Prius HEV technology currently offers the best approach to energy reduction for personal transportation. So starting some kind of Prius movement makes good sense from an economical, ecological, and ethical point of view.

My wife and I have been committed to driving fuel efficient high MPG cars for many decades. We initially bought a Volkswagen Squareback, and later purchased a Honda Civic Hatchback with a fuel economy rating of about 40 MPG.[20] [21] In 2004 we bought a used 2001 Honda Insight with automatic transmission which got 48 MPG. (Stick shift Insights can get more than 60 MPG.) This was the original two seat version made from 1999 to 2006. In 2006 we bought a used Toyota 2001 Prius (42 MPG). And in 2008 we traded in the Honda Insight for a 2006 version. Our current combined MPG average for our two cars is about 45 MPG, about twice the national average. In addition our average yearly miles driven is much less than the national average. Our current plan is to buy a new Prius c sometime in 2012, hoping for 53 MPG since our driving is mostly city.

In the fall of 2010, our friend Eric Johnson, editor of our popular 2006 film *"The Power of Community - How Cuba Survived Peak Oil"*, was looking for a way to further reduce his CO_2 emissions. Both of us were members of the Yellow Springs Energy Board at that time and both of us had previously made major changes to our homes to reduce energy consumption. Eric's effort included installing new triple pane windows, doing extensive air sealing and adding more insulation to his attic and basement. He was evaluating a ground source heat pump when I suggested he consider buying a Prius instead. I made this suggestion after reading a Kiplinger magazine article[22] that compared several very different modes of saving energy including the Prius, fluorescent light bulbs, and other dissimilar products. After considering the article, Eric bought a 2011 Prius rather than make more home energy improvements. He concluded he had reached the "point of diminishing returns" in CO_2 reducing changes to his home.

In the spring of 2011, I was interviewed by several radio shows concerning the Federal Trade Commission's (FTC) proposal for new Green Guides.[23] Their Green Guides were first issued in 1992 to ensure that the claims of so called green marketers were true and substantiated. They were revised in 1996 and 1998. The FTC was proposing more stringent rules for such claims to offset the "green washing" that has become popular. The purpose of the series of interviews was to discuss green products, green washing and how to be much more effective in reducing CO_2 emissions. On a radio show in Boulder, Colorado, the interviewer, who had apparently devoured all the information on my organization's website (communitysolution.org), said "I have read all the information and I understand it. Tell me what to do next." I asked her what kind of car she drove and

its' MPG. Her current car was a Japanese model with gas mileage of around 26 MPG. I suggested she buy a Prius and made the case, pointing out she would probably still be driving a car in 14 years, the average lifespan of a car. I emphasized that if she was an average driver in terms of miles driven yearly, then she would be spending far less for gasoline and reducing her CO_2 generation from travel to the lowest level possible. The point for both Eric and the interviewer in Boulder was to look past the conventional view of financial benefit or payback time to the societal need to cut energy emissions deeply and rapidly. These cuts have to be significant.

Going after the "low hanging fruit", such as changing light bulbs, is a small step and not very effective unless done rapidly on a nationwide basis. It is necessary to go for a deep cut to make fundamental energy reducing changes. Our cars are a clear target. We tend to philosophize about bicycles or mass transit but progress has been very slow in these two areas with no fundamental change in sight. A change in cars can be made immediately and can dramatically reduce CO_2 emissions.

My "moment of insight" was that the cars we need are already here and available. Unfortunately, there are only a handful of high MPG hybrids on the market. Most of the thirty or so that were marketed in 2011 are not much better than conventional cars.[24] Many of these others can be viewed as "placeholders" until their manufacturers get more serious about fuel economy. But the environment cannot continue to wait for new kinds of car technologies, such as PHEVs. Nor can it wait for automakers to gradually add token MPG hybrid models until it is convenient for them to build high MPG versions. We need to commit to high MPG cars now using technology that is reliable and available such as the Prius.

Selecting a Prius may require moving away culturally from excessive speed, excessive size, and a love of style and fashion (sex appeal). It is a commitment to a rigorous reduction in CO_2 generation. We must also take the physical risk of driving a smaller HEV in a road environment dominated by SUVs and large cars. For those with strong societal and ecological commitments, the Prius technology solution is a "no-brainer".

The $Prius_{eqv}$ Proposal

I have previously shown that the Toyota Prius is far and away the best car for reducing CO_2 emissions. [25] Thus it is the most ecologically sound car available. It is also the most economical car that can be purchased in terms of total costs. Out of the 300 cars currently being marketed in the U.S., it typically takes first or second place in both categories each year. It is a midsize car, not full size and not an SUV. If every car was replaced overnight with a Prius, automobile CO_2 emissions would be reduced almost 60% and the average consumer would save on their gasoline bills as shown in Table 3.

It is hard to compare the Prius to a standard car since it is a unique brand name and there is no conventional version of the Prius. So I will use the 2012 Camry Hybrid and 2012 Camry Conventional Vehicle, which respectively get 41 MPG and 28 MPG, for comparison. The Camry Hybrid gets 40% more miles from a gallon of gas on the same frame and engine size. This is a remarkable number. I know of no change in the last fifty years that provided such a sizable jump in performance. Thus it represents the best MPG improvement over any recent change in automobile technology.

The $Prius_{eqv}$ Proposal assumes that a very large number of people, numbering in the tens of millions, might be willing to standardize on a particular powertrain – the Toyota Hybrid Synergy Drive (HSD) as well as its future derivatives. Current derivatives include versions of the HSD used in the Prius v (first shipped in 2011), the Lexus CT200h (first shipped in 2011), the Prius c (city) small car (first shipped in March 2012), and the 2012 version of the Toyota Camry. If every new car purchased from now on utilized a HSD powertrain, the nation's fuel costs and CO_2 emissions for car transport could be cut by more than half within the current average lifespan of 14 years for cars. When Americans concerned with climate change eventually understand this, many will forego the comfort and convenience (as well as the cost and CO_2 emissions) of a larger car for the guarantee of a CO_2 reducing midsize car.

This proposal does not mean the car must be an actual Prius or a member of the Prii (plural of Prius) family, although that will typically be the case. As noted, the HSD is also used in the Lexus and Camry brands. The proposal would include other manufacturers who are using the HSD such as Mazda, who is buying HSD components from Toyota to be used in a forthcoming HEV. [26] [27] In the past, Nissan has used the HSD drive. However, for its future cars it will use an in house hybrid powertrain.[28] The $Prius_{eqv}$ Proposal suggests a MPG level to which many people will commit that is close to 50 MPG and under no circumstances less than the mid-40 MPG. Of the thirty eight HEV models that have been sold in the U.S., there are currently only four that fit this requirement – Prius, Lexus CT 200h, Civic, and Insight.[29]

Ford Motor Company might soon have a model that would fit the category of $Prius_{eqv}$. Note that Ford is third in terms of total historical hybrid sales, 183,000 units compared to Honda's 324,000 units and Toyota's 1,540,000 units (see Table 1). As recent as 2000, Ford had ten patents that it classified as hybrid technology. By 2002 Ford had approximately 30 hybrid patents. Today Ford has nearly 500 hybrid patents, many used in its forthcoming new Fusion Hybrid[30] which is anticipated to deliver 47 MPG city and 44 MPG highway.[31] And its 2012 Lincoln MKZ hybrid almost makes the 40+ MPG range, currently getting 39 MPG.

HEVs, while far ahead of PHEVs and BEVs, have not penetrated deeply into the car and light truck market. Total U.S. hybrid sales over the lifetime of the technology from 1999 to 2011 were 2.2 million vehicles (see Table 1). During this same period of time, 199 million cars and light trucks were shipped.[32] Thus in this twelve year period, hybrids captured 1% of the market. In 2011 total car sales were 12.7 million units compared to 233,000 hybrids, giving the hybrids about 2% of the market that year. Concern with climate change is still not enough to make a very big effect on hybrid sales.

New perspectives on transportation are needed when one considers a $Prius_{eqv}$ paradigm shift. The main qualification is to understand that the private car as we know it – large, expensive, stylish, fast, etc. – cannot continue to be the basis of personal transportation. The $Prius_{eqv}$ Proposal is simple and profound. It suggests buying a car based primarily on its MPG rating with secondary advantages being resale value and repair record. This implies that little value will be given to power, size, comfort, style and prestige. Prius People, as I call those who adopt this proposal, realize that the consumption of transportation energy must be radically curtailed. They are not able at this point to see a way to do without the car. Bicycles appear very dangerous for U.S. riders and mass transit is a concept that has been talked about for half a century and one that may take another half a century to develop. A Prius person accepts the fact that he or she will

have to drive a few more decades and wants to minimize the damage they do while driving. A Prius person simply acknowledges that the car is a destructive device but they do not yet know how to totally dispense with it. A Prius purchase is a step in the right direction moving from fashion to function.

Buying a New $Prius_{eqv}$ – An Ethical Choice

How can society get tens of millions of Prius HEVs on the road rapidly? The obvious answer is for tens of millions of people to buy one. There is no question that the Prius family include the most economical and ecological cars available. Changing the existing consumer paradigm requires a change in consciousness from personal gratification to long term human survival. Thus a Prius may also be the most ethical car one could drive.

The famous Triple Bottom Line[33] of the sustainability movement based originally on the report of the 1987 Brundtland Commission has for some time been divided into Economic Prosperity, Environmental Stewardship, and Social Equity. This division has been shortened to Economy, Environment, and Equity and in another form, the 3Ps – Profit, Planet, and People (profit for economy, planet for environment, and people for equity) as shown in Figure 3.

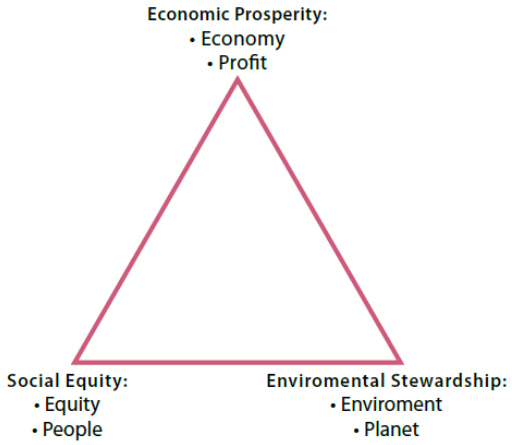

Figure 3: Triple Bottom Line [34]

Somehow in this definition and even in its placement on the triangle, Economic Prosperity takes precedence with some token recognition of the environment and even less recognition of people and social equity. In practice this perspective is more focused on corporations than on people. The P for profit is not referring to profit for people but profit for automakers. In general, profit is not a term used by most people to describe the nature or goals of human beings. Most people do not prepare a profit and loss statement annually. In a personal vein, relative to the term profit, there is the familiar religious statement “What doth it profit a man if he gains the whole world, and suffers the loss of his own soul?"[35] One might paraphrase this today to be “What doth it profit a man if he gain the wealth of the whole world, and suffer the loss of the physical world?"

Another perspective is to determine what is most economical for people rather than for automakers. For automobile companies, larger cars and SUVs provide the most profit over midsized, compact or sub compact cars. They are marketed as having the most "sex appeal". But the resulting negative environmental effect injures the planet and all the people. Thus the first P (profit) is at conflict with the second and third.

The P for planet (environmental or ecological) can be greatly simplified to CO_2 generated. This is a simple measure for society at large, including cars and buildings. The social equity or the people component can best be served by removing larger cars and SUVs, banning many cars that don't get high MPG and moving the focus from cost savings to ethical issues. The question is not comfort or payback but the moral question of what each driver is doing to the future of our children and grandchildren. I suggest a reordering to ethical, ecological and economical. The most ethical thing to do is to drive cars that have little environmental and personal effect. Ecologically, this means that the car generates the minimal amount of CO_2.

In this way the moral issue and the issue of Prius People may be the "precautionary principle". This principle states that if an action or policy has a suspected risk of causing harm to the public or to the environment the burden of proof that it is *not* harmful falls on those taking the action. This is needed even in the absence of scientific consensus that the action or policy is harmful.

Conclusion – Buy a Prius – Now!

The unrestricted growth in the car population in the rest of the world, particularly China, may well lead to climate calamity. But that is not an excuse to avoid action. Action is needed now, not later, and we can't wait for someone else or some other country to lead. Saving the climate is a good reason for buying a new Prius, which is to bring into the world a 50 MPG car to replace a 23 MPG car. The more midsize Prii that are purchased, the fewer SUVs and large cars will be made. Over some period of time the car fleet as a whole will increase its MPG rating. Whether the Prius purchase causes the scrapping of an older gas guzzler is immaterial – we can only choose the cars we drive and not worry about what happens to our previous car when it enters the resale market. It is important to note that a new Prius will eventually go into the used car market. The reason for buying a new Prius is to reduce one's personal CO_2 emissions. If your used car was one with relatively high MPG, then the byproduct is that a used car that gets good mileage is now available.

Begin by assuming most people will be drivers for a long time, maybe from the ages of 16 to 76, possibly a 60 year period. We can also assume in the beginning that younger people drive used cars and older people can afford new cars. But the choice is made each time one buys a car.

When we consider the instability of the climate, our concerns should be major. Many of the early people who bought the Prius were environmentalists and purchased the cars for that reason, taking on the risks of early adopters. As hybrid sales increase, it shows that more and more people are making a climate choice. Media often criticize the Prius as a rich yuppie car. But per mile costs are very low and the justification for purchase can be either for climate reasons or economic ones.

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