Challenging Vehicle Electrification and Plug-In Cars

By Pat Murphy

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Contents

Introduction

When I began seriously studying and writing about Peak Oil in 2003, I expected humanity would experience major difficulties and inconveniences, but there was little doubt in my mind that a change to a lower energy way of life was possible. However, Al Gore's 2006 film "An Inconvenient Truth" and the 2007 Fourth Assessment Report by the Intergovernmental Panel on Climate Change changed my mind – energy and emissions problems were more serious than I had realized. In January, 2011 the International Energy Agency (IEA) said that hopes for capping emissions were fading fast.[1] And in September 2011,[2] it was reported that global CO_2 emissions for 2010 had increased by more than 5 percent from 2009, an increase unprecedented in the last two decades. Global emissions of CO_2 have increased by 45 percent between 1990 and 2010 and reached an all-time high of 33 billion metric tons in that year. On October 19, 2011 the IEA stated that the world is heading for a "dire future".[3]

As the ecological and environmental situation continues to deteriorate "green" solutions abound from marketers more concerned with maintaining the status quo than undertaking fundamental change. In recent years, the battery electric vehicle (BEV) and pluggable hybrid electric vehicle (PHEV) have been offered as breakthrough "green" technologies that will encourage the additions of hundreds of millions more private cars to the rapidly growing global automotive fleet. The enthusiasm for this "electrification of transportation" is based principally on highly misleading MPG (MPG) claims by government leaders and large corporations. In 2008 President Obama committed the United States to building one million PHEVs, averaging 150 miles per gallon (MPG), by 2015.[4] In August 2009 Fritz Henderson, president of General Motors (GM), at that time the largest auto manufacturer in the world, announced a more optimistic claim for the Chevrolet Volt PHEV: 230 MPG![5] (Figure 1 shows the GM logo that accompanied the announcement). Not to be outdone, Nissan quickly announced that its new Leaf BEV would get 367 MPG. All three statements were blatantly misleading and false. Now that a few versions of plug-in cars are available, including the Volt and the Leaf, new MPG numbers are less than 100 MPG. Unfortunately, these new numbers are also questionable and it is becoming more apparent that most such cars will be in the 30-40 MPG range, slightly lower than hybrid vehicles such as the Prius.

Figure 1: GM Volt Logo for with MPG claim

I am not against automobile developments that will reduce CO_2 emissions and oil consumption. I own examples of such technologies--a 2001 Toyota Prius and a 2006 Honda Insight. But the extremely optimistic claims made for BEVs and PHEVs imply revolutionary breakthroughs that will dramatically reduce oil consumption and CO_2 generation. These false claims allow the continuation of the dream of a car (or two or three) in every garage in every household in the world. This dream has played and continues to play a significant role in the endangerment of human life on earth. Governments support the dream because in industrialized countries the private car is essential to continued economic growth.

We cannot continue to ignore the fact that improvements in MPG are less than the growth in car population and increasing annual vehicle miles traveled (VMT). Figure 2 illustrates the principle that continued growth of the car population and miles traveled yearly are outstripping the MPG improvements. Although fuel use is not growing as fast as the number of cars, nonetheless, it is still increasing. Only a reduction in total petroleum consumption can help to mitigate climate change.

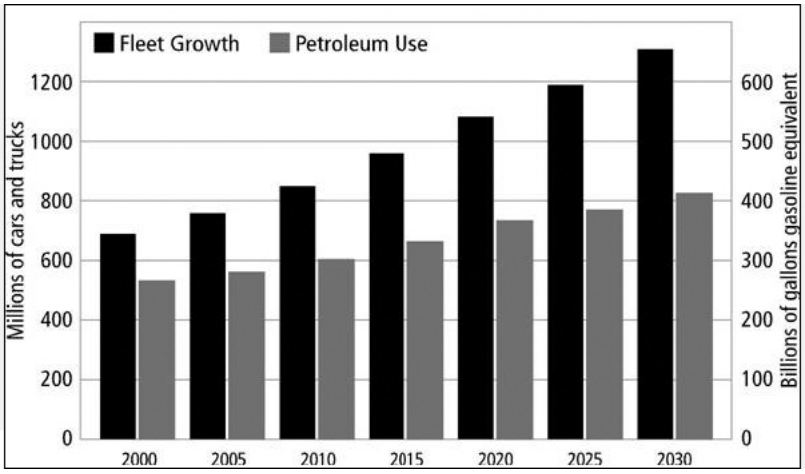

Figure 2: Number of Cars/Trucks vs. Petroleum Consumption

Electrification of Transport

An electric car represents essentially a shift from burning petroleum as gasoline or diesel in a vehicle to burning coal, natural gas, and uranium in a power plant, from which electricity is sent through the electric power grids to charge the electric vehicle's battery. CO_2 and other pollutants from fossil fuel consumption will still be generated, not from the hundreds of millions of cars as is done now, but from the tens of thousands of power plants, most of which burn coal. Furthermore, electrification of transport will not reduce CO_2 emissions 80 to 90 percent by 2050, as called for by most major governments and the International Energy Administration (IEA). Proponents of electric cars suggest alternatives such as the capture and burial of power plant CO_2 emissions or generating electricity from wind turbines and solar photovoltaics (PV). But I am not convinced that

burying CO_2 is technically feasible, given the enormous volumes, the rudimentary state of the technology and the threat to future generations. Although such claims may be achievable in the far future, the risk is great. Electricity from wind and PVs is growing rapidly but is still expensive and may not be able to provide the electricity for hundreds of millions of battery cars in the foreseeable future.

For decades, U.S. car companies, in collaboration with the U.S. government, have proposed radical technologies to replace the gasoline car. In 1970 President Nixon said, "I am inaugurating a program to marshal both government and private research with the goal of producing an unconventionally powered virtually pollution free automobile within five years." [6] When launching Project Independence three years later he noted, "Let this be our national goal: At the end of this decade, in the year 1980, the U. S. will not be dependent on any other country for the energy we need to provide our jobs, to heat our homes, and to keep our transportation moving."[7] Needless to say, none of these lofty goals were achieved.

Since then, car companies and government agencies have tried one new technology after the other, beginning with the fuel cell car, [8] followed by the Zero Emissions Vehicle (ZEV) electric car efforts in California in the late 1990s, then the Program for a New Generation of Vehicles (PNGV) diesel hybrid program of the Clinton administration, returning to the fuel cell concept under the George Bush administration, and now focused on a PHEV, a "poster child of the Obama administration. Several other papers on this website explore that checkered unprofitable past and suggest that a "clean" electric private car is yet to be shown as feasible if the goal is to reduce CO_2 emissions.

The World Auto Industry – Trends in Growth and MPG

Figure 3 shows the enormous growth of the car population from 1930 to the present, as well as projections to 2020. The figure shows that in 1960 the increase in the growth of the car population accelerated. If the world meets the current U.S. rate of a little less than one car per person, eventually there will be seven billion automobiles in use—about seven times the current number.

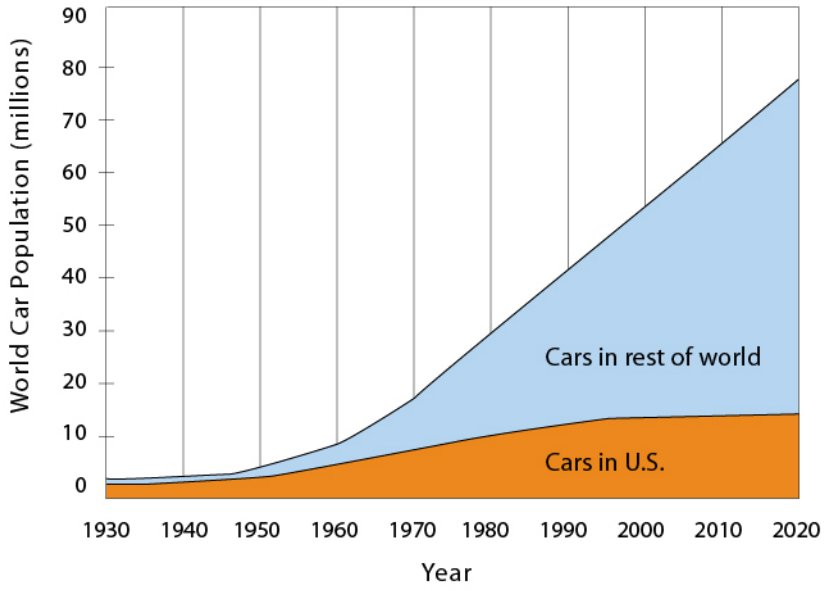

Figure 3: Growth in World Car Population 1930–2020

Figure 4 shows the rapid growth in world annual automobile production, increasing from eight million cars in 1950 to a new record of 74.7 million vehicles in 2010, including 54.9 million passenger cars and 19.8 million light trucks, a designation which includes the popular SUV. This is a 3.5 percent increase over the 72.2 million passenger vehicles produced in 2009.

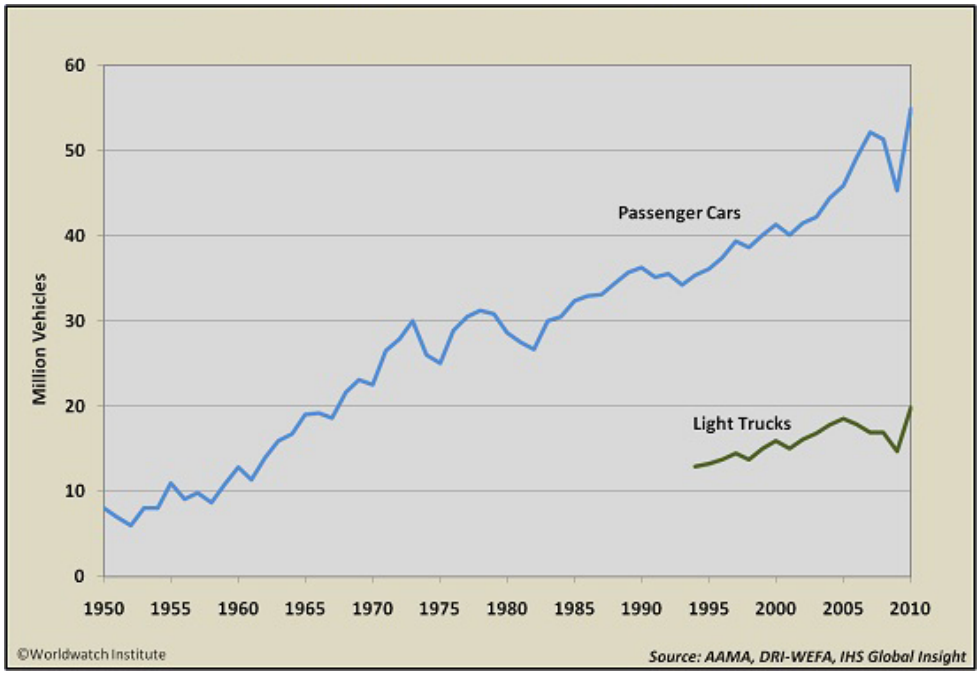

Figure 4: Growth in Annual Car Production 1950–2010

About 50 countries in the world produce cars. The top four producers—China, Japan, the U. S. and Germany—together provided 53 percent of global output. (See figure 5.) China's light-vehicle production has more than tripled since 2005, reaching 16.8 million in 2010—as many vehicles as produced in Japan and the United States combined.

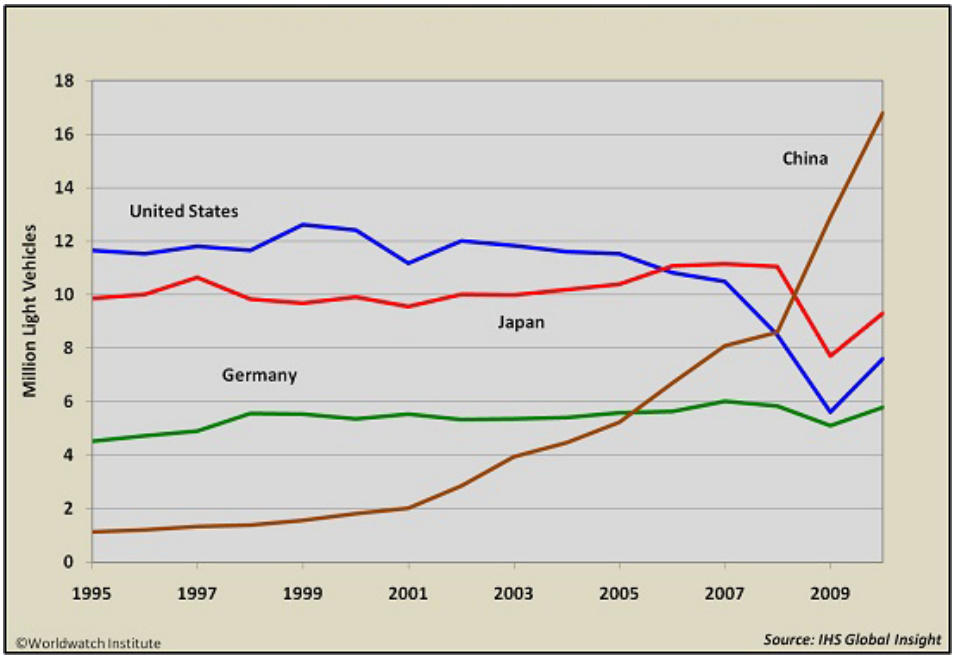

Figure 5: Leading Manufacturers of Light Vehicles

Japan's auto industry was affected negatively by the March 2011 earthquake and tsunami. Its share of production will show a significant decline in 2011 and full Japanese production will not recover until 2012. Auto industry analysts expect production of light vehicles to continue growing in the future, with 2012 production approaching 83 million and possibly 94 million by 2015. Much of this growth will be in the developing world, particularly China and India. Some 669 million passenger cars are being driven in the world today. Adding light- and heavy-duty trucks brings the number to 949 million vehicles.

Fuel efficiency has improved some in the major car nations in the first decade of the 21st century. Recent U.S. laws will result in somewhat higher MPG. (See fig. 6.) The United States has much lower MPG standards than Europe, Japan, and China. Current and proposed MPG standards will not significantly change the shape of the graph in figure 2, pointing out that the increase in MPG will not provide a decrease in gasoline and diesel fuels but only a somewhat smaller increase.

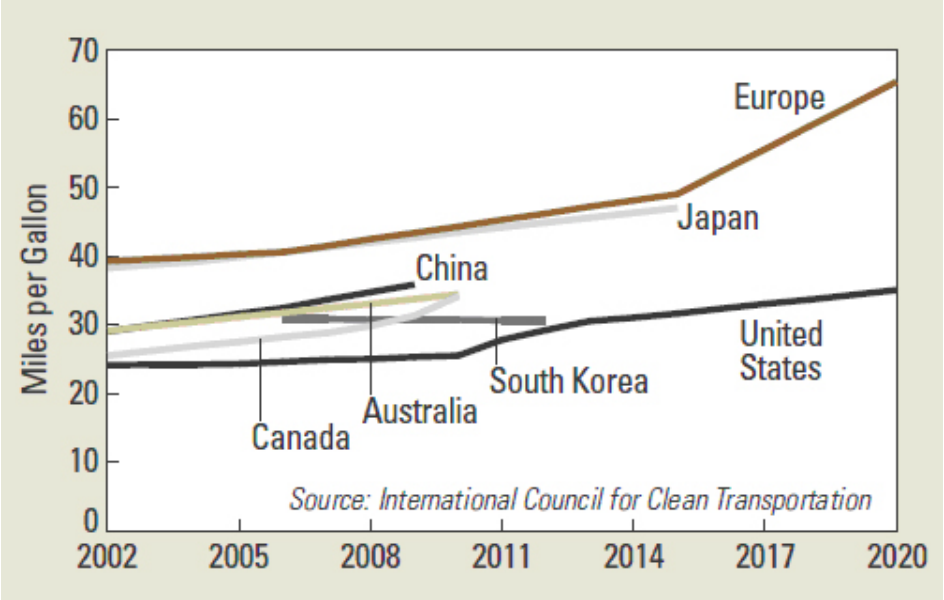

Figure 6: MPG for Major Car Populations

In terms of emissions, light vehicles purchased in 2009 in the U. S. averaged emissions of 247 grams of CO_2 per kilometer traveled, down from 423 grams in 1975, a 40 percent reduction in 34 years. Japan's emissions per vehicle are 131 grams of CO_2/km, and Europe emissions limit is 146 grams CO_2/km. The vehicles of U.S. companies—Chrysler, Ford, and GM—are among the worst performers in the world.

European countries have adopted diesel-powered cars (which account for 50 percent of total sales there) because diesels consume 30 percent less fuel than gasoline engines and emit 25 percent less CO_2. Worldwide demand for diesel-powered light vehicles is projected to increase from 16 million in 2007 to 29 million in 2017, resulting in an increase in market share from the current 23.6 percent to 31.5 percent. Evolving engine technology and cleaner fuels have rendered diesel passenger cars substantially cleaner than in the past, especially with regard to sulfur dioxide emissions. However, they still emit far more nitrogen oxides and particulate matter than gasoline cars. The transport sector, which relies heavily on trucks for freight movement, is responsible for about a quarter of the world's energy use and has the fastest-rising carbon emissions of any economic sector. Road transport currently accounts for 74 percent of the world's total transport-related CO_2 emissions.

The United States has ignored higher fuel efficiency for more than two decades. Following the first oil crisis of the early 1970s, sales of the biggest gas guzzlers—those achieving 15 MPG or less—declined dramatically, from 67 percent of sales in model year 1975 to just 4.5 percent in 1982. But the bulk of vehicle sales remain in the MPG performance interval between 15 and 25 MPG, and the popularity of SUVs has even led to reversals of fuel economy gains. Just 1.2 percent of all U.S. light vehicles in the 2007 model year could be categorized as truly fuel efficient, that is, achieving at least 35 miles per gallon, and thus, roughly on a par with European carbon limits.

A Review of Electric Car Technology

Most Americans fervently believe in technology and hope technological improvements, or "techno-fixes," will save us from the twin threats of diminishing fossil fuel resources (peak oil) and increasing CO_2 concentrations (climate change). When technology causes environmental damage and resource depletion, the American response is to strive for new, supposedly more benign, technology. Nowhere is this truer than in the case of the private automobile. But this focus on techno-fixes enables us to avoid effective actions that could mitigate resource depletion and reduce CO_2 generation. For example, the hope for "super-efficient cars" acts as a constant barrier to improvements in public transportation and innovative forms of shared transit. As noted earlier in Figure 2, making the automobile somewhat more efficient will not dramatically reduce emissions since the number of cars is increasing faster than MPG improvements.

The current infatuation with BEVs and PHEVs is based on bogus MPG claims of 150 MPG or higher, derived by using arcane and misleading algorithms from manufacturers and government agencies. To counter this propaganda of car, coal, and power companies, an "apples to apples" comparison is needed, bringing the current misleading MPG comparison for PHEVs and BEVs to scientific measures, such as CO_2 generated or BTUs (British thermal units) consumed per mile traveled. The papers on this website bring this badly needed perspective to the excessive performance claims of all kinds of electric vehicles.

Conclusion

This is the first of a set of papers which will provide a comprehensive analysis of the historical evolution of BEVs and PHEVs since 1990. They will document the unfortunate, inflated MPG claims and describe the mechanisms and arguments used to misrepresent electrification of transportation. The analysis begins with a discussion of the BEVs that were built in response to the California Air Resources Board legislation in the period from roughly 1998 to 2002. The next paper will review the history of the PHEV, tracing the evolution from the California garage shop of the California Cars Initiative (CalCars) and the efforts of the Electric Power Research Institute (EPRI) in the period beginning about 2002 to the shipment of the Volt in late 2010. The next paper analyzes the Hybrid Electric Vehicle (HEV) and covers the history of the Toyota Prius and Honda Insight beginning in the late 1990s. It includes earlier prototypes before the Prius and Insight as well as a description of the concept diesel hybrid cars built under the Clinton program, Partnership for a New Generation of Vehicles (PNGV). [9]

[1] Scenario to Cap World Emissions by 2020 Is Fading Fast, Warns IEA Economist, by Joel Kirkland, New York Times, January 24, 2011, http://www.nytimes.com/cwire/2011/01/24/24climatewire-scenario-to-cap-world-emissions-by-2020-is-f-69072.html accessed October 2011

[2] Steep increase in global CO2 emissions despite reductions by industrialized countries; driven by power generation and road transport by Green Car Congress 21 September 2011
Long-term trend in global CO_2 emissions 2011 report by Jos G.J. Olivier, Greet Janssens-Maenhout, Jeroen A.H.W. Peters, Julian Wilson, © PBL Netherlands Environmental Assessment Agency, The Hague, 2011; European Union, 2011
http://edgar.jrc.ec.europa.eu/news_docs/C02%20Mondiaal_%20webdef_19sept.pdf accessed October 2011

[3] IEA Sees Dire Future For Climate, Energy Without New Technology
http://online.wsj.com/article/BT-CO-20111019-708000.html accessed October 2011

[4] Barack Obama Speech: New Energy for America given August 4, 2008 in Lansing Michigan
http://www.pbs.org/newshour/bb/politics/july-dec08/obamaenergy_08-04.html accessed October 2011

[5] "GM Hopes Volt Juices Its Future" by Sharon Terlep, *Wall Street Journal*, 081209;
http://online.wsj.com/article/SB124998537270122333.html accessed October 2011

[6] Energy Independence: The Ever-Receding Mirage: 30 years of presidential futility and failure by Ronal Bailey, July 21, 2004, http://reason.com/archives/2004/07/21/energy-independence-the-ever-r accessed October 2011

[7] Is it Worthwhile to Fight for Energy Security, by Clinton Andrews, Rugers University
http://www.authorstream.com/Presentation/Donato-48587-energysecurity-Worthwhile-Fight-Energy-Security-Focusing-Use-1635-2000-Quadrillion-Btu-Petroleu-Education-ppt-powerpoint/ accessed October 2011

[8] Fuel Cell Summary by Energy Place,
http://www.energyplace.com/index.php?option=com_content&view=article&id=22&Itemid=38 accessed October 2011

[9] PNGV Concept Vehicles Presented to the Public in 2000, May 15, 2000, Vehicle Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy,
http://www1.eere.energy.gov/vehiclesandfuels/facts/favorites/fcvt_fotw128.html accessed October 2011