Blowing Smoke: Why the Current Government Incentive Regime Makes EVs and PHEVs a Distant Prospect—and How to Fix It

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INTRODUCTION

An entire generation has greeted the arrival of plug-in hybrid-electric vehicles ("PHEVs") with eager anticipation.[1] However, the rise of a

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trend does not necessarily imply that spending habits will change—much less in a permanent way.[2] The ambiguous prospects for popular PHEV and electric vehicle ("EV") adoption demands discussion of what may keep them out of driveways, and how to overcome those barriers.

Policymakers should not postpone discussing how to move Americans towards a more energy efficient transportation future. American oil consumption has climbed to 18.6 million barrels per day, with more than one-third of it imported from abroad.[3] The price of gas reached a peak national average of $4.05 per gallon in 2008, with oil trading at an unprecedented $147 per barrel.[4] Domestic oil production has declined over the past three decades, and American buying clout has similarly dwindled with rising oil demand from China and India.[5] Even if one brushes aside the ongoing peak oil debate,[6] the deleterious effects of American oil dependence remain irrefutably etched into its staggering impact on GDP, with potential losses of $45 billion in 2009 alone.[7] The widespread adoption of EVs and PHEVs could make a significant dent in foreign oil dependence. At present, the transportation sector is the dominant consumer of foreign oil, with the nation spending nearly $1 billion per day on oil, sustaining this dependency.[8] EVs and PHEVs

1. *Deloitte Suggests Gen Y's Embrace of Hybrid Vehicles May Be Auto Market's Tipping Point,* GREEN CAR CONGRESS (Jan. 19, 2012), www.greencarcongress.com/2012/01/deloitte-20120119.html.

2. *See* discussion in Part II, *infra*.

3. *Energy in Brief: How Dependent Are We On Foreign Oil?*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/energy_in_brief/article/foreign_oil_dependence.cfm (last updated May 10, 2013).

4. ROBERT A. BURGELMAN & DEBRA SCHIFRIN, STANFORD GRADUATE SCH. OF BUS., SM193, THE GROWTH OF THE ELECTRIC VEHICLE INDUSTRY: FACILITATING AND IMPEDING FORCES 3 (2011), *available at* https://gsbapps.stanford.edu/cases/detail1.asp?Document_ID=3491. This national average has since declined moderately, and as of May 14, 2013, stands at $3.58 per gallon. *AAA's Daily Fuel Gauge Report*, AAA, http://fuelgaugereport.aaa.com/?redirectto=http://fuelgaugereport.opisnet.com/index.asp (last visited May 14, 2013) (recounting the current daily national average price of gas).

5. BURGELMAN & SCHIFRIN, *supra* note 4, at 4.

6. *See generally* REMBRANDT KOPPELAAR, PEAK OIL NETH. FOUND., WORLD OIL PRODUCTION & PEAKING OUTLOOK (2005), *available at* http://peakoil.nl/wpcontent/uploads/2006/09/asponl_2005_report.pdf (explaining "peak oil" theory, i.e., the theory that global oil production will "peak" in the current generation, discussing the grave consequences that such a "peak" would have, and exploring the questions about oil measurement methodology that have spawned a debate).

7. Vehicle Techs. Office, *The Costs of Oil Dependence*, U.S. DEP'T OF ENERGY (July 19, 2010), http://www1.eere.energy.gov/vehiclesandfuels/facts/2010_fotw632.html. In economic terms, "potential losses" refers to the possible gains in GDP that the United States' oil dependence prevented it from achieving. *See id.*

8. *Batteries for Electrical Energy Storage in Transportation*, U.S. DEP'T OF ENERGY, ARPA-E, http://arpa-e.energy.gov/?q=arpa-e-programs/beest (last visited Feb. 18, 2013).

could utilize idle electricity infrastructure to reduce foreign oil dependence by up to fifty percent, or 6.5 million barrels of oil per day.[9]

More than the economy may be at stake. Air pollution (from automotive exhaust or otherwise) creates a serious risk for human health. Contemporary China illustrates the consequences of allowing inner-city carbon emissions to grow unchecked. A Chinese official noted in 2006 that forty-eight percent of Chinese cities were suffering from "moderate or serious air pollution."[10] China today has more premature deaths from air pollution than any other country.[11] Cutting carbon emissions from automotive exhaust will singlehandedly save the United States from China's nightmare scenario. However, car exhaust might be the place to start, and one study found that reaching sales of 50 million EV and PHEV units per year by 2050 could cut global carbon emissions to thirty percent below their 2005 levels.[12]

This Note seeks to analyze how, through proper government incentive programs, EVs and PHEVs might become one mechanism for reducing the United States' carbon emissions from transportation.[13] Part I will set the backdrop for this analysis by discussing the history of EVs and PHEVs, and the government incentive programs already in place. Part II will cover the issues impeding popular adoption of EVs and PHEVs by consumers. Finally, Part III will propose a "model" government incentive program to overcome these issues. This program can be broken into five parts: educating consumers about EVs and PHEVs,

9. Christina Davies Waldron & Peter Kobylarek, *The Reality of Electric Vehicles and the Grid*, ELECTRIC LIGHT & POWER (Jan. 1, 2011), http://www.elp.com/articles/print/volume-89/issue-1/sections/the-reality-of-electric-vehicles-and-the-grid.html.

10. *Bad Air Pervades in Half of Chinese Cities*, UPI.COM (Oct. 24, 2006, 11:39 AM) http://www.upi.com/Science_News/2006/10/24/Bad-air-pervades-in-half-of-Chinese-cities/UPI-33001161704396/.

11. Kevin Holden Platt, *Chinese Air Pollution Deadliest in World, Report Says*, NAT'L GEOGRAPHIC NEWS (July 9, 2007), http://news.nationalgeographic.com/news/2007/07/070709-china-pollution.html.

12. INT'L ENERGY AGENCY, TECHNOLOGY ROADMAP: ELECTRIC AND PLUG-IN HYBRID ELECTRIC VEHICLES 14 (2011), *available at* http://www.iea.org/publications/freepublications/publication/EV_PHEV_Roadmap.pdf.

13. The potential of EVs and PHEVs to reduce carbon emissions should not be understated. PHEVs reduce carbon emissions by thirty-seven to sixty-seven percent compared to traditional ICEs. SHERRY BOSCHERT, THE CLEANEST CARS: WELL-TO-WHEELS EMISSIONS COMPARISONS 3 (2008), *available at* http://images.pluginamerica.org/EmissionsSummary.pdf. EVs can reduce carbon emissions by eleven percent up to one hundred percent. *Id.* The increased load on the nation's power grid could raise the demand for coal, but even if the EV and PHEV revolution were powered strictly by electricity from coal, carbon emissions would still be reduced by up to fifty-nine percent. *Id.* Moreover, since coal is unlikely to be the sole source of electricity for new EVs and PHEVs, this number could potentially be higher.

switching the current tax credit scheme to an upfront rebate, reformulating the gas guzzler tax to make it more stringent, focusing on increasing fleet adoption of PHEVs, and establishing electrification "deployment communities" for EVs.

There are several things that this Note does not purport to do. First, it does not seek to establish that EVs and PHEVs are superior to other alternative-fuel possibilities, such as hydrogen fuel cells.[14] Second, unlike some of the scientific studies upon which it relies,[15] this Note does not set a "target" or "ideal" number for EV and PHEV adoption. Finally, this Note does not discuss how to finance these endeavors or, indeed, whether they should be financed at all. The purpose of this Note is to consider the greatest concerns of consumers towards EV and PHEV adoption and to recommend a policy that can overcome those concerns.

I. THE CURRENT REGULATORY LANDSCAPE FOR EVS AND PHEVS

A. The History and Technology of EVs and PHEVs

Affixing an electric motor to four wheels is hardly a new idea. At the beginning of the twentieth century, electric vehicles actually outsold their gas-powered counterparts.[16] The reasons for electric power's initial loss in the race against internal combustion engines ("ICEs") resemble some of the same difficulties keeping EVs and PHEVs off the road today,[17] namely, consumer anxieties about range and price.[18] As consumers latched onto cheap, ICE-powered vehicles such as Henry Ford's Model T, the electric car became virtually extinct.[19]

EVs reemerged onto the automotive scene with General Motors ("GM") introducing the EV1 in 1996.[20] The futuristic coupe was a flop,

14. This has already been discussed in several articles. *E.g.*, Joshua P. Fershee, *Struggling Past Oil: The Infrastructure Impediments to Adopting Next-Generation Transportation Fuel Sources*, 40 CUMB. L. REV. 87 (2009).

15. *See, e.g.*, Robert Burgelman & Andrew Grove, *The Drive Toward the Electric Mile—A Proposal for a Minimum Winning Game* 6 (Stanford Graduate Sch. of Bus., Research Paper No. 2013, 2009), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1348201 (positing that a "minimum winning game" in the strategy for increasing U.S. energy resilience would involve selling 1 million PHEVs in three years).

16. BURGELMAN & SCHIFRIN, *supra* note 4, at 1.

17. *See* discussion in Part II, *infra*.

18. BURGELMAN & SCHIFRIN, *supra* note 4, at 1.

19. *Id.* at 1–2.

20. *Id.* at 2.

with GM losing approximately $1 billion on the project.[21] Japanese automakers pioneered a different approach, using an electric motor to supplement the ICE's power instead of replacing the ICE entirely. Honda's Insight—the first of these hybrid electric vehicles ("HEVs")—debuted in 1999, and Toyota's Prius arrived on the global scene a year later.[22] HEVs have enjoyed greater popularity than EVs, with models ranging from Ford's Escape Hybrid[23] to Mercedes-Benz's S-Class Hybrid, with a retail price of $91,000.[24] Toyota's Prius remains the top seller in the HEV segment, shipping more than three million units as of 2011.[25]

Although GM's EV1 had not paved the company's future, its legacy was not completely lost. GM and a handful of other companies, such as Fisker,[26] began navigating a middle ground between HEVs and EVs, with GM introducing the Chevy Volt—its first PHEV—in 2010.[27] Before that, Tesla Motors had begun to develop a niche-market EV sports car in 2007[28] and three years later Nissan's Leaf EV debuted.[29]

PHEVs function much like regular HEVs, combining both an ICE and an electric motor.[30] HEVs and PHEVs charge their battery packs using the ICE and energy captured from the driver's use of the brake pedal (a process referred to as "regenerative braking").[31] PHEVs can also be plugged into any outlet to charge—even a standard 120-volt wall outlet.[32] Typically, PHEVs can travel between ten and forty miles in all-electric

21. Don Sherman, *GM at 100: Is Its Future Electric?*, N.Y. TIMES, Sep. 14, 2008, at AU1.

22. BURGELMAN & SCHIFRIN, *supra* note 4, at 2.

23. FORD MOTOR CO., http://www.ford.com (last visited May 14, 2013).

24. MERCEDES-BENZ USA, http://www.mbusa.com (last visited May 14, 2013).

25. *Cumulative Worldwide Sales of Toyota Hybrids Top 3M*, GREEN CAR CONGRESS (Mar. 8, 2011), http://www.greencarcongress.com/2011/03/cumulative-worldwide-sales-of-toyota-hybrids-top-3m-units.html.

26. *Id.*

27. Nick Chambers, *First Chevy Volts Reach Customers, Will Out-Deliver Nissan in December*, PLUGIN CARS (Dec. 16, 2010), http://www.plugincars.com/first-chevy-volts-reach-customers-will-out-deliver-nissan-december-106575.html.

28. BURGELMAN & SCHIFRIN, *supra* note 4, at 2; *see also* Joseph White, *Electric Car Maker Aims for the Top with Sports Car*, WALL ST. J. (Oct. 15, 2007), http://online.wsj.com/article/SB119220246200657368.html (describing Tesla's Roadster as a $98,000 sports car for the "high-tech elite").

29. BURGELMAN & SCHIFRIN, *supra* note 4, at 2.

30. *See, e.g.*, *Description of Plug-In Hybrid Electric Vehicles*, U.S. DEP'T OF ENERGY, http://www.afdc.energy.gov/vehicles/electric_basics_phev.html (last visited May 12, 2013) (describing the two power sources—electric motor and gasoline engine—for PHEVs, and how they function together).

31. DEP'T OF ENERGY, VEHICLE TECHNOLOGIES PROGRAM 1 (2011), *available at* http://www.afdc.energy.gov/pdfs/52723.pdf.

32. *Id.* at 3.

mode, after which the ICE takes over.[33] The opportunity to "plug in" and run the car without using a single drop of gasoline saves the driver on fuel costs and also reduces the driver's carbon footprint.[34]

Hybrid sales in the United States have grown slowly over the last decade. Market share for hybrid cars reached 3.0% in 2012,[35] a slight increase over the previous high of 2.8% in 2009.[36] Sales in 2012 accounted for 434,645 of the total 2.5 million hybrids sold over the past ten years.[37] EVs and PHEVs shipped a combined 53,172 units last year, capturing 0.4% of the domestic market.[38] This small market share demonstrates that despite the efforts of several companies and a variety of models, vehicles incorporating an electric motor have remained relegated to a niche market.

B. Current Government Incentives for the Production and Purchase of EVs and PHEVs

Government incentive regimes exist at both the federal and state level. The federal government offers, or has previously offered, tax credits for the purchase of EVS and PHEVs; for PHEV conversion kits; and for charging stations. State governments have also participated in incentivizing EVs and PHEVs, although in many states budgetary shortfalls have forced these programs to end early.

The federal government provides tax credits for PHEVs of up to $7500.[39] Both the Nissan Leaf and Chevy Volt are eligible for the maximum credit.[40] In the case of the Volt, this brings its purchase price

33. *Id.* at 1.

34. ELEC. POWER RESEARCH INST., TECHNICAL UPDATE—PLUG-IN HYBRID ELECTRIC VEHICLES: CHANGING THE ENERGY LANDSCAPE 1 (2005), *available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001011996 (follow the "download" link).

35. Jeff Cobb, *December 2012 Dashboard*, HYBRIDCARS (Jan. 8, 2013), http://www.hybridcars.com/december-2012-dashboard.

36. Peter Valdes-Dapena, *Hybrid Car Sales: Lots of Options, Few Takers*, CNNMONEY (Sept. 30, 2011, 5:09 PM), http://money.cnn.com/2011/09/30/autos/hybrid_car_sales/index.htm.

37. *Electric Drive Vehicle Sales Figures*, ELECTRIC DRIVE TRANSP. ASSOC., http://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952 (last visited July 1, 2013); *Hybrid Car Statistics*, EVS ROLL, http://www.evsroll.com/Hybrid_Car_Statistics.html (last visited May 12, 2013).

38. Cobb, *supra* note 35.

39. New Qualified Plug-in Electric Motor Vehicles, 26 U.S.C. § 30D (2012); *see also* I.R.S. Notice 2009-89, 2009-48 I.R.B. 714, *available at* http://www.irs.gov/irb/2009-48_IRB/ar09.html. The exact amount of tax credit depends upon the vehicle's battery capacity, measured in kilowatt-hours. *See* I.R.S. Notice 2009-89, 2009-48 I.R.B. 714.

40. *See Federal Tax Credits for Plug-in Hybrids*, DEP'T OF ENERGY, http://www.fueleconomy.gov/feg/taxphevb.shtml (last visited July 1, 2013) (indicating that the Chevrolet Volt is eligible for the maximum credit); *Federal Tax Credits for Electric Vehicles*, DEP'T OF ENERGY, http://www.fuel

(after the tax credit is received) down to roughly $33,500.[41] This number is somewhat close to the average new car purchase price of $27,075 in 2011.[42] However, most consumers buy used cars,[43] and even with the tax credit the Volt costs almost three times as much as the average used car—in other words, it's still far outside the typical consumer's price range.[44] The federal government has also offered a ten percent tax credit for plug-in electric drive conversion kits.[45] The credit program, initially part of the American Reinvestment and Recovery Act ("ARRA"), ended in December 2011 and has not been renewed.[46] Conversion kits cost on average of $12,000,[47] more than the average purchase price of a used car, although this Note does not speculate as to whether the prohibitive costs of the kits portended the conversion credit's demise.

Finally, the federal government provides tax credits for charging station installations. This incentive program originally offered a fifty percent credit for charging stations through December 2010, with a reduced thirty percent credit through December 2011.[48] The tax credit program has since been renewed—still with a thirty percent credit—through the end of 2013.[49] However, the current charging station credit may not be enough: one survey indicates that only thirteen percent of households would ever spend more than $1000 to install a charging station, which tends to retail at $2000.[50]

economy.gov/feg/taxevb.shtml (last visited July 1, 2013) (indicating the Nissan LEAF as eligible for the maximum credit).

41. The Volt retails for $39,145 before the tax credit is applied. CHEVROLET, http://www.chevrolet.com (last visited Feb. 17, 2013) (follow "Cars" section; then click "Volt" for current pricing information).

42. MANHEIM, THE AUTO INDUSTRY: THE VITAL IMPORTANCE OF USED CARS 1 (2011), *available at* http://www.manheim.com/pdfs/news/Importance-of-Used-Cars_041112.pdf.

43. *See id.* (indicating that three times as many used cars as new cars are sold each year).

44. As of 2011, the average used car sold for $9275. *Id.*

45. INTERNAL REVENUE SERVICE, ENERGY PROVISIONS OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (2009), *available at* http://www.irs.gov/uac/Energy-Provisions-of-the-American-Recovery-and-Reinvestment-Act-of-2009. This tax credit was subject to a $4,000 cap. *Id.*

46. *State and Federal Incentives*, PLUG IN AMERICA, http://www.pluginamerica.org/incentives (last visited May 14, 2013); *Tax Credits for Buying Electric and Hybrid Cars*, EFILE.COM, http://www.efile.com/tax-credit/hybrid-car-tax-credit/ (last visited Jan. 31, 2013) (describing changes to the tax credits).

47. Burgelman & Grove, *supra* note 15, at 69.

48. *Electric Car Charging Station Tax Credit Extended, But at Lower 30% Pre-Stimulus Levels*, PLUGINCARS (Dec. 17, 2010), http://www.plugincars.com/breaking-electric-car-charging-station-tax-credit-extended-lower-30-pre-stimulus-levels-106580.html.

49. *See* I.R.C. §§ 30C(a), (g).

50. *Cost of Recharging Stations and Electricity Could Slow Electric Car Adoption*, ENERGY EFFICIENCY NEWS (Jan. 14, 2011), http://www.energyefficiencynews.com/i/3714/.

Apart from the federal government, several states offer EV- and PHEV-related incentives to their residents.[51] These incentives often take the form of sales tax exemptions and carpool lane access.[52] A few states have taken a more aggressive approach. California, for example, has offered rebates of up to $5000 for EV buyers.[53] Unfortunately, this program became a victim of California's budgetary squeeze and ended in 2011.[54]

In summary, the government has not been entirely inactive in promoting EVs and PHEVs. At the federal level, incentives include tax credits on new EVs and PHEVs, as well as PHEV conversion kits. The federal government also provided a tax credit for charging stations, although this program has since expired and has not been renewed. States have provided some scattered incentives, sometimes phasing them out in the face of budgetary shortfalls. Overall, government incentives for EVs and PHEVs are sporadic and their future remains uncertain.

II. BARRIERS TO CONSUMER ADOPTION

Several studies have suggested that EV and PHEV market share will not grow appreciably in the near future.[55] The Energy Information Administration estimates that by 2030, only 4.3 million EVs (less than 1.5% of light-duty passenger vehicles) will be on the road.[56] The value of EVs and PHEVs to the environment, energy independence, and consumer wallets[57] demands an analysis of what roadblocks this industry will face and how they might be overcome.Consumer opposition to EVs and PHEVs can be broken down into four distinct issues: their relatively

51. *See State and Federal Incentives*, *supra* note 46. As of this writing, twenty-eight states offer EV- and PHEV-related incentives. *Id.*

52. *See id.*

53. Paul A. Eisenstein, *California Unplugs $5,000 Battery Car Rebate Program*, DETROIT BUREAU (Jul. 21, 2011), http://www.thedetroitbureau.com/2011/07/california-unplugs-5000-battery-car-rebate-program/.

54. *Id.*

55. *See, e.g.*, BURGELMAN & SCHIFRIN, *supra* note 4, at 8; BOOZ & CO., 2012 U.S. AUTOMOTIVE INDUSTRY SURVEY AND CONFIDENCE INDEX 24 (2012), *available at* http://www.booz.com/media/file/BoozCo_2012-US-Automotive-Industry-Survey-and-Confidence-Index.pdf (indicating, after a survey of automotive-industry executives, that alternative-powertrain adoption is "seen as extremely reliant on government support" and that half of all respondents believe the segment will account for less than five percent of the domestic market by 2020).

56. ELECTRIFICATION COALITION, ELECTRIFICATION ROADMAP: REVOLUTIONIZING TRANSPORTATION AND ACHIEVING ENERGY SECURITY 139 (2009), *available at* www.electrificationcoalition.org/sites/default/files/SAF_1213_EC-Roadmap_v12_Online.pdf.

57. *See* discussion in Part I, *supra*.

high purchase price, their short (all-electric) range and virtually nonexistent charging infrastructure, the increasing appeal of traditional ICE's as a fuel-efficient alternative, and the costs of repair associated with EV and PHEV ownership.

A. High Purchase Price

Consumer hesitation to pay a greater upfront price for EVs and PHEVs has hampered their sales. One can scarcely doubt that EVs and PHEVs offer savings upon each trip to the pump—or more accurately, each avoided trip to the pump. PHEVs cost one dollar or less to charge, and EVs roughly two to four dollars.[58] In cost per mile terms, a Toyota RAV4 will travel 100 miles for $10.00 (four gallons of gasoline at $2.50/gallon), while a RAV4-EV will cover the same distance for $3.00 (thirty kWh of electricity at ten cents per kWh).[59]

Cheaper refueling stops (or no refueling stops), however, has not convinced consumers that EVs and PHEVs are worth the extra investment. One survey found that the number of consumers initially interested in buying an EV, PHEV or regular hybrid decreased by fifty percent when they found out that it would cost an extra $5000 on average to do so.[60] Only fourteen percent of consumers factor long-term fuel savings into the car-buying calculus.[61]

Consumer skepticism about whether EVs and PHEVs are worthwhile at their current purchase prices may not be entirely misplaced. Battery costs, in particular, have driven hybrid prices sky high.[62] In Toyota's most recent Prius, battery costs alone add $14,000 to the purchase price.[63] The EV version of Ford's bestselling compact Focus, when it debuts in the near future, will set buyers back by nearly $40,000.[64]

In light of often-prohibitive purchases prices, long-term savings are not clear. A hybrid driver may spend seven to ten years attempting to

58. *Frequently Asked Questions*, PLUG IN AMERICA, http://www.pluginamerica.org/faq/general-question#t39n102 (last visited May 14, 2013).

59. *Id.*

60. BURGELMAN & SCHIFRIN, *supra* note 4, at 7.

61. ROBERT BURGELMAN & ANDREW GROVE, TOWARD ELECTRIC CARS AND CLEAN COAL: A COMPARATIVE ANALYSIS OF STRATEGIES AND STRATEGY-MAKING IN THE U.S. AND CHINA 29 (2010), *available at* https://gsbapps.stanford.edu/researchpapers/library/RP2048R.pdf.

62. *See Difference Engine: Tailpipe Truths*, ECONOMIST (Apr. 20, 2012 10:20 AM), http://www.economist.com/blogs/babbage/2012/04/electric-cars.

63. *Id.*

64. *Id.* This price does not factor in state or federal incentives. *Id.* Ford's base-model Focus retails at just over $16,000. *2013 Focus*, FORD MOTOR CO., http://www.ford.com/cars/focus/ (last visited May 12, 2013).

recoup his or her investment, and reap the "savings" that hybrids offer over regular cars only after that period.[65] This may explain why two out of three hybrid owners revert to conventional cars for their next purchase.[66] As Edmunds.com chief economist Lacey Plache observes, the economics of buying a hybrid car "don't make much sense."[67]

Many fleet owners and operators already treat the economics of hybrids, EVs, and PHEVs with great skepticism. More than sixty percent of public sector fleet managers and fifty percent of private sector fleet managers cited cost as one of the major barriers to reducing fleet emissions.[68] Just fifteen percent of private sector fleet managers demonstrated willingness (or ability) to foot the extra cost of a more efficient fleet.[69]

In summary, EVs and PHEVs will need to overcome the issue of consumer hesitancy to pay more upfront. This hesitancy may arise from doubts over long-term savings, or from a simple inability to pay the often-prohibitive purchase price for such a vehicle. Either way, EV and PHEV sales have been hampered by a price that consumers are not willing to pay.

B. Concerns Over Range and the "Plug-In" Infrastructure

Consumer reluctance towards EVs and PHEVs also arises from the limited range of the battery pack. The nearest charging station may be prohibitively far, or its wait time far too long. With no charging nearby, PHEV drivers will end up relying on gasoline for every trip; and EV drivers could become stranded.

The per-mile savings discussed in the first paragraph of Part II.A critically assumes that one can charge his or her EV or PHEV wherever he or she chooses to go. However, most agree that such a broad charging infrastructure does not appear to exist. One author alleges otherwise, claiming that the "required infrastructure already exists."[70] However, to support this claim, the author proposes that standard 120-volt wall outlets and gas stations comprise an adequate "infrastructure" for PHEVs.[71]

65. *Difference Engine: Tailpipe Truths*, *supra* note 62.
66. *Id.*
67. *Id.*
68. Burgelman & Grove, *supra* note 15, at 55.
69. *Id.*
70. Ashlee Duncan, *Pulling the Plug on Greenhouse Emissions: The U.S. Power Grid Could Accommodate Plug-In Electric Vehicles*, 3 ENVTL. & ENERGY L. & POL'Y J. 158, 165 (2008).
71. *Id.* at n.57.

However, charging a Nissan Leaf from a wall outlet takes 21 hours.[72] In other words, the current infrastructure is only adequate—as the aforementioned author claims—if one is willing to wait twenty hours for every sixty miles of driving. Moreover, relying on gas stations completely defeats the purpose (i.e. the intended fuel savings and consequent emission reductions) of purchasing a PHEV. For EV drivers, furthermore, relying on gas stations is not an option at all.

EV and PHEV charging infrastructure remains very limited. While charging stations have—to an extent—expanded beyond major metropolitan centers, drivers in many areas are still without access or at least without access within a reasonable distance.[73] Establishing a truly national infrastructure—one that makes charging reasonably accessible to every driver in every circumstance, or even most drivers in most circumstances, would require an extraordinary investment. This is not merely because so many areas are currently underserved, although that is certainly part of the cost: consider that Little Rock, Arkansas has nine chargers for 200,000 people,[74] and that rural Great Falls, Montana is 136 miles from any charging station.[75] It is also because developing a functional, consumer-amenable network would require the availability of at least some amount of high-speed charging. Drivers can spare four hours in some instances: a hotel or tourist destination might be able to afford one or more 240-volt chargers for their customers (for instance, GE's commercial-ready DuraStation, which retails for $4500 per unit).[76]

72. NISSAN, LEAF OWNER'S MANUAL EV-11 (2013), *available at* https://owners.nissanusa.com/content/techpub/ManualsAndGuides/NissanLEAF/2013/2013-NissanLEAF-owner-manual.pdf. Nissan, likely anticipating that owners will not want to wait twenty hours per charge, offers a 240-volt, four-hour home charger for an additional $999. *Charging at Home*, NISSAN, http://www.nissanusa.com/electric-cars/leaf/charging-range/charging/ (last visited May 12, 2013).

73. The Department of Energy's Alternative Fuels Data Center provides a map of 5,800 electric charging stations, with coverage varying by geographic area. *Electric Vehicle Charging Station Locations*, U.S. DEP'T OF ENERGY, http://www.afdc.energy.gov/fuels/electricity_locations.html (last visited May 12, 2013). Compare this figure to the 120,000 gas- and diesel-refueling stations available nationwide. Rebecca Smith, *Natural Gas Filling Stations: Few and Far Between*, WALL ST. J. (May 23, 2012 4:25 PM), http://online.wsj.com/article/SB10001424052702304707604577422252404819664.html.

74. These totals were reached using data from the Department Of Energy's Alternative Fuels Data Center and U.S. Census information. *Electric Vehicle Charging Station Locations*, *supra* note 73; *State & County QuickFacts: Little Rock (city), Arkansas*, U.S. CENSUS BUREAU, http://quickfacts.census.gov/qfd/states/05/0541000.html (last updated Mar. 14, 2013). Note the listed number of charging stations encompasses all stations within ten miles of Little Rock, including the neighboring town of Sherwood.

75. This figure was reached using the U.S. Department of Energy Alternative Fuels Data Center map. *Electric Vehicle Charging Station Locations*, *supra* note 73.

76. *General Electric DuraStation*, PLUG IN AMERICA, http://www.pluginamerica.org/accessories

However, drivers who are traveling or running several errands may find long wait times prohibitive. Direct-current stations dramatically reduce charging time: Eaton's DC "Quick Charger," for instance, can charge a car's battery to eighty percent capacity in as little as thirty minutes.[77] Though much more convenient than other stations, DC charging stations can be prohibitively expensive. Although Eaton lists no price on its website for the "Quick Charger," a comparable DC charger from Aerovironment sells for $39,900 per unit.[78] Consider, for the sake of comparison, that this expense would be greater than all currently existing monthly operating expenses at several major metropolitan parking garages.[79]

For EV owners, the current issues with infrastructure spell much graver problems than inconvenience and lost fuel savings. Though the importance of an expansive and convenient charging network to PHEV owners should not be understated—GM's PHEV, the Chevrolet Volt, can only drive twenty-five to fifty miles before turning to its stores of gasoline[80]—however, owners of pure EVs like the Nissan Leaf stand to lose much more. With no backup gasoline engine, running out of electricity leaves the driver completely stranded. *Car and Driver*'s Dave Vanderwerp illustrates this problem with a hypothetical:

> [I]f this writer had been driving a Leaf instead of a Volt, I would have had to deal a blow of rejection to a five-year-old nephew whose birthday party was 60 miles distant, due to the lack of a place to charge while there. Do you think he would have understood?[81]

To this end, manufacturers of EVs and PHEVs must overcome consumer concerns about battery range or risk completely eliminating the cost

/general-electric-durastation (last visited May 12, 2013); *see also DuraStation*, GE INDUS. SOLUTIONS, http://www.geindustrial.com/cwc/Dispatcher?REQUEST=PRODUCTS&famid=9404&id=Elec-evcs (last visited May 12, 2013) (listing a charge time of "4-8 hours" and price information).

77. *DC Quick Charger*, EATON, http://www.eaton.com/Eaton/ProductsServices/Electrical/ProductsandServices/ElectricalDistribution/ElectricVehicleChargingSolutions/DCQuickCharger/index.htm (last visited May 12, 2013).

78. *Aerovironment Fleet Fast Charging Station Line*, PLUG IN AMERICA, http://www.pluginamerica.org/accessories/aerovironment-fleet-fast-charging-station-line (last visited May 12, 2013).

79. VICTORIA TRANSP. POL'Y INST., TRANSPORTATION COST AND BENEFIT ANALYSIS II—PARKING COSTS 5.4-4, *available at* http://www.vtpi.org/tca/tca0504.pdf (indicating typical annual operating expenses for parking garages in four major metropolitan areas).

80. Dave Vanderwerp, *Electric Revival*, CAR & DRIVER (Oct. 2010), http://www.caranddriver.com/reviews/2011-chevrolet-volt-full-test-road-test.

81. *Id.* at 64.

savings from owning a PHEV, and worse yet, risk leaving EV owners stranded.

C. Competition from ICE Vehicles

Concerns over the price and travel range of EVs and PHEVs are particularly relevant in light of recent efficiency improvements in ICE vehicles. Average fuel economy for current model year vehicles improved by 9.8 miles per gallon for diesel engines and 2.6 miles per gallon for gasoline engines between 2008 and 2012.[82] Tata Motors' Nano—the world's cheapest mass-produced vehicle—retails for just $2600[83] in India, and averages just under sixty miles per gallon.[84] Admittedly, the tiny Nano represents a cost efficiency extreme that may not be ready for the mass market yet. One article even suggests that it has garnered a reputation for bursting into flames.[85]

Nevertheless, automakers have made strides towards making ICEs more efficient without the use of an electric motor. Ford's recent EcoBoost engine line uses a combination of turbocharging and direct-injection technology to deliver up to twenty percent better fuel economy than its naturally-aspirated counterparts.[86] Record EcoBoost sales of 127,683 units in 2011 have prompted Ford to triple production capacity of the engine line, offering EcoBoost in eleven different models.[87] This includes Ford's best-selling F-150 pickup, for which the more efficient EcoBoost V6 engine actually produces greater peak horsepower and torque than Ford's more traditional V8 truck engine.[88] In 2011, fifty-six

82. UNIV. OF MICHIGAN TRANSP. RESEARCH INST., RECENT FUEL ECONOMY TRENDS FOR NEW VEHICLES IN THE U.S. 13 (2012), *available at* http://deepblue.lib.umich.edu/bitstream/handle/2027.42/89864/102797.pdf;jsessionid=249891096503647B3469D441435A1230?sequence=1.

83. Tim Sullivan, *Tata Chief Says Cheap, Everyman Nano Is No Flop*, ASSOC. PRESS (Jan. 5, 2012), *available at* http://www.boston.com/business/articles/2012/01/05/tata_chief_says_cheap_everyman_nano_is_no_flop/.

84. Nano, TATA MOTORS, http://www.tatamotors.com/vehicles-and-services/nano/nano.php (last visited July 2, 2013) (mileage was calculated by converting kilometers per liter into miles per gallon).

85. *See* Sullivan, *supra* note 83.

86. Press Release, Ford Motor Co., Ford to Triple EcoBoost Vehicle Production Capacity in 2012 (Jan. 26, 2012), http://media.ford.com/article_display.cfm?article_id=35890.

87. *Id.*

88. Mike Levine, *How We Dyno Tested Ford's 3.5 Liter EcoBoost V-6 and 5.0 Liter V8 Engines*, PICKUPTRUCKS.COM (Apr. 25, 2011), http://news.pickuptrucks.com/2011/04/how-we-dyno-tested-fords-3-5-liter-ecoboost-v6-and-5-0-liter-v8-engines.html. Ford's EcoBoost V-6 produces 365 horsepower and 420 foot-pounds of torque, compared to 360 horsepower and 380 pound-feet of torque for its Coyote V-8 engine. *Id.* The EcoBoost also reaches its torque peak at a lower engine speed (2,500 rpm) than the Coyote V8, making it ideal for towing applications. *Id.*

percent of F-150 buyers opted for a fuel-efficient V6—either the EcoBoost or the base 3.7 liter engine—over the V8.[89]

Even diesel engines have recently emerged as a cost-efficient option for consumers. Diesel engines generally offer better fuel economy than gasoline engines, but they fell out of favor during the 1980's due to durability and emissions issues.[90] Today, more than half of all vehicles sold in Europe have diesel engines.[91] Contemporary diesel technology, as compared to technology available before 1990, is cleaner and more efficient. The EPA mandates that refiners produce ultra-low-sulfur diesel ("clean diesel") for highway vehicles.[92] A number of automakers have developed in-house technologies designed to bolster diesel's "clean" image.[93] For example, Mercedes has introduced a diesel engine option for much of its model line that utilizes a technology called BlueTEC.[94] BlueTEC diesel engines meet emissions standards in all fifty states, including the particularly stringent California emissions standards.[95] The key to BlueTec's "super clean diesel"[96] technology is its use of a urea solution called AdBlue, which can be replenished by the servicer at regularly-scheduled service intervals.[97] Mercedes-Benz's GL

89. Press Release, Ford Motor Co., *supra* note 86.

90. *See, e.g.*, Sonari Glinton, *Automakers Give Disregarded Diesels a Second Look*, NAT'L PUB. RADIO (Jan. 30, 2012 1:37 PM), http://www.npr.org/2012/01/30/146092475/automakers-give-disregarded-diesels-a-second-look; Jim Motavalli, *Fixing Diesel's Bad Reputation with 50-MPG Clean Cars*, MOTHER NATURE NETWORK (Feb. 8, 2013, 1:20 PM), http://www.mnn.com/green-tech/transportation/blogs/fixing-diesels-bad-reputation-with-50-mpg-clean-cars.

91. *European Experience Shows that Cars and Trucks Powered by Clean Diesel Key to Meeting CO2 Emissions Reduction Targets*, DIESEL TECH. FORUM (May 21, 2013), http://www.dieselforum.org/news/european-experience-shows-that-cars-and-trucks-powered-by-clean-diesel-key-to-meeting-co2-emissions-reduction-targets.

92. *See Highway ULSD Fuel*, CLEAN DIESEL FUEL ALLIANCE INFO. CTR., http://www.clean-diesel.org/highway.html (last visited June 28, 2013).

93. Mercedes-Benz, discussed *infra*, is not the only automaker to jump on the clean-diesel bandwagon. *See, e.g.*, *TDI Clean Diesel & Hybrid*, VOLKSWAGON, http://web.vw.com/tdi-clean-diesel-and-hybrid/ (last visited June 28, 2013).

94. *BlueTEC Clean Diesel*, MERCEDES-BENZ USA, http://www.mbusa.com/mercedes/benz/green/diesel_bluetec (last visited May 15, 2013).

95. *DiamlerChrylser Hopes BLUETEC Initiative Will Catalyze Light-Duty Diesel In U.S.*, GREEN CAR CONGRESS (Jan. 12, 2006), http://www.greencarcongress.com/2006/01/daimlerchrysler.html. California emissions standards require a sixty-four percent reduction in nitrous oxide emissions and a fifty percent reduction in particulate matter emissions versus the somewhat less stringent standards of non-California emissions states. *Id.*; *see also* Cal. Code Regs. tit. 13, § 1961(a) (2008).

96. Eric Loveday, *Mercedes to Bring Bluetec Diesel to European-Market Sprinters by 2012, But We Get It First!*, AUTOBLOG GREEN (Apr. 20, 2010), http://green.autoblog.com/2010/04/20/mercedes-to-bring-bluetec-diesel-to-european-market-sprinters-by.

97. *DiamlerChrylser Hopes BLUETEC Initiative Will Catalyze Light-Duty Diesel In U.S.*, *supra* note 95.

BlueTec, a full-sized sport utility vehicle, actually offers better fuel economy than the comparably-sized Chevrolet Tahoe Hybrid.[98] J.D. Power and Associates anticipates that diesel passenger car sales in the United States will quadruple by 2015, from a current market share of 3.4%.[99] The predicted competition between diesel and hybrid vehicles is summed up by a Green Car Congress article:

> [T]he pace of the overall BlueTec diesel rollout in the US . . . may, over the next several years, contribute to altering the competitive landscape for improved fuel-efficiency, with clean diesel cars becoming poised to occupy the territory currently being scoped out by many hybrid implementations—fuel economy improvements of some 20–30% over comparable current gasoline platforms—with a lower-cost solution than hybrids.[100]

The advancement of gasoline and "clean diesel" technology as a competitive hurdle for EVs and PHEVs rings particularly true in the context of fleet sales. When asked what has most greatly impeded their conversion to more environmentally friendly vehicles, fleet managers most commonly cite a "lack of appropriate vehicles."[101] Though fuel-saving gasoline and diesel engines have appeared in such common fleet vehicles as the Ford F-150 and Dodge Sprinter, EVs and PHEVs nonetheless remain primarily the province of the passenger car segment, such as the Toyota Prius Plug-In Hybrid and the Chevrolet Volt.

Consumer skepticism towards EVs and PHEVs is particularly relevant in light of recent strides by automakers to make conventional ICE vehicles more cost efficient. Examples such as Ford's EcoBoost engine line and Mercedes-Benz's BlueTec diesel technology illustrate the competition that EVs and PHEVs could face in carving out a greater market share. This competition will be particularly great in the fleet vehicle market, where the EV and PHEV market segments do not currently have a strong contender.

D. Cost of Ownership

Cost of ownership creates serious issues for the EV and PHEV market. For example, EVs and PHEVs require specially-trained mechanics for

98. *Id.* (stating that the former offers a combined average fuel economy of twenty-six miles per gallon and the latter, twenty-five).

99. *Id.*

100. *Id.*

101. Burgelman & Grove, *supra* note 15, at 55.

many kinds of service.[102] This poses a particularly grave issue for fleet owners, who would need to hire or retrain entire teams of mechanics to service their EV or PHEV vehicles. Another example, perhaps even more disconcerting, is that battery replacement costs remain high.

Making repairs cheaper and more widely available remains a challenge for EVs and PHEVs. Fleet owners, more than struggling to find the right EV or PHEV for their fleet (as indicated in the aforementioned study), may simply be concerned that their new investment will turn into an endless stream of costly and time-consuming repairs. Dr. Herbert Kohler, who has worked on Mercedes-Benz's diesel and hybrid projects, notes that "[t]he diesels are simpler [and] more reliable [than hybrids]. I can say this as someone who is on both sides of the [issue]."[103] Exemplifying the complexity of PHEVs, the Chevrolet Volt has three different engines: an eighty-four-horsepower gasoline engine, a 149-horsepower electric motor, and a small seventy-four-horsepower electric "generator" motor.[104] Normally, only the 149-horsepower motor directly propels the car, while the "generator" motor generates electricity for the propelling motor, and either the battery pack or the gasoline engine, in turn, spins the "generator" motor.[105] However, above fifty miles per hour, the "generator" motor links into the planetary gearset, so that both electric motors drive the car at the same time.[106] The Volt also requires three different cooling systems: one each to cool the gasoline engine, the two electric motors and the giant (288-cell) battery pack.[107] Repair specialists for gasoline and diesel engines are widely available—engine repair classes have even been incorporated into high school vocational training programs nationwide—but hybrid engine specialists remain at a shortage.[108]

102. *See* Alison Lakin, *The Real Costs of Owning a Hybrid*, DRIVERSIDE, http://www.driverside.com/auto-library/the_real_costs_of_owning_a_hybrid-55 (last visited Feb. 20, 2012) ("A mechanic can only work on a hybrid if he has been specially trained, making auto shops that perform maintenance on hybrids a rarity.").

103. *DiamlerChrylser Hopes BLUETEC Initiative Will Catalyze Light-Duty Diesel In U.S.*, *supra* note 95.

104. Don Sherman, *What Makes Volt Run? (It's Not so Simple)*, N.Y. TIMES, Dec. 24, 2010, http://www.nytimes.com/2010/12/26/automobiles/26MODE.html.

105. *Volt Powertrain*, CAR AND DRIVER, http://media.caranddriver.com/ez/original/application/d661f9d94df87b6417357fa2b6219a84.pdf (last visited July 1, 2013).

106. *Id*.

107. Vanderwerp, *supra* note 80.

108. *See, e.g.*, Brendan Lynch, *Fed Grant to Fix Shortage of Hybrid-Car Mechanics Mechanics*, BOS. HERALD (Jul. 17, 2011), http://bostonherald.com/business/general/view/2011_0717fed_grant_to_fix_shortage_of_hybrid-car_mechanics_mechanics (describing an $8 million U.S. Department of Labor grant designed to cover the current gap in hybrid mechanic availability).

Consumers have also voiced concerns over battery replacement costs.[109] GM has refused to comment on the replacement cost of the Volt's "very expensive"[110] battery, although sources have suggested that it could cost as much as $10,000.[111] Battery costs are declining for at least some models, but a less stratospheric price does not necessarily mean that batteries have become affordable for the typical consumer. In 2008, Toyota cut battery replacement costs for the Prius from $5500 to a still-hefty $3000.[112] This price figure does not include labor, which may add an additional $900 to the bill.[113]

In summary, the strength of the consumer marketplace for EVs and PHEVs remains in doubt. Consumers have balked at the high purchase price of EVs and PHEVs, expressed concern over their potential range on an electric charge, questioned their cost of ownership, and turned to traditional ICE vehicles as an increasingly fuel-efficient alternative. The challenge of helping EVs and PHEVs gain market share should not go unaddressed by the government. The proliferation of these vehicles could save consumers money, benefit the environment, and decrease foreign oil dependence.

III. DESIGNING GOVERNMENT INCENTIVES TO ACCELERATE ADOPTION

The government should implement a five-pronged strategy to combat consumer concerns with EVs and PHEVs. First, the government should initiate an education campaign highlighting how EVs and PHEVs work, and what benefits are possible by switching to them. Second, the current tax credit regime should be replaced with an upfront rebate, reducing "sticker shock" and increasing access to EVs and PHEVs across the socioeconomic spectrum. Third, the government should broaden the application of the gas guzzler tax. This would make gas-guzzling ICE vehicles less appealing and generate extra revenue. Fourth, strategic emphasis should be placed on converting ICE fleets to PHEVs. Converting fleets en masse would encourage development of a recharging infrastructure, increase consumer exposure to EVs and

109. *See* Keith Naughton, *Assaulted Batteries*, NEWSWEEK (May 26, 2008, 8:00 PM), http://www.thedailybeast.com/newsweek/2008/05/26/assaulted-batteries.html (discussing consumer fears about prohibitive battery replacement costs).

110. Vanderwerp, *supra* note 80.

111. *Id.*

112. *Replacement Hybrid Battery Costs Plummet*, ECOMODDER, http://ecomodder.com/blog/replacement-hybrid-battery-costs-plummet/ (last visited Feb. 20, 2012).

113. Naughton, *supra* note 109.

PHEVs, and bring about a new generation of EV and PHEV mechanics.[114] Finally, the government should develop electrification "deployment communities" to spur the growth of the EV market and infrastructure.

A. Consumer Education

The government should develop a consumer education campaign highlighting the benefits of buying an EV or PHEV. This would help overcome the barriers to understanding that make consumers uncertain about, and consequently less interested in, EVs and PHEVs. Such an education program could be implemented in a variety of ways at relatively low cost.

The complex terminology used by environmentalists and energy experts to describe the workings and implications of plug-in vehicles has created a significant language barrier for the ordinary consumer. Consequently, consumers have only a limited understanding of how the technology works and how it would benefit them.[115] One researcher notes that "households are still trying to translate basic information . . . . [Consumers] don't know what it means to add, say, 150 kWh to their household's monthly electricity usage. It's not the same as knowing a tank of gas costs forty dollars and lasts them five days."[116]

Moreover, consumers do not understand charging etiquette when seeking a place to charge away from home.[117] Participants in one study, who were provided with PHEVs, reported that they were "uncertain of the propriety of asking friends, acquaintances, and business owners to recharge."[118] This uncertainty over etiquette crippled the cost savings enjoyed by most study participants, since it meant that they preferred to only plug in at home.[119]

There are several possible ways to implement an educational campaign on EVs and PHEVs, none of which would be particularly expensive or

114. *See* discussion in Part IV.D., *infra*.

115. *See Want Consumers to Buy Plug-In Hybrids?*, INST. OF TRANSP. STUDIES, UNIV. OF CAL., DAVIS (Feb. 2011), http://www.its.ucdavis.edu/?page_id=10487.

116. *Id.*

117. 1 INST. OF TRANSP. STUDIES, UNIV. OF CAL., DAVIS, PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV) DEMONSTRATION AND CONSUMER EDUCATION, OUTREACH, AND MARKET RESEARCH PROGRAM 42 (2009), *available at* http://publications.its.ucdavis.edu/publication_detail.php?id=1438 (follow the "Download PDF'" link).

118. *Id*. at 43.

119. *See id.* ("[A]s most households lacked a sense of the etiquette that would shape recharging at away-from-home locations, less away-from-home recharging was observed than may otherwise occur in a world where the rules and conventions are known.").

complex. One option is to broadcast a catchy message that reduces EVs and PHEVs to simplest terms, in the same vein as the National Highway Traffic Safety Administration's "Click It or Ticket" campaign.[120] That campaign drove an 8.6 percent increase in seat belt usage in just four weeks.[121] In North Carolina, the birthplace of the "Click It or Ticket" campaign, seat belt usage jumped from sixty-five to eighty percent in a six-month period.[122] A catchy slogan could be used not only to sell additional EVs and PHEVs, but also to remove the uncertainty surrounding charging etiquette and make it trendy (e.g. "friends let friends charge").

Another option is to simply make information on cost savings from EVs and PHEVs—written in plain English—as broadly available as possible, whether through the Internet, in pamphlet form, or otherwise. Austin Energy's "Plug-In Partners" campaign, although geared toward manufacturers rather than consumers,[123] appears to provide a model for this kind of "plain-English" promotional activity.[124]

An educational campaign would enhance the presence of EVs and PHEVs in the popular marketplace. This is so important because consumers may currently face barriers to understanding how EVs and PHEVs could benefit them—in other words, to understanding why they should be interested in either product in the first place. An educational campaign could eliminate such barriers.

B. Switching from a Tax Credit to a Rebate

The current tax credit program should be reshaped into an upfront rebate that dealers can use to decrease the car's purchase price directly. Although education may help consumers understand the benefits of an

120. PHEV pioneer Felix Kramer may have already stumbled upon precisely the catchy phrases that the PHEV market is looking for: "100+ miles per gallon plus a penny a mile of electricity," and "cleaner, cheaper, domestic." Felix Kramer, *CalCars' Plug-In Campaign: Victory After 8+ Years*, GM-VOLT (Dec. 22, 2010), http://gm-volt.com/2010/12/22/calcars-plug-in-campaign-victory-after-8-years/.

121. M.G. SOLOMON ET AL., EVALUATION OF CLICK IT OR TICKET MODEL PROGRAMS 2 (2002) *available at* http://www.nhtsa.gov/people/injury/airbags/clickitcomposite/clickit_composite.pdf.

122. *Success Stories: Click It or Ticket*, SOC. MARKETING INST., http://www.social-marketing.org/success/cs-clickit.html (last visited May 14, 2013).

123. *See Plug-In Partners*, AUSTIN ENERGY, http://www.austinenergy.com/About%20Us/Environmental%20Initiatives/plug-in%20Partners/index.htm (last visited May 14, 2013).

124. *See id.* Note the plainspoken language of the website's "Drivers" page. *Drivers*, AUSTIN ENERGY, http://www.austinenergy.com/About%20Us/Environmental%20Initiatives/plug-in%20Partners/drivers.htm (last visited Feb. 21, 2013) (illustrating the type of easy-to-understand information that should be more broadly available).

EV or PHEV, it may not singlehandedly eliminate consumer aversion to the high upfront cost of EVs and PHEVs.[125] Moreover, changing the tax credit into a rebate would make EVs and PHEVs more broadly accessible to the population as a whole.[126] Tax credits impede accessibility for prospective new buyers for two reasons. First, tax credits provide a delayed return: consumers must pay the full purchase price upfront, and wait until filing their taxes to receive the credit.[127] This limits the usefulness of tax credits to only those consumers who can pay the full price upfront and do not need the benefit upfront in order to finance the expenditure. Second, under the current regime, EV and PHEV tax credits are non-refundable.[128] In other words, the full amount of the credit is only available to those who would have been liable for that amount in tax dollars anyway.[129] Consequently, an EV or PHEV buyer would need to earn at least $55,000 per year if single—or $75,000 a year if married filing jointly—to receive the full benefit of this tax credit.[130] In sum, changing the tax credit to a rebate would expand the pool of consumers who can benefit from it, and reduce the amount that consumers must finance to purchase the car.[131]

Although the popularity of a rebate program could increase government spending, a model program may already exist for when economic circumstances improve. Quebec began offering rebates up to C$8000 ($8,358 USD) on EVs and PHEVs in 2012.[132] The program operates on a sliding scale, awarding the maximum rebate amount for EVs with high-capacity battery packs and smaller amounts for reduced-range EVs and for PHEVs.[133] Using a sliding scale not only makes the

125. This aversion to the higher purchase price of EVs and PHEVs is well documented. *See* BURGELMAN & SCHIFRIN, *supra* note 4, at 7 (noting that, in a survey of consumers who previously expressed interest in buying an HEV or EV, consumer interest dropped by fifty percent "when they discovered it would cost $5,000 extra on average to buy the car").

126. *See* Geoffrey Styles, *EV Rebates vs. Tax Credits*, ENERGY COLLECTIVE (Feb. 9, 2011), http://theenergycollective.com/geoffrey-styles/51393/ev-rebates-vs-tax-credits ("The main advantage of turning the tax credit into a rebate is in making it available to more people, and in the process putting more EVs into the hands of less affluent buyers.").

127. *Id.*

128. *Id.*

129. *Id.*

130. *Id.* Note that this scenario assumes a consumer who makes the "normal deductions and exemptions." *Id.*

131. *Id.* Reducing the amount that consumers must finance would also allow more consumers to qualify for financing in the first place. *Id.*

132. Eric Loveday, *Quebec to Offer Plug-In Vehicle Rebates of up to C$8,000*, AUTOBLOG (Apr. 11, 2011, 2:54 PM), http://green.autoblog.com/2011/04/11/quebec-offer-plug-in-vehicle-rebates-8000-dollars/ (author calculated the exchange rate when the article was published).

133. *Id.*

program more cost efficient (since some PHEV buyers only receive a partial rebate), but it also promotes the purchase of the most fuel-efficient vehicles insofar as buyers want to receive the highest rebate possible. The province has set aside C$50 million ($52.3 million USD) for the program.[134]

The Canadian province Ontario offered a similar rebate program in 2010.[135] New EV and PHEV buyers received rebates of between $5000 and $8500 (in addition to other incentives including carpool lane access).[136] The program only made rebates available to the first 10,000 applicants.[137] Offering a limited number of rebates might be appealing to the federal government if it does not wish to (or does not have the resources to) make a significant investment at the outset of the program. Moreover, it gives consumers an incentive to act quickly.

Reshaping the current tax credit program for EV and PHEV buyers into an upfront rebate could increase the popularity of these vehicles in two significant ways. First, it would help overcome the "sticker shock" that often drives consumers away from EVs and PHEVs. Second, it would help make EVs and PHEVs available to a broader socioeconomic swath of the population.

C. Applying the Gas Guzzler Tax More Aggressively

The government should complement this rebate system by expanding the gas guzzler tax to include a larger range of vehicles. One alternative to an expanded gas guzzler tax is to raise the tax on gasoline.[138] However, the political opposition to a higher gas tax makes it unlikely that such a course of action would be successful, whereas a more aggressive gas guzzler tax could be easier to push through the legislature and just as effective.

Multiple authors[139] have proposed encouraging people to switch to EVs and PHEVs by increasing the tax on gasoline. The gas tax currently averages forty-seven cents per gallon across the fifty states.[140] A higher

134. *Id.*; *see generally* GOVERNMENT OF QUÉBEC, RUNNING ON GREEN POWER!—ELECTRIC VEHICLES: 2011–2020 QUÉBEC ACTION PLAN (2011), *available at* http://www.vehiculeselectriques.gouv.qc.ca/english/pdf/action-plan.pdf (describing Quebec's EV/PHEV rebate program).

135. *See Ontario Paves the Way for Electric Vehicles*, ONTARIO MINISTRY OF TRANSP. (June 18, 2010), http://news.ontario.ca/mto/en/2010/06/ontario-paves-the-way-for-electric-vehicles.html.

136. *Id.*

137. *Id.*

138. ELECTRIFICATION COALITION, *supra* note 56, at 133.

139. *Id.*

140. *Id.*

gas tax would, logically, drive ICE users to the EV and PHEV marketplace as they seek relief for their wallets. Other developed countries already impose much higher fuel taxes than the United States.[141] In the United Kingdom, for example, gasoline is taxed at the equivalent of $3.28 per gallon, or twenty times the tax on gasoline in the United States.[142]

One could argue that rising gas prices, paired with consumer frustration towards price volatility, will eventually drive consumers to EVs and PHEVs without government intervention, but thus far the occasional price spikes have actually had the opposite effect.[143] Consumers have become accustomed to price volatility.[144] In 2008, gasoline peaked at more than $4.00 per gallon,[145] but had fallen more than fifty percent to under $2.00 per gallon by the end of the year.[146] In light of experiences like this, consumers have formed the expectation that high gasoline prices are unsustainable—in other words, their experience has suggested that when gas prices climb, they must inevitably come back down.[147] It does not take an economist to find the flaw in this logic: no matter how many peaks and valleys gasoline prices have, they continue to climb overall.[148] Nevertheless, the EV and PHEV

141. *Id.*
142. *Id.*
143. *Id.*
144. *Id.*
145. BURGELMAN & SCHIFRIN, *supra* note 4, at 3.
146. ELECTRIFICATION COALITION, *supra* note 56, at 133.
147. *Id.*
148. The cost of fuel has not merely kept pace with inflation; it has increasingly taken over the budgets of businesses and individuals. After a period of stability during the 1990s, real fuel prices have steadily increased over the past decade. *See* DEP'T OF TRANSP., BUREAU OF TRANSP. STATISTICS, A DECADE OF CHANGE IN FUEL PRICES AND U.S. DOMESTIC PASSENGER AVIATION OPERATIONS 2 (2012), *available at* http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/special_reports_and_issue_briefs/special_report/2012_03_33/pdf/entire.pdf. An inflation-adjusted oil price chart shows that crude oil prices have—excepting a few aberrations—risen exponentially in relation to the inflation rate since 1999. Tim McMahon, *Historical Oil Prices Chart*, INFLATIONDATA.COM (Apr. 16, 2013), http://inflationdata.com/Inflation/Inflation_Rate/Historical_Oil_Prices_Chart.asp. An Energy Information Administration report projects that oil price increases will continue to outpace inflation through at least 2035, "as pressure from growth in global demand continues." *Hearing to Receive Testimony on the U.S. and Global Energy Outlook of 2012: Hearing before the S. Comm. on Energy & Natural Resources*, 112th Cong. 4 (2012) (statement of Howard Gruenspecht, Acting Administrator, Energy Information Administration), *available at* http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=fb2dc2b6-10a5-4a62-8b7cf6f8f0b1fae3 (predicting also that prices will rise to $146 per barrel—in 2010 dollars—by 2035); *see also* VICTORIA TRANSP. POLICY INST., THE FUTURE ISN'T WHAT IT USED TO BE: CHANGING TRENDS AND THEIR IMPLICATIONS FOR TRANSPORT PLANNING 18 (2013), *available at* http://www.vtpi.org/future.pdf (anticipating that real fuel prices will continue to increase "during the next few decades").

market would benefit if gasoline prices were consistently high.[149] This would erode the expectation of consumers that high gasoline prices are unsustainable.[150] Imposing higher gasoline taxes tends to keep prices more stable.[151] In countries with high gas taxes, gasoline is a relatively consistent $7.00 to $9.00 per gallon.[152] By emulating this model, the United States could encourage consumers to switch from ICE vehicles to EVs and PHEVs, and perhaps even use the additional proceeds from the tax to help finance the other policy initiatives recommended in this note.

The only problem with the model above, which uses a gasoline tax to change consumer behavior, is that imposing a gasoline tax could be politically untenable.[153] It would be difficult to find a legislator who would propose such a measure and endanger their political career. Even if the measure could in theory earn some support, a less politically galvanizing—and therefore more likely to pass—alternative exists.

This alternative proposal entails simply applying the gas guzzler tax more broadly. The gas guzzler tax is a one-time tax on consumers who purchase vehicles that fall below a certain miles-per-gallon threshold.[154] The Environmental Protection Agency ("EPA"), which administers the tax, uses a sliding scale to calculate it.[155] Any car with a combined average below 22.5 miles per gallon will pay some amount of gas guzzler tax, from $1000 (for cars just under 22.5 miles per gallon) to $7700 (for cars under 12.5 miles per gallon).[156]

149. ELECTRIFICATION COALITION, *supra* note 56, at 133.

150. *Id.*

151. *Id.*

152. *Id.*

153. *See id.* (noting "the substantial likelihood of a rapid repeal of [higher gasoline] taxes in the early years after enactment for political reasons," and "the political difficulties of enacting a gas tax increase at a level that would have a dramatic impact"); Jim Tankersley, *Senators Consider Gasoline Tax as Part of Climate Bill*, L.A. TIMES (Apr. 14, 2010), http://articles.latimes.com/2010/apr/14/nation/la-na-gas-tax14-2010apr14 (observing that some legislators "fear the political specter of increasing gasoline prices" by raising the gasoline tax). *But see* MINETA TRANSP. INST., WHAT DO AMERICANS THINK ABOUT FEDERAL TAX OPTIONS TO SUPPORT PUBLIC TRANSIT, HIGHWAYS, AND LOCAL STREETS AND ROADS? 3 (2012), *available at* http://transweb.sjsu.edu/PDFs/research/1128-american-survey-federal-taxes-public-transit-highways-streets-roads.pdf (finding that while support levels for gas tax increases "tend to be below 50 percent and are often considerably lower," they are sometimes significantly higher "when the tax increase is linked to some sort of environmental benefit").

154. ENVTL. PROT. AGENCY, Gas Guzzler Tax 2 (2012), *available at* http://www.epa.gov/fueleconomy/guzzler/420f12068.pdf. Technically, the tax is placed on producers, but it is generally passed along to consumers. *See id.* ("The IRS collects the tax directly from the manufacturer or importer of the vehicles.").

155. *Id.*

156. *Id.*

Raising the gas guzzler tax threshold from 22.5 miles per gallon to some higher figure would not stir the same political opposition as a higher gasoline tax because consumers have a meaningful chance to avoid paying it. While a higher gasoline tax would impact anyone who drives a vehicle with an ICE (including PHEV owners, because PHEVs still have a gasoline engine), a more aggressive gas guzzler tax would only affect those who choose to purchase higher-consumption, less-environmentally-friendly vehicles. Moreover, because the gas guzzler tax is only imposed when purchasing a new vehicle,[157] this proposal would avoid taxing those who cannot afford to buy a new car. Taxing this group would not create any incentive for them to switch from an ICE vehicle to an EV or PHEV, since they cannot afford either type of vehicle anyway.

There are several ways to strengthen the presence of the current gas guzzler tax. One option, as previously mentioned, is to raise the threshold at which the tax is applied from the current level of 22.5 miles per gallon. Another option is to increase the amount of the gas guzzler tax—for instance, by starting it at $2500 instead of $1000. Perhaps the most intuitive choice is to extend the gas guzzler tax to trucks, minivans, and sport utility vehicles. The current gas guzzler tax does not apply to any of these vehicles, but rather only to passenger cars.[158] As the EPA's website explains, "[t]rucks, minivans, and sport utility vehicles . . . are not covered because these vehicle types were not widely available in 1978 and were rarely used for non-commercial purposes."[159] However, this is clearly no longer the case today, resulting in a significant gas guzzler loophole. One study estimates that applying a gas guzzler tax to light trucks would generate an extra $880 million a year in revenue.[160] In summary, the federal government should make the current gas guzzler tax more aggressive in order to drive consumers away from traditional ICE vehicles and towards EVs and PHEVs. Other authors have proposed that this objective should be accomplished through a higher tax on gas itself.[161] However, in light of the political opposition that this would

157. *Id.* at 1.

158. 40 C.F.R. § 600.314 (2013).

159. *Gas Guzzler Tax*, EPA, http://www.epa.gov/fueleconomy/guzzler/index.htm (last updated Oct. 18, 2012).

160. UNION OF CONCERNED SCIENTISTS, FUEL ECONOMY FRAUD (EXECUTIVE SUMMARY) 7 (n.d.), *available at* http://www.ucsusa.org/assets/documents/clean_vehicles/executive_summary_final_1.pdf.

161. *See, e.g.*, ELECTRIFICATION COALITION, *supra* note 56, at 133.

likely stir in a recovering economy, using the gas guzzler tax on manufacturers is a more viable option.

D. Focusing on Encouraging Fleet Conversions

The federal government should focus on strategies that encourage fleets to convert to EVs or PHEVs. This strategic focus would serve three goals: driving the development of an EV/PHEV infrastructure, increasing popular exposure to EVs and PHEVs, and engendering a new generation of EV and PHEV mechanics.

EV industry stakeholders have stated that promoting fleet use will help increase popularity and sales among consumers.[162] Fleets account for about sixteen million light duty vehicles, or six percent of the national total.[163] As previously mentioned, two of the greatest barriers to fleet adoption are a lack of suitable EV and PHEV vehicles as well as fleet operator reluctance to pay a greater price upfront.[164] Subsidizing ICE to PHEV retrofits for fleet operators would alleviate both of these problems: fleet operators could keep the vehicles that are best suited for the job, and would not have to pay for an entirely new fleet of vehicles.

Currently, retrofits are expensive (although not nearly as expensive as a new PHEV) and ineligible for any federal subsidies. PHEV retrofits average roughly $12,000 per vehicle.[165] The federal government's incentive program for EV and PHEV retrofits, which expired at the end of 2011, provided a ten percent tax credit for conversions (capped at $4000).[166] This reduced the average conversion cost by $1200, to $10,800.

The government could adopt any of several approaches to facilitate fleet retrofits, depending on funds available. One suggestion for the quickest way to convert one million vehicles into PHEVs is by paying the full cost of retrofitting for fleet owners, which "would result in the government investing approximately $24 billion."[167] A cheaper alternative might be to subsidize retrofits one vehicle type or model type at a time. The government could reach consumers and fleet owners alike by selecting a vehicle that is common among both groups, such as the Ford F-series. Retrofit kits must be designed for specific vehicle models

162. Jeff Cobb, *Plug-In Vehicle Industry Needs Fleet Sales*, HYBRID CARS (Sep. 17, 2011), http://www.hybridcars.com/news/plug-vehicle-indistry-places-hope-fleet-purchases-31072.html.

163. *Id.*

164. *See* discussion in Part II.A, *supra*.

165. Burgelman & Grove, *supra* note 15, at 70.

166. *See State and Federal Incentives*, *supra* note 46.

167. Burgelman & Grove, *supra* note 15, at 89.

because there is no "one-size-fits-all" kit.[168] As more fleet owners purchase the subsidized retrofit kit—for the F-series, for example—the price will fall, allowing consumers to purchase the kit as well.[169] This will also allow the government to reduce its subsidy over time as the retrofit kit becomes increasingly cheap to produce and install.

Regardless of how the retrofit subsidy program is implemented, its benefits will emerge in three important ways. First, fleet adoption will help "work[] out the kinks" in the EV and PHEV charging network infrastructure.[170] Fleet vehicles tend to repeatedly follow the same routes,[171] which will encourage the development of a network of charging stations along these routes. Second, the appearance of PHEV systems in delivery trucks, utility trucks, and other commonly-seen fleet vehicles will increase their exposure to the population generally. This is particularly important in light of the fact that consumers are unfamiliar with EVs and PHEVs.[172] Finally, the rise of PHEVs in fleets will help engender a generation of EV- and PHEV-certified mechanics. Although the availability of these mechanics is low right now,[173] training is not particularly expensive (a certification program costs about $3000),[174] and an increased PHEV presence among fleets could provide just the incentive local garages need to begin looking for new hires.

The government could enhance the presence of EVs and PHEVs in the popular marketplace by focusing its incentive programs on improving fleet sales of these products. A strategic focus on fleet sales would enhance the EV and PHEV infrastructure, provide a degree of popular exposure to EV and PHEV vehicles, and create a much-needed generation of specially trained mechanics to service these vehicles.

E. Focusing on Electrification "Deployment Communities"

The government should also focus strategically on the development and implementation of EV "deployment communities." These selected communities would be equipped with a comprehensive and easily accessible charging infrastructure. The presence of this infrastructure would entice local consumers towards EV adoption. The rise of EVs in these communities would complement the rise of PHEVs among fleets.

168. *Id.* at 51.
169. Fleet owners generally have much more capital on hand than consumers. *Id.*
170. Cobb, *supra* note 162.
171. *Id.*
172. *See* discussion Part II, *infra*.
173. *See* discussion Part II, *infra*.
174. Burgelman & Grove, *supra* note 15, at 48.

Such "deployment communities" would develop much-needed charging infrastructure while educating and enticing the public towards EVs.

"Deployment communities" are at the heart of the Electrification Coalition's policy recommendations for EV market proliferation.[175] Under this proposal, the government[176] would pay to erect a complete EV charging infrastructure in six to eight cities nationwide.[177] The Electrification Coalition suggests that, if left to private market forces, EVs could indefinitely remain a niche market.[178] However, this does not mean that the public will always have to fund EVs and EV charging infrastructure. The goals of the "deployment community" model are to make EVs enticing to consumers and to drive down costs using economies of scale.[179]

Launching "deployment communities" will make EVs more enticing to consumers. As previously discussed, one of the greatest barriers to EV and PHEV sales is a lack of consumer understanding about the products.[180] The Electrification Coalition argues that a useful way to appeal to end-users in fragmented and widely dispersed markets is by providing a real-life demonstration of how the product would work in an everyday context.[181] "By demonstrating the benefits of grid-enabled vehicles in a real world environment," these specially selected communities "will make consumers, policymakers and industry aware of the tremendous potential of the electrification of transportation."[182]

More than making EVs an appealing prospect, deployment communities will also drive down the costs associated with the EV infrastructure. As previously mentioned, cost is one barrier to charging infrastructure implementation.[183] By concentrating government resources in a selected handful of "deployment communities," producers

175. *Priorities: Deployment Communities*, ELECTRIFICATION COALITION, http://www.electrificationcoalition.org/priorities/deployment-communities (last visited May 14, 2013) (describing its deployment communities policy recommendation as central to the successful market adoption of PEVs).

176. The Electrification Coalition suggests primarily federal funding for the project, and some assistance from hosting states and localities for these "deployment communities." *Id.*

177. *Id.*

178. *Id.* Specifically, "[d]eployment communities will guarantee that electric vehicles are not relegated to a niche product owned and operated solely by environmentalists and technological enthusiasts." *Id.*

179. ELECTRIFICATION COALITION, *supra* note 56, at 141.

180. *See* discussion in Part II, *infra*.

181. ELECTRIFICATION COALITION, *supra* note 56, at 141.

182. *Id.* at 141, 143 (discussing the community selection criteria for the deployment program).

183. *See* discussion in Part II, *infra*.

in those areas can take advantage of economies of scale.[184] For example, the Electrification Coalition notes that charging facility costs "can be reduced significantly" when several such facilities are purchased and installed at once.[185]

IV. CONCLUSION

EVs and PHEVs have the chance to combat air pollution and growing oil dependency in the United States. However, their chances of proliferating the American market at more than a niche-market level remain in doubt. Although some incentives for buying EVs and PHEVs already exist at the state and federal levels, these incentives are either being phased out or are simply inadequate to turn these fuel-saving cars into a popular consumer good. Concerns over high purchase price, lack of charging infrastructure and costs of ownership, as well as growing competition from more fuel-efficient ICE's, have driven consumers away from EVs and PHEVs. The government must resolve these concerns using a multifaceted strategy that combines consumer education; switching the tax credit on EVs and PHEVs to an upfront rebate; broadening the reach of the gas guzzler tax; encouraging fleet owners to convert to PHEVs; and creating electrification "deployment communities" to showcase the potential of EVs. By combining these strategies, the government can help EVs and PHEVs break out of the niche market. Although such a multidimensional strategy represents a serious undertaking, it is designed to solve an equally serious challenge to environmental and economic integrity. EVs and PHEVs could lead the way towards a cleaner and more efficient transportation future.

184. ELECTRIFICATION COALITION, *supra* note 56, at 141.
185. *Id.* at 142.