Argonne NATIONAL LABORATORY

ANL/ESD/09-5

Multi-Path Transportation Futures Study: Vehicle Characterization and Scenario Analyses

Appendix E: Other NEMS-MP Results for the Base Case and Scenarios

Energy Systems Division

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Multi-Path Transportation Futures Study: Vehicle Characterization and Scenario Analyses

Appendix E: Other NEMS-MP Results for the Base Case and Scenarios

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ACRONYMS AND DEFINITIONS

ATV	advanced technology vehicle
BC	Base Case
Btu	British thermal unit
CAFE	Corporate Average Fuel Economy
CO_2	carbon dioxide
CV	conventional vehicle
DOE	U.S. Department of Energy
EIA	Energy Information Administration
E85	A blend of ethanol and gasoline on a volume basis. (In this appendix, where reference is made to E85, the ethanol content is actually 74%.)
FCV	fuel cell vehicle
gal	gallon
GGE	gasoline gallon equivalent
GHEV	gasoline HEV
GPRA	Government Performance and Results Act
H_2	hydrogen
kg	kilogram
kWh	kilowatt-hour
LT	light truck
LV	light vehicle (can be cars and light trucks)
MP	Multi-Path Transportation Futures Study
MPG	miles per gallon
MPGGE	miles per gallon of gasoline equivalent
NEMS	National Energy Modeling System
NEMS-MP	The integrated NEMS version used for this MP Study
PHEV	plug-in HEV
PHEVXX	A PHEV with an all-electric range of XX miles. For example, a PHEV40 has an all-electric range of 40 miles.
(P)HEV	part of the name of a scenario with both HEVs and PHEVs

Quad	A measure of energy use in British thermal units (Btus), in which 1 Quad = 1 quadrillion (10^{15}) Btu.
VMT	vehicle miles traveled

APPENDIX E: OTHER NEMS-MP RESULTS FOR THE BASE CASE AND SCENARIOS

The NEMS-MP model generates numerous results for each run of a scenario. (This model is the integrated National Energy Modeling System [NEMS] version used for the Multi-Path Transportation Futures Study [MP].) This appendix examines additional findings beyond the primary results reported in the *Multi-Path Transportation Futures Study: Vehicle Characterization and Scenario Analyses* (Reference 1). These additional results are provided in order to help further illuminate some of the primary results. Specifically discussed in this appendix are:

- Energy use results for light vehicles (LVs), including details about the underlying total vehicle miles traveled (VMT), the average vehicle fuel economy, and the volumes of the different fuels used;
- Resource fuels and their use in the production of ethanol, hydrogen (H_2), and electricity;
- Ethanol use in the scenarios (i.e., the ethanol consumption in E85 vs. other blends, the percent of travel by flex fuel vehicles on E85, etc.);
- Relative availability of E85 and H_2 stations;
- Fuel prices;
- Vehicle prices; and
- Consumer savings.

These results are discussed as follows:

- The three scenarios (Mixed, (P)HEV & Ethanol, and H2 Success) when assuming vehicle prices developed through literature review;
- The three scenarios with vehicle prices that incorporate the achievement of the U.S. Department of Energy (DOE) program vehicle cost goals;
- The three scenarios with “literature review” vehicle prices, plus vehicle subsidies; and
- The three scenarios with “program goals” vehicle prices, plus vehicle subsidies.

The four versions or cases of each scenario are referred to as:

- Literature Review No Subsidies,
- Program Goals No Subsidies,
- Literature Review with Subsidies, and
- Program Goals with Subsidies.

Two additional points must be made here. First, none of the results presented for LVs in this section include Class 2B trucks. Results for this class are included occasionally in Reference 1. They represent a small, though noticeable, segment of the "LV plus 2B" market (e.g., a little more than 3% of today's energy use in that market). We generally do not include them in this discussion, simply because it requires additional effort to combine the NEMS-MP results for them with the results for the other LVs. (Where there is an exception, we will indicate so.)

Second, where reference is made to E85, the ethanol content is actually 74%. The Energy Information Administration (EIA) assumes that, to address cold-starting issues, the percent of ethanol in E85 will vary seasonally. The EIA uses an annual average ethanol content of 74% in its forecasts. That assumption is maintained in the NEMS-MP scenario runs.

E.1 SCENARIOS WITH "LITERATURE REVIEW" VEHICLE PRICES AND NO SUBSIDIES

E.1.1 LV Energy Use

As shown in Reference 1, Section 7.1.2, LV energy use (including 2Bs) is projected in the Base Case to increase by 50% between now and 2050, with most of the growth post-2030. The "Literature Review No Subsidies" versions of the three scenarios reduce that growth by 2 to 3 percentage points by 2030 and by 9 to 10 percentage points by 2050. The variations between the scenarios are not great, but do exist, largely because of small differences in total LV VMT and average vehicle fuel economy. Total LV energy use ultimately is determined by these latter two factors. There are also some differences in the types of fuels used in the scenarios. (Each of these differences is amplified in the versions of the scenarios using "program goals" vehicle prices and incorporating vehicle subsidies.)

E.1.1.1 Total VMT Increase over Time

Table E-1 and Figure E-1 present the increase in LV travel over time from the year 2005 for the Base Case and the scenarios. The increased travel in the Base Case (110% by 2050, or more than a doubling of the 2005 VMT) is consistent with past EIA projections of increased travel per vehicle, as well as growth in the LV stock. The scenarios assume the same vehicle stock as the Base Case, but their average VMT/vehicle is higher. As a result, the increase in travel over time is greater in the scenarios: 120% by 2050. This result is due to the rebound effect, in which VMT increases as a result of lower costs per mile of travel. Because of the increased market penetration of advanced technology vehicles (ATVs) in the scenarios, the average fuel economy of LVs in the scenarios is better than in the Base Case (see Section E.1.1.2). Fuel prices are also generally lower than in the Base Case (see Section E.1.5).

The increase in travel over the Base Case is very similar in all three scenarios and occurs largely from approximately 2030 onward. This is, in part, because the ATV penetration by technology type is very similar in the scenarios. It is also due to the fact that the rebound effect in the NEMS-MP model is applied to the fleet as a whole and not to individual technologies. In other words, all vehicle technologies in any analysis year have the same annual VMT, even when their vehicle fuel economies and fuel prices differ. The correct application of the rebound effect would have vehicles of different technologies being driven different annual vehicle miles, based on their differences in fuel cost/mile.

Finally, the increase in travel of the scenarios over the Base Case has a dampening effect on the energy savings that could be achieved with the market penetration of ATVs in the scenarios. As an example, if the Mixed scenario had the same VMT as the Base Case, it would have resulted in a 14% reduction in LV energy use (excluding that of 2Bs) by 2050 instead of only 10%.

E.1.1.2 Vehicle Fuel Economy

Table E-2 and Figures E-2 and E-3 present both the average new vehicle fuel economy and the on-road fuel economy of the LV stock (all LVs in operation, not including 2Bs). The new vehicle fuel economy of the Base Case does not rise much above the 35-miles-per-gallon (MPG) Corporate Average Fuel Economy (CAFE) requirement (to be reached in 2020). All three scenarios reach approximately 44 MPG by 2050. The on-road fuel economy of the scenarios is about 8% better than the Base Case in 2030 and nearly 20% better by 2050.

E.1.1.3 Fuel Type

Table E-3 and Figures E-4 through E-8 detail energy consumption by fuel type: motor gasoline, diesel, E85, electricity, H_2, and other fuels. Motor gasoline includes ethanol, and E85 includes gasoline.

Motor gasoline consumption (Figure E-4) is highest in the Base Case, growing from 16 quads in 2005 to nearly 20 quads in 2050. In 2050, gasoline consumption in the H2 Success scenario is

16 quads (a 19% reduction from the Base Case); in the Mixed scenario, 14 quads (a 28% reduction); and in the (P)HEV & Ethanol scenario, just over 12 quads (a 37% reduction).

As shown in Figure E-5, diesel consumption in all three scenarios is higher than in the Base Case through 2035, but then it is subsequently lower. By 2020, consumption almost doubles relative to the Base Case, with increases between 84% in the (P)HEV & Ethanol scenario and 89% in the Mixed scenario. By 2035, diesel consumption in the Base Case and all three scenarios is about the same: 1.7 quads. By 2050, diesel consumption in the scenarios is about 30% less than the 3.5 quads consumed in the Base Case.

Figure E-6 depicts the energy consumed as E85. Not surprisingly, E85 consumption is highest in the (P)HEV & Ethanol scenario: consumption jumps to 1.4 quads by 2020 (nearly 35 times the E85 consumed in the Base Case) and continues to increase to more than 7 quads in 2050. This consumption level is much higher than in the Base Case, in which just less than 1 quad/year of E85 is consumed by 2050. Less total E85 is consumed in the Mixed and H2 Success scenarios than in the (P)HEV & Ethanol scenario: 5 quads and 3 quads, respectively, by 2050. Still, these volumes represent substantial increases over the Base Case.

Energy consumed as electricity by PHEVs is negligible in both the Base Case and the scenarios (Figure E-7). (For purposes of this section of the MP report, the acronym "PHEV" includes both gasoline and fuel cell plug-ins.) In fact, there is greater use of electricity by PHEVs in the Base Case than in any of the scenarios. PHEV10s achieve greater market penetration in the Base Case than do PHEV40s in any of the scenarios, which is what leads to greater electricity use in the Base Case.

Energy consumed as H_2 fuel is presented in Figure E-8. Not surprisingly, H_2 consumption is very low given that the fuel cell vehicle (FCV) stock is less than 2% of all stock in 2050 in the H2 Success scenario, which has the highest penetration of FCVs. In that scenario in 2050, H_2 consumption is less than 0.2 quads.

E.1.2 Resource Fuels

To understand the impacts of the scenarios on carbon dioxide (CO_2) emissions, we need to have not only estimates of the impacts of the scenarios on LV energy use (both total and type), but also of the resource fuels used to produce those fuels. Various feedstocks can be used to produce ethanol, H_2, and electricity — all with different CO_2 consequences. The estimates of the resource fuels used to produce them in the Base Case and scenarios are reviewed below.

E.1.2.1 Ethanol Production by Feedstock Type

In order to understand the CO_2 emissions implications of the Base Case and scenario ethanol feedstock results, we first need to discuss how the NEMS-MP model treats the ethanol feedstocks with respect to CO_2 emissions. In general, ethanol itself is assigned a zero CO_2 emission value regardless of source, but CO_2 emissions are accounted for based on energy use in ethanol's processing. For corn ethanol, emissions associated with the fossil fuels consumed in the production process are included, as are emissions associated with the increased energy expended for using additional fertilizer and growing corn. For cellulosic ethanol, all of the energy source is assumed to be sustainably grown biomass and therefore is assumed to have zero net CO_2 emissions (or even negative emissions because by-product electricity displaces electric power from other sources). Energy used to produce imported ethanol occurs in other countries and is therefore not counted in the U.S. totals generated by NEMS-MP. Clearly from the global perspective, any CO_2 generated in the production of this ethanol should be included. Still, some of this imported ethanol may be cellulosic, and some will be produced from sugar cane, which has low CO_2 emissions.

With this in mind, Table E-4 and Figures E-9 and E-10 show the breakdown of ethanol production by feedstock type, currently and in 2030 and 2050. Nearly all ethanol produced today is made domestically from corn; the rest is imported. In the Base Case, the dominance of corn will continue, though imports are projected to increase.

In the (P)HEV & Ethanol scenario, which has more optimistic assumptions about cellulosic ethanol technology improvements, high production levels of cellulose-based ethanol are achieved early. By 2030, more than 80% of the 42 billion gallons of ethanol produced (including imports) is cellulose-based. This value decreases to just less than 75% in 2050, presumably because high demand for ethanol (67 billion gallons) requires both corn-based and cellulose-based production.

Total ethanol production is higher in the Mixed and H2 Success scenarios than in the Base Case but lower than in the (P)HEV & Ethanol scenario. Total ethanol production in 2050 in the Mixed scenario is 51 billion gallons, and in the H2 Success scenario it is 38 billion gallons. Cellulosic ethanol production is also higher than in the Base Case. The volumes of cellulosic ethanol used in the Mixed and H2 Success scenarios are similar because of an additional (unintended) constraint placed on its production in the Mixed scenario. (This additional constraint applies in all versions of the Mixed scenario.)

In summary, the scenarios use much more zero-CO_2 emission cellulosic ethanol than the Base Case due to a combination of assumptions about cellulosic ethanol technology improvements and a higher demand from flex-fuel vehicles (see Section E.1.3.2).

E.1.2.2 H_2 Production by Fuel Source and Production Type

Table E-5 and Figures E-11 and E-12 show the percentage of H_2 by fuel source and production type in 2030 and 2050. Virtually no H_2 is produced today for LV use. In the Base Case, Mixed, and (P)HEV & Ethanol scenarios, all the H_2 is produced at the station forecourt using natural gas in all years. That is also true for the H2 Success scenario for many years. But by 2050, a very small share (1%) of the H_2 is reformed at a central facility using either biomass or coal in this scenario. In summary, almost all of the H_2 produced in the Base Case and the scenarios is produced from fossil fuels.

E.1.2.3 Total Electricity Generation by Fuel Type

Table E-6 and Figures E-13 and E-14 show electricity generation by fuel source (%) in 2030 and 2050. In the Base Case:

- Coal is the base fuel from which most (over 50%) electricity is generated from now through 2050;
- Nuclear power generates a steady 20% throughout time;
- Renewable resources generate approximately 10% throughout time; and
- Natural gas and petroleum generate the remainder.

Total electricity generation nearly doubles between now and 2050 in the Base Case.

Electricity production is impacted in two ways by the scenarios. One way is that electricity demand can be impacted by a change in the share of PHEVs (either gasoline or fuel cell). The other way is through changes in end-use generation that is co-produced with cellulosic ethanol or coal-to-liquids production. This "end-use" generation is not included in the total generation estimates for the electric power sector, as reported in Table E-6. All the scenarios have more optimistic assumptions about the cost of cellulosic ethanol production than the Base Case, thereby leading, generally, to greater cellulosic ethanol production and thus co-production of electricity.

As detailed in Table E-6, in this first set of scenario cases, total reported electricity generation declines slightly from the Base Case in 2030 and 2050. This decline is the result of both the decrease in vehicle electricity demand, shown in Table E-3, and a net increase in end-use generation. The overall effect of these changes in demand on the electricity generation mix of the scenarios relative to the Base Case is small.

The fact that two changes in electricity use are occurring simultaneously (PHEV use and end-use generation of electricity) makes it very difficult to estimate the marginal fuels used to generate electricity for plug-in vehicles. We have not tried to do so here.

E.1.3 Ethanol Use

One question of interest is where all the ethanol projected to be produced in the scenarios will be used. The 2050 volumes are 24 billion gallons in the Base Case and 51, 67, and 38 billion gallons in the Mixed, (P)HEV & Ethanol, and H2 Success scenarios, respectively (see Table E-4). This section discusses ethanol's use in the scenarios.

E.1.3.1 Ethanol Consumption in E85 and in Blends

Table E-7 and Figures E-15 and E-16 present the percentage of ethanol used in E85 and motor gasoline blends in 2030 and 2050, as well as the ethanol blend percent in gasoline ("splash blend %"). Today, virtually all ethanol is used in blends. There was no NEMS-MP model output for the splash blend level for the year 2005, but for 2010 the estimate is 8.6%.

The maximum splash blend level allowed is 10% in individual states. However, because California has a lower maximum level, the national average maximum is approximately 9.5–9.6%. That level is achieved in the Base Case by 2015. In subsequent years, some additional ethanol is used in gasoline blends because the total gasoline market increases. If E85 is cost-effective relative to gasoline, additional ethanol is used in E85. By 2050, 72% of the ethanol is used in gasoline blends in the Base Case, and the remaining 28% is used in E85.

As in the Base Case, the maximum amount of ethanol (9.5–9.6%) that can be used in gasoline blends is being used in the scenarios by 2015. The remaining volumes of ethanol used in the scenarios are used in E85. The highest percentage of E85 use is in the (P)HEV & Ethanol scenario, and the least is in the H2 Success scenario. In 2030, 73% of ethanol is consumed as E85 in the (P)HEV & Ethanol scenario, 45% in the Mixed scenario, and 24% in the H2 Success scenario. By 2050, these numbers have climbed to 83%, 75%, and 62%, respectively.

E.1.3.2 Share of Vehicle Stock That is Flex Fuel

Table E-8 and Figures E-17 and E-18 show the estimated share of the car and LT stock that are flexible fuel vehicles able to use E85 as well as gasoline. In the Mixed and (P)HEV & Ethanol scenarios, more than 33% of the stock (cars and light trucks [LTs]) is flex fuel by 2020, with an increase to more than 50% by 2030 and nearly 70% by 2050. In the H2 Success scenario, the share of vehicles that are flex fuel vehicles is only slightly higher than in the Base Case. By 2050, 6% of the car stock and 14% of the LT stock is flex fuel in the Base Case, while 7% of the car stock and 20% of the LT stock is flex fuel in the H2 Success scenario.

These particular results are strongly influenced by assumptions we made with respect to which vehicles might be flex fuel in the individual scenarios. These assumptions are discussed in Reference 1. Simply put, we assumed that all advanced conventional vehicles and PHEVs sold would be flex fuel from the first one sold in the Mixed and (P)HEV & Ethanol scenarios. Gasoline hybrid electric vehicles (GHEVs) that are not flex fuel are already being produced. However, we assumed that by 2020 all new GHEVs would be flex fuel in these two scenarios. In the Base Case and H2 Success scenario, the only flex fuel vehicles are baseline (not advanced) conventional-drivetrain flex fuel vehicles (also in use in the other two scenarios).

E.1.3.3 Percentage of Travel by Flex Fuel Vehicles on E85

Given these flex fuel vehicle shares and the E85 volumes estimated for the scenarios, it should not be surprising that the flex fuel vehicles travel for a considerable amount of time on E85.

Table E-9 and Figure E-19 show the percentage of flex fuel vehicle travel powered by E85. The greatest amount of travel on E85 over time occurs in the (P)HEV & Ethanol scenario: 25% of travel by flex fuel vehicles is on E85 in 2020, with an increase to 40% by 2030 and 50% by 2040. This huge increase from today's negligible levels is made possible because of lower cost ethanol and an investment over time in fueling stations offering E85.

While the greatest amount of travel on E85 over time is achieved in the (P)HEV & Ethanol scenario, the H2 Success scenario has the highest share of travel on E85 by 2040 and forward: 60% by 2040 and 68% by 2050. This occurs because E85 prices are more attractive relative to gasoline prices in this scenario. In part due to the low assumed flex fuel vehicle availability, there is less demand for ethanol overall and hence lower E85 prices, which makes it attractive for those vehicles that are flex capable.

E.1.4 E85 and H_2 Station Availability

Concern often centers on whether enough stations will be available to support the users of flex fuel vehicles who prefer to use E85 or the drivers of FCVs in search of H_2. Table E-10 and Figures E-20 and E-21 show the availability of E85 and H_2 fueling stations in the Base Case and scenarios as a percentage of the total number of gasoline fuel stations in place in 2005, as estimated in NEMS-MP: 172,400. We chose to present station availability in this manner because gasoline fuel stations are now widespread, and we considered a comparison to their current availability to be useful.

In the Base Case, E85 stations increase from a fraction of a percent in 2005 to 18% in 2050. The number of stations is higher in 2050 in each of the scenarios: 22% offer E85 in the Mixed scenario, 27% in the H2 Success scenario, and 33% in the (P)HEV & Ethanol scenario.

The number of H_2 stations is significantly lower than E85 stations in all cases. This of course makes sense, since so few FCVs are used in any of the scenarios. In the Base Case, Mixed, and (P)HEV & Ethanol scenarios, the number of stations is less than 1% in all years. In 2050, about 100 stations offer H_2 in the Base Case, and 750 stations offer it in the Mixed and (P)HEV & Ethanol scenarios.

In the H2 Success scenario, the number of stations increases rapidly, from none in 2010 to nearly 6,000 stations in 2020, and then to about 11,500 stations (7% of 2005 conventional fueling stations) in 2030. This is due to the H_2 station jump-start discussed in Reference 1. The increase post-2030 (after the jump-start ends) is much slower, with only about 13,000 stations in 2050 (8% of 2005 conventional vehicle [CV] stations).

E.1.5 Fuel Prices

Table E-11 and Figures E-22 through E-26 detail the price of fuel by type for the key transportation sector fuels: motor gasoline, diesel, E85, electricity, and H_2. (We do not present all transportation sector fuel prices). The fuel prices vary across scenarios and the Base Case, in part because we varied ethanol and H_2 production cost assumptions across the scenarios and the Base Case. The specific assumptions are discussed in Reference 1, but in summary:

- The Base Case assumes higher ethanol and H_2 production costs than all the scenarios, and
- The three scenarios have the same assumptions as each other, except that:
  - The (P)HEV &Ethanol scenario has the most optimistic ethanol cost assumptions, and
  - The H2 Success scenario has the most optimistic H_2 cost assumptions.

The fuel prices also vary across the scenarios because of the impact of reduced gasoline demand on gasoline prices.

Figure E-22 depicts the price of motor gasoline. In the Base Case, the price rises from $19/MMBtu (about $2.33/gasoline gallon equivalent [GGE][1]) to $31/MMBtu ($3.93/GGE) in 2050. In the Mixed and H2 Success scenarios, the price rises to only $29/MMBtu ($3.59/GGE) in 2050 — a 9% decrease from the Base Case. In the (P)HEV & Ethanol scenario, the price rises even less to only $28/MMBtu ($3.49/GGE) — an 11% decrease from the Base Case. This greater reduction in gasoline price in the (P)HEV & Ethanol scenario corresponds to the greater reduction in gasoline consumption (as discussed in Section E.1.1.3).

Diesel prices, shown in Figure E-23, increase from $18/MMBtu ($2.19/GGE) in 2005 to $28/MMBtu ($3.52/GGE) in 2050 in the Base Case. The price increase is more moderate in the scenarios: diesel costs only $27/MMBtu ($3.42) in 2050 — a decrease of 3% from the Base Case. In the Base Case and all scenarios, diesel prices are consistently lower than gasoline prices.

The price of E85 (Figure E-24) in the Base Case, except for a blip in 2010, rises from $23/MMBtu ($2.89/GGE) in 2005 to $31/MMBtu ($3.84/GGE) in 2050. E85 prices in the scenarios are generally considerably lower, particularly in the (P)HEV & Ethanol scenario. But this result should be expected because of the differences in the production cost assumptions underlying the scenarios, as explained above, and the differences in total ethanol demand. The price of E85 relative to gasoline is generally higher through 2030, except in the (P)HEV & Ethanol scenario. By 2040, the E85 prices of the scenarios and the Base Case are generally lower than that of gasoline.

The electricity price estimated in NEMS-MP for PHEV users assumes that they are residential customers charging off-peak (Figure E-25). The portion of LV energy consumed as electricity is very small in these scenarios (as discussed in Section E.1.1.3), so pricing in all three scenarios differs little from the Base Case. The price decreases from $30/MMBtu ($3.72/GGE or 10 cents/kilowatt-hour [kWh]) to $23.5/MMBtu ($2.93/GGE or 8 cents/kWh) in 2050. Beyond 2035, electricity is favorably priced with respect to gasoline in the Base Case and all scenarios.

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[1] 1 GGE = 125,000 British thermal units (Btu).

H_2 prices, presented in Figure E-26, are considerably lower in the scenarios than in the Base Case due to assumed continued improvements in H_2 technologies compared with no improvement in the Base Case. The H2 Success case has slightly lower prices in the long term because of slightly improved technology, but H_2 demand remains very small and is insufficient to lead to further price reductions through economies of scale.

E.1.6 Average New Vehicle Prices

Table E-12 and Figures E-27 and E-28 provide estimated prices for new cars and new LTs, respectively, in the Base Case and the three scenarios. The prices in the Base Case account for the impacts of the CAFE regulations. The average prices for new vehicles — both cars and LTs — are higher in all the scenarios than in the Base Case due to the increased adoption of ATVs. Average new car prices increase by between 1% and 2% (from $29,000 in the Base Case to $30,400 in the H2 Success scenario in 2050), and LT prices increase by 1% to 1.2% (from $34,000 in the Base Case to $34,400 in the H2 Success scenario in 2050).

E.1.7 Consumer Savings

Consumers can save money with the market penetration of energy-efficient technologies. DOE estimates the savings to consumers of its programs in its Government Performance and Results Act (GPRA) benefits analysis. In estimating the savings for the DOE vehicle-related technology programs, DOE defines consumer savings to be the difference between the total U.S. energy expenditures plus amortized vehicle expenditures of (a) the base case it is using and (b) a projection that incorporates increased market penetration of ATVs as a result, in part, of its programs. In this section, we estimate consumer savings of the MP scenarios relative to the MP Base Case using the same methodology.

E.1.7.1 Total Energy Expenditures

Total energy expenditures are presented in Table E-13, along with total transportation expenditures (for information purposes only). While it might seem that we should be interested in only the energy expenditures of consumers that use LVs, the greater penetration of ATVs in the LV market impacts the prices of motor fuels used by heavy trucks and in non-highway uses. Further, the greater penetration of ATVs can also impact electricity generation and thus costs to other users. (PHEV penetration would potentially have some effect on the cost of electricity to other users. In addition, the co-production of electricity in the course of producing cellulosic ethanol may affect the cost of electricity to other users by slightly reducing demand from the grid.) Therefore, “total energy expenditures” are used in the consumer savings calculation.

Table E-13 shows that the total energy expenditures of the scenarios are lower than those of the Base Case, with the (P)HEV & Ethanol scenario being the lowest. By 2050, total energy expenditures in that scenario are 7% less than those of the Base Case.

E.1.7.2 Amortized Vehicle Expenditures

The total amortized vehicle expenditures for any year in the Base Case and scenarios are the sum of the amortized cost of all the vehicles sold in that year and the preceding 9 years, assuming a 10% discount rate (i.e., each vehicle is amortized over a 10-year period for this post-processing of expenditures). This is the same assumption that is made in the DOE GPRA benefits analysis. Table E-14 and Figures E-29 and E-30 present these expenditures. We do not have complete amortized costs for the years 2005 and 2010, but that does not matter. The real issue is the "difference" in costs between the Base Case and scenarios, and there should be virtually no difference in those years.

In the Base Case, the sum total of amortized payments climbs from $420 billion in 2015 (which corresponds to vehicles purchased between 2005 and 2015) to $520 billion in 2050 for cars and from $380 billion in 2015 to $665 billion in 2050 for LTs. In the scenarios, these expenditures are similar, though slightly higher, particularly for the LTs. Thus, the total consumer vehicle expenditures (for cars and LTs together) are very slightly higher than those of the Base Case (e.g., approximately 1% higher in 2030 and 2050).

E.1.7.3 Total Consumer Savings

Table E-15 and Figure E-31 show the total consumer savings, calculated by comparing the total energy and vehicle expenditures in each scenario against those of the Base Case. In the Base Case, total consumer expenditure increases from $2.0 trillion in 2015 to $3.5 trillion in 2050. Expenditures are generally lower in the scenarios, though expenditures in the Mixed and H2 Success scenarios are actually slightly higher (by at most about $1 billion) through 2020. Therefore, the scenarios do generate consumer savings, except in the early years of the Mixed and H2 Success scenarios.

Over time, the savings of the (P)HEV & Ethanol scenario are the greatest of all the scenarios. However, by 2040, the savings of the three scenarios are similar. By 2050, the (P)HEV & Ethanol scenario saves $150 billion, the Mixed scenario saves $134 billion, and the H2 Success scenario saves $141 billion. On average, the consumer savings of the scenarios is about 4% in 2050.

E.2 SCENARIOS WITH "PROGRAM GOALS" VEHICLE PRICES AND NO SUBSIDIES

E.2.1 LV Energy Use

As indicated in Section E.1.1, LV energy use (including 2Bs) is projected in the Base Case to increase by 50% between now and 2050, with most of the growth post-2030. The "Program Goals No Subsidies" versions of the scenarios reduce that growth by 5 to 8 percentage points by

2030 and by 14 to 19 percentage points by 2050 — substantially more than that achieved by the "Literature Review No Subsidies" cases. Since total LV energy use ultimately is determined by total VMT and vehicle fuel economy, these two factors are discussed below.

E.2.1.1 Total VMT Increase over Time

Table E-16 and Figure E-32 present the increase in LV travel over time from 2005 for the Base Case and the scenarios. As discussed in Section E.1.1, the scenarios assume the same vehicle stock as the Base Case, but their average VMT/vehicle is higher due to the rebound effect. The average fuel economy of LVs in the scenarios is better than in the Base Case (see Section E.2.1.2), and fuel prices are also generally lower than in the Base Case (see Section E.2.5). As such, the cost/mile of travel is lower in the scenarios, thereby encouraging additional travel.

The increase in travel is very similar in all three scenarios and occurs steadily over time. The percentage of increase in all three scenarios — about 130% over 2005 levels — is higher than in the Base Case (110%). As noted in Section E.1.1.1, this significant increase in VMT has a dampening effect on the energy savings that might otherwise be achieved with the market penetration of ATVs in the scenarios. As an example, if the Mixed scenario had the same VMT as the Base Case, it would have resulted in a 24% reduction in LV energy use (excluding that of 2Bs) by 2050 instead of only 17%.

E.2.1.2 Vehicle Fuel Economy

Table E-17 and Figures E-33 and E-34 present both the average new vehicle fuel economy and the on-road fuel economy of the LV stock. The average new vehicle fuel economy in all three scenarios surpasses 50 MPG by 2050, and thus it is considerably higher than that achieved in the "Literature Review No Subsidies" versions of the scenarios (44 MPG). The on-road fuel economy of the scenarios is also better than that achieved in the "Literature Review No Subsidies" cases (35% improvement over the Base Case by 2050 vs. 20%).

E.2.1.3 Fuel Type

Table E-18 and Figures E-35 through E-39 detail energy consumption by fuel type. Motor gasoline includes ethanol, and E85 includes gasoline.

Motor gasoline consumption, shown in Figure E-35, is highest in the Base Case, growing from 16 quads in 2005 to nearly 20 quads in 2050. In 2050 in the H2 Success scenario, gasoline consumption is 12 quads (a 38% reduction from the Base Case); in the Mixed scenario, 11 quads (a 43% reduction); and in the (P)HEV & Ethanol scenario, just over 10 quads (a 47% reduction).

As Figure E-36 shows, diesel consumption in all three scenarios is higher than in the Base Case through 2045, but then it is lower. In 2020 and 2030, consumption is about two times Base Case levels (average increase is 135% in 2020 and 95% in 2030). In 2045, diesel consumption in the

Base Case and all three scenarios is about 2.9 quads. By 2050, diesel consumption in the scenarios ranges from 12% to 30% less than the Base Case (3.5 quads).

Figure E-37 depicts the energy consumed as E85. Not surprisingly, E85 consumption is highest in the (P)HEV & Ethanol scenario: consumption jumps to nearly 1 quad by 2020 (nearly 20 times the E85 consumed in the Base Case) and continues to increase to over 6 quads in 2050, at which time consumption in the Base Case is just under 1 quad. Less total E85 is used in the Mixed and H2 Success scenarios: 4.6 quads and 2 quads, respectively, in 2050. E85 consumption is lower in all three of these "Program Goals No Subsidies" versions of the scenarios than in the "Literature Review No Subsidies" cases.

Electricity consumption by PHEVs is relatively low. As Figure E-38 shows, in the Base Case and the scenarios, the highest annual electrical fuel consumption in 2050 is just above 0.25 quads, which corresponds to only 43 million barrels of oil, or about 1% of total LV energy consumption. Electricity consumption is highest in the H2 Success scenario, at 0.25 quads in 2050. Consumption for that year is only 0.16 quads in the (P)HEV & Ethanol scenario, 0.12 quads in the Mixed scenario, and 0.02 quads in the Base Case. The main reason for the higher level of electricity consumption in the H2 Success scenario is that there are actually more plug-ins (gasoline and fuel cell) on the road in the H2 Success scenario than in the other two scenarios. Plug-in FCVs in particular penetrate the LV market at higher levels than in the other two scenarios.

Energy consumed as H_2 fuel is depicted in Figure E-39. Not surprisingly, H_2 consumption increases most significantly in the H2 Success scenario: it climbs from zero in 2010 to more than 0.3 quads in 2030 (80 times the .01 quads of H_2 consumed in the Base Case) and to 2.5 quads in 2050 (a nearly 340-fold increase over the .07 quads consumed in the Base Case). Increases in H_2 consumption are more modest in the Mixed and (P)HEV & Ethanol scenarios: 5 times the Base Case consumption in 2030 and nearly 1 quad by 2050 (over 100 times the 2050 Base Case consumption).

E.2.2 Resource Fuels

As stated in Section E.1.2, a full understanding of the impacts of the scenarios on CO_2 emissions requires both estimates of the impacts of the scenarios on LV energy use (both total and type) and knowledge of the resource fuels used to produce those fuels. Estimates of the resource fuels used to produce ethanol, H_2 and electricity are reviewed below.

E.2.2.1 Ethanol Production by Feedstock Type

Table E-19 and Figures E-40 and E-41 show the breakdown of ethanol production by feedstock type, currently and in 2030 and 2050. As stated before, nearly all ethanol produced today is made domestically from corn, and the rest is imported. In the Base Case, the dominance of domestic corn continues, although imports are projected to increase.

In the (P)HEV & Ethanol scenario, high production levels of cellulose-based ethanol are achieved early. By 2030, over 90% of the 37 billion gallons of ethanol produced (including imports) is cellulose-based. This value decreases to just less than 80% in 2050, presumably because high demand for ethanol (59 billion gallons) requires both corn-based and cellulose-based production.

Total ethanol production is higher in the Mixed scenario than in the Base Case, but lower than in the (P)HEV & Ethanol scenario: 46 billion gallons in 2050. Total ethanol use in the H2 Success scenario is lower than in the other two scenarios, being in fact very similar to the Base Case volume. However, much more cellulosic ethanol is produced in both the Mixed and H2 Success scenarios than in the Base Case.

As with the "Literature Review No Subsidies" versions of the scenarios, the "Program Goals No Subsidies" cases use much more zero-CO_2 emission cellulosic ethanol than the Base Case due to a combination of assumptions about cellulosic ethanol technology improvements and a higher demand for flex-fuel vehicles.

E.2.2.2 H_2 Production by Fuel Source and Production Type

Table E-20 and Figures E-42 and E-43 show the percentage of H_2 by fuel source and production type in 2030 and 2050. Virtually no H_2 is produced today for LV use. Very little H_2 is produced in any year in the Base Case, in which production is still less than 100 million kilograms (kg) of H_2 in 2050, all of which is produced at the station forecourt using natural gas. In the (P)HEV & Ethanol and Mixed scenarios, H_2 production begins to pick up in 2030, at which time 175 million kg are produced, all at the station forecourt using natural gas. However, by 2050, 6.2 billion kg are produced in the (P)HEV & Ethanol scenario and 6.9 billion kg in the Mixed scenario. Of this, most (88% and 82%) is still produced at the station forecourt using natural gas. The rest is largely produced from coal, most of which is unsequestered production (i.e., the CO_2 emissions from H_2 production are not captured).

In the H2 Success scenario, advanced H_2 production techniques are already online by 2030. Nearly one-quarter of the 2.3 billion kg produced is generated at a central facility: 11% from biomass, 10% from coal (15% of which is sequestered production), and a very small portion from natural gas. By 2050, over 60% of the 19 billion kg produced is generated at a central facility: 30% from biomass, 37% from coal (17% of which is sequestered production), and 1.1% from natural gas.

In summary, while almost all the H_2 produced in the Base Case, (P)HEV & Ethanol, and Mixed scenarios is made from fossil fuels, over one-quarter of the H_2 produced in the H2 Success scenario is made from biomass. When the H_2 produced from coal with carbon sequestration is combined with the H_2 produced from biomass, 36% of the H_2 produced in 2050 in the H2 Success scenario is derived from low carbon technologies.

E.2.2.3 Total Electricity Generation by Fuel Type

Table E-21 and Figures E-44 and E-45 detail the percentage of electricity by fuel source and production type in 2030 and 2050. There is not much change from the results discussed for the "Literature Review No Subsidies" versions of the scenarios. Coal still dominates electricity production. The total electricity generation of the scenarios is still below that of the Base Case (see Section E.1.2.3 for an explanation).

E.2.3 Ethanol Use

By 2050, 24 billion gallons of ethanol are used in the Base Case and 46, 59, and 27 billion gallons are used in the Mixed, (P)HEV & Ethanol, and H2 Success scenarios, respectively. This section discusses how that ethanol is used.

E.2.3.1 Ethanol Consumption in E85 and in Blends

Table E-22 and Figures E-46 and E-47 present the percentage of ethanol used in E85 and motor gasoline blends in 2030 and 2050, as well as the splash blend percentage. Today, virtually all ethanol is used in blends.

As indicated in Section E.1.3.1, the maximum splash blend level allowed is 10% in individual states. However, because California has a lower maximum level, the national average maximum is approximately 9.5%. That level is achieved in the Base Case by 2015. In subsequent years, additional ethanol is used in E85. Thus, by 2050 in the Base Case, 72% of the ethanol is used in gasoline blends, and the remaining 28% is used in E85.

As in the Base Case, the maximum amount of ethanol (9.5%) that can be used in gasoline blends is being used in the scenarios by 2015. The remaining volumes of ethanol used in the scenarios are used in E85. As with the "Literature Review No Subsidies" versions of the scenarios, the highest percentage of E85 use is in the (P)HEV & Ethanol scenario, and the least is in the H2 Success scenario. In 2030, 72% of ethanol is consumed as E85 in the (P)HEV & Ethanol scenario, 41% in the Mixed scenario, and 16% in the H2 Success scenario. By 2050, these numbers have climbed to 83%, 77%, and 58%, respectively.

E.2.3.2 Share of Vehicle Stock That Is Flex Fuel

Table E-23 and Figures E-48 and E-49 present the estimated share of the car and LT stock that are flexible fuel vehicles able to use E85 as well as gasoline. In the Base Case, the number of flex-fuel-capable cars and LTs increases from 0.5% and 4%, respectively, with an increase to 6% of cars in 2005 and 14% of LTs in 2050. In the Mixed and (P)HEV & Ethanol scenarios, more than 50% of both cars and LTs on the road are flex fuel by 2030. By 2050, approximately 60% of cars and LTs are flex fuel. In the H2 Success scenario, the number of flex fuel vehicles is roughly equivalent to the Base Case until 2050.

These particular results are strongly influenced by assumptions made with respect to which vehicles might be flex fuel. See Section E.1.3.2 for a further discussion of the underlying assumptions.

E.2.3.3 Percentage of Travel by Flex Fuel Vehicles on E85

Given these flex fuel vehicle shares and the E85 volumes estimated for the scenarios, it should not be surprising that the flex fuel vehicles travel for a considerable amount of time on E85. Table E-24 and Figure E-50 show the percentage of flex fuel vehicle travel powered by E85. As with the "Literature Review No Subsidies" versions of the scenarios, the greatest amount of travel on E85 over time is in the (P)HEV & Ethanol scenario: 25% of travel by flex fuel vehicles is on E85 in 2025, with an increase to nearly 40% by 2030, then growing slowly for an increase to just greater than 50% by 2050. However, also as in the "Literature Review No Subsidies" cases, the H2 Success scenario has the highest share of travel on E85 by flex fuel vehicles by 2040 and forward. The scenario uses approximately the same total volume of ethanol as in the Base Case by 2050, but there is much less gasoline into which it can be blended, thus making it available for use in E85 by the nearly 10% of the stock that is flex fuel.

E.2.4 E85 and H_2 Station Availability

Table E-25 and Figures E-51 and E-52 show the availability of alternative fuel stations (E85 and H_2) as a percentage of the total number of conventional fuel stations in place in 2005. In the Base Case, E85 stations increase from a fraction of a percent in 2005 to 18% in 2050. The percentage of stations offering E85 (as a percent of year-2005 conventional stations) is approximately the same in 2050 in the H2 Success scenario, but it is higher in the Mixed scenario (20%) and the (P)HEV & Ethanol scenario (27%). These percentages are lower than in the "Literature Review No Subsidies" versions of the scenarios.

The availability of H_2 stations increases greatly over the "Literature Review No Subsidies" versions of the scenarios. By 2005 in the Mixed and (P)HEV & Ethanol scenarios, H_2 is available at approximately 20% of year-2005 stations versus less than 1% in the "Literature Review No Subsidies" cases. However, the substantial increase in H_2 station availability does not occur until late in the scenarios.

In the H2 Success scenario, the number of stations increases steadily, from none in 2010 to about 13,500 stations (about 8% of 2005 conventional fueling stations) in 2030. This is due to the H_2 station jump-start discussed in Reference 1. The post-2030 increase (after the jump-start ends) remains high, with about 115,000 stations in 2050, or nearly 68% of the year-2005 conventional fueling stations.

E.2.5 Fuel Prices

Table E-26 and Figures E-53 through E-57 detail the price of fuel by type for the key transportation sector fuels: motor gasoline, diesel, E85, electricity, and H_2. The fuel prices vary across the scenarios and the Base Case, in part because we varied ethanol and H_2 production cost assumptions across the scenarios and the Base Case. The assumptions are briefly described in Section E.1.5.

Figure E-53 depicts the price of motor gasoline. In the Base Case, the price rises from \$19/MMBtu (about \$2.33/GGE) to \$31/MMBtu (\$3.93/GGE) in 2050. In the three scenarios, the price rises, on average, to only about \$26/MMBtu (\$3.23/GGE) in 2050, which is an 18% decrease from the Base Case. It is worth noting that gasoline prices are lower earlier in the (P)HEV & Ethanol scenario — a full 5 percentage points less than in the Mixed and H2 Success scenarios by 2030. Gasoline prices are also lower than those estimated for the "Literature Review No Subsidies" versions of the scenarios.

Diesel prices, shown in Figure E-54, increase from \$18/MMBtu (\$2.20/GGE) in 2005 to approximately \$28/MMBtu (\$3.50/GGE) in 2050 in the Base Case and scenarios. While early on in the scenarios, the prices are lower than gasoline prices, by 2040 they are higher.

The price of E85 is provided in Figure E-55. The (P)HEV & Ethanol scenario generally has the lowest E85 prices through 2030, while the H2 Success scenario has the lowest prices post-2035. As with the "Literature Review No Subsidies" cases, the price of E85 relative to gasoline is generally higher through 2030, except in the (P)HEV & Ethanol scenario. By 2040, the E85 prices of the scenarios and the Base Case are generally lower than that of gasoline.

As indicated previously, the electricity price estimated in NEMS-MP pertains only to PHEV users who are assumed to be residential customers charging off-peak (Figure E-56). The portion of energy consumed as electricity is relatively small in the "Program Goals No Subsidies" versions of the scenarios (as discussed in Section E.2.1.3), so pricing in all three scenarios differs little from the Base Case. Beyond 2035, electricity is favorably priced with respect to gasoline in the Base Case. However, it is not favorably priced (on a \$/million Btu basis) in the scenarios until 2045.

H_2 prices, shown in Figure E-57, increase from \$31/MMBtu (\$3.87/GGE) in 2010 to \$32/MMBtu (\$4.00/GGE) in 2050 in the Base Case. Prices are lower in all three scenarios. Prices in the H2 Success scenario are slightly higher than in the other scenarios in the early years (through 2025) due to higher demand and are slightly lower in later years (after 2030). Ultimately, in 2050, the price of H_2 in the H2 Success scenario is \$21/MMBtu (\$2.63/GGE).

E.2.6 Average New Vehicle Prices

Table E-27 and Figures E-58 and E-59 present estimated prices for new cars and new LTs, respectively, in the Base Case and the three scenarios. The average price of new cars and LTs in the scenarios is virtually the same over time, though the prices of the H2 Success scenario might be considered slightly higher. The average prices for a new car are slightly higher (at most $400) in all scenarios than in the Base Case through 2040. By 2050, the average price for a new car in the scenarios is the same as in the Base Case. The same is true for LTs, except that in 2050 the average new LT price is slightly higher than in the Base Case (about $300).

E.2.7 Consumer Savings

As explained in Section E.1.7, consumer savings are estimated here based on the method used in the DOE GPRA process. See Section E.1.7 for a brief explanation of the method.

E.2.7.1 Total Energy Expenditures

Table E-28 provides the total energy expenditures of the Base Case and scenarios. Those of the scenarios are lower than those of the Base Case. The expenditures in the (P)HEV & Ethanol scenario are the lowest through 2030, and those of the H2 Success scenario are the lowest by 2040. By 2050, total energy expenditures in the H2 Success scenario are 13% less than those of the Base Case.

E.2.7.2 Amortized Vehicle Expenditures

Table E-29 and Figures E-60 and E-61 present amortized vehicle expenditures. In the Base Case, the sum total of amortized payments climbs from $420 billion in 2015 to $520 billion in 2050 for cars and from $380 billion in 2015 to $665 billion in 2050 for LTs. In the scenarios, total vehicle expenditures climb from $421 billion in 2015 to $510 billion in 2050 for cars and from $387 billion to $683 billion in 2050 for LTs. Total consumer vehicle expenditures (cars and LTs) in the scenarios are thus very similar to, though slightly higher than, those of the Base Case.

E.2.7.3 Total Consumer Savings

Table E-30 and Figure E-62 show the total consumer savings, calculated by comparing the total energy and vehicle expenditures in each scenario against those of the Base Case. All the scenarios generate consumer savings from the start, with the (P)HEV & Ethanol scenario having the greatest savings through 2030. It is not clear which of the three scenarios has the greatest cumulative savings over time. By 2050, the (P)HEV & Ethanol scenario saves $233 billion, the Mixed scenario saves $230 billion, and the H2 Success scenario saves $281 billion. In that year, the consumer savings of the scenarios ranges from 6.5% to 8%. This amount of savings is higher than the 4% estimated for the "Literature Review No Subsidies" versions of the scenarios.

E.3 SCENARIOS WITH "LITERATURE REVIEW" VEHICLE PRICES PLUS SUBSIDIES

E.3.1 LV Energy Use

As stated previously, LV energy use (including 2Bs) is projected in the Base Case to increase by 50% between now and 2050, with most of the growth post-2030. The "Literature Review with Subsidies" versions of the scenarios reduce that growth by 5 to 9 percentage points by 2030 and by 20 to 23 percentage points by 2050 — more than twice the reduction achieved in the "Literature Review No Subsidies" cases (the other versions of the scenarios with which comparisons are most appropriate). Since LV energy use ultimately is determined by total LV VMT and vehicle fuel economy, these two factors are discussed below.

E.3.1.1 Total VMT Increase over Time

Table E-31 and Figure E-63 present the increase in LV travel over time from 2005 for the Base Case and the scenarios. As stated before, the scenarios assume the same vehicle stock as the Base Case, but their average VMT/vehicle is higher due to the rebound effect. The average fuel economy of LVs in the scenarios is better than in the Base Case (see Section E.3.1.2), and fuel prices are also generally lower than in the Base Case (see Section E.3.5). As such, the cost/mile of travel is lower in the scenarios, thereby encouraging additional travel.

The increase in travel over the Base Case is very similar in all three scenarios and occurs steadily over time. The percentage increase in all three scenarios — about 137% over 2005 levels — is higher than in the Base Case (110%). As noted previously, this significant increase in VMT has a dampening effect on the energy savings that could be achieved with the market penetration of ATVs in the scenarios. As an example, if the Mixed scenario had the same VMT as the Base Case, it would have resulted in a 33% reduction in LV energy use (excluding that of 2Bs) by 2050 instead of 24%.

E.3.1.2 Vehicle Fuel Economy

Table E-32 and Figures E-64 and E-65 show both the average new vehicle fuel economy and the on-road fuel economy of the LV stock. The average new vehicle fuel economy in all three scenarios is close to or surpasses 60 MPG by 2050, which is much higher than the 44 MPG of the "Literature Review No Subsidies" versions of the scenarios. The on-road fuel economy of the scenarios is about 20% better than the Base Case in 2030 and nearly 55% better by 2050.

E.3.1.3 Fuel Type

Table E-33 and Figures E-66 through E-70 detail energy consumption by fuel type. Motor gasoline includes ethanol, and E85 includes gasoline.

Motor gasoline consumption (Figure E-66) is highest in the Base Case, growing from 16 quads in 2005 to nearly 20 quads in 2050. In 2050 in the H2 Success scenario, consumption is 10.9 quads (a 45% reduction from the Base Case); in the Mixed scenario, consumption is 10.7 quads (a 46% reduction); and in the (P)HEV & Ethanol scenario, consumption is just over 10 quads (a 49% reduction).

As Figure E-67 shows, diesel consumption in all three scenarios is higher than in the Base Case through 2030, but then it is subsequently lower. By 2020, consumption almost doubles relative to the Base Case (i.e., increases between 83% in the (P)HEV & Ethanol scenario and 88% in the Mixed and H2 Success scenarios). In 2030, diesel consumption in the Base Case and all three scenarios is about 1.25 quads on average. By 2050 in the scenarios, diesel consumption is about 1.2 quads, which is a 68% reduction from the 3.5 quads consumed in the Base Case.

Fig 68 depicts the energy consumed as E85. Not surprisingly, E85 consumption is highest in the (P)HEV & Ethanol scenario: consumption jumps to 1.4 quads by 2020 (nearly 35 times the E85 consumed in the Base Case) and continues to increase to 6 quads in 2050. This consumption level is much higher than in the Base Case, in which just less than 1 quad/year of E85 is consumed by 2050. Less total E85 is consumed in the Mixed and H2 Success scenarios than in the (P)HEV & Ethanol scenario: 4 quads and 2 quads, respectively, in 2050. These volumes are less than in the "Literature Review No Subsidies" versions of the scenarios.

The use of electricity by PHEVs is shown in Figure E-69. Consumption is negligible in both the Base Case and the H2 scenarios, but electricity consumption begins a steady climb after 2025 in the Mixed and (P)HEV & Ethanol scenarios: in 2050, consumption is 0.9 and 1.4 quads, respectively. The increase in electricity consumption is a direct result of the increased market penetration of PHEVs that begins before 2020. By 2025, 24% of all LV sales are PHEVs in the (P)HEV & Ethanol scenario and 19% in the Mixed scenario. By 2050, the PHEV stock shares are 46% in the (P)HEV & Ethanol scenario and 28% in the Mixed scenario.

Energy consumed as H_2, presented in Figure E-70, increases markedly in the H2 Success and Mixed scenarios. Not surprisingly, H_2 consumption is very low in the Base Case and (P)HEV & Ethanol scenarios, given that in both cases the FCV stock is less than 0.2% of all stock in 2050. In the Mixed scenario, H_2 consumption increases after 2035 (at which time FCV market penetration begins to inch upwards), reaching over 1.5 quads in 2050. In the H2 Success scenario, H_2 consumption increases noticeably as early as 2020 (spurred by early FCV market penetration), reaching over 5 quads — one-fourth of all LV energy consumption — in 2050.

E.3.2 Resource Fuels

As stated previously, a full understanding of the impacts of the scenarios on CO_2 emissions requires both estimates of the impacts of the scenarios on LV energy use (both total and type) and knowledge of the resource fuels used to produce those fuels. Estimates of the resource fuels used to produce ethanol, H_2 and electricity are reviewed below.

E.3.2.1 Ethanol Production by Feedstock Type

Table E-34 and Figures E-71 and E-72 show the breakdown of ethanol production by feedstock type, currently and in 2030 and 2050. As stated before, nearly all ethanol produced today is made domestically from corn, and the rest is imported. In the Base Case, the dominance of corn continues, although imports are projected to increase.

In the (P)HEV & Ethanol scenario, high production levels of cellulose-based ethanol are achieved early. By 2030, over 85% of the 40 billion gallons of ethanol produced (including imports) is cellulose-based. This value decreases to just less than 80% in 2050, presumably because high demand for ethanol (57 billion gallons) requires both corn-based and cellulose-based production.

Total ethanol production is higher in both the Mixed and H2 Success scenarios than in the Base Case (though barely for the H2 Success scenario), but lower than in the (P)HEV & Ethanol scenario. Total ethanol production in 2050 in the Mixed scenario is 41 billion gallons, and in the H2 Success scenario it is 24.5 billion gallons. Cellulosic ethanol production is also higher than in the Base Case.

As with the "Literature Review No Subsidies" cases, the scenarios use much more zero-CO_2 emission cellulosic ethanol than the Base Case.

E.3.2.2 H_2 Production by Fuel Source and Production Type

Table E-35 and Figures E-73 and E-74 present the percentage of H_2 by fuel source and production type in 2030 and 2050. Very little H_2 is produced in any year in the Base Case and (P)HEV & Ethanol scenario, and all that is produced is done so at the station forecourt using natural gas. In the Mixed scenario, H_2 production begins to pick up in 2030, but again all of it is produced at the station forecourt using natural gas. By 2050, 12 billion kg are produced, 25% of which is produced at a central facility using mostly coal. Most of the H_2 produced from coal is produced via unsequestered production.

In the H2 Success scenario, advanced H_2 production techniques are already online by 2030. Over half of the 6 billion kg produced is generated at a central facility: 30% from biomass, 22% from coal (15% of which is sequestered production), and 2% from natural gas. By 2050, over 60% of the 40 billion kg produced is generated at a central facility: 27% from biomass and 36% from coal (17% of which is sequestered production).

In summary, while almost all of the H_2 produced in the Base Case, (P)HEV & Ethanol, and Mixed scenarios is produced from fossil fuels, by 2050 over one-quarter of the H_2 produced in the H2 Success scenario is produced from biomass. When the H_2 produced from coal with carbon sequestration is combined with the H_2 produced from biomass, 33% of the H_2 produced in 2050 in the H2 Success scenario is produced from low carbon technologies.

E.3.2.3 Total Electricity Generation by Fuel Type

Table E-36 and Figures E-75 and E-76 detail the percentage of electricity by fuel source and production type in 2030 and 2050. Because of the dramatic increase in PHEV penetration in the Mixed and (P)HEV & Ethanol scenarios, some differences occur between the Base Case and these two scenarios and between these versions of the scenarios and the “Literature Review No Subsidies” versions of the scenarios. First, the increased penetration of the PHEVs leads to higher total electricity generation than in the Base Case. (For example, by 2050 the total electricity generated in the (P)HEV & Ethanol scenario is 4.5% higher than in the Base Case.) Second, the increased demand also appears to lead to slightly higher coal generation shares than in the “Literature Review No Subsidies” cases (e.g., 60.5% vs. 58.1% in 2050 in the (P)HEV & Ethanol scenario). However, the differences in generation and generation mix for these two scenarios versus the Base Case are modest.

E.3.3 Ethanol Use

By 2050, 24 billion gallons of ethanol are used in the Base Case and 41, 57, and 25 billion gallons are used in the Mixed, (P)HEV & Ethanol, and H2 Success scenarios, respectively. This section discusses how that ethanol is used.

E.3.3.1 Ethanol Consumption in E85 and in Blends

Table E-37 and Figures E-77 and E-78 show the percentage of ethanol used in E85 and motor gasoline blends in 2030 and 2050, as well as the splash blend percentage. Today, virtually all ethanol is used in blends.

As indicated previously, the maximum splash blend level allowed is 10% in individual states. However, because California has a lower maximum level, the national average maximum is approximately 9.5%. That level is achieved in the Base Case by 2015. In subsequent years, additional ethanol is used in E85. Thus, by 2050 in the Base Case, 72% of the ethanol is used in gasoline blends in the Base Case, and the remaining 28% is used in E85.

As in the Base Case, the maximum amount of ethanol (9.5%) that can be used in gasoline blends is being used in the scenarios by 2015. The remaining volumes of ethanol used in the scenarios are used in E85. As with the “Literature Review No Subsidies” versions of the scenarios, the highest percentage of E85 use is in the (P)HEV & Ethanol scenario, and the least is in the H2 Success scenario. In 2030, 73% of ethanol is consumed as E85 in the (P)HEV & Ethanol scenario, 44% in the Mixed scenario, and 24% in the H2 Success scenario. By 2050, these numbers have climbed to 83%, 75%, and 58%, respectively.

E.3.3.2 Share of Vehicle Stock That is Flex Fuel

Table E-38 and Figures E-79 and E-80 present the estimated share of the car and LT stock that are flexible fuel vehicles able to use E85 as well as gasoline. The Base Case and the H2 Success scenario are fairly similar: flex fuel cars increase from 0.5% of the car stock now to 4% to 6% by 2050, while flex fuel LTs increase from 4% of the LT stock to 13% to 14%. The flex fuel stock (cars and LTs) is much higher in the Mixed and (P)HEV & Ethanol scenarios: more than 33% of the stock is flex-fuel-capable by 2020, increasing to about 60% by 2030 and to 68% (Mixed) to 82% ((P)HEV & Ethanol) by 2050. Post-2020, the flex fuel shares of these two scenarios are higher than in the "Literature Review No Subsidies" versions of the scenarios.

As discussed previously, these particular results are strongly influenced by assumptions made with respect to which vehicles might be flex fuel. See Section E.1.3.2 for a further discussion of the underlying assumptions.

E.3.3.3 Percentage of Travel by Flex Fuel Vehicles on E85

Given these flex fuel vehicle shares and the E85 volumes estimated for the scenarios, it should not be surprising that the flex fuel vehicles travel for a considerable amount of time on E85. Table E-39 and Figure E-81 show the percentage of flex fuel vehicle travel powered by E85. The greatest amount of travel on E85 over time is in the (P)HEV & Ethanol scenario until 2035: 25% of travel by flex fuel vehicles is on E85 in 2020, with an increase to 40% by 2030, then growing slowly for an increase to 50% by 2050. However, also as with the "Literature Review No Subsidies" versions of these scenarios, the H2 Success scenario has the highest share of travel on E85 by flex fuel vehicles by 2040 and forward. The H2 Success scenario uses approximately the same total volume of ethanol as in the Base Case by 2050, but there is much less gasoline into which it can be blended, thus making it available for use in E85 by the nearly 10% of the stock that is flex fuel.

E.3.4 E85 and H_2 Station Availability

Table E-40 and Figures E-82 and E-83 show the availability of alternative fuel stations (E85 and H_2) as a percentage of the total number of conventional fuel stations in place in 2005. In the Base Case, E85 stations increase from a fraction of a percent in 2005 to 18% in 2050. The percentage of stations offering E85 (as a percent of year-2005 conventional stations) is slightly lower by 2050 in the Mixed and H2 Success scenarios, though it is slightly higher than in the Base Case until that year. By 2050 in the (P)HEV & Ethanol scenario, 27% of (year 2005) stations offer E85. The E85 station availability for all the scenarios is slightly lower than in the "Literature Review No Subsidies" versions of the scenarios.

For the Mixed and H2 Success scenarios, the availability of H_2 stations increases greatly over the "Literature Review No Subsidies" versions of the scenarios. By 2050 in the Mixed scenario, H_2 is available at approximately 36% of year-2005 stations versus less than 1% in the "Literature

Review No Subsidies" version of the scenario. However, the substantial increase in H_2 station availability does not occur until late in the scenario.

In the H2 Success scenario, the number of stations increases steadily, from none in 2010 to over 10,000 stations in 2025 and to about 35,000 stations (20% of 2005 conventional stations) in 2030. This is due to the H_2 station jump-start discussed in Reference 1. The increase post-2030 (after the jump-start ends) remains high, with more than 240,000 stations in 2050 (nearly 140% of the 2005 CV stations).

E.3.5 Fuel Prices

Table E-41 and Figures E-84 through E-88 present the price of fuel by type for the key transportation sector fuels: motor gasoline, diesel, E85, electricity, and H_2. The fuel prices vary across the scenarios and the Base Case, in part because we varied ethanol and H_2 production cost assumptions across the scenarios and the Base Case. The assumptions are briefly discussed in Section E.1.5.

Figure E-84 depicts the price of motor gasoline. In the Base Case, the price rises from $19/MMBtu (about $2.33/GGE) to $31/MMBtu ($3.93/GGE) in 2050. The prices rise less in each of the scenarios: to $25/MMBtu ($3.15/GGE) in the (P)HEV & Ethanol scenario, a 20% reduction from the Base Case; to $24.5/MMBtu ($3.10/GGE) in the Mixed scenario, a 22% reduction from the Base Case; and to $24/MMBtu ($2.99/GGE) in the H2 Success scenarios, a 24% decrease from the Base Case. Gasoline prices are also lower than are estimated for the "Literature Review No Subsidies" versions of the scenarios.

Diesel prices, shown in Figure E-85, increase from $18/MMBtu ($2.19/GGE) in 2005 to $28/MMBtu ($3.52/GGE) in 2050 in the Base Case. The price increase is more moderate in the scenarios: diesel costs only $27/MMBtu ($3.39/GGE) in 2050, a decrease of 4% from the Base Case. In all the scenarios, by 2040 diesel prices are higher than gasoline prices.

The price of E85 is depicted in Figure E-86. The (P)HEV & Ethanol scenario generally has the lowest E85 prices through 2030, while the H2 Success scenario has the lowest prices by 2040. As with the "Literature Review No Subsidies" cases, the price of E85 relative to gasoline is generally higher through 2030, except in the (P)HEV & Ethanol scenario. By 2040, the E85 prices of the scenarios and the Base Case are generally lower than that of gasoline.

The electricity price estimated for PHEV users is presented in Figure E-87. In the (P)HEV & Ethanol and Mixed scenarios, electricity consumption by PHEVs begins a steady climb by 2025. As a result of the increased demand, electricity prices are higher for these two scenarios than in the Base Case or H2 Success scenario. The prices are also higher for these two scenarios than are estimated for the "Literature Review No Subsidies" versions of the scenarios. However, the electricity price increases are really "within the noise" of electricity price estimates. For example, the price of electricity for PHEV users in 2050 in the (P)HEV & Ethanol scenario is estimated to be $.088/kWh in the "Literature Review with Subsidies" version of the scenario versus $.08/kWh in the "Literature Review No Subsidies" version. Finally, the price of electricity in all the scenarios is higher than the price of gasoline until about 2050 (with the (P)HEV & Ethanol scenario as an exception).

H_2 prices, shown in Figure E-88, increase from $31/MMBtu ($3.87/GGE) in 2010 to $32/MMBtu ($4.00/GGE) in 2050 in the Base Case. Prices are lower in all three scenarios. Prices in the H2 Success scenario are slightly higher in the early years (through 2025) due to higher demand, but are nearly 10 percentage points lower in later years (after 2030).

E.3.6 Average New Vehicle Prices

Table E-42 and Figures E-89 and E-90 present estimated prices for new cars and new LTs, respectively, in the Base Case and the three scenarios. The scenario prices reflect the vehicle subsidies assumed for the analysis. As discussed in Reference 1, the per vehicle subsidies vary across scenarios. Still, by 2035, the average price for a new car is lower in all the scenarios than in the Base Case. By 2050, the difference is nearly $2,000. The average price of a new LT is higher in all the scenarios than in the Base Case until 2050, when it is lower by at most $300.

E.3.7 Consumer Savings

As stated previously, consumer savings are estimated here based on the method used in the DOE GPRA process. See Section E.1.7 for a brief explanation of that method.

E.3.7.1 Total Energy Expenditures

Table E-43 details the total energy expenditures of the Base Case and scenarios. Those of the scenarios are lower than those of the Base Case. The total energy expenditures of the (P)HEV & Ethanol scenario are the lowest through 2030 and are very similar to the other scenarios in the later years. By 2050, the total energy expenditures of all three scenarios are 14% less than those of the Base Case.

E.3.7.2 Amortized Vehicle Expenditures

Table E-44 and Figures E-91 and E-92 present amortized vehicle expenditures. In the Base Case, the sum total of the amortized payments climbs from $420 billion in 2015 to $520 billion in 2050 for cars and from $380 billion in 2015 to $665 billion in 2050 for LTs. In the scenarios, total vehicle expenditures climb from $410 billion in 2015 to $480 billion in 2050 for cars (i.e., they are lower) and from $387 billion to $673–$686 billion in 2050 for LTs (i.e., they are higher). By 2040, total vehicle expenditures (cars and LTs) are slightly lower in two of the three scenarios than those of the Base Case.

E.3.7.3 Total Consumer Savings

Table E-45 and Figure E-93 show the total consumer savings, calculated by comparing the total expenditures in each scenario against the Base Case. The scenarios generate consumer savings, except in the early years of the Mixed and H2 Success scenarios. The savings of the (P)HEV & Ethanol scenario are the greatest of all the scenarios through 2040. By 2050, the (P)HEV & Ethanol scenario saves $348 billion, the Mixed scenario saves $349 billion, and the H2 Success scenario saves $362 billion. On average, the consumer savings of the three scenarios is about 10%, obviously greater than that achieved in the "Literature Review No Subsidies" versions of the scenarios.

E.4 SCENARIOS WITH "PROGRAM GOALS" VEHICLE PRICES PLUS SUBSIDIES

E.4.1 LV Energy Use

LV energy use (including 2Bs) is projected in the Base Case to increase by 50% between now and 2050, with most of the growth post-2030. The "Program Goals with Subsidies" versions of the scenarios reduce that growth by 6 to 8 percentage points by 2030 and by 18 to 23 percentage points by 2050 — slightly more than the reduction in the "Program Goals No Subsidies" cases (the other versions of the scenarios with which comparisons are most appropriate). Since LV energy use is determined by LV VMT and vehicle fuel economy, these two factors are discussed below.

E.4.1.1 Total VMT Increase over Time

Table E-46 and Figure E-94 present the increase in LV travel over time from 2005 for the Base Case and the scenarios. As stated before, the scenarios assume the same vehicle stock as the Base Case, but their average VMT/vehicle is higher due to the rebound effect. The average fuel economy of LVs in the scenarios is better than in the Base Case (see Section E.4.1.2), and fuel prices are also generally lower than in the Base Case (see Section E.4.5). As such, the cost/mile of travel is lower in the scenarios, thereby encouraging additional travel.

The increase in travel over the Base Case is very similar in all three scenarios and occurs steadily over time. The percentage increase ranges from 137% to 143% over 2005 levels by 2050, which is higher than the Base Case increase of 110%. As in other versions of the scenarios, this significant increase in VMT has a dampening effect on the energy savings that could be achieved with the market penetration of ATVs in the scenarios. As an example, if the Mixed scenario had the same VMT as the Base Case, it would have resulted in a 28% reduction in LV energy use (excluding that of 2Bs) instead of 19%.

E.4.1.2 Vehicle Fuel Economy

Table E-47 and Figures E-95 and E-96 present both the average new vehicle fuel economy and the on-road fuel economy of the LV stock. The average fuel economy in all three scenarios is close to or surpasses 60 MPG by 2050, and the H2 Success average fuel economy even approaches 70 MPG. The on-road fuel economy of the scenarios is about 16% better than that of the Base Case in 2030, and it is between 48% (Mixed) and 64% (H2 Success) improved by 2050.

E.4.1.3 Fuel Type

Table E-48 and Figures E-97 through E-101 detail energy consumption by fuel type. Motor gasoline includes ethanol, and E85 includes gasoline.

Motor gasoline consumption, shown in Figure E-97, is highest in the Base Case, growing from 16 quads in 2005 to nearly 20 quads in 2050. In 2050 In the Mixed scenario, gasoline consumption is 11 quads (a 43% reduction) and in the (P)HEV & Ethanol and H2 Success scenarios, consumption is 9.5 quads (a 51% reduction from the Base Case).

As Figure E-98 shows, diesel consumption in all three scenarios is higher than in the Base Case through 2040 in the Mixed and H2 Success scenarios and through 2035 in the (P)HEV & Ethanol scenario; in subsequent years, it is lower. In 2020 and 2030, consumption is about two times the Base Case levels (the average increase is 138% in 2020 and 92% in 2030). By 2050 in the scenarios, diesel consumption ranges from 1.4 quads in the (P)HEV & Ethanol scenario, to 1.7 quads in the H2 Success scenario, and to 2.3 quads in the Mixed scenario, which correspond to reductions of 60%, 52%, and 36%, respectively, from the Base Case (3.5 quads).

Figure E-99 depicts the energy consumed as E85. Not surprisingly, E85 consumption is highest in the (P)HEV & Ethanol scenario: consumption jumps to over 1 quad by 2020 (nearly 30 times the E85 consumed in the Base Case) and continues to increase to nearly 6 quads in 2050, at which time consumption in the Base Case is just under 1 quad. Less total E85 is consumed in the Mixed and H2 Success scenarios: 4.6 quads and 1.3 quads, respectively, in 2050. The E85 consumption is slightly lower in this version of the scenario than in the "Program Goals No Subsidies" version, probably because of the changes in the fleet mix brought on by the vehicle subsidies.

PHEV use of electricity is significantly higher in the "Program Goals with Subsidies" versions of the (P)HEV & Ethanol and Mixed scenarios than in the "Program Goals No Subsidies" versions of these scenarios. As Figure E-100 shows, electricity consumption is highest in the (P)HEV & Ethanol scenario, at 1.2 quads in 2050. The amount of energy consumed as electricity begins to increase steadily after the introduction of subsidies for PHEVs in 2030. Electricity consumption in the H2 Success scenario declines relative to its use in the "Program Goals No Subsidies" version of the scenario.

Energy consumed as H_2 fuel, depicted in Figure E-101, is significantly higher in the "Program Goals with Subsidies" version of the H2 Success scenario than in the "Program Goals No

Subsidies" version. The market penetration of FCVs increases markedly with vehicle subsidies. In this version of the scenario, H_2 consumption climbs from zero in 2010 to over 0.3 quads in 2030 and to nearly 6 quads in 2050, more than doubling the H_2 consumption of the "Program Goals No Subsidies" case in 2050. In the Mixed scenario, H_2 consumption is almost the same as in the "Program Goals No Subsidies" version of the scenario. The H_2 consumption drops dramatically in the (P)HEV & Ethanol scenario.

E.4.2 Resource Fuels

As stated before, a full understanding of the impacts of the scenarios on CO_2 emissions requires both estimates of the impacts of the scenarios on LV energy use (both total and type) and knowledge of the resource fuels used to produce those fuels. Estimates of the resource fuels used to produce ethanol, H_2 and electricity are reviewed below.

E.4.2.1 Ethanol Production by Feedstock Type

Table E-49 and Figures E-102 and E-103 show the breakdown of ethanol production by feedstock type, currently and in 2030 and 2050. Nearly all ethanol produced today is made domestically from corn, and the rest is imported. In the Base Case, the dominance of corn continues, although imports are projected to increase.

In the (P)HEV & Ethanol scenario, high production levels of cellulose-based ethanol are achieved early. By 2030, just under 90% of ethanol is cellulose-based and by 2050, 82%. This is very similar to the results for "Program Goals No Subsidies" version of this scenario.

The Mixed and H2 Success scenarios differ greatly in the amount of ethanol produced. By 2005, 46 billion gallons are produced in the Mixed scenario, but only 20 billion gallons are produced in the H2 Success scenario. The latter volume is less than that of the Base Case. Still, much more cellulosic ethanol is produced in the H2 Success scenario than in the Base Case (17 billion gallons vs. 1 billion gallons).

In summary, as in other versions of the scenarios, much more zero-CO_2 emission cellulosic ethanol is used than is used in the Base Case.

E.4.2.2 H_2 Production by Fuel Source and Production Type

Table E-50 and Figures E-104 and E-105 present the percentage of H_2 by fuel source and production type in 2030 and 2050. Very little H_2 is produced in any year in the Base Case, and what is produced is all generated at the station forecourt using natural gas.

The change in fleet mix as a result of vehicle subsidies causes a dramatic drop in the volume of H_2 produced in the (P)HEV & Ethanol scenario: from about 6 billion kg in the "Program Goals No Subsidies" version of the scenario to 2 billion kg in this version. However, there were small changes in the feedstock makeup of H_2 production, with a slightly higher share (22%) produced from coal than before (12%). The greatest source of H_2 production is still via natural gas at the station forecourt.

The H_2 consumption in the Mixed scenario is at a very similar level as in the "Program Goals No Subsidies" version of the scenario: over 6 billion kg by 2050. The resource fuel mix is also similar between the two versions of this scenario. It is still dominated by production from natural gas at the station forecourt, but with 15% from coal.

In the H2 Success scenario, H_2 production reaches 42 billion kg by 2050, as opposed to the 19 billion kg of the "Program Goals No Subsidies" version of the scenario. Advanced H_2 production techniques are already online by 2030: 20% of H_2 is produced via central biomass and 14% via central carbon (14% of which is sequestered production). By 2050, over one-quarter of H_2 is produced by central biomass and over one-third by central carbon (17% of which is sequestered production). This is quite similar to the feedstock shares of the "Program Goals No Subsidies" case.

In summary, by 2050, while almost all of the H_2 produced in the Base Case, (P)HEV & Ethanol, and Mixed scenarios is produced from fossil fuels (little of which is sequestered), over one-third of the H_2 produced in the H2 Success scenario is produced using low-carbon technologies (biomass and coal with sequestered production).

E.4.2.3 Total Electricity Generation by Fuel Type

Table E-51 and Figures E-106 and E-107 show the percentage of electricity by fuel source and production type in 2030 and 2050. Because of the dramatic increase in PHEV penetration in the Mixed and (P)HEV & Ethanol scenarios, there are some differences between the Base Case and these two scenarios and between these versions of the scenarios and the "Program Goals No Subsidies" versions of the scenarios. First, the increased penetration of the PHEVs leads to higher total electricity generation than in the Base Case. (For example, by 2050 the total electricity generated in the (P)HEV & Ethanol scenario is 4% higher than in the Base Case.) Second, the increased demand also appears to lead to slightly higher coal generation shares than in the "Program Goals No Subsidies" cases (e.g., 60.4% vs. 58.7% in 2050 in the (P)HEV & Ethanol scenario). However, the differences in generation and generation mix for these two scenarios versus the Base Case are modest.

E.4.3 Ethanol Use

By 2050, 24 billion gallons of ethanol are used in the Base Case and 46, 55, and 20 billion gallons are used in the Mixed, (P)HEV & Ethanol, and H2 Success scenarios, respectively. This section discusses ethanol's use in the scenarios.

E.4.3.1 Ethanol Consumption in E85 and in Blends

Table E-52 and Figures E-108 and E-109 show the percentage of ethanol used in E85 and motor gasoline blends in 2030 and 2050, as well as the ethanol blend percent in gasoline ("splash blend %"). Today, virtually all ethanol is used in blends.

As stated before, the maximum splash blend level allowed is 10% in individual states. However, because California has a lower maximum level, the national average maximum is approximately 9.5%. That level is achieved in the Base Case by 2015. In subsequent years, additional ethanol is used in E85. By 2050, 72% of the ethanol is used in gasoline blends in the Base Case, and the remaining 28% is used in E85.

As in the Base Case, the maximum amount of ethanol (9.5%) that can be used in gasoline blends is being used in the scenarios by 2015. The remaining volumes of ethanol used in the scenarios are used in E85. As with all other versions of the scenarios, the highest percentage of E85 use is in the (P)HEV & Ethanol scenario: in 2030, 73% of ethanol is consumed as E85 and, in 2050, 83%.

In this "Program Goals with Subsidies" version of the H2 Success scenario, the H2 Success scenario uses less total ethanol than the Base Case, even as early as 2030. Yet, the scenario has a higher share of ethanol used in E85 than in the Base Case in 2030 and 2050. There is less total gasoline in which to blend ethanol in the scenario than in the Base Case.

E.4.3.2 Share of Vehicle Stock That is Flex Fuel

Table E-53 and Figures E-110 and E-111 show the estimated share of the car and LT stock that are flexible fuel vehicles able to use E85 as well as gasoline. In the Base Case, the number of flex fuel cars and LTs increases from the current 0.5% and 4%, respectively, to 6% of cars and 14% of LTs in 2050. The flex fuel stock (cars and LTs) is much higher in the Mixed and (P)HEV & Ethanol scenarios: more than 33% are flex-fuel-capable by 2020, with more than 50% by 2030 and from 68% (Mixed) to 80% ([P]HEV & Ethanol) by 2050. Post-2030, the flex fuel shares of these two scenarios are higher than in the "Program Goals No Subsidies" versions of the scenarios. However, this should occur because the purchase of (flex fuel) PHEVs is being encouraged in these two scenarios. Alternatively, the flex fuel shares in the H2 Success scenario are slightly higher than in the Base Case early on, but are lower by 2040. This is the result of the increased penetration of FCVs, which are not flex fuel.

Again, these particular results are strongly influenced by assumptions made with respect to which vehicles might be flex fuel. See Section E.1.3.2 for a further discussion of these assumptions.

E.4.3.3 Percentage of Travel by Flex Fuel Vehicles on E85

Given these flex fuel vehicle shares and the E85 volumes estimated for the scenarios, it should not be surprising that the flex fuel vehicles travel for a considerable amount of time on E85. Table E-54 and Figure E-112 show the percentage of flex fuel vehicle travel powered by E85. As in the review of other versions of the scenarios, the greatest amount of travel on E85 over time is in the (P)HEV & Ethanol scenario, while the H2 Success scenario has the highest share of travel by flex fuel vehicles by 2040 and forward.

E.4.4 E85 and H_2 Station Availability

Table E-55 and Figures E-113 and E-114 show the availability of alternative fuel stations (E85 and H_2) as a percentage of the total number of conventional fuel stations in place in 2005 (169,000). In the Base Case, E85 stations increase from a fraction of a percent in 2005 to 18% in 2050. By 2050, the percentage of stations offering E85 is 13% in the H2 Success scenario, 26% in the (P)HEV & Ethanol scenario, and 105% in the Mixed scenario. (Note: The latter estimate is "unusual" and needs to be treated carefully. The share of flex fuel stock in the Mixed scenario does not differ all that much between its "Program Goals with Subsidies" and "Program Goals No Subsidies" versions, and neither does the percent of travel on E85 nor the total ethanol volume used. Therefore, a question remains as to why the E85 station availability would be 105% in this case and 20% in the other version.)

The percentage of stations offering H_2 (as a percent of 2005 conventional stations) in the Mixed scenario is very similar in this version of the scenario to that in the "Program Goals No Subsidies" version: 21% by 2050 vs. 22%. The percentage of stations offering H_2 in the (P)HEV & Ethanol scenario drops dramatically: 6% in this version vs. 19% in the "Program Goals No Subsidies" version.

In the H2 Success scenario, the number of stations increases steadily, from none in 2010 to about 13,500 stations (about 8% of 2005 conventional fueling stations) in 2030, with a more rapid increase to about 230,000 stations in 2050. This is equivalent to 133% of 2005 conventional stations, or nearly double the number of H_2 stations in the "Program Goals No Subsidies" version of the scenario.

E.4.5 Fuel Prices

Table E-56 and Figures E-115 through E-119 detail the price of fuel by type for the key transportation sector fuels: motor gasoline, diesel, E85, electricity, and H_2. The fuel prices vary across scenarios and the Base Case, in part because we varied ethanol and H_2 production cost assumptions across the scenarios and the Base Case. The assumptions are briefly discussed in Section E.1.5.

Figure E-115 depicts the price of motor gasoline. In the Base Case, the price rises from \$19/MMBtu (about \$2.33/GGE) to \$31/MMBtu (\$3.93/GGE) in 2050. The price rises less in the scenarios by 2050, with prices between \$22/MMBtu (\$2.80/GGE), as in the H2 Success scenario (a 29% decrease from the Base Case), and \$25/MMBtu (\$3.15/GGE), as in the Mixed scenario (a 20% decrease from the Base Case). Gasoline prices are also lower than are estimated for the "Program Goals No Subsidies" versions of these scenarios. It is also worth noting that gasoline prices are lower earlier in the (P)HEV & Ethanol scenario — a full 5 percentage points less than in the Mixed and H2 Success scenarios by 2030.

Diesel prices, shown in Figure E-116, increase from \$18/MMBtu (\$2.20/GGE) in 2005 to \$28/MMBtu (\$3.50/GGE) in 2050 in the Base Case and \$27/MMBtu in the scenarios. Diesel prices are lower than gasoline prices until about 2040, when they become higher.

The price of E85 is depicted in Figure E-117. The (P)HEV & Ethanol scenario generally has the lowest E85 prices through 2030, while the H2 Success scenario has the lowest prices by 2040. There is considerable variation in the relationship between E85 prices and gasoline prices. For example, E85 prices are lower than gasoline prices from 2020 forward in the (P)HEV & Ethanol scenario, while E85 prices are always higher than gasoline prices in the Mixed scenario.

The electricity price estimated for PHEV users is shown in Figure E-118. It changes little as a result of the increased penetration of PHEVs where subsidized. In scenarios that encourage the purchase of PHEVs — the Mixed and (P)HEV & Ethanol scenarios — demand for electricity increases in the period after the subsidy (post-2030), and electricity prices increase slightly over those in the "Program Goals No Subsidies" versions of the scenarios. By 2050, electricity costs are \$24/MMBtu (\$3.03/GGE) in the Mixed scenario (a 2% increase over the price of the "Program Goals No Subsidies" case) and \$25/MMBtu (\$3.12/GGE) in the (P)HEV & Ethanol scenario (a 5% increase). In the H2 Success scenario, in which subsidies encourage the purchase of technology that competes with PHEVs, the demand for electricity decreases. Not surprisingly, the price for electricity is slightly lower (1%) than in the "Program Goals No Subsidies" version of the scenario: \$23/MMBtu (\$2.91/GGE).

H_2 prices, detailed in Figure E-119, also change very little as a result of the increased market penetration of FCVs where subsidized. The price increases (relative to the "Program Goals No Subsidies" versions of the scenarios) by a fraction of a percent in the Mixed and H2 Success scenarios, and it decreases by just over 2% in the (P)HEV & Ethanol scenario. The stability of the H_2 price in the Mixed scenario is unsurprising, given the same level of H_2 demand as in the "Program Goals No Subsidies" case. A comparison of the changes in price in the (P)HEV & Ethanol and H2 Success scenarios is more interesting. On the one hand, the decrease in the H_2 price in the (P)HEV & Ethanol scenario is likely due to a decrease in demand. On the other hand, the relative stability of the H_2 price in the H2 Success scenario, given increased demand, might be attributed to changes in H_2 production (see Section E.4.2.2).

E.4.6 Average New Vehicle Prices

Table E-57 and Figures E-120 and E-121 present estimated prices for new cars and new LTs, respectively, in the Base Case and the three scenarios. The scenario prices reflect the vehicle subsidies assumed for the analysis, which vary across the scenarios. Still, by 2040, the average price for a new car and a new LT is either the same or lower in all the scenarios than in the Base Case. By 2050, the average car in the scenarios costs from $700 to $2,900 less. By 2050, the average LT in the scenarios costs from $0 to $2,300 less.

E.4.7 Consumer Savings

As stated previously, consumer savings are estimated here based on the method used in the DOE GPRA process. See Section E.1.7 for a brief explanation of that method.

E.4.7.1 Total Energy Expenditures

Table E-58 details the total energy expenditures of the Base Case and the scenarios. Those of the scenarios are lower than those of the Base Case. The total energy expenditures of the (P)HEV & Ethanol scenario are the lowest through 2040, while those of the H2 Success scenario are the lowest in 2050. By 2050, total energy expenditures in the scenarios range from 12% to 16% lower than those of the Base Case. The total energy expenditures are also slightly lower than in the “Program Goals No Subsidies” versions of these scenarios.

E.4.7.2 Amortized Vehicle Expenditures

Table E-59 and Figures E-122 and E-123 present amortized vehicle expenditures. In the Base Case, the sum total of amortized vehicle expenditures climbs from $420 billion in 2015 to $520 billion in 2050 for cars and from $380 billion in 2015 to $665 billion in 2050 for LTs. In the scenarios, total vehicle expenditures are less for cars, increasing from $421 billion in 2015 to between approximately $460 billion (H2 Success scenario) to $500 billion (Mixed scenario) in 2050. Scenario expenditures tend to be higher than those of the Base Case for LTs, ranging from $390 billion in 2005 to between $665 billion (H2 Success scenario) and $685 billion (Mixed scenario) in 2050. By 2040, total vehicle expenditures (car and LT) are virtually the same or slightly lower in the scenarios than in the Base Case.

E.4.7.3 Total Consumer Savings

Table E-60 and Figure E-124 show the total consumer savings, calculated by comparing the total expenditures in each scenario against the Base Case. All of the scenarios generate consumer savings right from the start, with the (P)HEV & Ethanol scenario having the greatest savings through 2045. However, the H2 Success scenario has substantially greater savings by 2050. In 2050, the (P)HEV & Ethanol scenario saves $385 billion, the Mixed scenario saves $281 billion, and the H2 Success scenario saves $439 billion. The average consumer savings in that year range from 8% to 12.5% — the greatest range exhibited in all versions of the scenarios.

REFERENCE

1. Plotkin, S., et al., *Multi-Path Transportation Futures Study: Vehicle Characterization and Scenario Analyses*, Argonne National Laboratory (July 8, 2009).

LITERATURE REVIEW/NO SUBSIDIES SCENARIOS: TABULAR RESULTS

TABLE E-1 Total LV VMT Increase from 2005 (%): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
Base Case	0.0%	4.2%	24.5%	53.3%	81.3%	110.4%
Mixed	0.0%	4.3%	25.5%	55.9%	87.3%	120.3%
(P)HEV & Ethanol	0.0%	4.3%	26.0%	56.4%	87.5%	121.3%
H2 Success	0.0%	4.3%	25.5%	55.9%	87.2%	120.0%
Base Case VMT (trillion miles)	2.65	2.8	3.3	4.1	4.8	5.6

TABLE E-2 Vehicle Fuel Economy (MPGGE[1]): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
NEW LDV MPGGE (TESTED)						
Base Case	25.2	29.1	35.1	35.4	35.8	35.7
Mixed	25.2	29.1	36.8	39.1	41.4	44.2
(P)HEV & Ethanol	25.2	29.1	36.5	38.9	41.2	43.7
H2 Success	25.2	29.1	36.8	39.3	41.1	44.1
ON-ROAD STOCK LDV MPGGE						
Base Case	19.6	19.8	23.2	26.4	27.3	27.5
Mixed	19.6	19.8	24.2	28.4	30.6	32.7
(P)HEV & Ethanol	19.6	19.8	24.1	28.3	30.6	32.5
H2 Success	19.6	19.8	24.2	28.5	30.6	32.5

[1] Miles per gallon of gasoline equivalent.

TABLE E-3 LV Energy Use by Fuel Type (quads): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline (includes blends)						
Base Case	16.0	16.1	16.1	16.9	18.3	19.6
Mixed	16.0	15.9	15.2	14.8	13.6	14.1
(P)HEV & Ethanol	16.0	15.9	14.2	12.5	12.0	12.3
H2 Success	16.0	15.9	15.4	15.5	15.4	16.0
Distillate Fuel Oil (diesel)						
Base Case	0.3	0.3	0.6	1.1	2.2	3.5
Mixed	0.3	0.5	1.1	1.5	2.0	2.6
(P)HEV & Ethanol	0.3	0.5	1.1	1.4	1.9	2.4
H2 Success	0.3	0.5	1.1	1.5	1.9	2.5
E85						
Base Case	0.0	0.0	0.0	0.1	0.4	0.9
Mixed	0.0	0.0	0.3	1.4	4.0	4.9
(P)HEV & Ethanol	0.0	0.0	1.4	3.9	5.9	7.2
H2 Success	0.0	0.0	0.2	0.5	2.1	3.1
Electricity						
Base Case	0.00	0.00	0.00	0.01	0.02	0.02
Mixed	0.00	0.00	0.00	0.00	0.01	0.01
(P)HEV & Ethanol	0.00	0.00	0.00	0.00	0.01	0.02
H2 Success	0.00	0.00	0.00	0.00	0.01	0.01
H_2						
Base Case	0.00	0.00	0.00	0.00	0.01	0.01
Mixed	0.00	0.00	0.00	0.00	0.01	0.02
(P)HEV & Ethanol	0.00	0.00	0.00	0.00	0.01	0.02
H2 Success	0.00	0.00	0.00	0.04	0.10	0.17
Other						
Base Case	0.05	0.05	0.03	0.01	0.01	0.01
Mixed	0.05	0.05	0.03	0.01	0.01	0.00
(P)HEV & Ethanol	0.05	0.05	0.03	0.01	0.01	0.00
H2 Success	0.05	0.05	0.03	0.01	0.01	0.00
Total						
Base Case	16.4	16.5	16.8	18.2	20.9	24.0
Mixed	16.4	16.5	16.7	17.7	19.6	21.6
(P)HEV & Ethanol	16.4	16.5	16.7	17.9	19.8	22.0
H2 Success	16.4	16.5	16.7	17.7	19.6	21.7

TABLE E-4 Ethanol Production by Feedstock Type: Literature Review, No Subsidies

	BC[1]	MIX	(P)HEV	H2
2005				
Cellulose Based	0.0%			
Corn Based	97.3%			
Imports	2.7%			
Other Feedstock	0.0%			
Total (billion gal)	4.02			
2030				
Cellulose Based	1.6%	28.2%	83.2%	28.1%
Corn Based	79.4%	56.6%	11.2%	56.0%
Imports	19.0%	15.2%	5.6%	15.9%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	15.8	23.6	41.7	17.9
2050				
Cellulose Based	4.6%	56.8%	72.9%	75.4%
Corn Based	73.9%	33.6%	20.1%	15.8%
Imports	21.5%	9.6%	7.0%	8.8%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	24.0	50.8	67.2	38.3

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-5 H_2 Production by Fuel Source and Production Type: Literature Review, No Subsidies

	BC[1]	MIX	PHEV	H2
2030				
Central Biomass	0.0%	0.0%	0.0%	0.0%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	0.0%	0.0%	0.0%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	100.0%	100.0%	100.0%
Total (billion kg)	0.03	0.03	0.03	0.29
2050				
Central Biomass	0.0%	0.0%	0.0%	0.3%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	0.0%	0.0%	0.1%

TABLE E-5 (Cont.)

	BC[1]	MIX	PHEV	H2
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	0.0%	0.0%	0.7%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	100.0%	100.0%	98.9%
Total (billion kg)	0.06	0.12	0.12	1.26

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-6 Electricity Generation by Fuel Type: Literature Review, No Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Coal	51.3%			
Petroleum	3.0%			
Natural Gas	17.4%			
Nuclear Power	20.1%			
Renewable Sources	8.3%			
Total (billion kWh)	3,880			
2030				
Coal	55.7%	56.2%	55.8%	56.2%
Petroleum	1.5%	1.5%	1.6%	1.5%
Natural Gas	13.7%	13.7%	14.2%	13.7%
Nuclear Power	19.0%	19.0%	19.1%	18.9%
Renewable Sources	10.1%	9.6%	9.3%	9.7%
Total (billion kWh)	5,175	5,173	5,097	5,164
2050				
Coal	56.3%	57.7%	58.1%	58.0%
Petroleum	1.2%	1.2%	1.3%	1.2%
Natural Gas	12.1%	12.4%	12.7%	12.3%
Nuclear Power	20.2%	20.0%	19.5%	19.8%
Renewable Sources	10.1%	8.6%	8.4%	8.5%
Total (billion kWh)	6,878	6,836	6,788	6,821

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-7 Ethanol Consumption in E85 and in Blends (%): Literature Review, No Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Used in E85	0.0			
Used in Gasoline Blending	100.0			
Total	100.0			
Splash Blend % of Motor Gasoline Pool	8.6 (2010)			
2030				
Used in E85	6.6	44.8	73.1	23.9
Used in Gasoline Blending	93.4	55.2	26.9	76.1
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.5	9.5	9.5
2050				
Used in E85	27.7	74.7	82.8	62.4
Used in Gasoline Blending	72.3	25.3	17.2	37.6
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.5	9.5	9.5

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-8 Flex Fuel Share of Vehicle Stock: Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
SHARE OF CAR STOCK THAT IS FLEX FUEL (%)						
Base Case	0.5	1.7	4.0	4.7	5.0	5.6
Mixed	0.6	3.1	34.8	56.4	64.9	69.1
(P)HEV & Ethanol	0.6	3.1	34.9	57.0	65.4	69.7
H2 Success	0.5	2.3	5.9	6.8	7.0	7.0
SHARE OF LT STOCK THAT IS FLEX FUEL (%)						
Base Case	4.0	7.1	12.7	14.0	13.5	13.9
Mixed	4.1	9.5	35.0	55.5	62.2	63.9
(P)HEV & Ethanol	4.1	9.5	35.7	57.1	63.4	65.0
H2 Success	4.0	8.9	15.7	16.1	17.8	19.9

TABLE E-9 Percent of Travel by Flex Fuel Vehicles on E85: Literature Review, No Subsidies

	2005 (%)	2010 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)
Base Case	0.3	0.2	2.6	7.4	18.6	31.3
Mixed	0.3	0.2	5.7	14.6	34.4	35.9
(P)HEV & Ethanol	0.3	0.2	24.5	40.8	49.4	51.3
H2 Success	0.3	0.3	0.8	20.7	60.5	67.5

TABLE E-10 Availability of E85 and H_2 Stations (% of CV stations in 2005): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
E85 Stations						
Base Case	0.6	2.1	6.7	9.2	12.8	17.5
Mixed	0.6	2.6	8.8	11.4	16.6	21.7
(P)HEV & Ethanol	0.6	2.6	10.2	17.1	24.8	33.3
H2 Success	0.6	2.6	8.8	11.7	19.0	26.9
H_2 Stations						
Base Case	0.0	0.0	0.0	0.0	0.1	0.1
Mixed	0.0	0.0	0.0	0.1	0.3	0.5
(P)HEV & Ethanol	0.0	0.0	0.0	0.1	0.3	0.4
H2 Success	0.0	0.1	3.4	6.8	7.3	7.7

TABLE E-11 Transportation Sector Fuel Prices ($/million Btu): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline						
Base Case	18.6	21.0	23.3	25.2	28.3	31.5
Mixed	18.6	20.8	23.1	24.2	26.3	28.7
(P)HEV & Ethanol	18.6	20.7	22.2	23.8	26.1	27.9
H2 Success	18.6	20.8	23.0	24.3	26.3	28.8
Distillate Fuel Oil (diesel)						
Base Case	17.5	18.8	21.0	22.3	24.6	28.2
Mixed	17.5	18.9	20.9	22.4	24.4	27.3
(P)HEV & Ethanol	17.5	18.9	21.0	22.3	24.2	27.4
H2 Success	17.5	18.9	20.9	22.4	24.5	27.4
E85						
Base Case	23.1	28.4	25.3	26.0	28.1	30.7
Mixed	23.1	24.9	25.5	25.2	25.9	28.9
(P)HEV & Ethanol	23.1	24.8	20.8	23.2	25.4	27.5
H2 Success	23.1	25.0	24.7	24.4	23.5	26.0
Electricity						
Base Case	29.8	27.7	25.9	25.6	24.4	23.4
Mixed	29.8	28.0	25.8	25.5	24.4	23.5
(P)HEV & Ethanol	29.8	27.7	25.5	25.9	24.2	23.3
H2 Success	29.8	27.8	25.9	25.6	24.7	23.6
H_2						
Base Case	NA[1]	30.9	29.7	30.2	31.0	32.0
Mixed	NA	27.7	22.7	22.4	23.1	24.1
(P)HEV & Ethanol	NA	27.7	22.5	22.5	23.1	24.0
H2 Success	NA	29.2	23.9	21.8	22.3	23.4

[1] NA = Not applicable.

TABLE E-12 New Vehicle Prices (thousand 2005$): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
AVERAGE NEW CAR PRICE						
Base Case	26.4	27.9	29.7	29.7	29.8	29.9
Mixed	26.4	28.2	29.9	30.1	30.2	30.3
(P)HEV & Ethanol	26.4	28.2	29.9	30.1	30.2	30.2
H2 Success	26.4	28.2	29.9	30.2	30.3	30.4
AVERAGE NEW LT PRICE						
Base Case	29.9	31.5	33.5	33.7	33.9	34.0
Mixed	29.9	31.8	33.6	33.9	34.2	34.4
(P)HEV & Ethanol	29.9	31.8	33.6	33.9	34.2	34.3
H2 Success	29.9	31.8	33.6	34.0	34.2	34.4

TABLE E-13 Total Energy Expenditures (billion 2005$): Literature Review, No Subsidies

	2005	2010	2020	2030	2040	2050
Total Transportation Expenditures						
Base Case	475	548	649	765	982	1,297
Mixed	475	543	641	734	903	1,151
(P)HEV & Ethanol	475	543	627	727	898	1,143
H2 Success	475	543	641	733	898	1,146
Total Energy Expenditures						
Base Case	1,040	1,149	1,292	1,496	1,839	2,326
Mixed	1,040	1,148	1,283	1,462	1,755	2,177
(P)HEV & Ethanol	1,040	1,146	1,258	1,455	1,751	2,163
H2 Success	1,040	1,148	1,283	1,465	1,749	2,168

TABLE E-14 Amortized Vehicle Expenditures (billion 2005$): Literature Review, No Subsidies

	2015	2020	2030	2040	2050
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – CAR					
Base Case	420	458	493	510	521
Mixed	422	461	498	513	522
(P)HEV & Ethanol	421	457	494	512	521
H2 Success	422	461	499	515	525
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – LT					
Base Case	380	401	496	584	665
Mixed	386	408	501	592	678
(P)HEV & Ethanol	387	412	504	593	679
H2 Success	386	408	501	593	678

TABLE E-15 Consumer Savings (billion 2005$): Literature Review, No Subsidies

	2015	2020	2030	2040	2050
ENERGY EXPENDITURES AND VEHICLE EXPENDITURES (billion 2005$)					
Base Case	2,015	2,151	2,486	2,933	3,512
Mixed	2,015	2,151	2,461	2,861	3,378
(P)HEV & Ethanol	2,009	2,127	2,452	2,857	3,362
H2 Success	2,016	2,152	2,465	2,857	3,371
CONSUMER SAVINGS FOR SCENARIOS (billion 2005$)					
Mixed	–0.3	–0.4	25.0	72.5	134.3
(P)HEV & Ethanol	5.8	23.9	33.3	76.6	150.0
H2 Success	–1.3	–1.0	20.8	76.2	141.3
CONSUMER SAVINGS (% SAVED FROM BASE CASE)					
Mixed	0.0%	0.0%	1.0%	2.5%	3.8%
(P)HEV & Ethanol	0.3%	1.1%	1.3%	2.6%	4.3%
H2 Success	–0.1%	0.0%	0.8%	2.6%	4.0%

PROGRAM GOALS/NO SUBSIDIES SCENARIOS: TABULAR RESULTS

TABLE E-16 Total LV VMT Increase from 2005 (%): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
Base Case	0.0%	4.2%	24.5%	53.3%	81.3%	110.4%
Mixed	0.0%	4.3%	26.2%	58.2%	92.4%	128.2%
(P)HEV & Ethanol	0.0%	4.3%	26.5%	59.4%	93.1%	129.0%
H2 Success	0.0%	4.3%	26.2%	58.5%	93.7%	132.2%
Base Case VMT (trillion miles)	2.65	2.8	3.3	4.1	4.8	5.6

TABLE E-17 Vehicle Fuel Economy (MPGGE): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
NEW LDV MPGGE (TESTED)						
Base Case	25.2	28.0	35.1	35.4	35.8	35.7
Mixed	25.2	29.1	39.5	42.6	45.1	53.2
(P)HEV & Ethanol	25.2	29.1	39.1	41.6	45.0	52.3
H2 Success	25.2	29.1	39.7	44.3	48.6	55.8
ON-ROAD STOCK LDV MPGGE						
Base Case	19.6	19.8	23.2	26.4	27.3	27.5
Mixed	19.6	19.8	24.9	30.4	33.2	36.4
(P)HEV & Ethanol	19.6	19.8	24.9	30.1	32.7	36.1
H2 Success	19.6	19.8	24.9	30.9	34.8	39.0

TABLE E-18 LV Energy Use by Fuel Type (quads): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline (includes blends)						
Base Case	16.0	16.1	16.1	16.9	18.3	19.6
Mixed	16.0	15.9	14.7	13.6	11.5	11.2
(P)HEV & Ethanol	16.0	15.9	14.2	11.7	11.3	10.5
H2 Success	16.0	15.9	14.9	14.0	13.0	12.2
Distillate Fuel Oil (diesel)						
Base Case	0.3	0.3	0.6	1.1	2.2	3.5
Mixed	0.3	0.5	1.4	2.3	2.8	3.1
(P)HEV & Ethanol	0.3	0.5	1.4	2.1	2.5	2.9
H2 Success	0.3	0.5	1.4	2.2	2.5	2.5
E85						
Base Case	0.0	0.0	0.0	0.1	0.4	0.9
Mixed	0.0	0.0	0.3	1.0	3.7	4.6
(P)HEV & Ethanol	0.0	0.0	0.8	3.5	5.0	6.3
H2 Success	0.0	0.0	0.1	0.3	1.3	1.9
Electricity						
Base Case	0.00	0.00	0.00	0.01	0.02	0.02
Mixed	0.00	0.00	0.00	0.02	0.05	0.12
(P)HEV & Ethanol	0.00	0.00	0.00	0.02	0.07	0.16
H2 Success	0.00	0.00	0.00	0.02	0.13	0.26
H_2						
Base Case	0.00	0.00	0.00	0.00	0.01	0.01
Mixed	0.00	0.00	0.00	0.02	0.15	0.93
(P)HEV & Ethanol	0.00	0.00	0.00	0.02	0.14	0.83
H2 Success	0.00	0.00	0.01	0.31	1.08	2.56
Other						
Base Case	0.05	0.05	0.03	0.01	0.01	0.01
Mixed	0.05	0.05	0.03	0.01	0.00	0.00
(P)HEV & Ethanol	0.05	0.05	0.03	0.01	0.00	0.00
H2 Success	0.05	0.05	0.03	0.01	0.00	0.00
Total						
Base Case	16.4	16.5	16.8	18.2	20.9	24.0
Mixed	16.4	16.5	16.4	16.9	18.2	20.0
(P)HEV & Ethanol	16.4	16.5	16.4	17.3	19.1	20.6
H2 Success	16.4	16.5	16.4	16.8	18.1	19.4

TABLE E-19 Ethanol Production by Feedstock Type: Program Goals, No Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Cellulose Based	0.0%			
Corn Based	97.3%			
Imports	2.7%			
Other Feedstock	0.0%			
Total (billion gal)	4.02			
2030				
Cellulose Based	1.6%	32.7%	90.5%	25.3%
Corn Based	79.4%	52.5%	5.6%	57.2%
Imports	19.0%	14.8%	3.9%	17.4%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	15.8	20.4	37.3	14.8
2050				
Cellulose Based	4.6%	62.4%	78.0%	88.4%
Corn Based	73.9%	28.0%	15.8%	5.5%
Imports	21.5%	9.7%	6.1%	6.1%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	24.0	46.3	59.0	26.8

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-20 H_2 Production by Fuel Source and Production Type: Program Goals, No Subsidies

	BC[1]	MIX	PHEV	H2
2030				
Central Biomass	0.0%	0.0%	0.0%	11.2%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	0.0%	0.0%	1.6%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	0.0%	0.0%	8.8%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	0.1%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	100.0%	100.0%	78.4%
Total (billion kg)	0.03	0.18	0.17	2.27
2050				
Central Biomass	0.0%	1.2%	0.0%	29.7%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	3.1%	2.2%	6.2%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	14.4%	10.0%	29.9%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	1.1%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	81.3%	87.8%	33.1%
Total (billion kg)	0.06	6.88	6.16	19.07

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-21 Electricity Generation by Fuel Type: Program Goals, No Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Coal	51.3%			
Petroleum	3.0%			
Natural Gas	17.4%			
Nuclear Power	20.1%			
Renewable Sources	8.3%			
Total (billion kWh)	3,880			
2030				
Coal	55.7%	56.1%	55.7%	56.2%
Petroleum	1.5%	1.5%	1.5%	1.5%
Natural Gas	13.7%	13.5%	14.3%	13.5%
Nuclear Power	19.0%	19.2%	19.2%	18.9%
Renewable Sources	10.1%	9.7%	9.2%	9.8%
Total (billion kWh)	5,175	5,171	5,112	5,163
2050				
Coal	56.3%	58.6%	58.7%	58.7%
Petroleum	1.2%	1.2%	1.2%	1.2%
Natural Gas	12.1%	11.8%	12.1%	11.6%
Nuclear Power	20.2%	19.8%	19.5%	20.3%
Renewable Sources	10.1%	8.5%	8.4%	8.3%
Total (billion kWh)	6,878	6,860	6,838	6,849

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-22 Ethanol Consumption in E85 and in Blends (%): Program Goals, No Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Used in E85	0.0			
Used in Gasoline Blending	100.0			
Total	100.0			
Splash Blend % of Motor Gasoline Pool	8.6 (2010)			
2030				
Used in E85	6.6	41.2	71.6	16.3
Used in Gasoline Blending	93.4	58.8	28.4	83.7
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.5	9.5	9.5
2050				
Used in E85	27.7	77.0	82.8	57.8
Used in Gasoline Blending	72.3	23.0	17.2	42.2
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.6	9.6	9.5

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-23 Flex Fuel Share of Vehicle Stock: Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
SHARE OF CAR STOCK THAT IS FLEX FUEL (%)						
Base Case	0.5	1.7	4.0	4.7	5.0	5.6
Mixed	0.6	3.1	33.8	53.8	61.5	60.7
(P)HEV & Ethanol	0.6	3.1	33.9	54.8	63.0	62.6
H2 Success	0.5	2.3	5.3	5.4	4.9	4.0
SHARE OF LT STOCK THAT IS FLEX FUEL (%)						
Base Case	4.0	7.1	12.7	14.0	13.5	13.9
Mixed	4.1	9.5	34.3	55.3	61.6	59.4
(P)HEV & Ethanol	4.1	9.5	34.7	57.0	63.2	61.0
H2 Success	4.0	8.9	13.9	12.4	12.5	12.2

TABLE E-24 Percent of Travel by Flex Fuel Vehicles on E85: Program Goals, No Subsidies

	2005 (%)	2010 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)
Base Case	0.3	0.2	2.6	7.4	18.6	31.3
Mixed	0.3	0.2	5.2	12.3	38.3	41.2
(P)HEV & Ethanol	0.3	0.2	16.2	37.9	43.9	51.2
H2 Success	0.3	0.3	6.5	14.8	53.2	66.0

TABLE E-25 Availability of E85 and H_2 Stations (% of CV stations in 2005): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
E85 Stations						
Base Case	0.6	2.1	6.7	9.2	12.8	17.5
Mixed	0.6	2.7	8.0	9.2	15.0	19.9
(P)HEV & Ethanol	0.6	2.6	8.6	14.8	21.2	27.1
H2 Success	0.6	2.6	8.0	9.2	14.4	18.0
H_2 Stations						
Base Case	0.0	0.0	0.0	0.0	0.1	0.1
Mixed	0.0	0.0	0.0	0.6	3.5	21.8
(P)HEV & Ethanol	0.0	0.0	0.0	0.5	3.2	19.4
H2 Success	0.0	0.1	3.3	7.9	30.2	67.7

TABLE E-26 Transportation Sector Fuel Prices ($/million Btu): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline						
Base Case	18.6	21.0	23.3	25.2	28.3	31.5
Mixed	18.6	20.8	22.8	24.0	23.9	26.3
(P)HEV & Ethanol	18.6	20.8	22.3	22.5	24.0	25.7
H2 Success	18.6	20.7	22.8	23.9	24.5	25.8
Distillate Fuel Oil (diesel)						
Base Case	17.5	18.8	21.0	22.3	24.6	28.2
Mixed	17.5	18.9	20.9	22.6	24.7	27.7
(P)HEV & Ethanol	17.5	18.9	20.9	22.5	24.4	27.8
H2 Success	17.5	18.9	21.1	22.5	24.5	27.3
E85						
Base Case	23.1	28.4	25.3	26.0	28.1	30.7
Mixed	23.1	24.5	24.7	24.5	23.3	26.3
(P)HEV & Ethanol	23.1	24.9	21.3	21.9	23.8	25.1
H2 Success	23.1	24.9	24.4	24.1	22.2	23.0
Electricity						
Base Case	29.8	27.7	25.9	25.6	24.4	23.4
Mixed	29.8	27.9	25.9	25.5	24.8	23.7
(P)HEV & Ethanol	29.8	27.7	25.5	25.6	24.9	23.8
H2 Success	29.8	27.8	25.9	25.9	25.4	23.5
H_2						
Base Case	N/A	30.9	29.7	30.2	31.0	32.0
Mixed	N/A	27.7	22.8	22.5	23.1	23.6
(P)HEV & Ethanol	N/A	27.7	22.6	22.4	23.1	23.7
H2 Success	N/A	29.2	23.9	21.8	20.9	21.0

TABLE E-27 New Vehicle Prices (thousand 2005$): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
AVERAGE NEW CAR PRICE						
Base Case	26.4	27.9	29.7	29.7	29.8	29.9
Mixed	26.4	28.2	29.8	30.0	30.0	29.8
(P)HEV & Ethanol	26.4	28.2	29.8	30.0	30.0	29.9
H2 Success	26.4	28.2	29.8	30.1	30.2	29.8
AVERAGE NEW LT PRICE						
Base Case	29.9	31.5	33.5	33.7	33.9	34.0
Mixed	29.9	31.8	33.6	33.9	34.0	34.2
(P)HEV & Ethanol	29.9	31.8	33.5	33.7	34.0	34.2
H2 Success	29.9	31.8	33.6	34.1	34.3	34.3

TABLE E-28 Total Energy Expenditures (billion 2005$): Program Goals, No Subsidies

	2005	2010	2020	2030	2040	2050
Total Transportation Expenditures						
Base Case	475	548	649	765	982	1,297
Mixed	475	543	630	711	827	1,060
(P)HEV & Ethanol	475	543	621	694	848	1,066
H2 Success	475	543	631	706	828	1,017
Total Energy Expenditures						
Base Case	1,040	1,149	1,292	1,496	1,839	2,326
Mixed	1,040	1,147	1,272	1,440	1,679	2,091
(P)HEV & Ethanol	1,040	1,147	1,255	1,418	1,700	2,088
H2 Success	1,040	1,147	1,272	1,438	1,678	2,034

TABLE E-29 Amortized Vehicle Expenditures (billion 2005$): Program Goals, No Subsidies

	2015	2020	2030	2040	2050
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – CAR					
Base Case	420	458	493	510	521
Mixed	421	458	494	507	511
(P)HEV & Ethanol	421	456	486	501	510
H2 Success	421	458	496	510	511
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – LT					
Base Case	380	401	496	584	665
Mixed	387	410	501	594	681
(P)HEV & Ethanol	387	412	509	599	682
H2 Success	387	410	503	598	686

TABLE E-30 Consumer Savings (billion 2005$): Program Goals, No Subsidies

	2015	2020	2030	2040	2050
ENERGY EXPENDITURES AND VEHICLE EXPENDITURES (billion 2005$)					
Base Case	2,015	2,151	2,486	2,933	3,512
Mixed	2,012	2,139	2,435	2,779	3,283
(P)HEV & Ethanol	2,005	2,122	2,412	2,800	3,280
H2 Success	2,012	2,140	2,437	2,787	3,231
CONSUMER SAVINGS FOR SCENARIOS (billion 2005$)					
Mixed	2.9	11.7	50.3	153.8	229.6
(P)HEV & Ethanol	9.7	28.9	73.3	133.4	232.5
H2 Success	2.5	11.2	48.2	146.3	281.4
CONSUMER SAVINGS (% SAVED FROM BASE CASE)					
Mixed	0.1%	0.5%	2.0%	5.2%	6.5%
(P)HEV & Ethanol	0.5%	1.3%	2.9%	4.5%	6.6%
H2 Success	0.1%	0.5%	1.9%	5.0%	8.0%

LITERATURE REVIEW WITH SUBSIDIES SCENARIOS: TABULAR RESULTS

TABLE E-31 Total LV VMT Increase from 2005 (%): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
Base Case	0.0%	4.2%	24.5%	53.3%	81.3%	110.4%
Mixed	0.0%	4.3%	25.6%	58.4%	96.5%	137.8%
(P)HEV & Ethanol	0.0%	4.3%	26.0%	59.5%	97.6%	136.9%
H2 Success	0.0%	4.3%	25.5%	57.2%	96.1%	137.7%
Base Case VMT (trillion miles)	2.65	2.8	3.3	4.1	4.8	5.6

TABLE E-32 Vehicle Fuel Economy (MPGGE): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
NEW LDV MPGGE (TESTED)						
Base Case	25.2	28.0	35.1	35.4	35.8	35.7
Mixed	25.2	29.1	38.0	47.6	52.8	64.6
(P)HEV & Ethanol	25.2	29.1	37.3	47.1	52.5	60.3
H2 Success	25.2	29.1	37.2	45.3	52.1	58.1
ON-ROAD STOCK LDV MPGGE						
Base Case	19.6	19.8	23.2	26.4	27.3	27.5
Mixed	19.6	19.8	24.3	31.7	37.2	43.2
(P)HEV & Ethanol	19.6	19.8	24.2	31.6	37.1	42.3
H2 Success	19.6	19.8	24.2	30.0	36.5	41.2

TABLE E-33 LV Energy Use by Fuel Type (quads): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline (includes blends)						
Base Case	16.0	16.1	16.1	16.9	18.3	19.6
Mixed	16.0	15.9	15.2	13.8	11.9	10.7
(P)HEV & Ethanol	16.0	15.9	14.2	11.6	10.9	10.0
H2 Success	16.0	15.9	15.3	14.6	12.3	10.9
Distillate Fuel Oil (diesel)						
Base Case	0.3	0.3	0.6	1.1	2.2	3.5
Mixed	0.3	0.5	1.1	1.4	1.4	1.3
(P)HEV & Ethanol	0.3	0.5	1.1	1.2	1.2	1.1
H2 Success	0.3	0.5	1.1	1.4	1.3	1.0
E85						
Base Case	0.0	0.0	0.0	0.1	0.4	0.9
Mixed	0.0	0.0	0.3	1.2	3.2	3.9
(P)HEV & Ethanol	0.0	0.0	1.4	3.7	4.9	6.0
H2 Success	0.0	0.0	0.2	0.5	1.4	1.8
Electricity						
Base Case	0.00	0.00	0.00	0.01	0.02	0.02
Mixed	0.00	0.00	0.01	0.24	0.58	0.89
(P)HEV & Ethanol	0.00	0.00	0.01	0.30	0.80	1.39
H2 Success	0.00	0.00	0.00	0.00	0.00	0.01
H_2						
Base Case	0.00	0.00	0.00	0.00	0.01	0.01
Mixed	0.00	0.00	0.00	0.03	0.27	1.57
(P)HEV & Ethanol	0.00	0.00	0.00	0.00	0.01	0.01
H2 Success	0.00	0.00	0.02	0.78	3.14	5.40
Other						
Base Case	0.05	0.05	0.03	0.01	0.01	0.01
Mixed	0.05	0.05	0.03	0.01	0.00	0.00
(P)HEV & Ethanol	0.05	0.05	0.03	0.01	0.00	0.00
H2 Success	0.05	0.05	0.03	0.01	0.00	0.00
Total						
Base Case	16.4	16.5	16.8	18.3	20.9	24.0
Mixed	16.4	16.5	16.6	16.6	17.4	18.3
(P)HEV & Ethanol	16.4	16.5	16.7	16.9	17.7	18.5
H2 Success	16.4	16.5	16.7	17.3	18.1	19.2

TABLE E-34 Ethanol Production by Feedstock Type: Literature Review with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Cellulose Based	0.0%			
Corn Based	97.3%			
Imports	2.7%			
Other Feedstock	0.0%			
Total (billion gal)	4.02			
2030				
Cellulose Based	1.6%	30.4%	87.2%	29.6%
Corn Based	79.4%	55.0%	8.5%	54.1%
Imports	19.0%	14.6%	4.3%	16.4%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	15.8	21.9	39.5	17.0
2050				
Cellulose Based	4.6%	70.7%	79.8%	86.9%
Corn Based	73.9%	21.8%	14.3%	6.8%
Imports	21.5%	7.6%	5.9%	6.3%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	24.0	40.9	56.7	24.5

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-35 H_2 Production by Fuel Source and Production Type: Literature Review with Subsidies

	BC[1]	MIX	PHEV	H2
2030				
Central Biomass	0.0%	0.0%	0.0%	29.8%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	0.0%	0.0%	3.3%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	0.0%	0.0%	19.0%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	2.0%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	100.0%	100.0%	45.9%
Total (billion kg)	0.03	0.24	0.03	5.81
2050				
Central Biomass	0.0%	1.2%	0.0%	26.6%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	4.0%	0.0%	6.0%

TABLE E-35 (Cont.)

	BC[1]	MIX	PHEV	H2
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	19.1%	0.0%	29.8%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	75.8%	100.0%	37.6%
Total (billion kg)	0.06	11.71	0.08	40.13

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-36 Electricity Generation by Fuel Type: Literature Review with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Coal	51.3%			
Petroleum	3.0%			
Natural Gas	17.4%			
Nuclear Power	20.1%			
Renewable Sources	8.3%			
Total (billion kWh)	3,880			
2030				
Coal	55.7%	56.8%	56.3%	56.5%
Petroleum	1.5%	1.5%	1.5%	1.5%
Natural Gas	13.7%	13.4%	14.2%	13.3%
Nuclear Power	19.0%	18.8%	18.9%	19.0%
Renewable Sources	10.1%	9.5%	9.1%	9.7%
Total (billion kWh)	5,175	5,245	5,198	5,172
2050				
Coal	56.3%	59.3%	60.5%	57.9%
Petroleum	1.2%	1.2%	1.2%	1.3%
Natural Gas	12.1%	9.8%	9.6%	11.9%
Nuclear Power	20.2%	21.3%	20.4%	20.6%
Renewable Sources	10.1%	8.4%	8.3%	8.3%
Total (billion kWh)	6,878	7,118	7,189	6,716

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-37 Ethanol Consumption in E85 and in Blends (%): Literature Review with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Used in E85	0.0			
Used in Gasoline Blending	100.0			
Total	100.0			
Splash Blend % of Motor Gasoline Pool	8.6 (2010)			
2030				
Used in E85	6.6	44.4	73.4	24.3
Used in Gasoline Blending	93.4	55.6	26.6	75.7
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.5	9.5	9.5
2050				
Used in E85	27.7	75.0	82.9	57.6
Used in Gasoline Blending	72.3	25.0	17.1	42.4
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.6	9.5	9.6

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-38 Flex Fuel Share of Vehicle Stock: Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
SHARE OF CAR STOCK THAT IS FLEX FUEL (%)						
Base Case	0.5	1.7	4.0	4.7	5.0	5.6
Mixed	0.6	3.1	35.0	63.0	74.6	70.2
(P)HEV & Ethanol	0.6	3.1	35.2	64.7	79.3	86.4
H2 Success	0.5	2.3	5.8	6.1	4.7	3.5
SHARE OF LT STOCK THAT IS FLEX FUEL (%)						
Base Case	4.0	7.1	12.7	14.0	13.5	13.9
Mixed	4.1	9.5	35.1	58.7	68.0	66.0
(P)HEV & Ethanol	4.1	9.5	35.8	60.6	71.4	77.7
H2 Success	4.0	8.9	15.6	15.4	13.9	12.6

TABLE E-39 Percent of Travel by Flex Fuel Vehicles on E85: Literature Review with Subsidies

	2005 (%)	2010 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)
Base Case	0.3	0.2	2.6	7.4	18.6	31.3
Mixed	0.3	0.2	5.6	14.1	30.8	35.9
(P)HEV & Ethanol	0.3	0.2	24.5	41.2	44.6	50.8
H2 Success	0.3	0.3	0.8	21.4	48.9	59.2

TABLE E-40 Availability of E85 and H_2 Stations (% of CV stations in 2005): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
E85 Stations						
Base Case	0.6	2.1	6.7	9.2	12.8	17.5
Mixed	0.6	2.6	8.8	10.1	14.3	16.5
(P)HEV & Ethanol	0.6	2.6	10.2	16.3	21.6	27.3
H2 Success	0.6	2.6	8.8	11.0	12.9	13.9
H_2 Stations						
Base Case	0.0	0.0	0.0	0.0	0.1	0.1
Mixed	0.0	0.0	0.0	0.8	6.0	35.9
(P)HEV & Ethanol	0.0	0.0	0.0	0.1	0.2	0.3
H2 Success	0.0	0.1	3.4	20.3	84.6	139.4

TABLE E-41 Transportation Sector Fuel Prices ($/million Btu): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline						
Base Case	18.6	21.0	23.3	25.2	28.3	31.5
Mixed	18.6	20.8	23.1	24.0	23.9	24.7
(P)HEV & Ethanol	18.6	20.7	22.2	22.7	23.4	25.1
H2 Success	18.6	20.8	23.1	23.9	23.0	23.9
Distillate Fuel Oil (diesel)						
Base Case	17.5	18.8	21.0	22.3	24.6	28.2
Mixed	17.5	18.9	21.0	22.3	24.3	27.3
(P)HEV & Ethanol	17.5	18.9	21.0	22.3	24.3	27.0
H2 Success	17.5	18.9	21.0	22.3	24.4	27.1
E85						
Base Case	23.1	28.4	25.3	26.0	28.1	30.7
Mixed	23.1	24.9	25.5	24.6	23.7	24.5
(P)HEV & Ethanol	23.1	24.9	20.8	22.2	23.3	24.6
H2 Success	23.1	25.0	24.7	24.1	21.7	22.3
Electricity						
Base Case	29.8	27.7	25.9	25.6	24.4	23.4
Mixed	29.8	27.9	25.7	25.8	25.3	24.0
(P)HEV & Ethanol	29.8	27.7	25.4	25.9	25.7	25.7
H2 Success	29.8	27.8	25.7	25.3	24.5	23.0
H_2						
Base Case		30.9	29.7	30.2	31.0	32.0
Mixed		27.7	22.7	22.5	23.0	23.5
(P)HEV & Ethanol		27.7	22.5	22.5	23.0	23.7
H2 Success		29.2	23.9	20.7	21.1	21.3

TABLE E-42 New Vehicle Prices (thousand 2005$): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
AVERAGE NEW CAR PRICE						
Base Case	26.4	27.9	29.7	29.7	29.8	29.9
Mixed	26.4	28.2	30.0	29.8	29.1	27.9
(P)HEV & Ethanol	26.4	28.2	29.9	29.4	28.7	27.9
H2 Success	26.4	28.2	29.9	29.2	28.3	27.7
AVERAGE NEW LT PRICE						
Base Case	29.9	31.5	33.5	33.7	33.9	34.0
Mixed	29.9	31.8	33.7	34.2	34.2	33.9
(P)HEV & Ethanol	29.9	31.8	33.5	34.1	34.0	33.7
H2 Success	29.9	31.8	33.6	34.3	34.2	33.9

TABLE E-43 Total Energy Expenditures (billion 2005$): Literature Review with Subsidies

	2005	2010	2020	2030	2040	2050
Total Transportation Expenditures						
Base Case	475	548	649	765	982	1,297
Mixed	475	543	642	705	804	981
(P)HEV & Ethanol	475	543	626	687	806	992
H2 Success	475	544	642	714	798	973
Total Energy Expenditures						
Base Case	1,040	1,149	1,292	1,496	1,839	2,326
Mixed	1,040	1,148	1,282	1,434	1,652	1,995
(P)HEV & Ethanol	1,040	1,145	1,258	1,413	1,653	2,006
H2 Success	1,040	1,148	1,281	1,443	1,661	1,995

TABLE E-44 Amortized Vehicle Expenditures (billion 2005$): Literature Review with Subsidies

	2015	2020	2030	2040	2050
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – CAR					
Base Case	420	458	493	510	521
Mixed	422	461	495	496	481
(P)HEV & Ethanol	421	457	486	483	479
H2 Success	422	460	489	487	483
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – LT					
Base Case	380	401	496	584	665
Mixed	386	408	505	600	686
(P)HEV & Ethanol	387	412	509	604	679
H2 Success	386	408	503	596	673

TABLE E-45 Consumer Savings (billion 2005$): Literature Review with Subsidies

	2005	2015	2020	2030	2040	2050
ENERGY EXPENDITURES AND VEHICLE EXPENDITURES (billion 2005$)						
Base Case		2,015	2,151	2,486	2,933	3,512
Mixed		2,016	2,151	2,433	2,748	3,163
(P)HEV & Ethanol		2,009	2,126	2,408	2,740	3,164
H2 Success		2,016	2,150	2,436	2,744	3,150
CONSUMER SAVINGS FOR SCENARIOS (billion 2005$)						
Mixed		–1.0	–0.2	52.2	185.0	349.4
(P)HEV & Ethanol		5.4	24.8	77.8	193.6	347.7
H2 Success		–1.0	1.3	50.1	189.6	362.0
CONSUMER SAVINGS (% SAVED FROM BASE CASE)						
Mixed		0.0%	0.0%	2.1%	6.3%	9.9%
(P)HEV & Ethanol		0.3%	1.2%	3.1%	6.6%	9.9%
H2 Success		0.0%	0.1%	2.0%	6.5%	10.3%

PROGRAM GOALS WITH SUBSIDIES SCENARIOS: TABULAR RESULTS

TABLE E-46 Total LV VMT Increase from 2005 (%): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
Base Case	0.0%	4.2%	24.5%	53.3%	81.3%	110.4%
Mixed	0.0%	4.3%	26.2%	58.4%	97.3%	136.6%
(P)HEV & Ethanol	0.0%	4.3%	26.6%	59.4%	99.6%	140.2%
H2 Success	0.0%	4.3%	26.2%	58.6%	95.9%	142.7%
Base case VMT (trillion miles)	2.65	2.8	3.3	4.1	4.8	5.6

TABLE E-47 Vehicle Fuel Economy (MPGGE): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
NEW LDV MPGGE (TESTED)						
Base Case	25.2	28.0	35.1	35.4	35.8	35.7
Mixed	25.2	29.1	39.5	46.3	50.6	59.0
(P)HEV & Ethanol	25.2	29.1	38.9	48.6	54.9	60.2
H2 Success	25.2	29.1	39.7	44.6	56.1	67.8
ON-ROAD STOCK LDV MPGGE						
Base Case	19.6	19.8	23.2	26.4	27.3	27.5
Mixed	19.6	19.8	24.9	30.6	36.3	40.7
(P)HEV & Ethanol	19.6	19.8	24.8	30.4	38.1	43.2
H2 Success	19.6	19.8	24.9	30.9	36.4	45.1

TABLE E-48 LV Energy Use by Fuel Type (quads): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline (includes blends)						
Base Case	16.0	16.1	16.1	16.9	18.3	19.6
Mixed	16.0	15.9	14.7	13.7	11.4	11.1
(P)HEV & Ethanol	16.0	15.9	13.9	11.5	10.5	9.6
H2 Success	16.0	15.9	14.9	14.0	12.4	9.5
Distillate Fuel Oil (diesel)						
Base Case	0.3	0.3	0.6	1.1	2.2	3.5
Mixed	0.3	0.5	1.4	2.2	2.4	2.3
(P)HEV & Ethanol	0.3	0.5	1.4	2.0	1.7	1.4
H2 Success	0.3	0.5	1.4	2.2	2.3	1.7
E85						
Base Case	0.0	0.0	0.0	0.1	0.4	0.9
Mixed	0.0	0.0	0.3	1.1	3.6	4.5
(P)HEV & Ethanol	0.0	0.0	1.2	3.5	4.7	5.8
H2 Success	0.0	0.0	0.1	0.3	1.1	1.3
Electricity						
Base Case	0.00	0.00	0.00	0.01	0.02	0.02
Mixed	0.00	0.00	0.00	0.04	0.40	0.76
(P)HEV & Ethanol	0.00	0.00	0.00	0.05	0.64	1.20
H2 Success	0.00	0.00	0.00	0.02	0.08	0.09
H_2						
Base Case	0.00	0.00	0.00	0.00	0.01	0.01
Mixed	0.00	0.00	0.00	0.02	0.15	0.88
(P)HEV & Ethanol	0.00	0.00	0.00	0.02	0.07	0.25
H2 Success	0.00	0.00	0.01	0.31	1.91	5.67
Other						
Base Case	0.05	0.05	0.03	0.01	0.01	0.01
Mixed	0.05	0.05	0.03	0.01	0.00	0.00
(P)HEV & Ethanol	0.05	0.05	0.03	0.01	0.00	0.00
H2 Success	0.05	0.05	0.03	0.01	0.00	0.00
Total						
Base Case	16.4	16.5	16.8	18.2	20.9	24.0
Mixed	16.4	16.5	16.4	17.2	17.9	19.6
(P)HEV & Ethanol	16.4	16.5	16.5	17.2	17.6	18.3
H2 Success	16.4	16.5	16.4	16.8	17.8	18.3

TABLE E-49 Ethanol Production by Feedstock Type: Program Goals with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Cellulose Based	0.0%			
Corn Based	97.3%			
Imports	2.7%			
Other Feedstock	0.0%			
Total (billion gal)	4.02			
2030				
Cellulose Based	1.6%	31.7%	89.1%	25.3%
Corn Based	79.4%	53.5%	6.8%	57.2%
Imports	19.0%	14.8%	4.1%	17.5%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	15.8	21.0	38.2	14.8
2050				
Cellulose Based	4.6%	63.4%	81.9%	89.1%
Corn Based	73.9%	27.2%	12.3%	7.0%
Imports	21.5%	9.4%	5.9%	3.9%
Other Feedstock	0.0%	0.0%	0.0%	0.0%
Total (billion gal)	24.0	45.6	54.9	19.5

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-50 H_2 Production by Fuel Source and Production Type: Program Goals with Subsidies

	BC[1]	MIX	PHEV	H2
2030				
Central Biomass	0.0%	0.0%	0.0%	19.5%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	0.0%	0.0%	1.9%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	0.0%	0.0%	11.6%
Central Unsequestered Natural Gas	0.0%	0.0%	0.0%	0.6%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	100.0%	100.0%	66.4%
Total (billion kg)	0.03	0.18	0.17	2.32
2050				
Central Biomass	0.0%	1.1%	0.0%	26.0%
Central Electrolysis	0.0%	0.0%	0.0%	0.0%
Central Nuclear	0.0%	0.0%	0.0%	0.0%
Central Sequestered Coal	0.0%	2.6%	4.1%	6.3%
Central Sequestered Natural Gas	0.0%	0.0%	0.0%	0.0%
Central Unsequestered Coal	0.0%	12.0%	17.9%	30.8%
Central Unsequestered Natural Gas	0.0%	0.0%	1.9%	0.0%
City-Gate Natural Gas	0.0%	0.0%	0.0%	0.0%
Forecourt Electrolysis	0.0%	0.0%	0.0%	0.0%
Forecourt Ethanol	0.0%	0.0%	0.0%	0.0%
Forecourt Natural Gas	100.0%	84.4%	76.2%	36.9%
Total (billion kg)	0.06	6.52	1.85	42.17

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-51 Electricity Generation by Fuel Type: Program Goals with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Coal	51.3%			
Petroleum	3.0%			
Natural Gas	17.4%			
Nuclear Power	20.1%			
Renewable Sources	8.3%			
Total (billion kWh)	3,880			
2030				
Coal	55.7%	56.2%	55.7%	56.2%
Petroleum	1.5%	1.5%	1.6%	1.5%
Natural Gas	13.7%	13.8%	14.3%	13.5%
Nuclear Power	19.0%	19.0%	19.1%	19.0%
Renewable Sources	10.1%	9.6%	9.3%	9.8%
Total (billion kWh)	5,175	5,180	5,107	5,177
2050				
Coal	56.3%	59.0%	60.4%	58.2%
Petroleum	1.2%	1.2%	1.2%	1.3%
Natural Gas	12.1%	10.4%	9.7%	11.5%
Nuclear Power	20.2%	21.0%	20.5%	20.6%
Renewable Sources	10.1%	8.3%	8.2%	8.4%
Total (billion kWh)	6,878	7,082	7,156	6,716

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-52 Ethanol Consumption in E85 and in Blends (%): Program Goals with Subsidies

	BC[1]	MIX	PHEV	H2
2005				
Used in E85	0.0			
Used in Gasoline Blending	100.0			
Total	100.0			
Splash Blend % of Motor Gasoline Pool	8.6 (2010)			
2030				
Used in E85	6.6	42.1	72.7	16.6
Used in Gasoline Blending	93.4	57.9	27.3	83.4
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.5	9.5	9.5
2050				
Used in E85	27.7	76.6	82.9	52.5
Used in Gasoline Blending	72.3	23.4	17.1	47.5
Total	100.0	100.0	100.0	100.0
Splash Blend % of Motor Gasoline Pool	9.5	9.6	9.6	9.5

[1] BC = Base Case, MIX = Mixed Scenario, (P)HEV = (P)HEV & Ethanol Scenario, H2 = H2 Success Scenario.

TABLE E-53 Flex Fuel Share of Vehicle Stock: Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
SHARE OF CAR STOCK THAT IS FLEX FUEL (%)						
Base Case	0.5	1.7	4.0	4.7	5.0	5.6
Mixed	0.6	3.1	33.8	54.3	67.5	69.3
(P)HEV & Ethanol	0.6	3.1	34.0	55.7	74.6	82.7
H2 Success	0.5	2.3	5.3	5.4	4.5	2.9
SHARE OF LT STOCK THAT IS FLEX FUEL (%)						
Base Case	4.0	7.1	12.7	14.0	13.5	13.9
Mixed	4.1	9.5	34.3	55.5	65.8	65.8
(P)HEV & Ethanol	4.1	9.5	34.9	57.8	73.0	78.2
H2 Success	4.0	8.9	13.9	12.4	11.1	8.1

TABLE E-54 Percent of Travel by Flex Fuel Vehicles on E85: Program Goals with Subsidies

	2005 (%)	2010 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)
Base Case	0.3	0.2	2.6	7.4	18.6	31.3
Mixed	0.3	0.2	5.3	10.0	34.0	36.0
(P)HEV & Ethanol	0.3	0.2	21.9	39.1	42.7	48.8
H2 Success	0.3	0.3	6.5	15.4	47.0	62.3

TABLE E-55 Availability of E85 and H_2 Stations (% of CV stations in 2005): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
E85 Stations						
Base Case	0.6	2.1	6.7	9.2	12.8	17.5
Mixed	0.6	2.6	8.0	9.1	90.1	104.6
(P)HEV & Ethanol	0.6	2.7	9.4	15.5	21.2	26.3
H2 Success	0.6	2.6	8.0	9.2	13.3	12.7
H_2 Stations						
Base Case	0.0	0.0	0.0	0.0	0.1	0.1
Mixed	0.0	0.0	0.0	0.6	3.4	20.8
(P)HEV & Ethanol	0.0	0.0	0.0	0.5	1.6	5.6
H2 Success	0.0	0.1	3.4	7.9	46.2	133.0

TABLE E-56 Transportation Sector Fuel Prices ($/million Btu): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
Motor Gasoline						
Base Case	18.6	21.0	23.3	25.2	28.3	31.5
Mixed	18.6	20.7	22.7	23.7	22.8	25.2
(P)HEV & Ethanol	18.6	20.8	22.2	22.4	22.4	24.4
H2 Success	18.6	20.8	22.7	23.9	23.1	22.4
Distillate Fuel Oil (diesel)						
Base Case	17.5	18.8	21.0	22.3	24.6	28.2
Mixed	17.5	18.9	20.9	22.6	24.5	27.3
(P)HEV & Ethanol	17.5	18.9	21.0	22.5	24.2	27.0
H2 Success	17.5	18.9	20.9	22.5	24.7	27.0
E85						
Base Case	23.1	28.4	25.3	26.0	28.1	30.7
Mixed	23.1	25.0	24.7	24.1	24.1	26.6
(P)HEV & Ethanol	23.1	25.0	20.6	21.9	22.4	24.0
H2 Success	23.1	25.1	24.4	23.9	21.4	20.2
Electricity						
Base Case	29.8	27.7	25.9	25.6	24.4	23.4
Mixed	29.8	27.8	26.0	25.7	25.4	24.2
(P)HEV & Ethanol	29.8	27.8	25.5	25.9	25.5	25.0
H2 Success	29.8	27.8	25.8	25.7	25.1	23.3
H_2						
Base Case	N/A	30.9	29.7	30.2	31.0	32.0
Mixed	N/A	27.7	22.7	22.5	23.1	23.7
(P)HEV & Ethanol	N/A	27.7	22.5	22.5	23.0	23.1
H2 Success	N/A	29.1	24.0	21.4	20.6	21.1

TABLE E-57 New Vehicle Prices (thousand 2005$): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
AVERAGE NEW CAR PRICE						
Base Case	26.4	27.9	29.7	29.7	29.8	29.9
Mixed	26.4	28.2	29.8	29.6	29.4	29.2
(P)HEV & Ethanol	26.4	28.2	29.8	28.7	28.4	28.3
H2 Success	26.4	28.2	29.8	30.1	28.7	26.3
AVERAGE NEW LT PRICE						
Base Case	29.9	31.5	33.5	33.7	33.9	34.0
Mixed	29.9	31.8	33.6	33.9	33.9	34.0
(P)HEV & Ethanol	29.9	31.8	33.5	33.3	33.3	33.4
H2 Success	29.9	31.8	33.6	34.1	33.6	31.7

TABLE E-58 Total Energy Expenditures (billion 2005$): Program Goals with Subsidies

	2005	2010	2020	2030	2040	2050
Total Transportation Expenditures						
Base Case	475	548	649	765	982	1,297
Mixed	475	543	629	713	808	1,033
(P)HEV & Ethanol	475	544	621	690	785	973
H2 Success	475	543	629	706	800	931
Total Energy Expenditures						
Base Case	1,040	1,149	1,292	1,496	1,839	2,326
Mixed	1,040	1,147	1,272	1,443	1,657	2,051
(P)HEV & Ethanol	1,040	1,147	1,253	1,417	1,630	1,976
H2 Success	1,040	1,147	1,269	1,434	1,652	1,950

TABLE E-59 Amortized Vehicle Expenditures (billion 2005$): Program Goals with Subsidies

	2015	2020	2030	2040	2050
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – CAR					
Base Case	420	458	493	510	521
Mixed	421	458	492	494	494
(P)HEV & Ethanol	421	455	480	465	476
H2 Success	421	458	495	498	457
TOTAL CONSUMER VEHICLE EXPENDITURES (billion 2005$) – LT					
Base Case	380	401	496	584	665
Mixed	387	409	502	599	686
(P)HEV & Ethanol	387	412	507	602	675
H2 Success	387	410	503	595	665

TABLE E-60 Consumer Savings (billion 2005$): Program Goals with Subsidies

	2015	2020	2030	2040	2050
ENERGY EXPENDITURES AND VEHICLE EXPENDITURES (billion 2005$)					
Base Case	2,015	2,151	2,486	2,933	3,512
Mixed	2,012	2,139	2,437	2,749	3,231
(P)HEV & Ethanol	2,005	2,120	2,404	2,697	3,127
H2 Success	2,010	2,137	2,432	2,746	3,073
CONSUMER SAVINGS FOR SCENARIOS (billion 2005$)					
Mixed	2.7	11.8	49.1	183.8	280.8
(P)HEV & Ethanol	9.5	31.2	81.9	236.4	384.6
H2 Success	4.6	14.4	53.4	187.4	439.3
CONSUMER SAVINGS (% SAVED FROM BASE CASE)					
Mixed	0.1%	0.5%	2.0%	6.3%	8.0%
(P)HEV & Ethanol	0.5%	1.5%	3.3%	8.1%	11.0%
H2 Success	0.2%	0.7%	2.1%	6.4%	12.5%

LITERATURE REVIEW/NO SUBSIDIES SCENARIOS: GRAPHICAL RESULTS

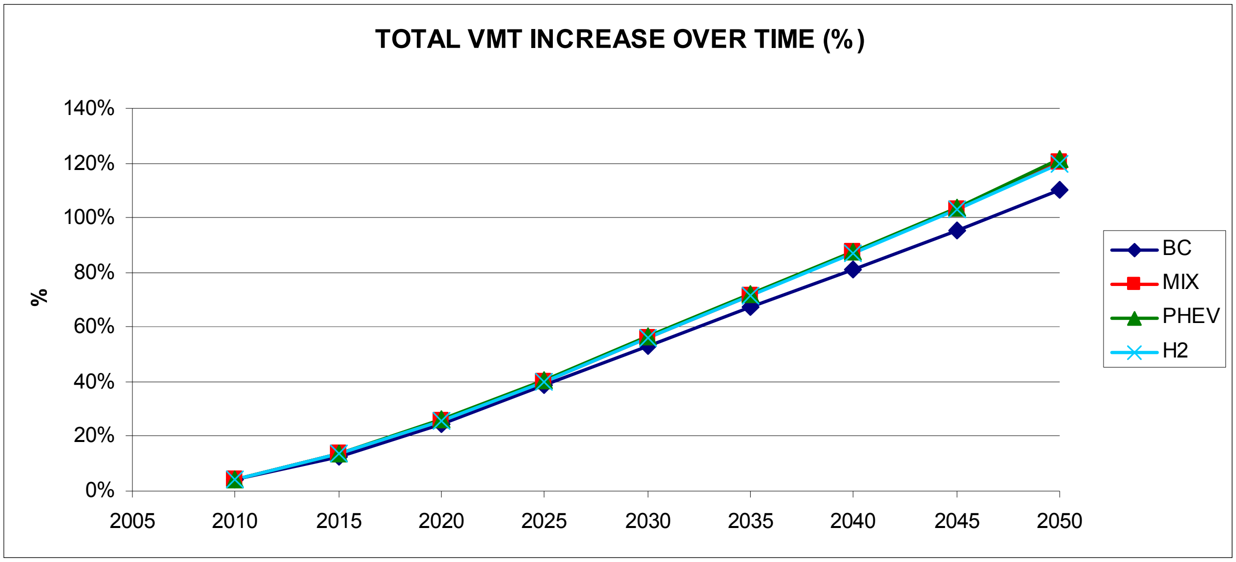

FIGURE E-1 Total VMT Increase over Time (Literature Review, No Subsidies)

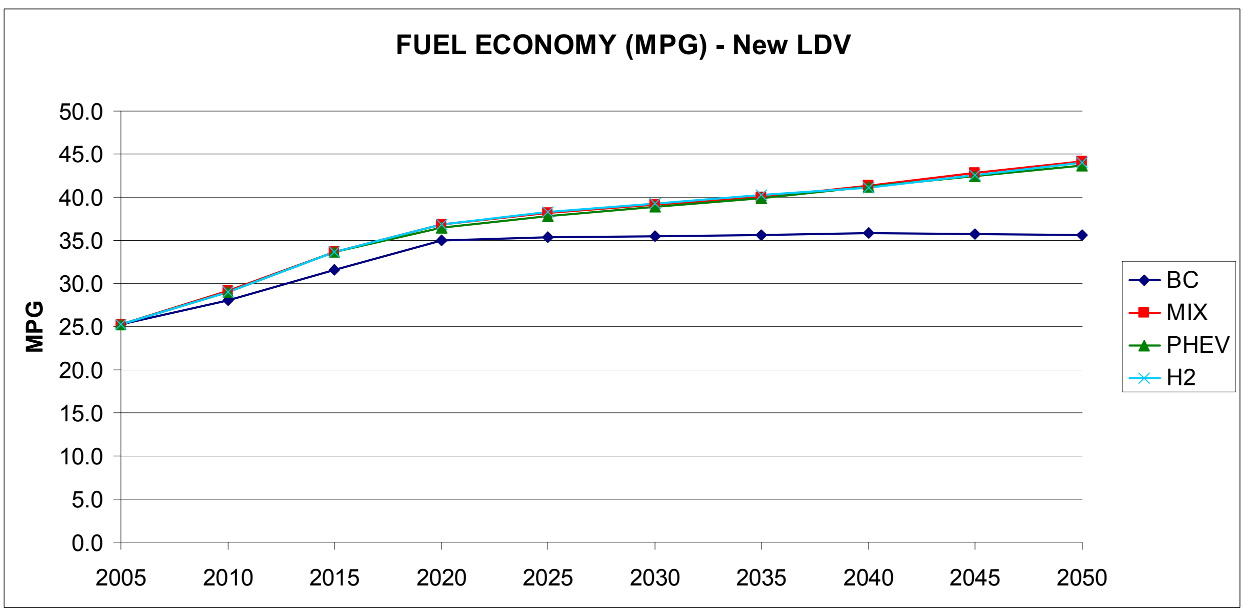

FIGURE E-2 New LV Fuel Economy (Literature Review, No Subsidies)

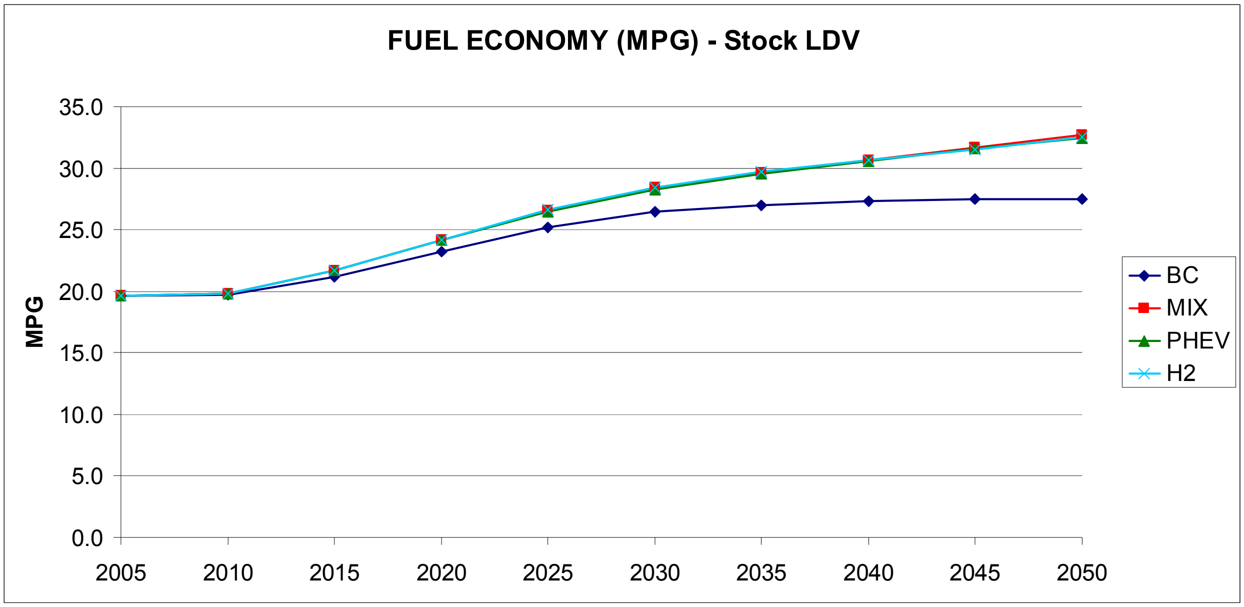

FIGURE E-3 LV Stock Fuel Economy (Literature Review, No Subsidies)

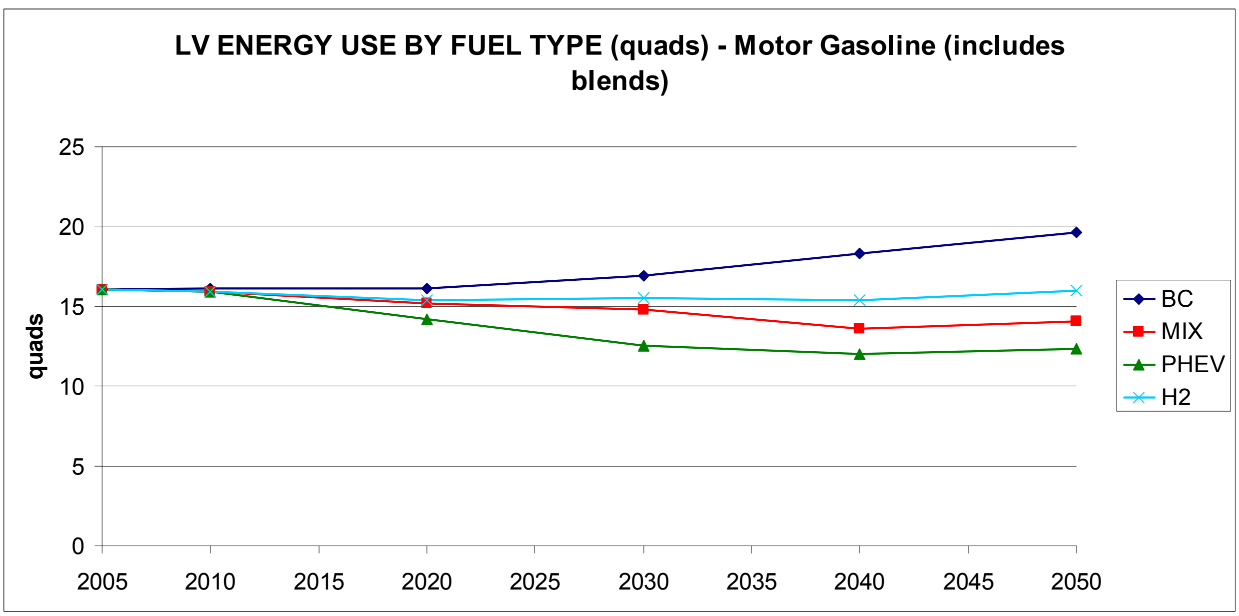

FIGURE E-4 LV Motor Gasoline Demand (Literature Review, No Subsidies)

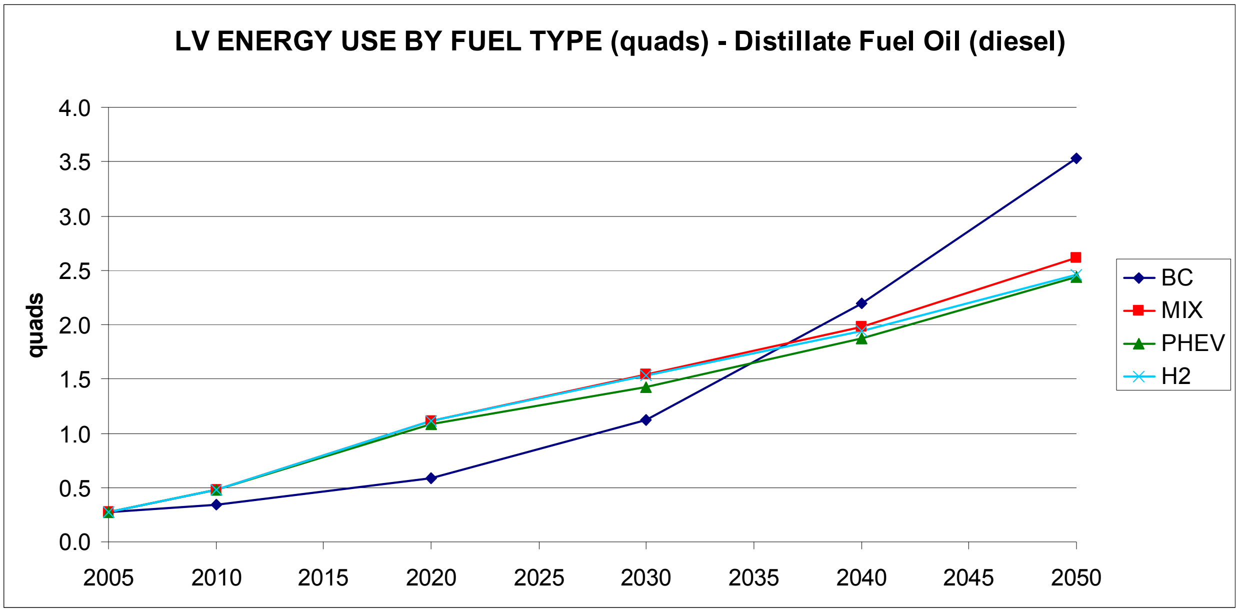

FIGURE E-5 LV Diesel Fuel Demand (Literature Review, No Subsidies)

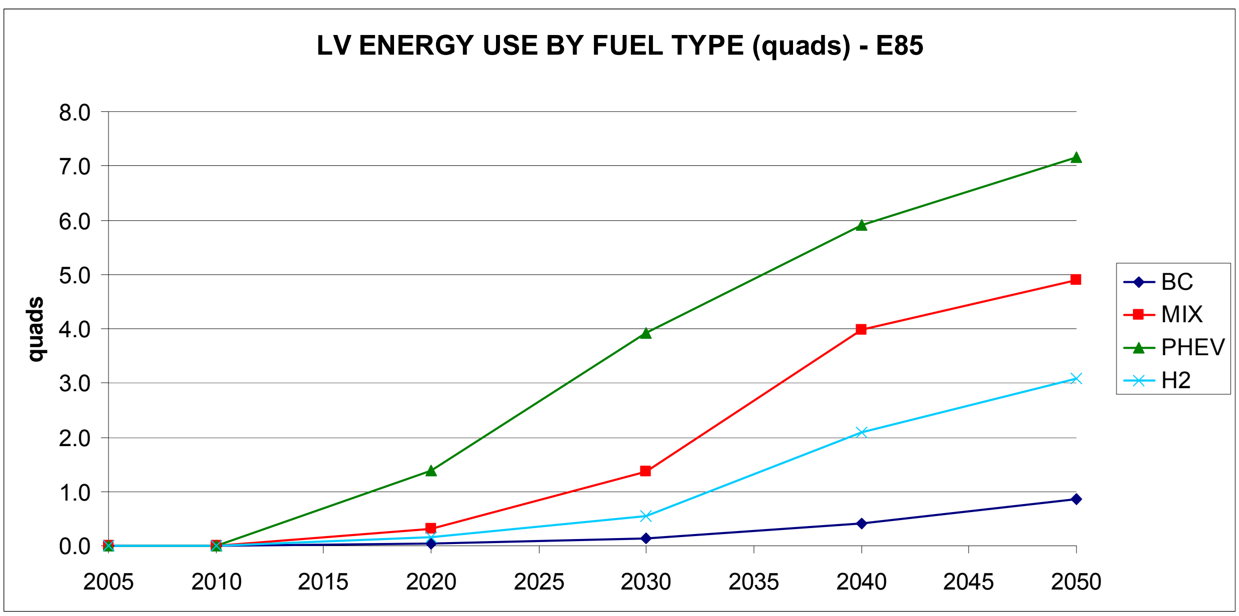

FIGURE E-6 LV E85 Demand (Literature Review, No Subsidies)

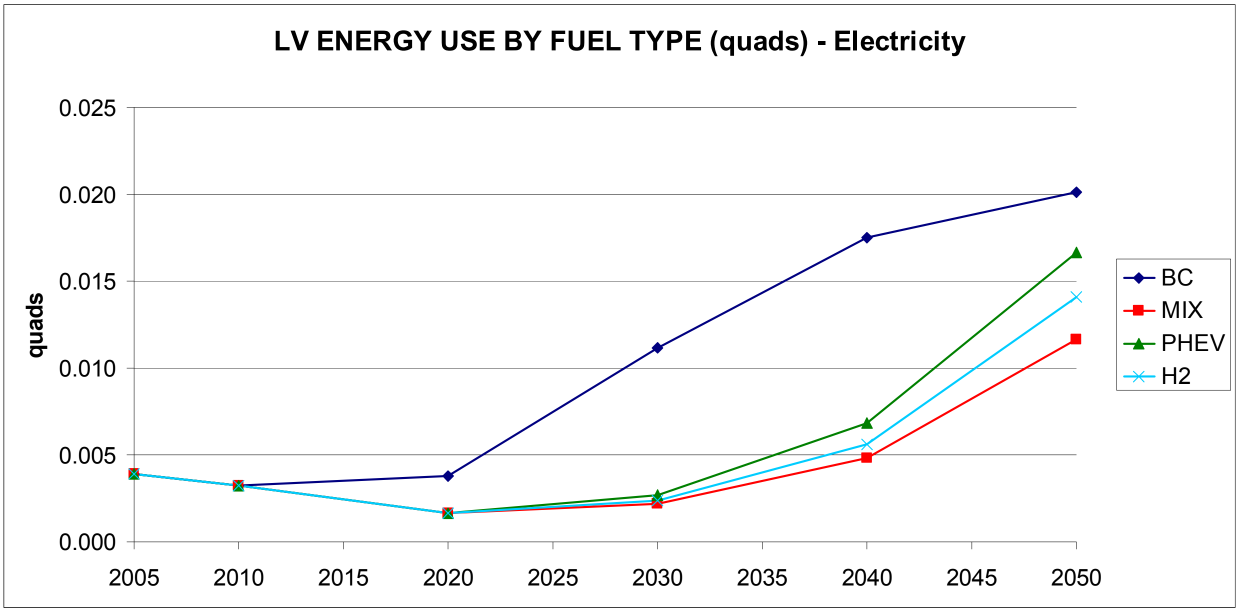

FIGURE E-7 LV Electricity Demand (Literature Review, No Subsidies)

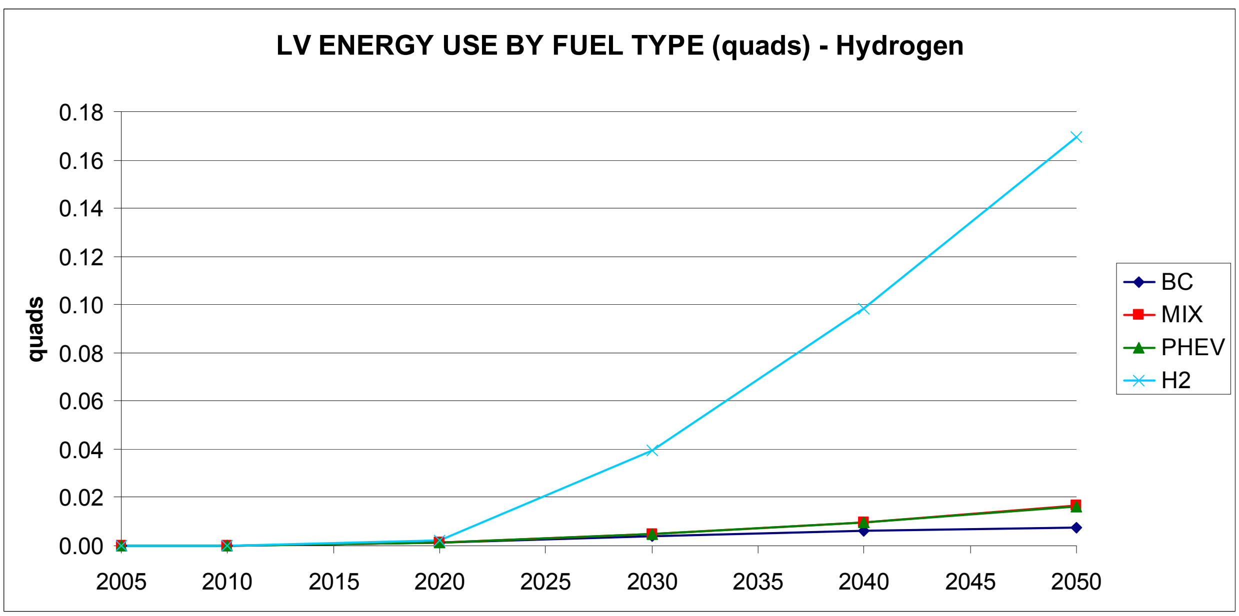

FIGURE E-8 LV H_2 Demand (Literature Review, No Subsidies)

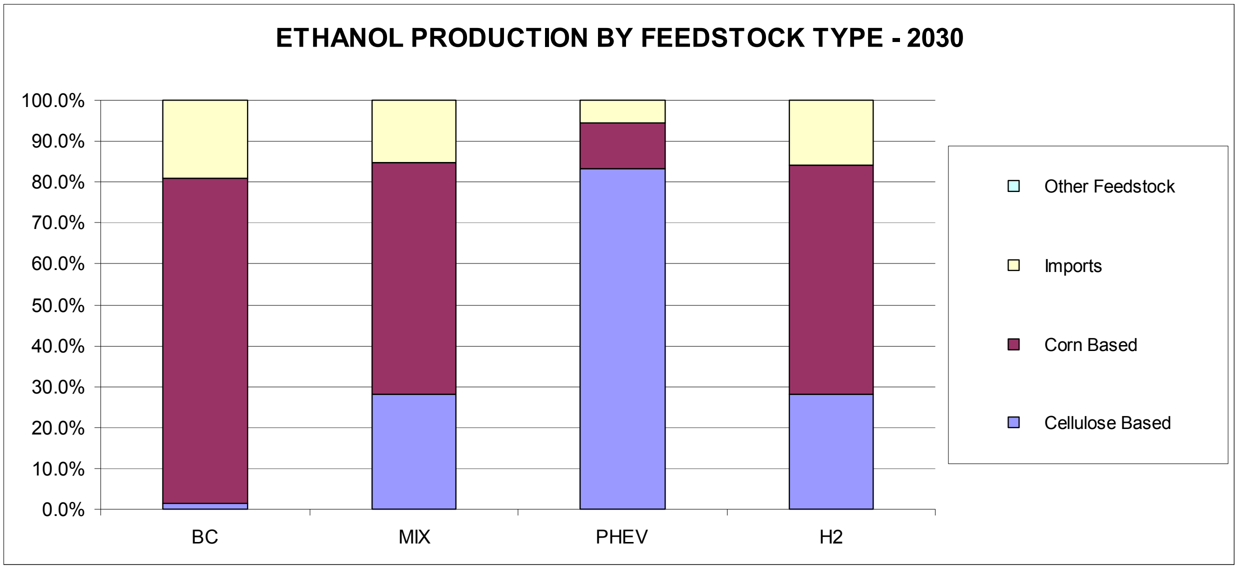

FIGURE E-9 Ethanol Production by Feedstock Type in 2030 (Literature Review, No Subsidies)

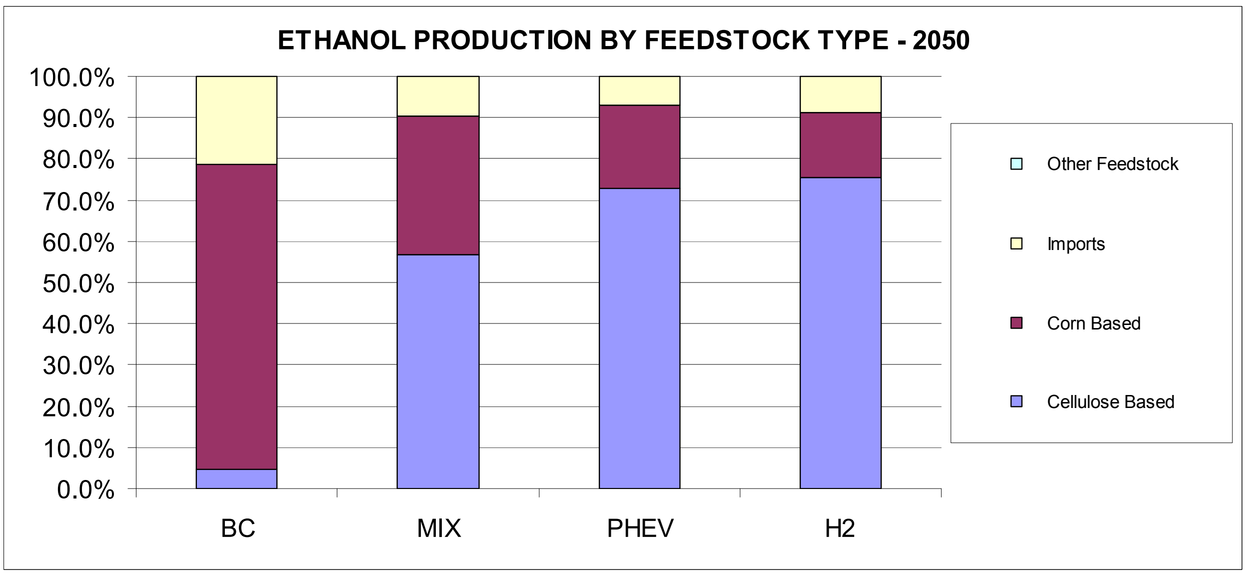

FIGURE E-10 Ethanol Production by Feedstock Type in 2050 (Literature Review, No Subsidies)

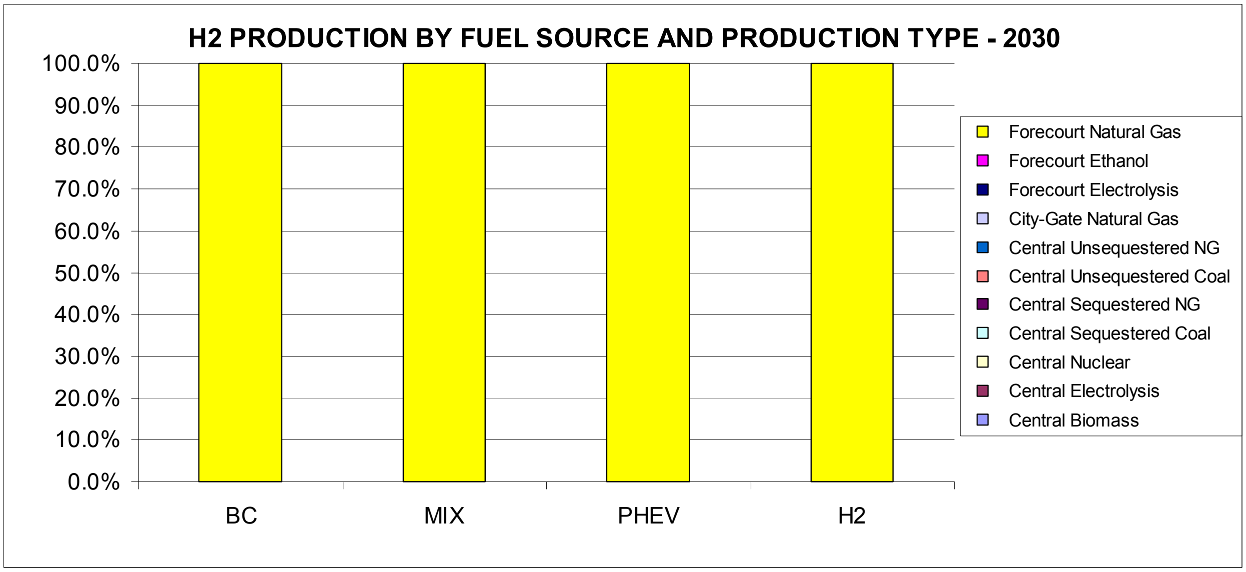

FIGURE E-11 H_2 Production by Fuel Source and Production Type in 2030 (Literature Review, No Subsidies)

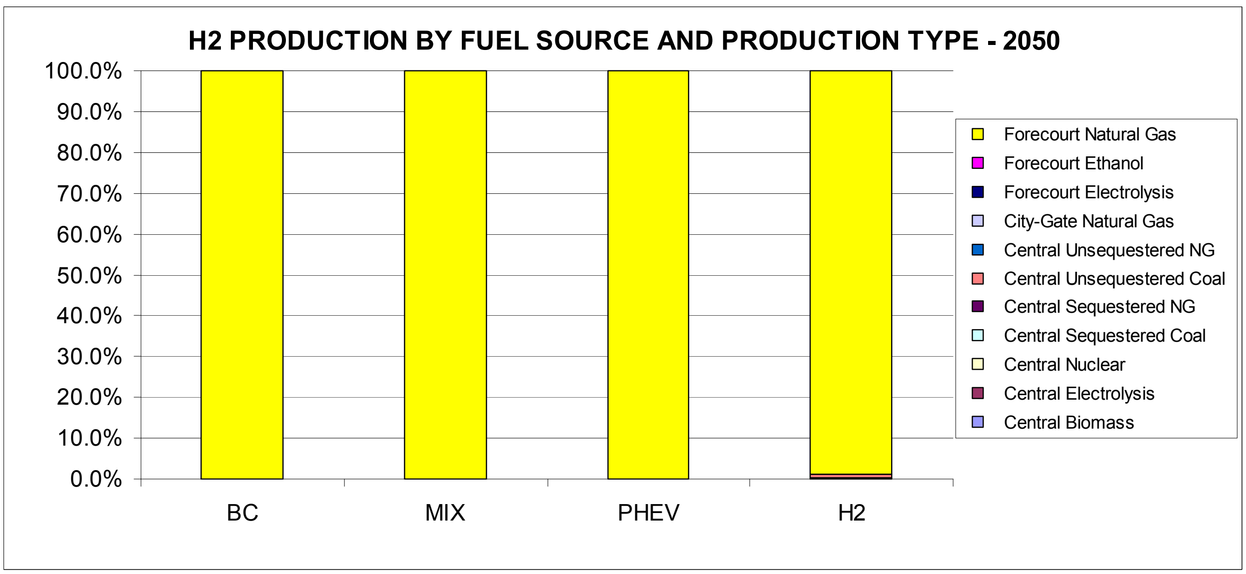

FIGURE E-12 H_2 Production by Fuel Source and Production Type in 2050 (Literature Review, No Subsidies)

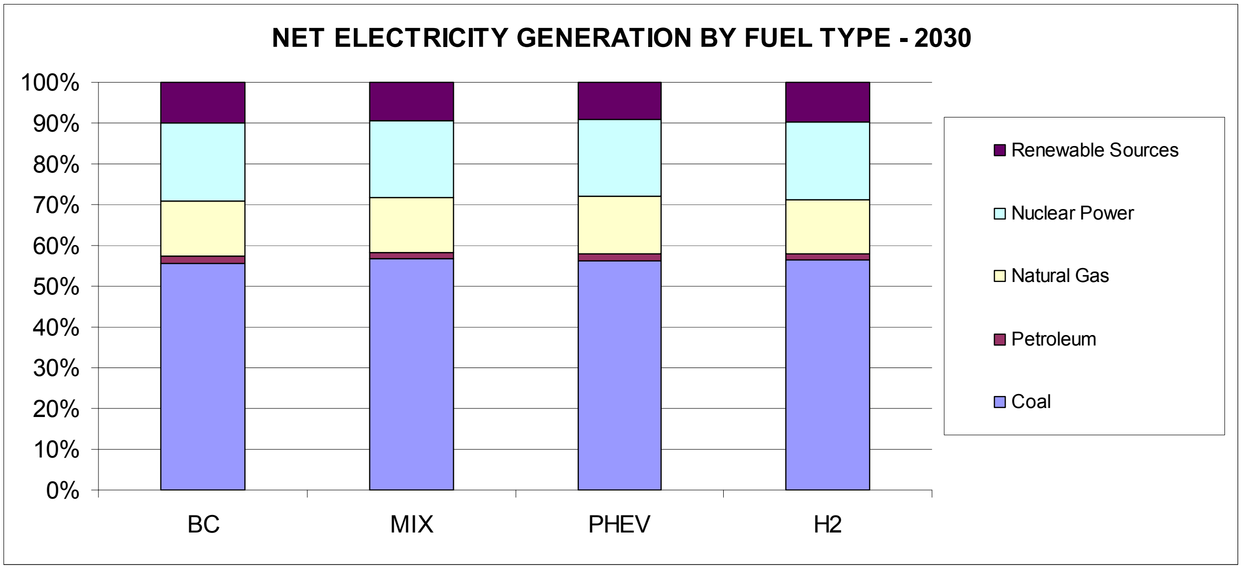

FIGURE E-13 Net Electricity Generation by Fuel Type in 2030 (Literature Review, No Subsidies)

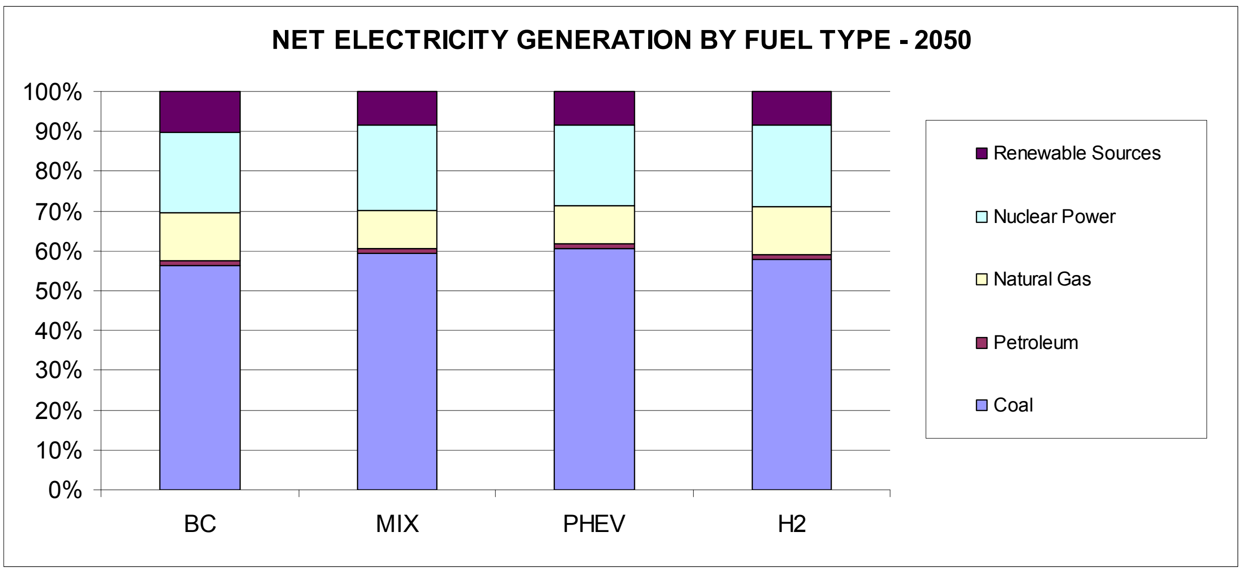

FIGURE E-14 Net Electricity Generation by Fuel Type in 2050 (Literature Review, No Subsidies)

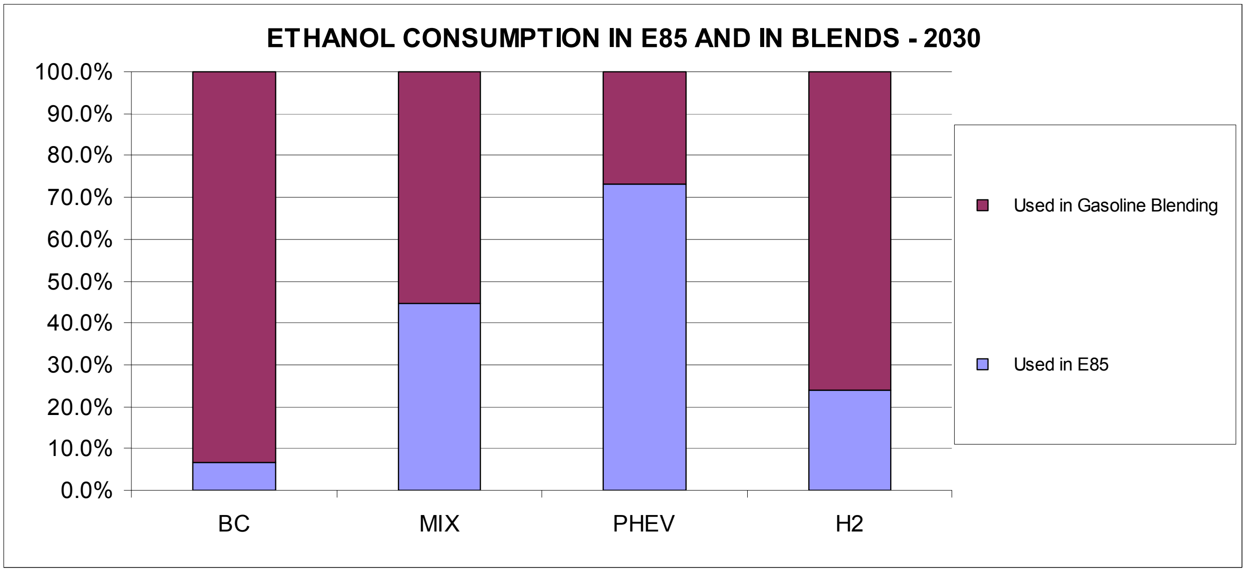

FIGURE E-15 Ethanol Consumption in E85 and Blends in 2030 (Literature Review, No Subsidies)

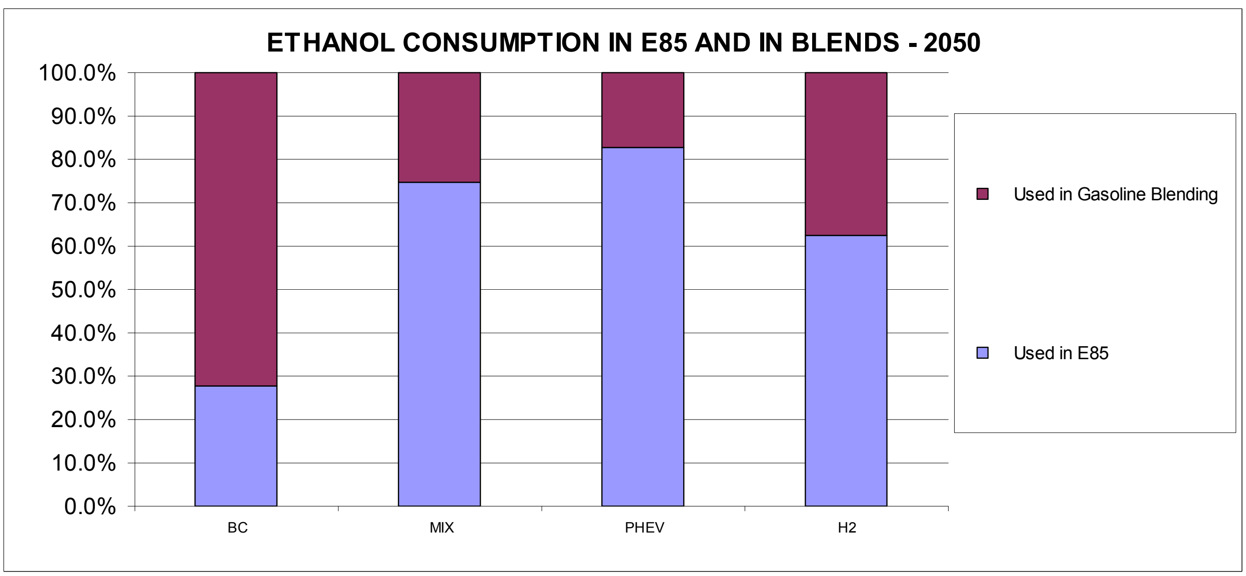

FIGURE E-16 Ethanol Consumption in E85 and Blends in 2050 (Literature Review, No Subsidies

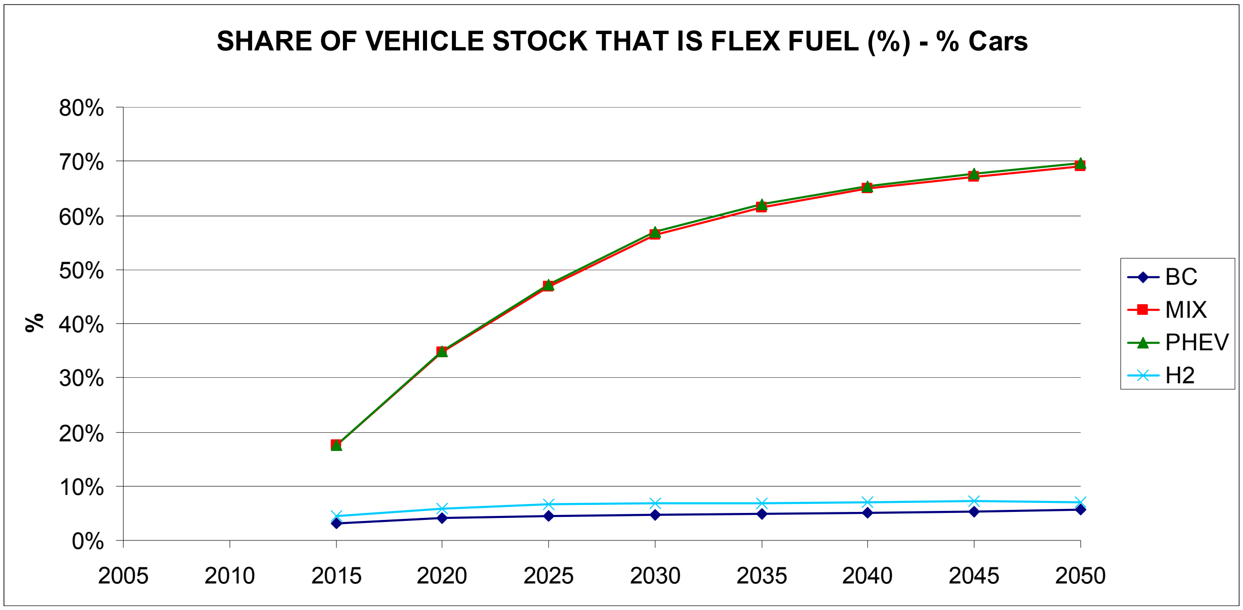

FIGURE E-17 Flex Fuel Share of Car Stock (Literature Review, No Subsidies)

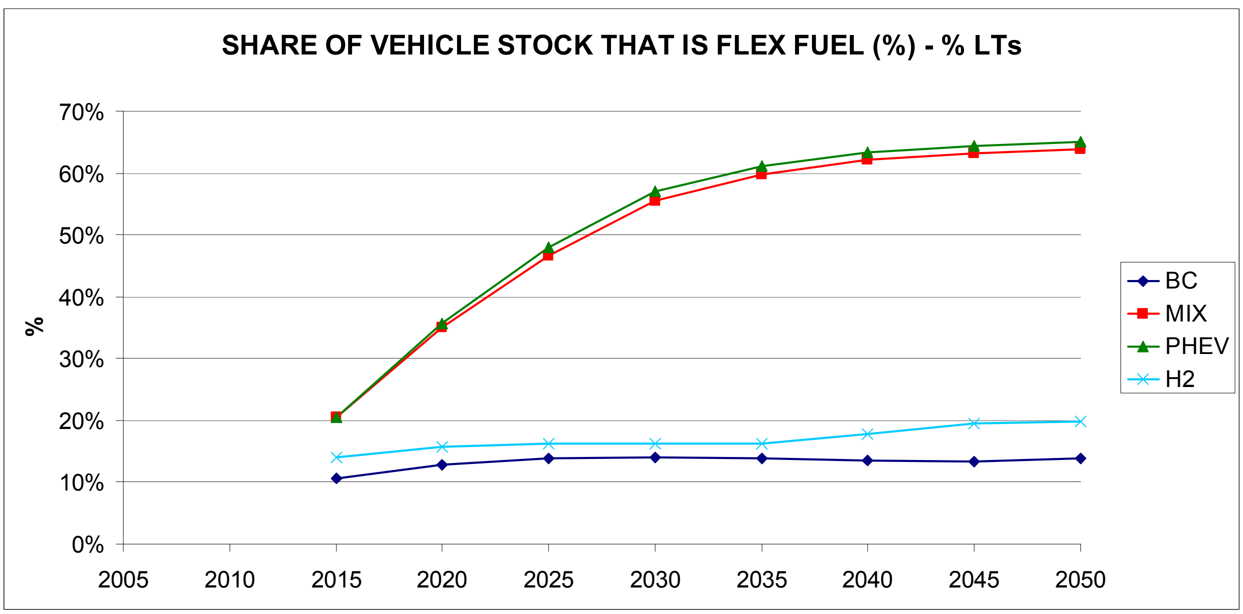

FIGURE E-18 Flex Fuel Share of LT Stock (Literature Review, No Subsidies)

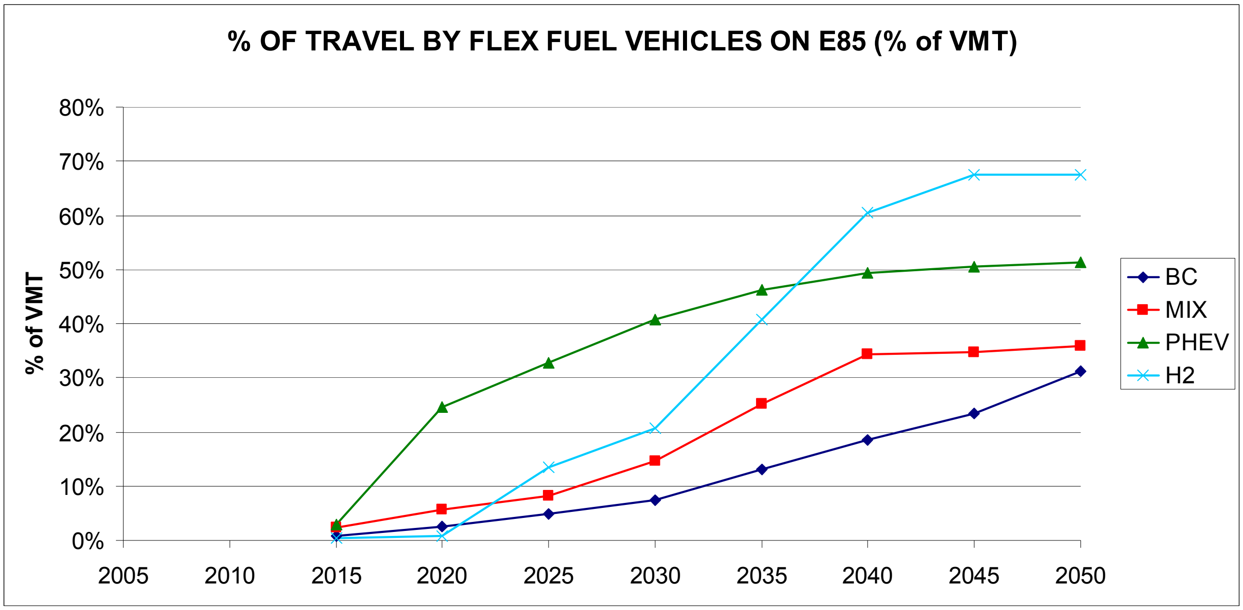

FIGURE E-19 Percent of Travel by Flex Fuel Vehicles on E85 (Literature Review, No Subsidies)

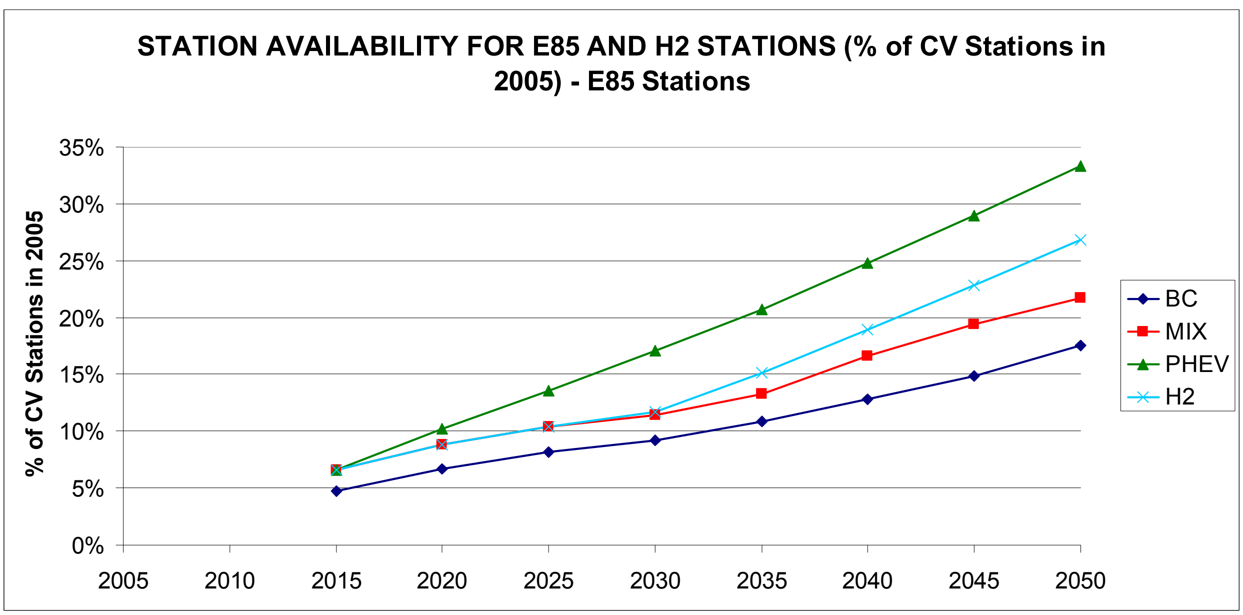

FIGURE E-20 E85 Station Availability (Literature Review, No Subsidies)

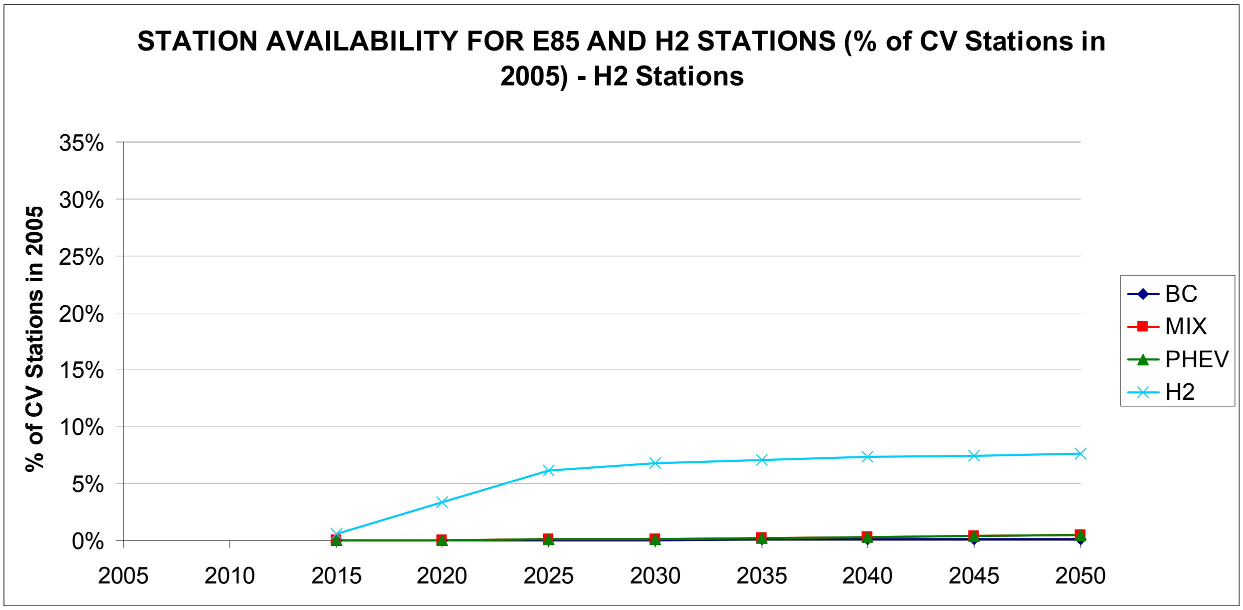

FIGURE E-21 H_2 Station Availability (Literature Review, No Subsidies)

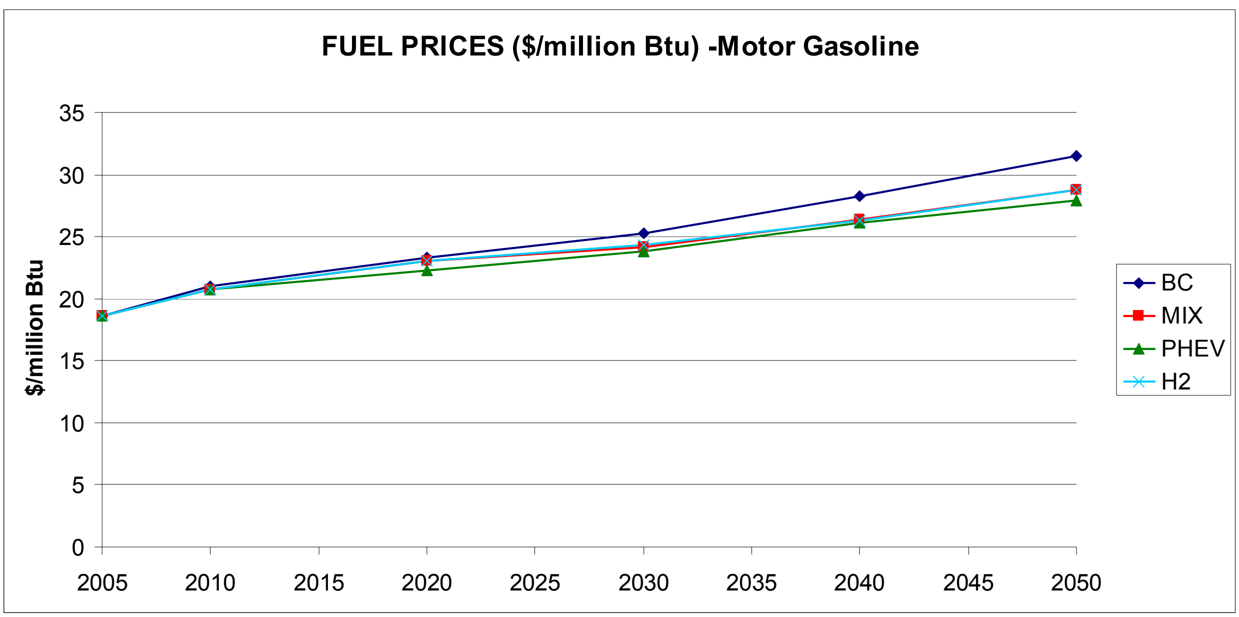

FIGURE E-22 Motor Gasoline Fuel Prices (Literature Review, No Subsidies)

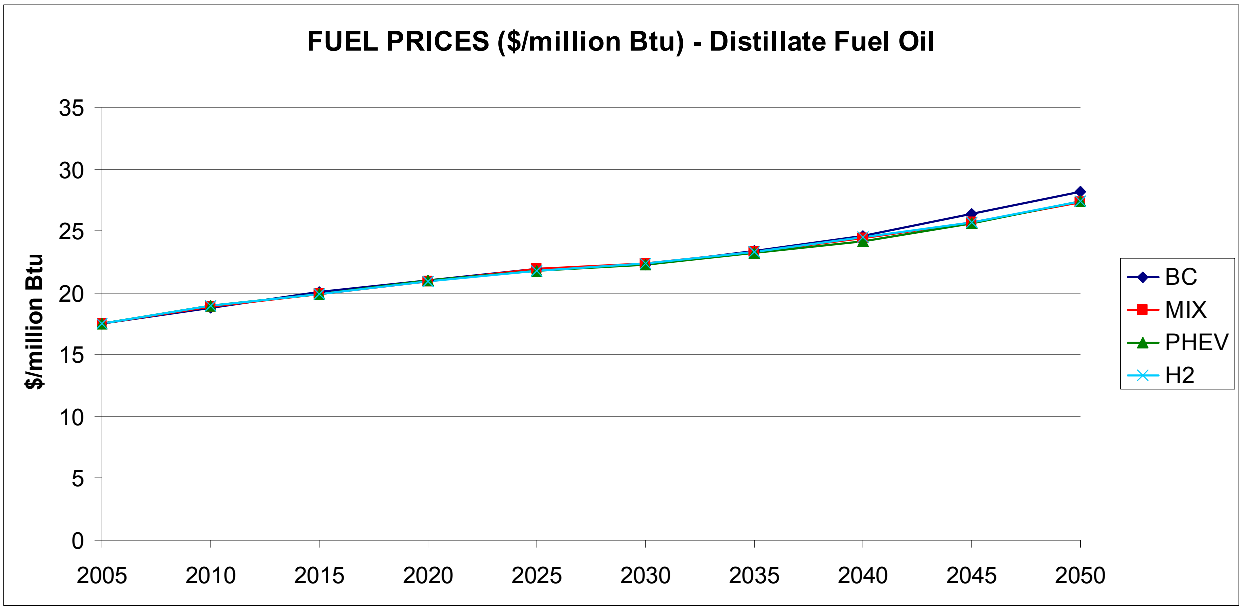

FIGURE E-23 Diesel Fuel Prices (Literature Review, No Subsidies)

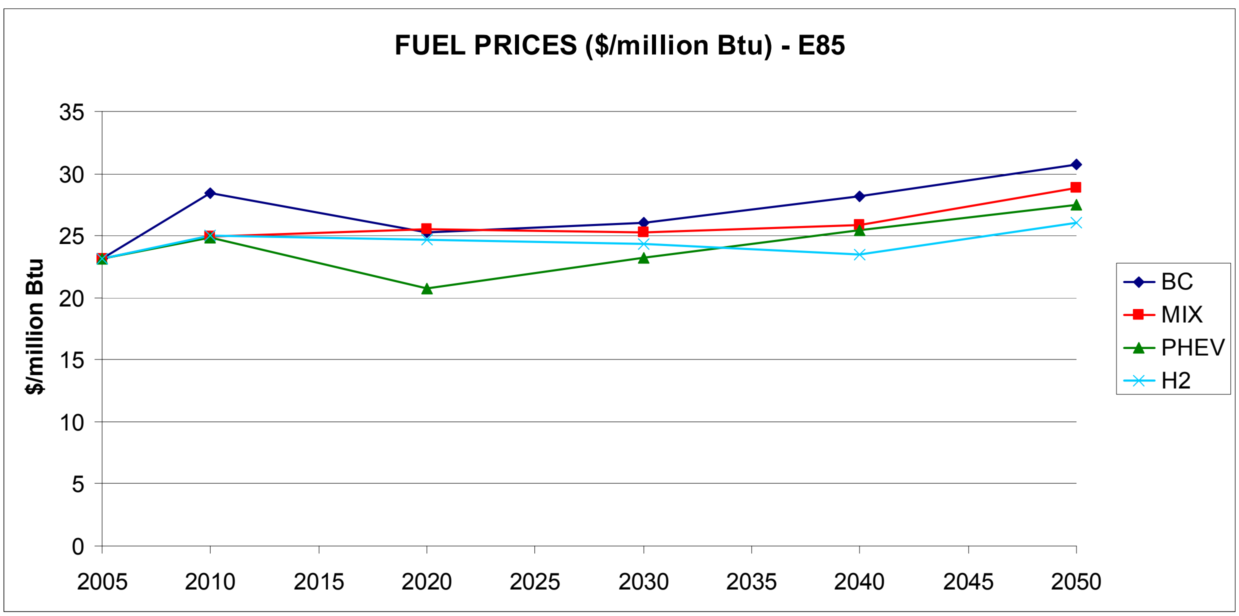

FIGURE E-24 E85 Fuel Prices (Literature Review, No Subsidies)

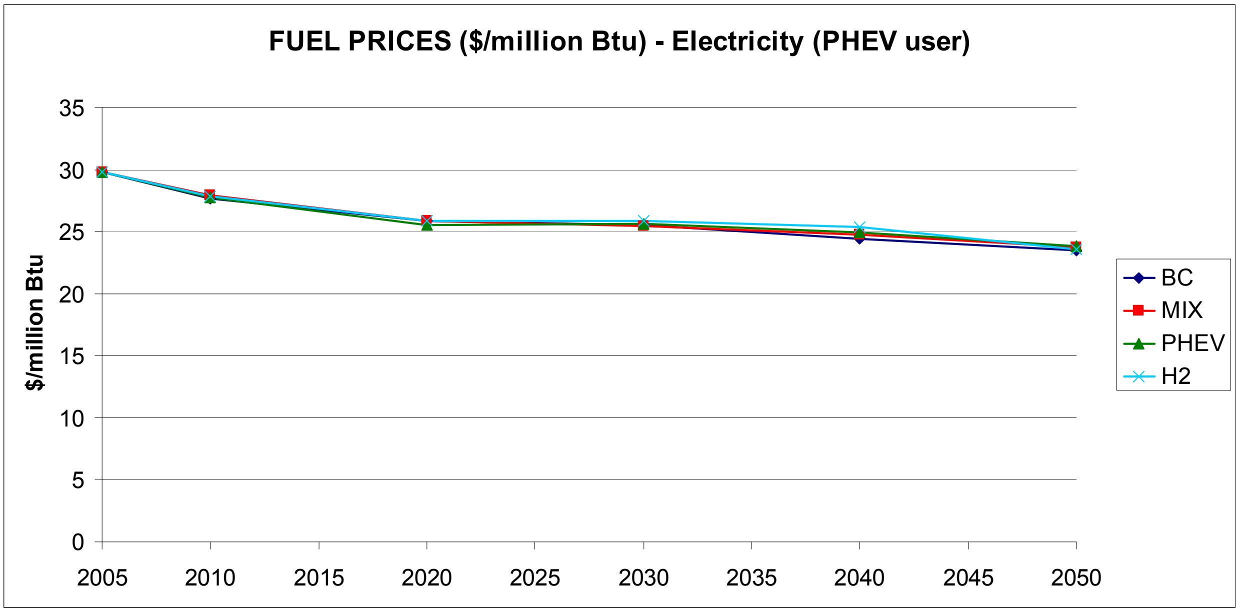

FIGURE E-25 Electricity Prices for the PHEV User (Literature Review, No Subsidies)

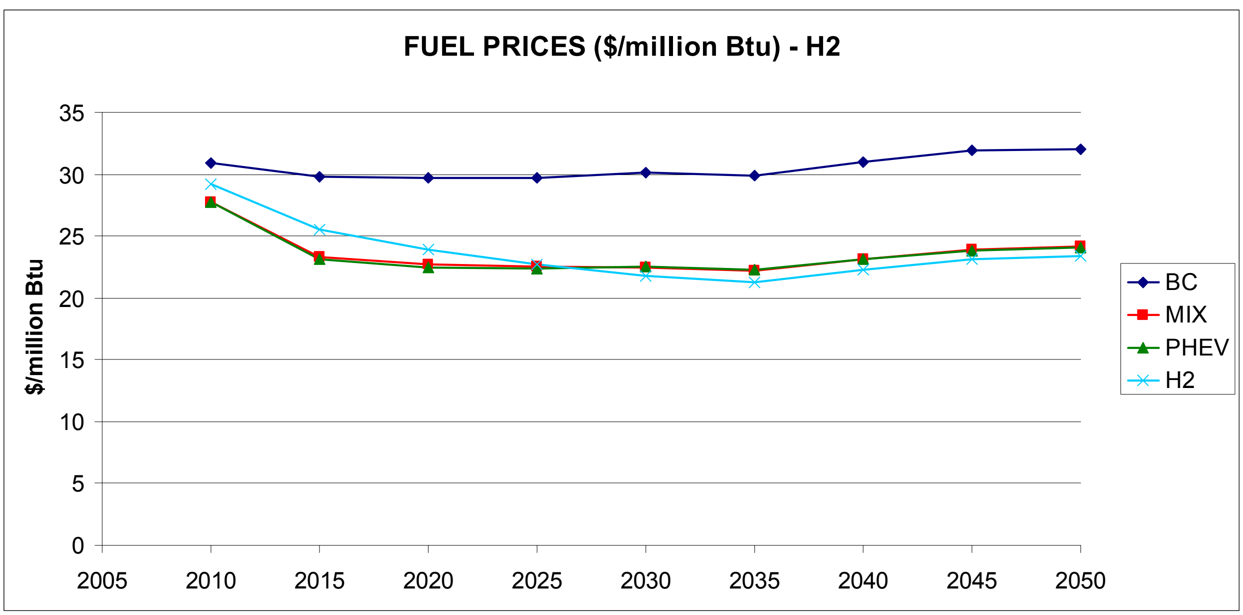

FIGURE E-26 H_2 Fuel Prices (Literature Review, No Subsidies)

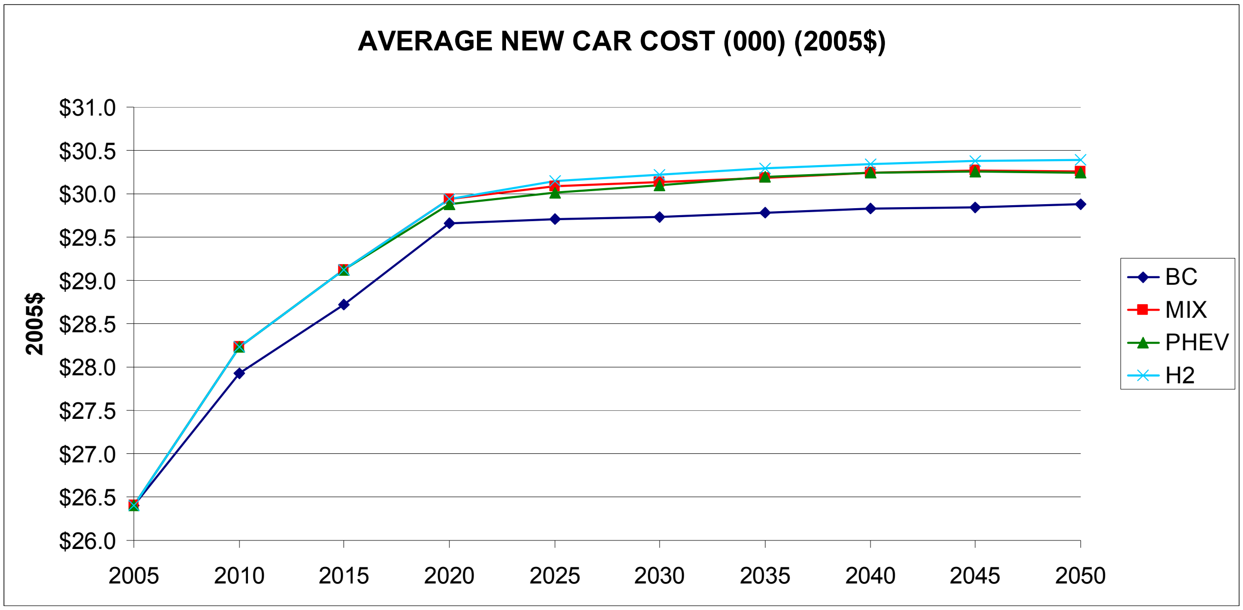

FIGURE E-27 Average New Car Prices (Literature Review, No Subsidies)

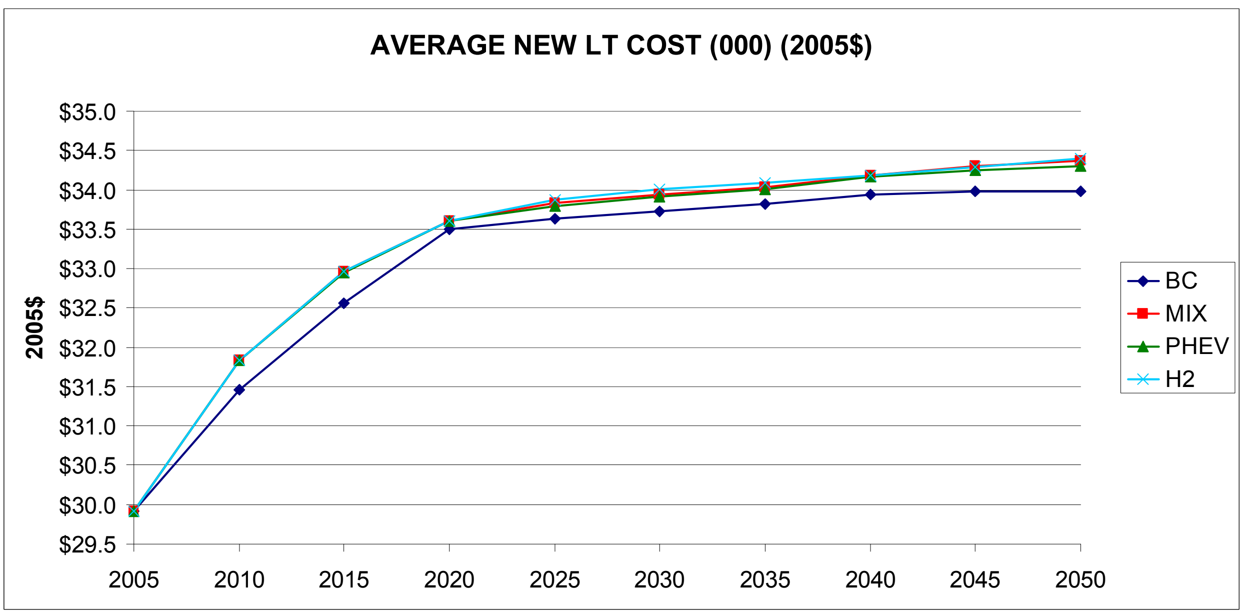

FIGURE E-28 Average New LT Prices (Literature Review, No Subsidies)

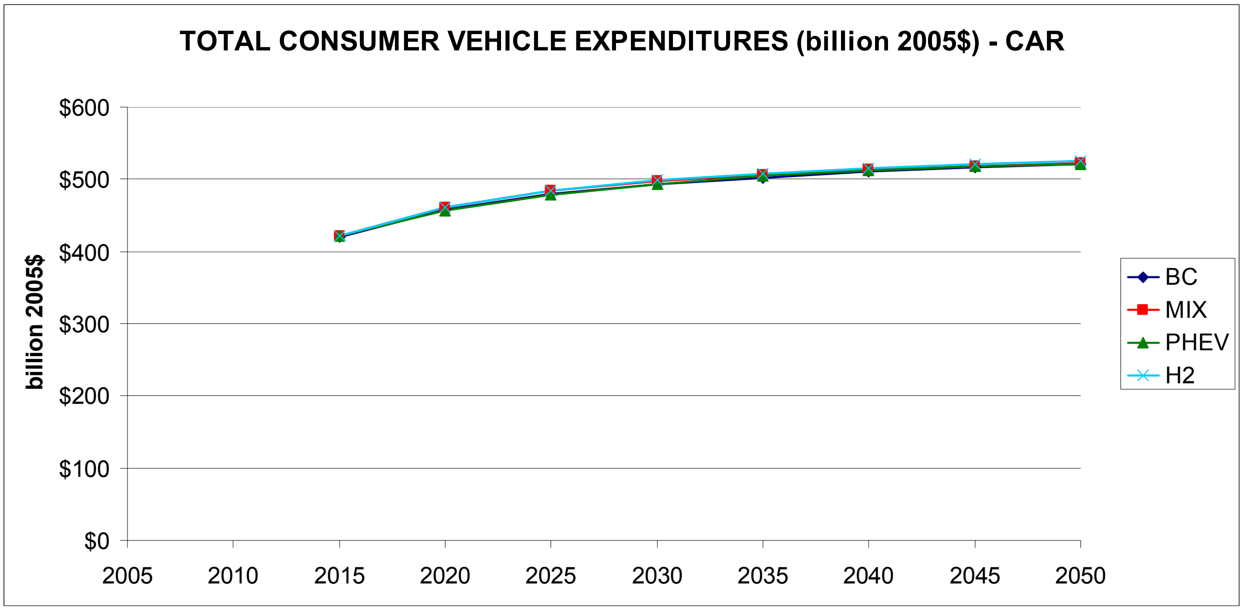

FIGURE E-29 Total Consumer Car Expenditures (Literature Review, No Subsidies)

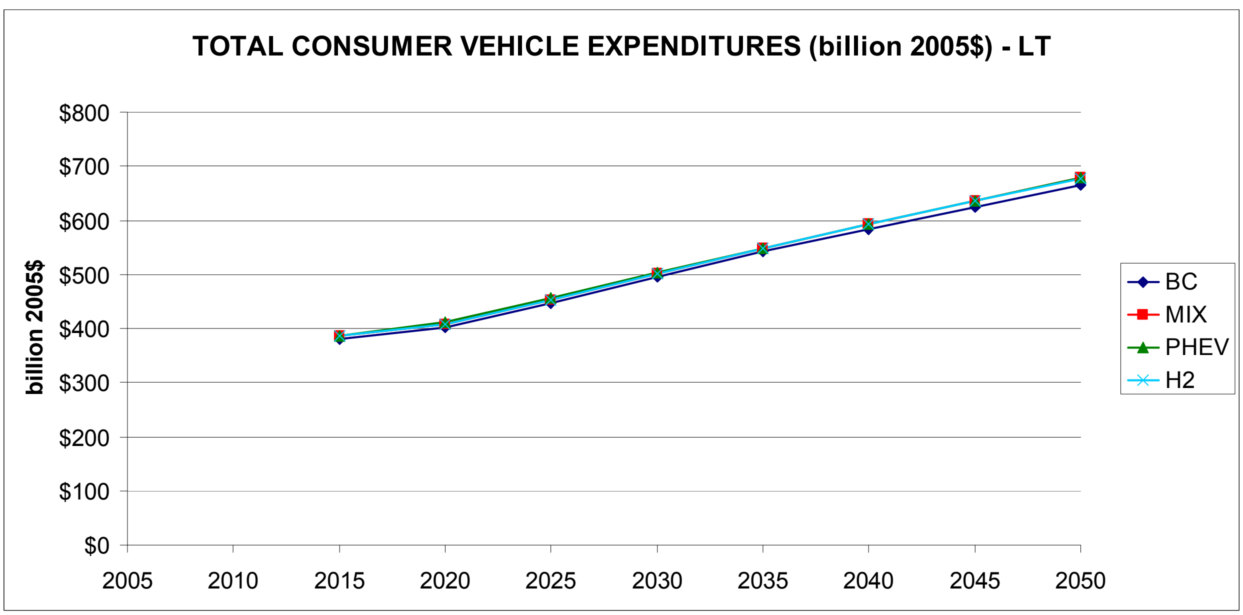

FIGURE E-30 Total Consumer LT Expenditures (Literature Review, No Subsidies)

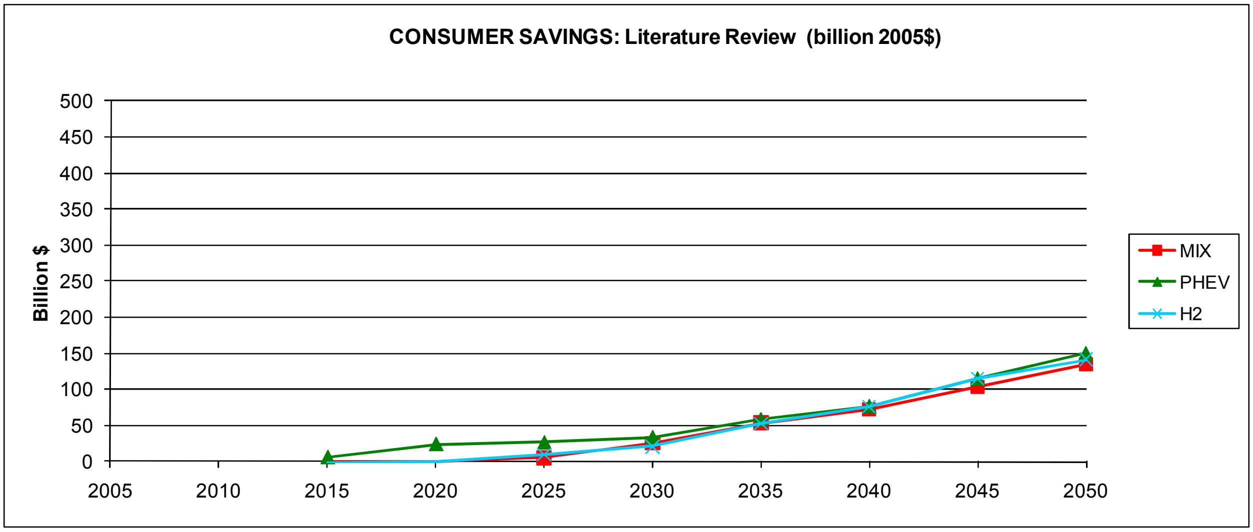

FIGURE E-31 Total Consumer Savings (Literature Review, No Subsidies)

PROGRAM GOALS/NO SUBSIDIES SCENARIOS: GRAPHICAL RESULTS

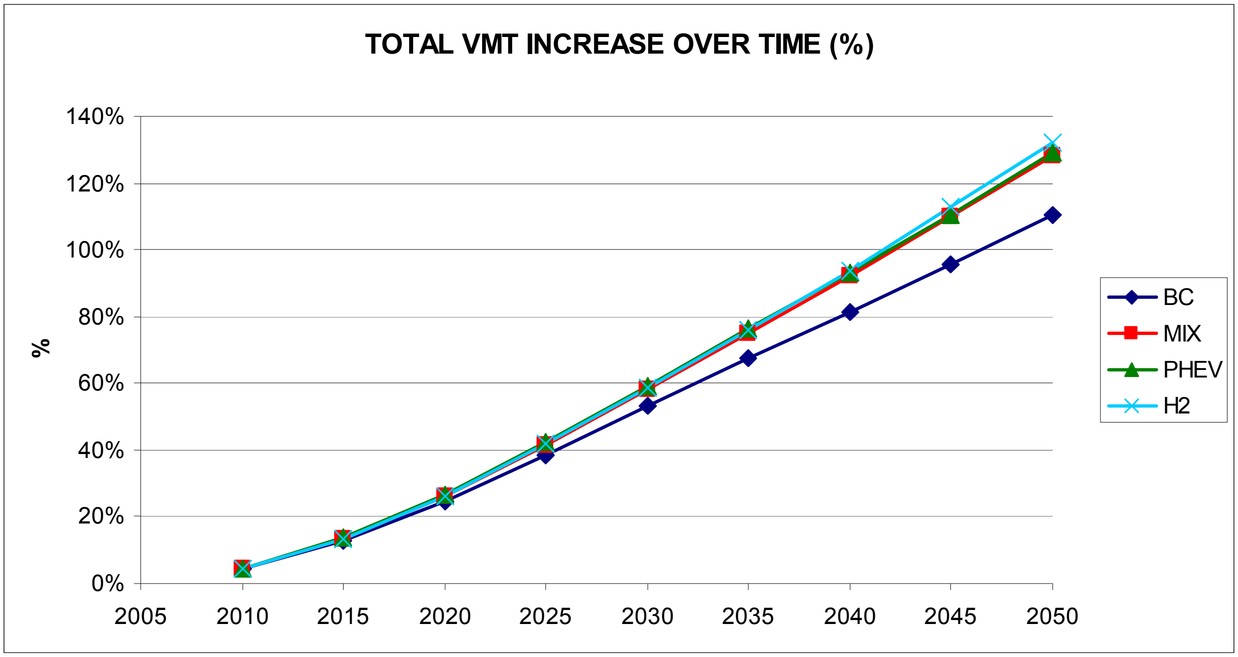

FIGURE E-32 Total VMT Increase over Time (Program Goals, No Subsidies)

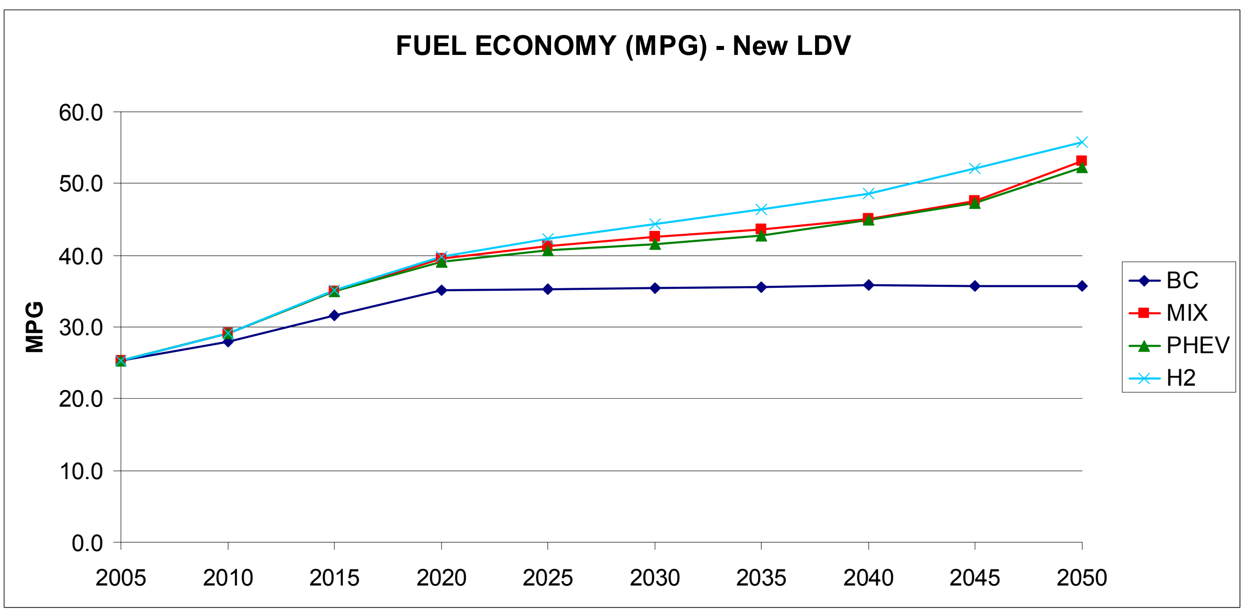

FIGURE E-33 New LV Fuel Economy (Program Goals, No Subsidies)

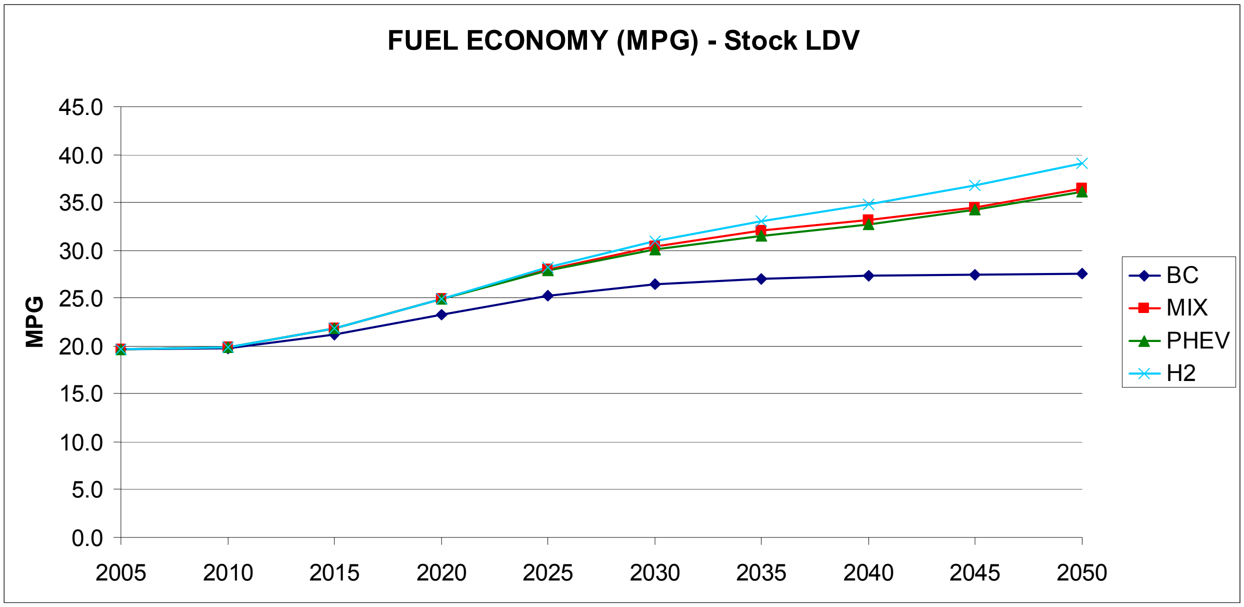

FIGURE E-34 LV Stock Fuel Economy (Program Goals, No Subsidies)

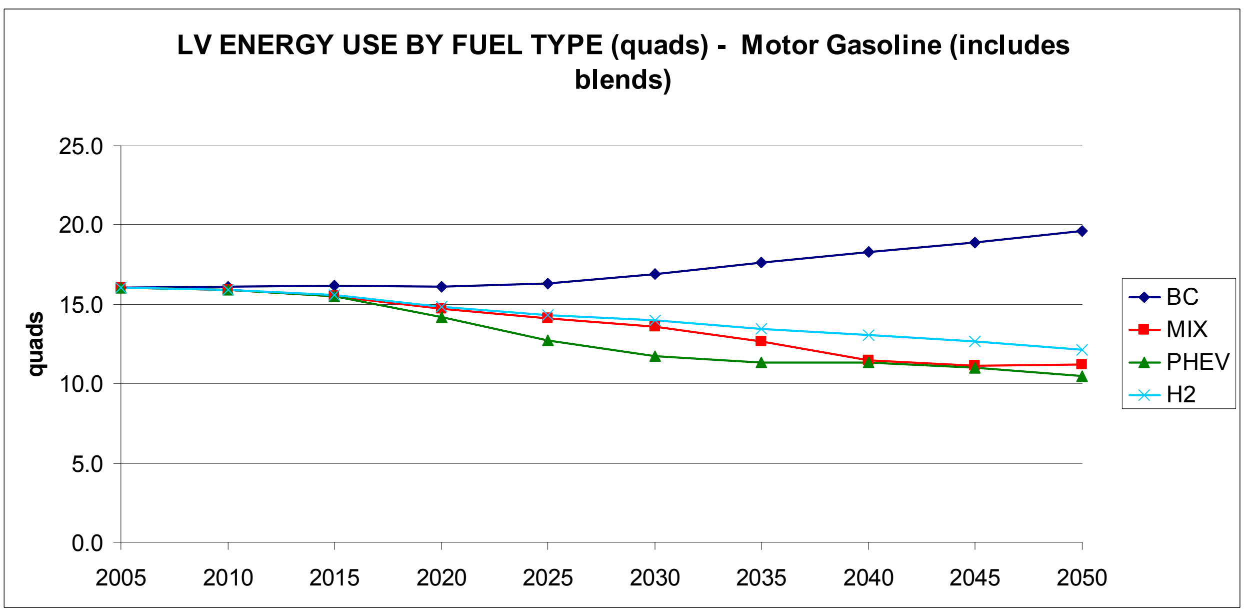

FIGURE E-35 LV Motor Gasoline Demand (Program Goals, No Subsidies)

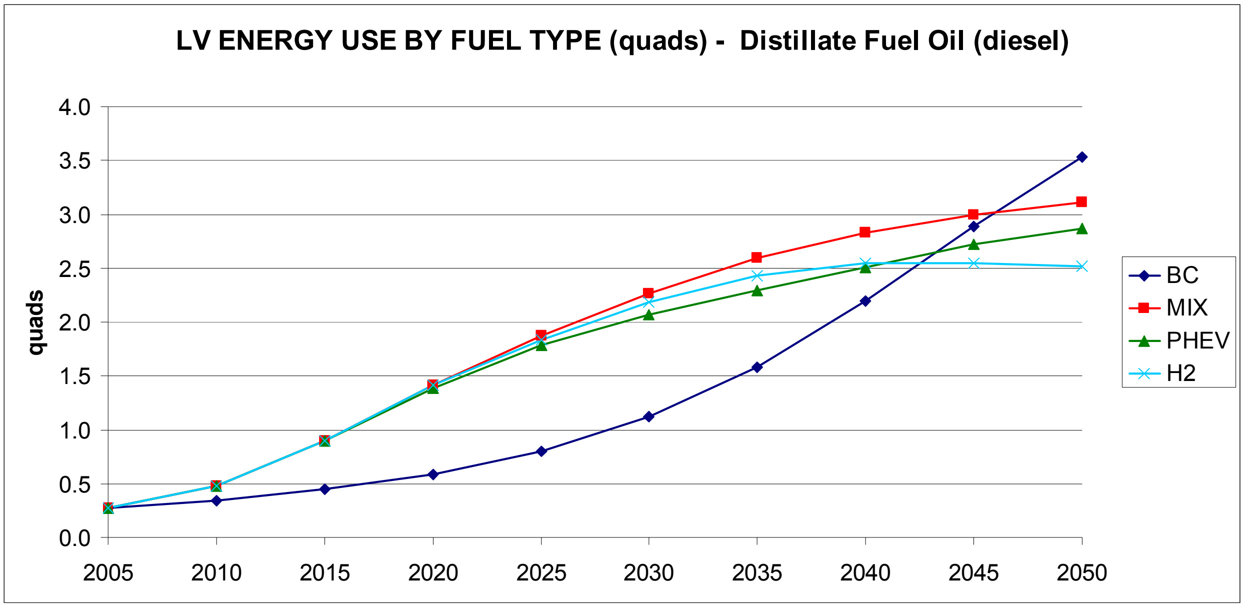

FIGURE E-36 LV Diesel Fuel Demand (Program Goals, No Subsidies)

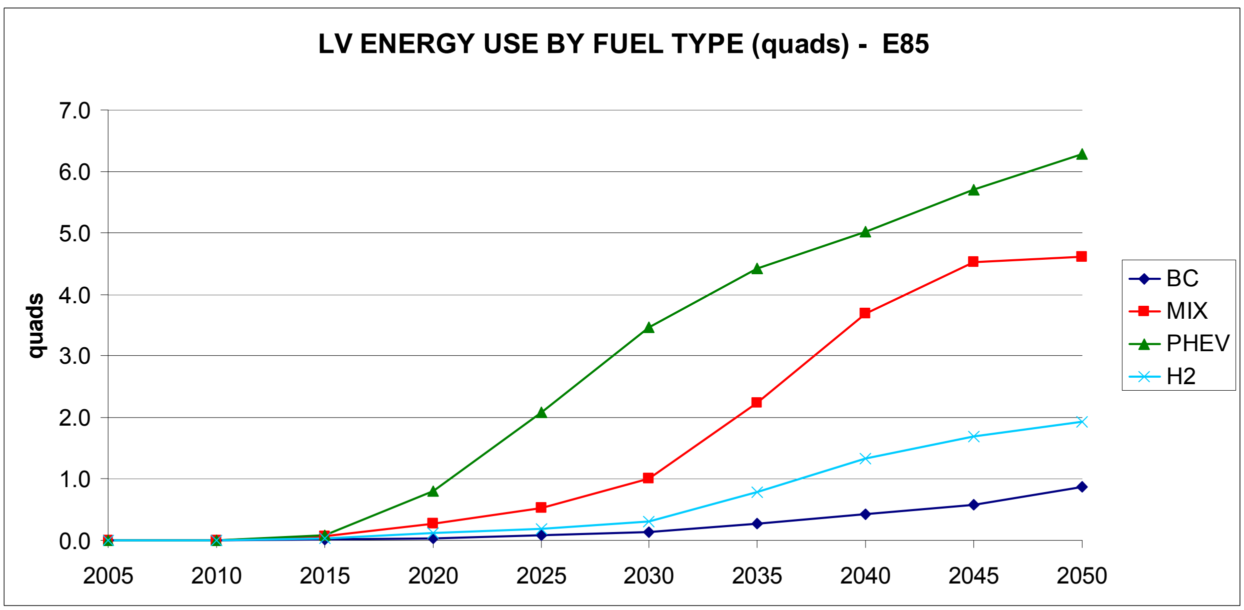

FIGURE E-37 LV E85 Demand (Program Goals, No Subsidies)

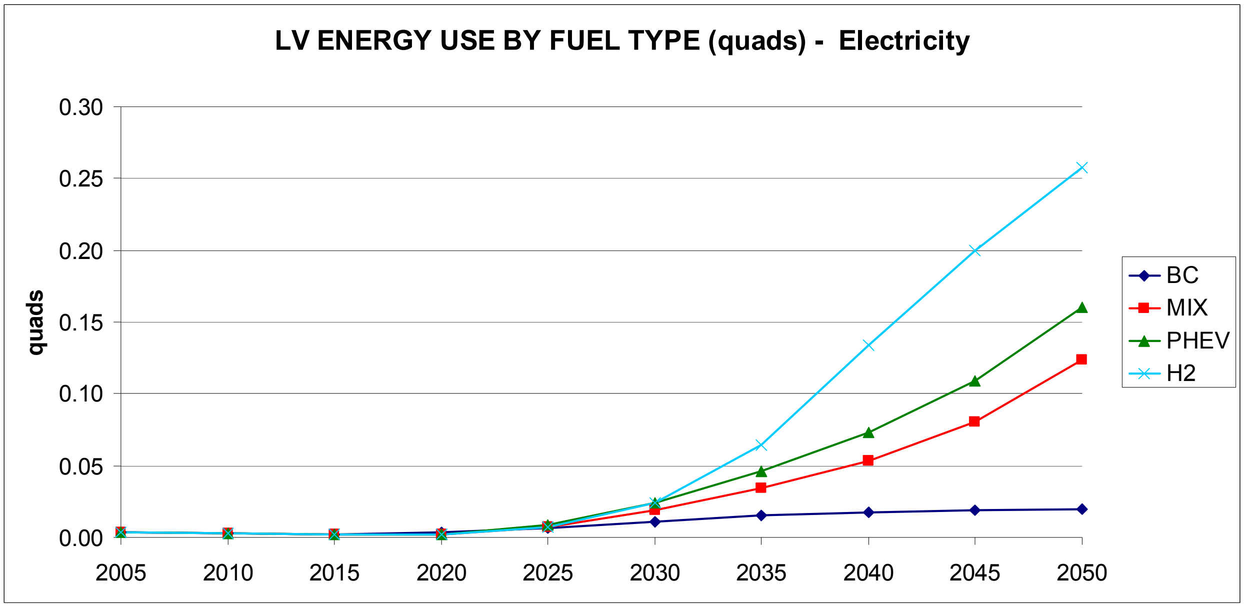

FIGURE E-38 LV Electricity Demand (Program Goals, No Subsidies)

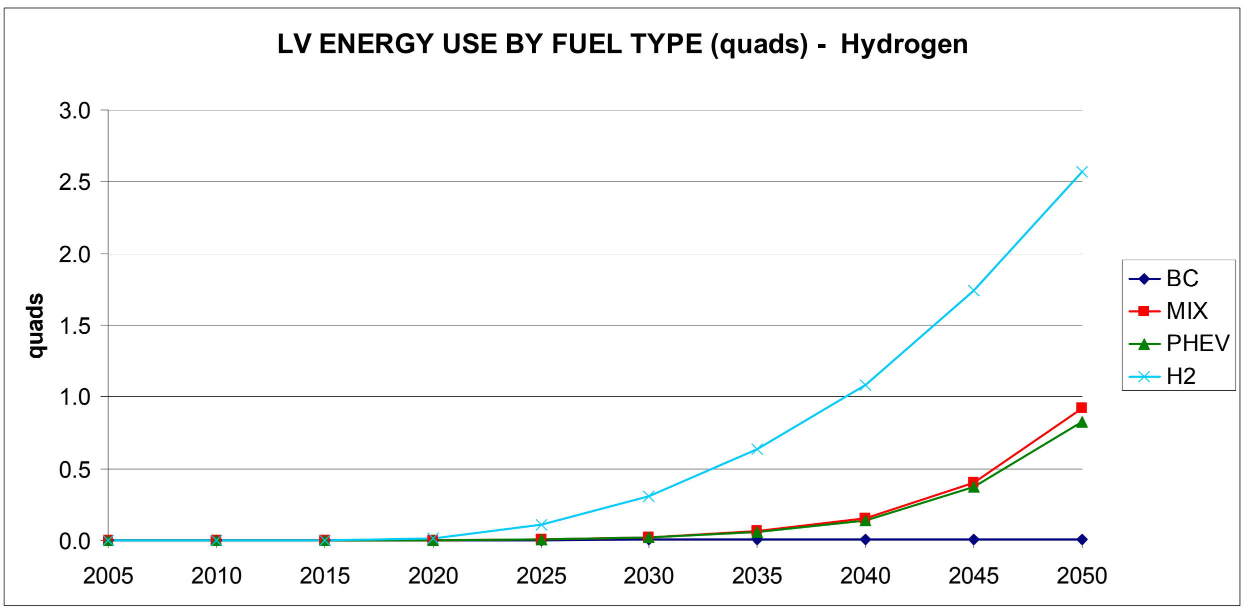

FIGURE E-39 LV H_2 Demand (Program Goals, No Subsidies)

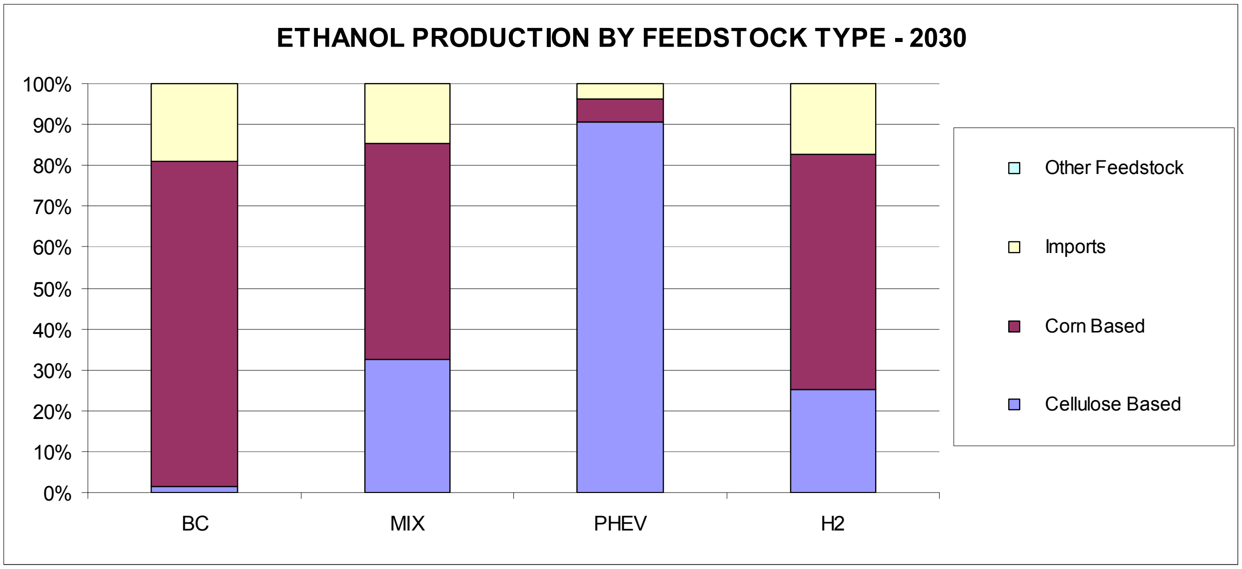

FIGURE E-40 Ethanol Production by Feedstock Type in 2030 (Program Goals, No Subsidies)

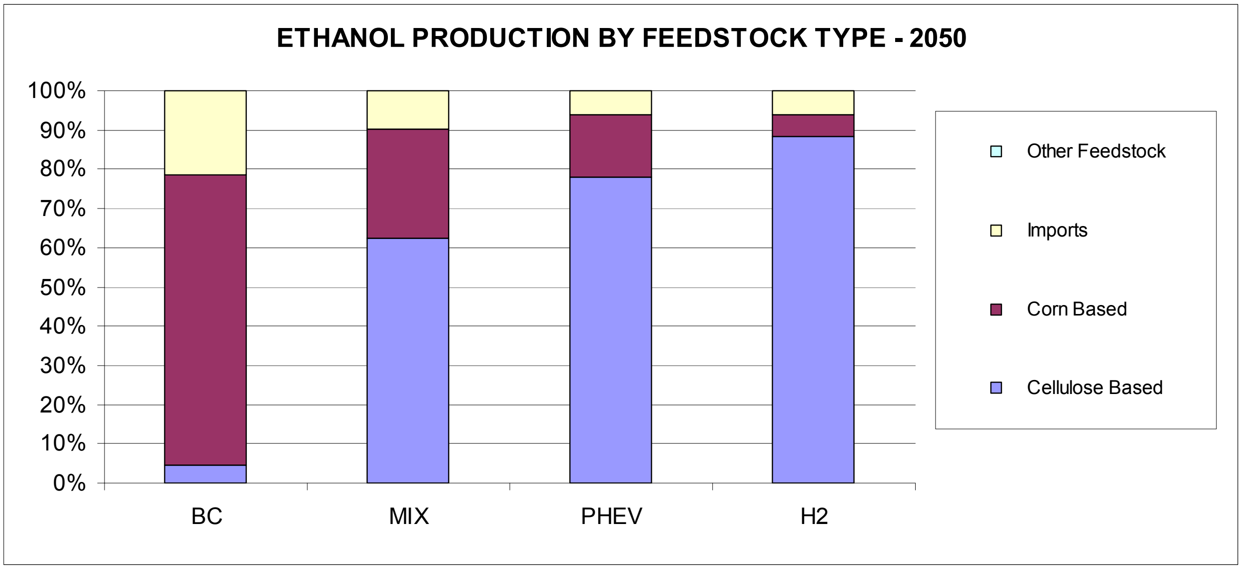

FIGURE E-41 Ethanol Production by Feedstock Type in 2050 (Program Goals, No Subsidies)

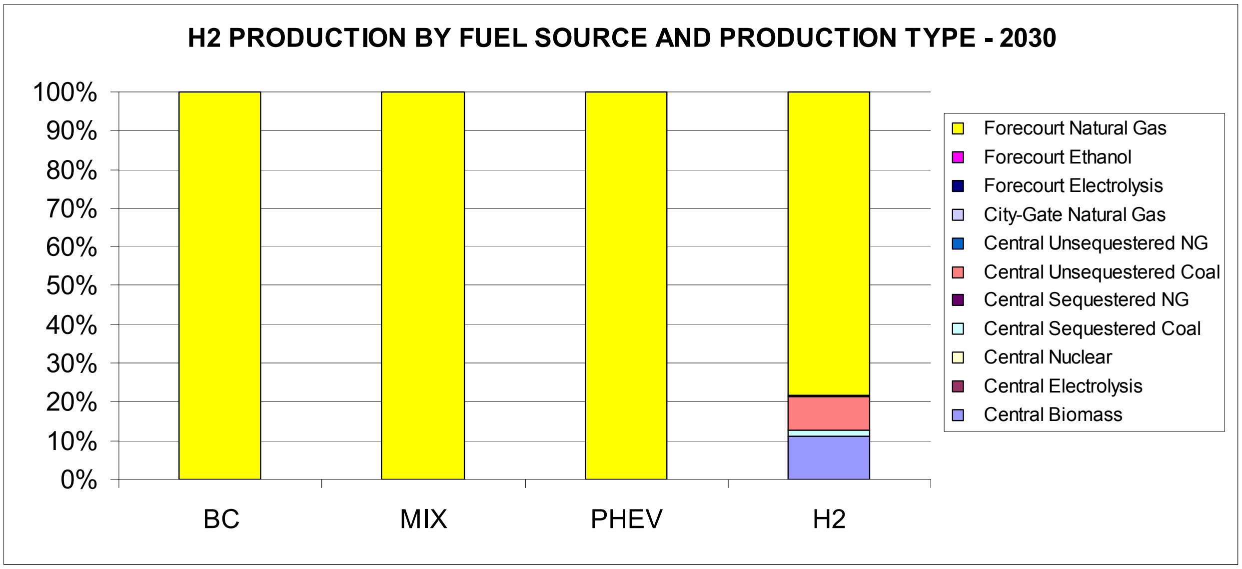

FIGURE E-42 H_2 Production by Fuel Source and Production Type in 2030 (Program Goals, No Subsidies)

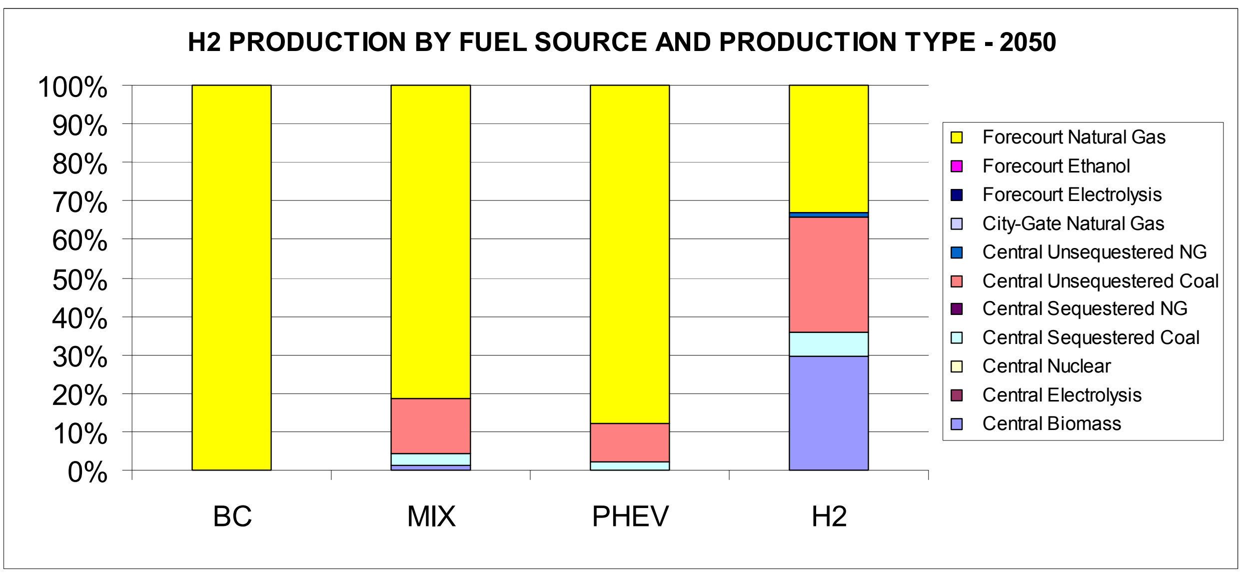

FIGURE E-43 H_2 Production by Fuel Source and Production Type in 2050 (Program Goals, No Subsidies)

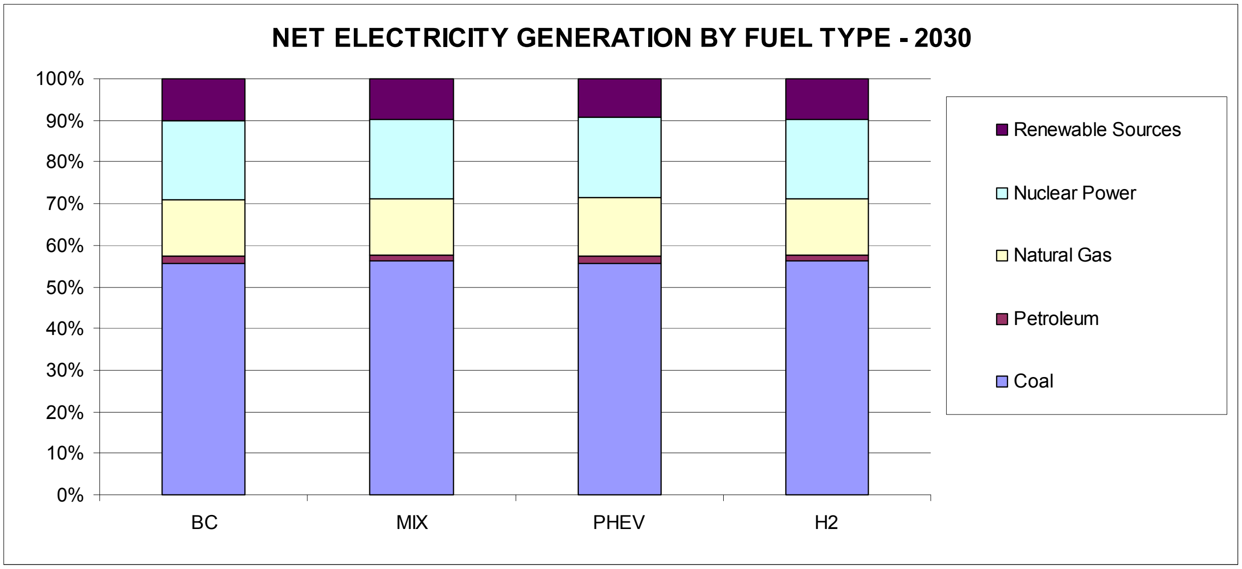

FIGURE E-44 Net Electricity Generation by Fuel Type in 2030 (Program Goals, No Subsidies)

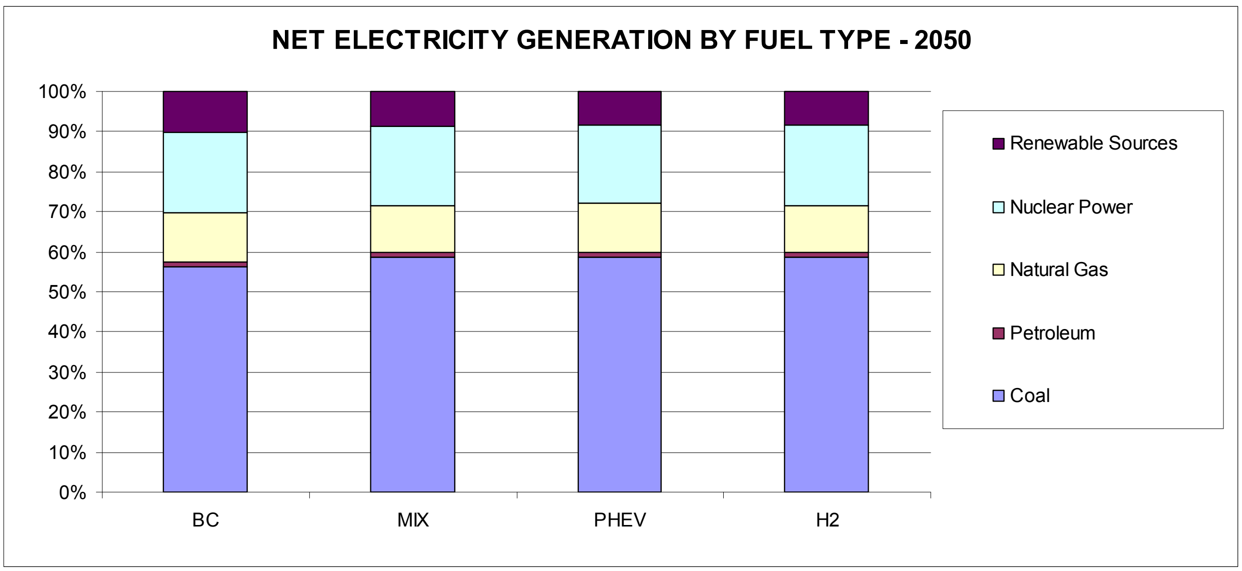

FIGURE E-45 Net Electricity Generation by Fuel Type in 2050 (Program Goals, No Subsidies)

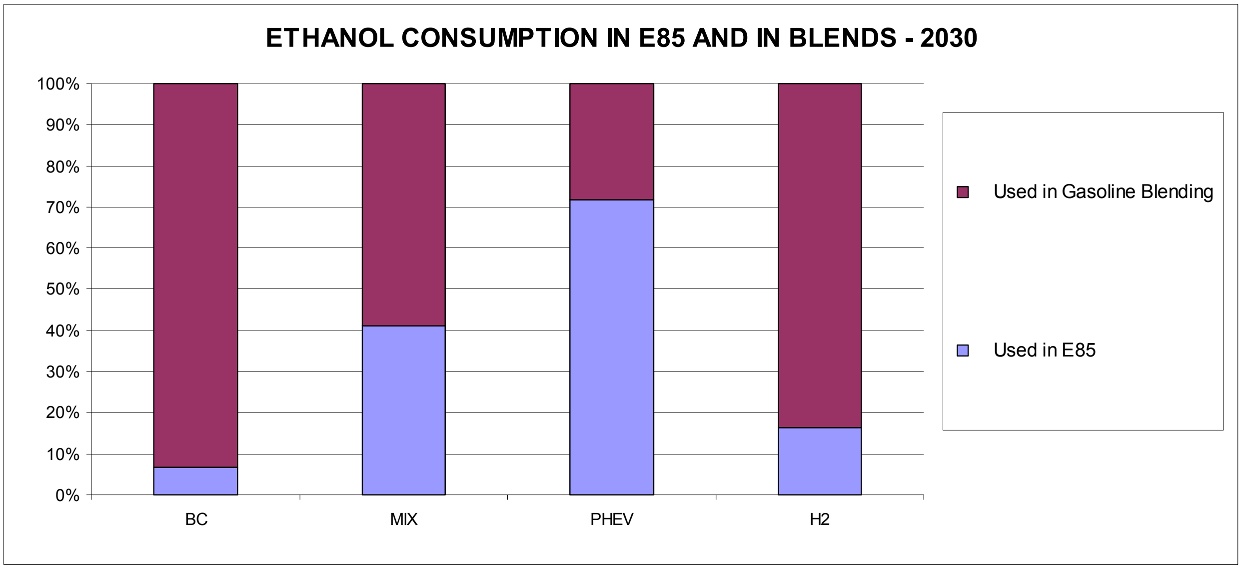

FIGURE E-46 Ethanol Consumption in E85 and Blends in 2030 (Program Goals, No Subsidies)

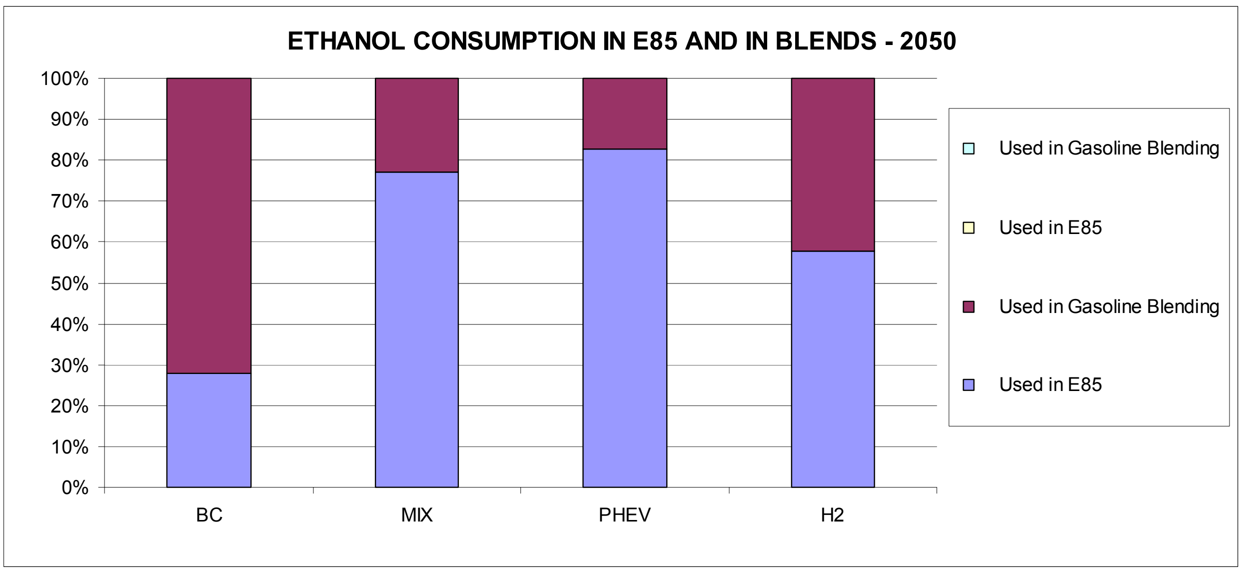

FIGURE E-47 Ethanol Consumption in E85 and Blends in 2050 (Program Goals, No Subsidies)

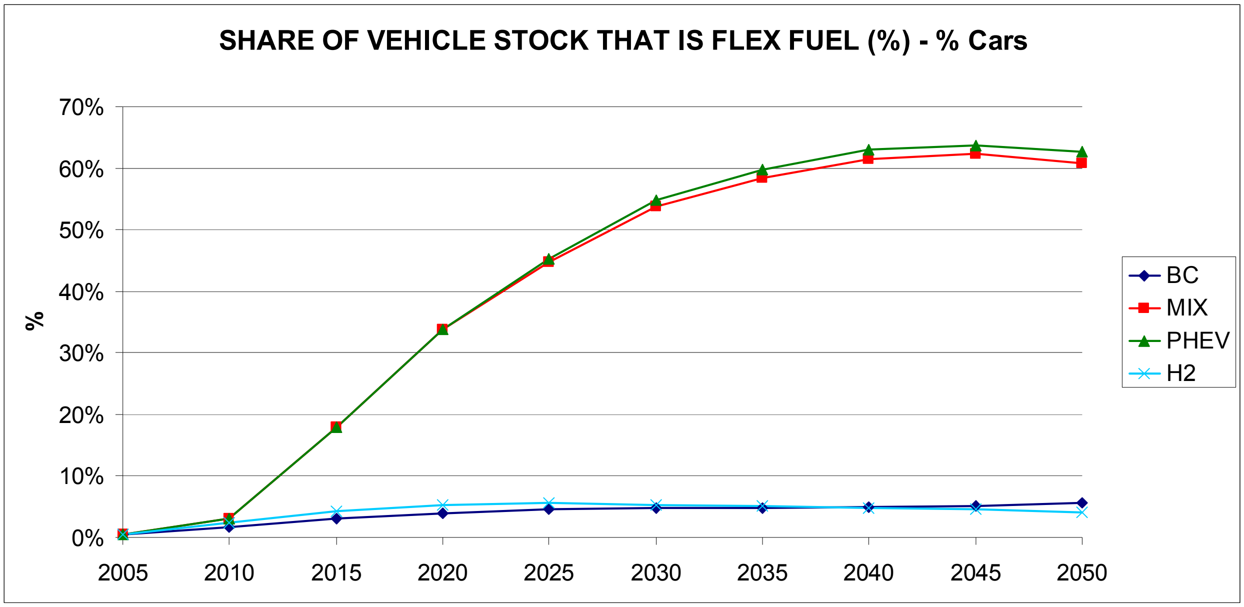

FIGURE E-48 Flex Fuel Share of Car Stock (Program Goals, No Subsidies)

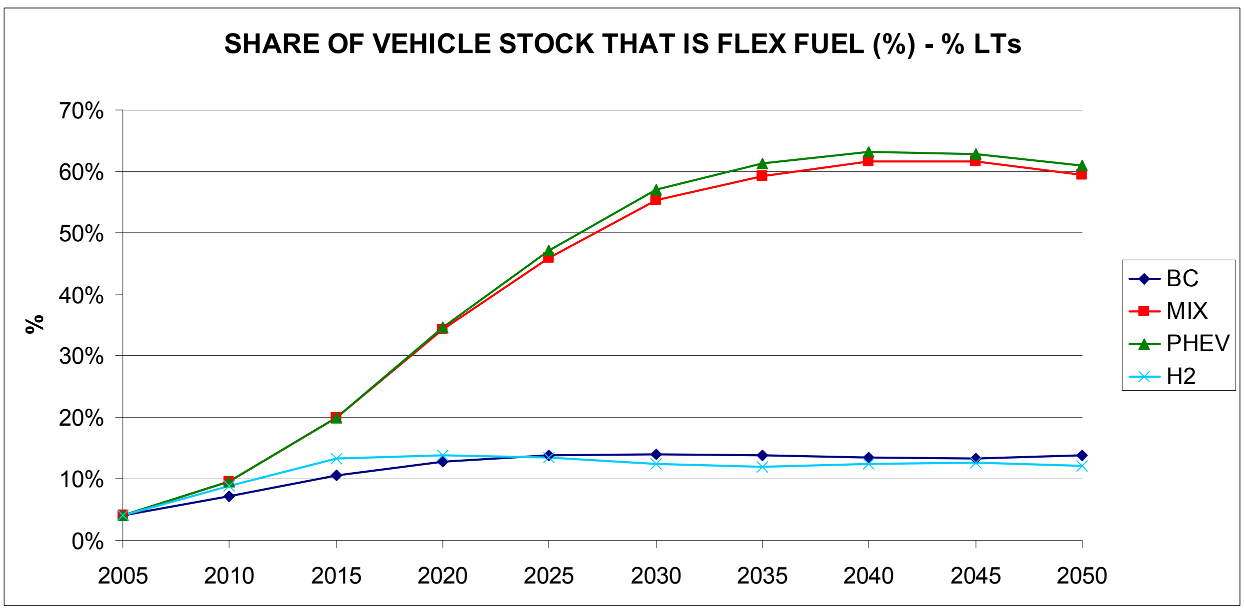

FIGURE E-49 Flex Fuel Share of LT Stock (Program Goals, No Subsidies)

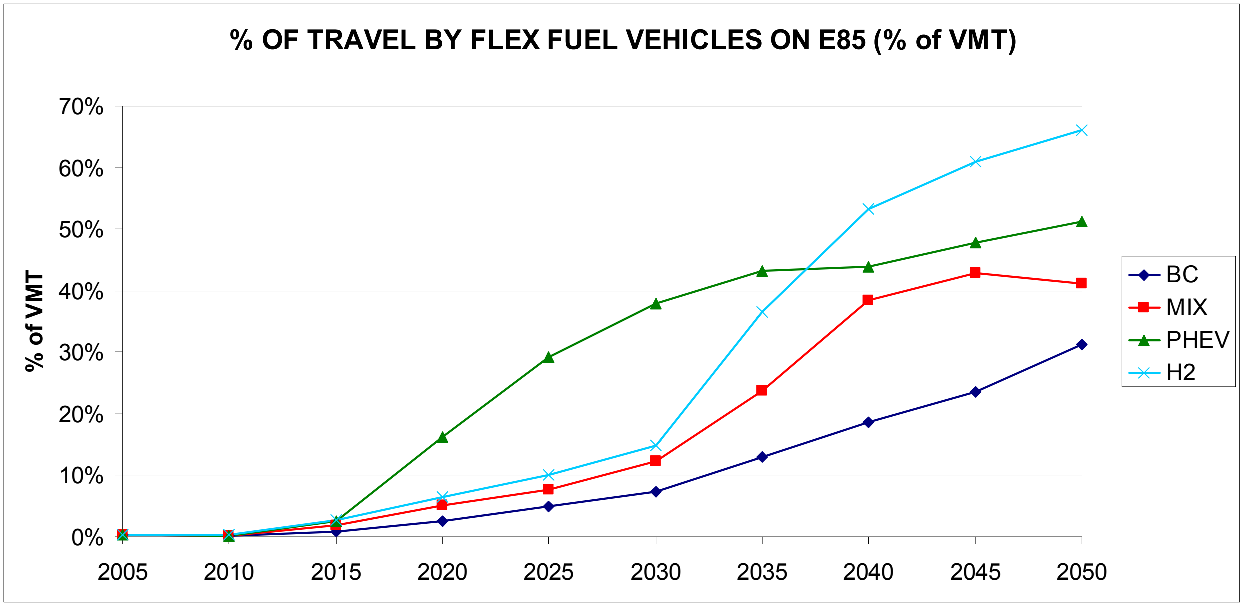

FIGURE E-50 Percent of Travel by Flex Fuel Vehicles on E85 (Program Goals, No Subsidies)

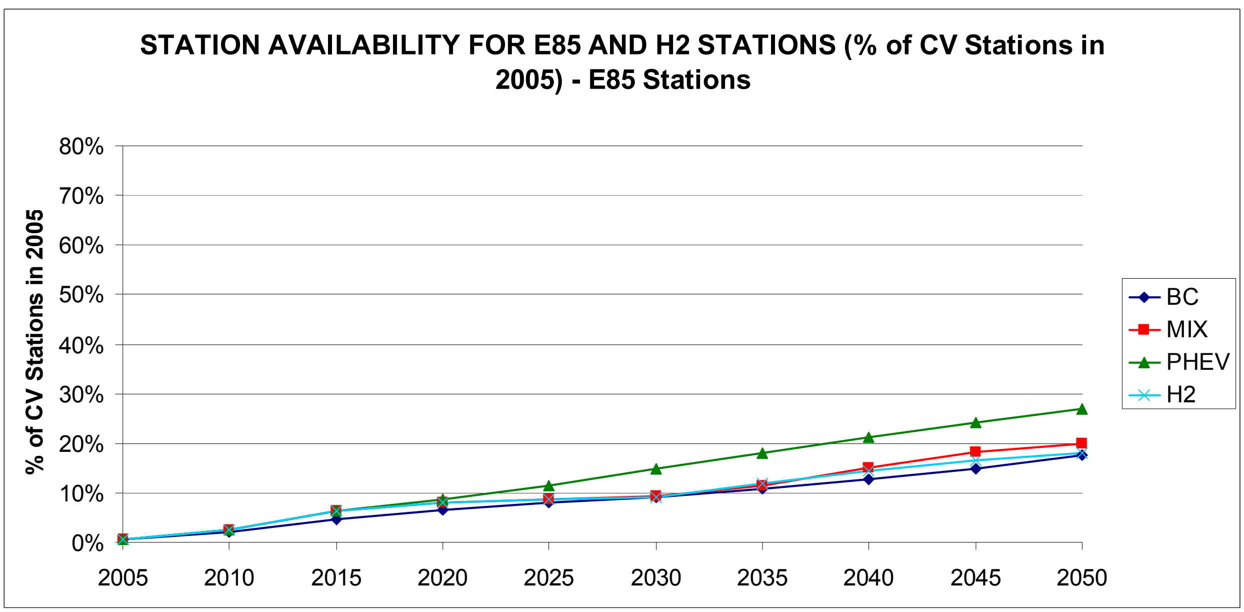

FIGURE E-51 E85 Station Availability (Program Goals, No Subsidies)

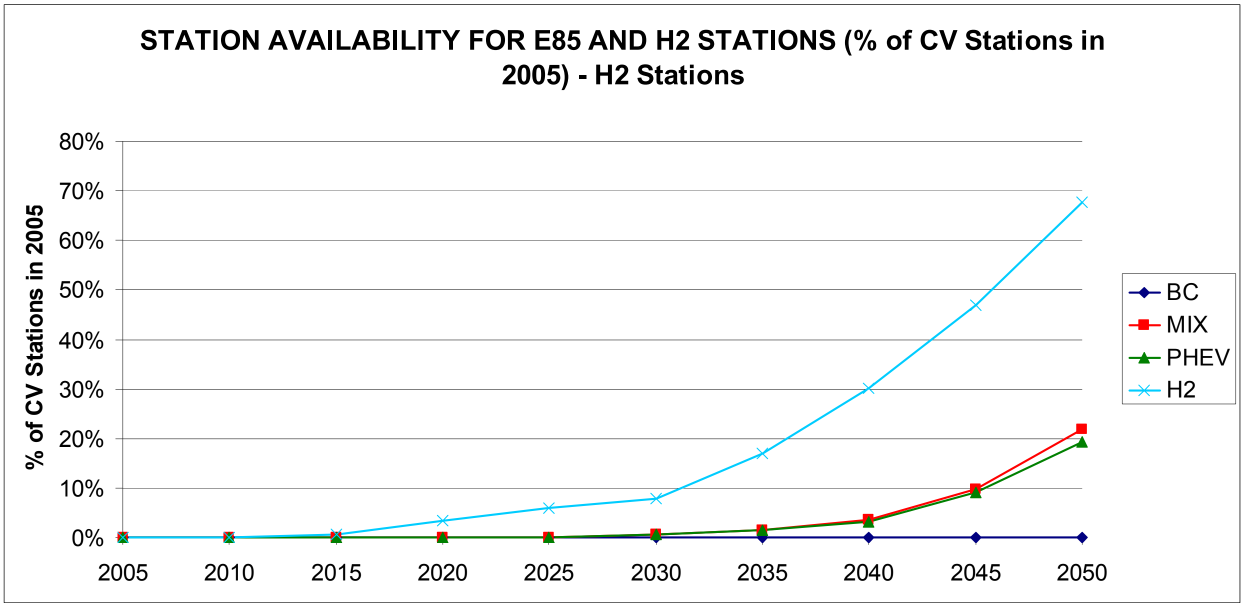

FIGURE E-52 H_2 Station Availability (Program Goals, No Subsidies)

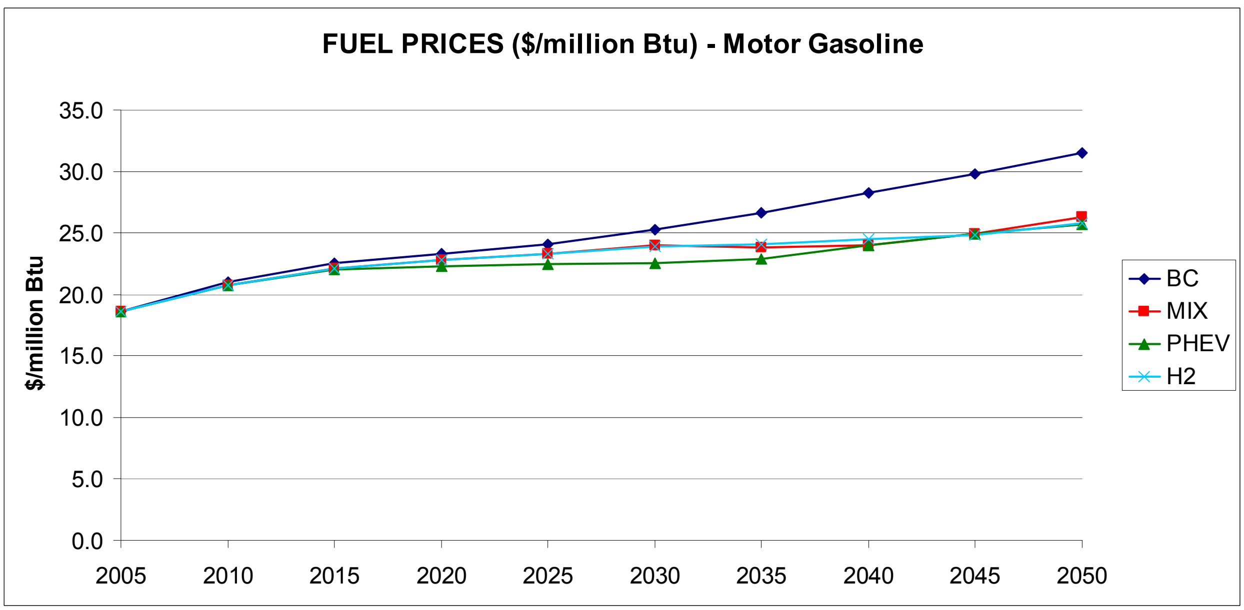

FIGURE E-53 Motor Gasoline Fuel Prices (Program Goals, No Subsidies)

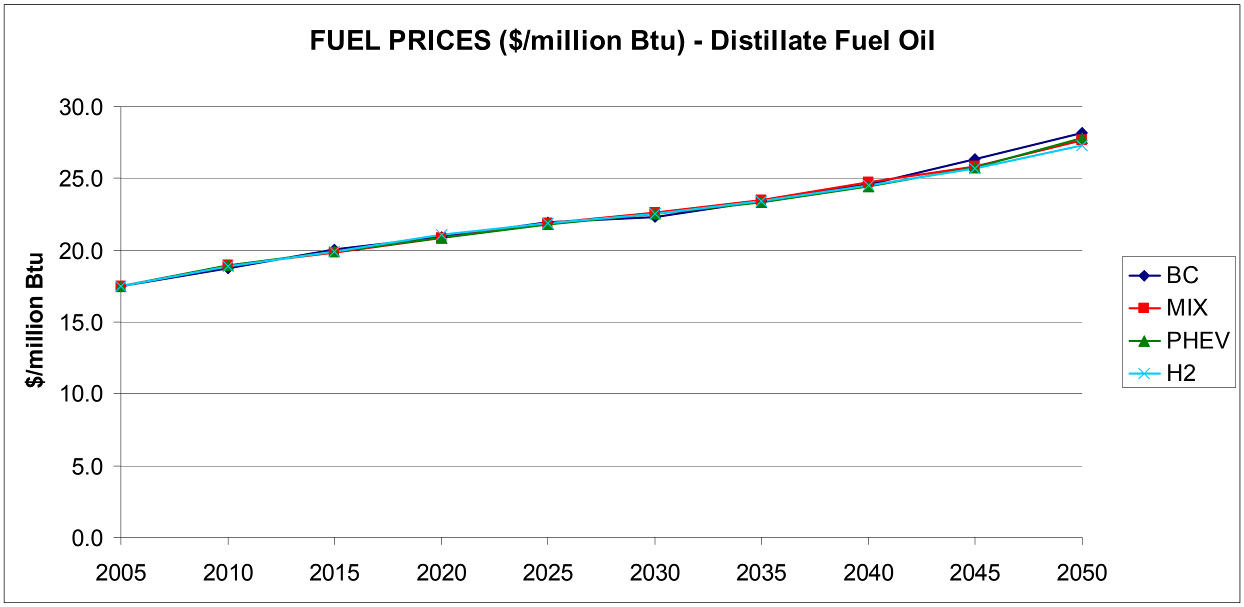

FIGURE E-54 Diesel Fuel Prices (Program Goals, No Subsidies)

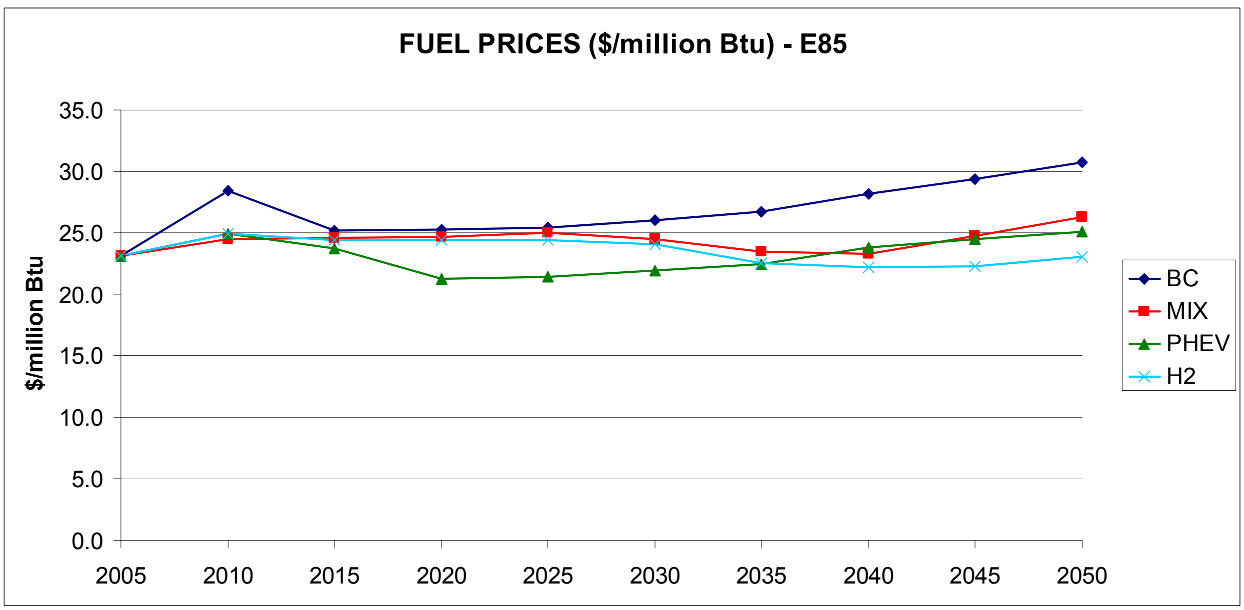

FIGURE E-55 E85 Fuel Prices (Program Goals, No Subsidies)

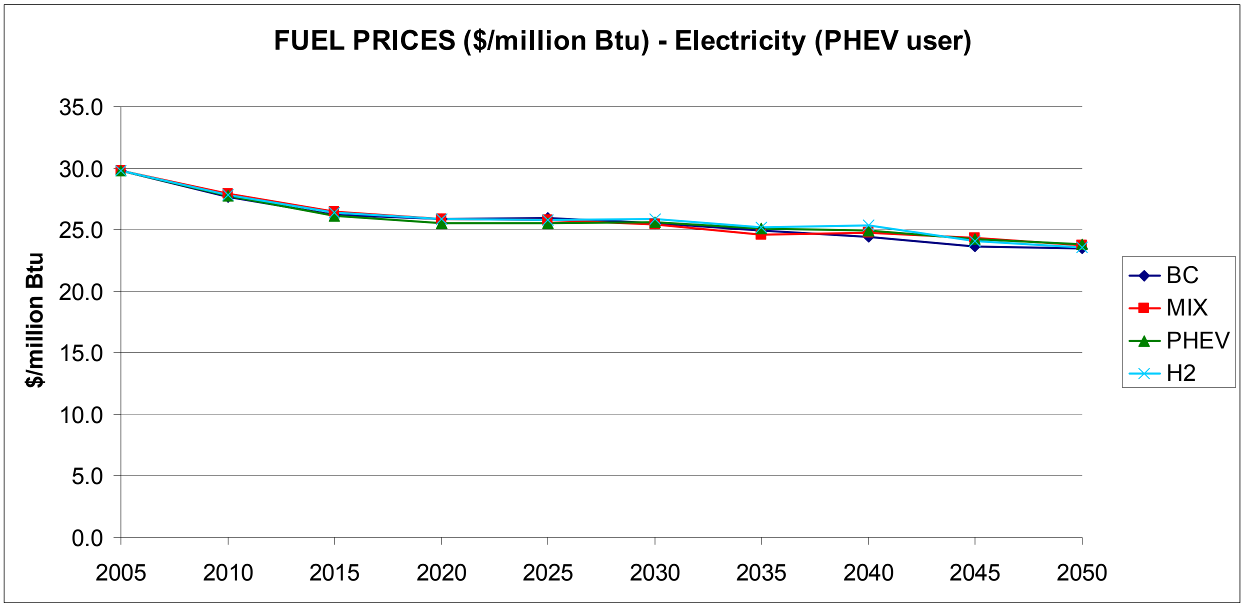

FIGURE E-56 Electricity Prices for the PHEV User (Program Goals, No Subsidies)

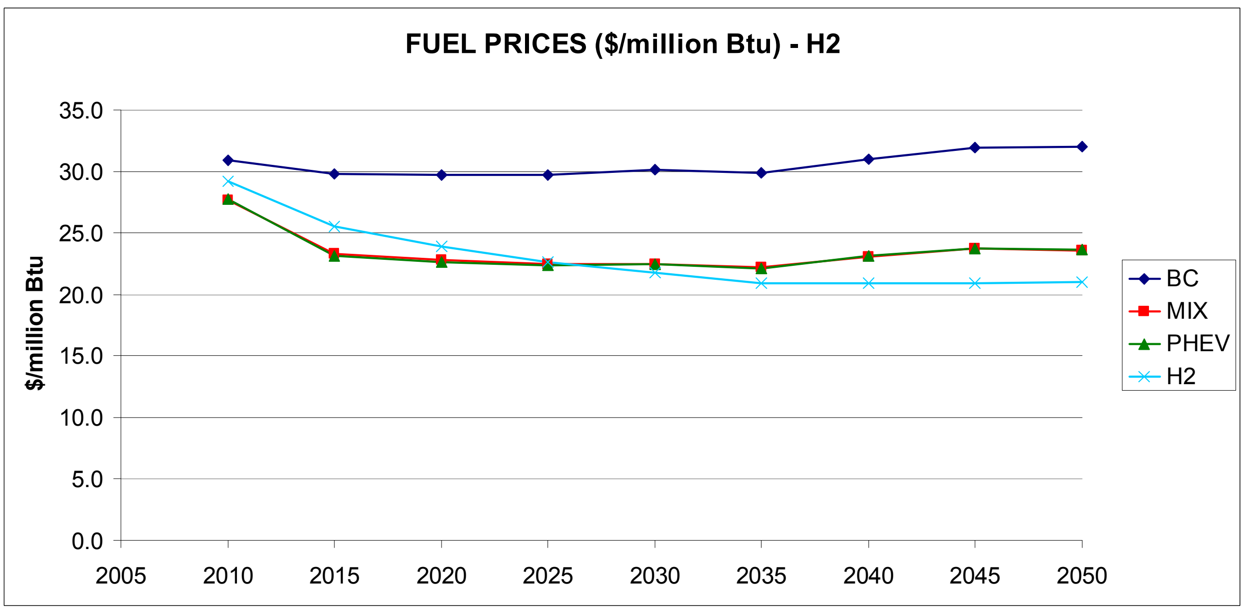

FIGURE E-57 H_2 Fuel Prices (Program Goals, No Subsidies)

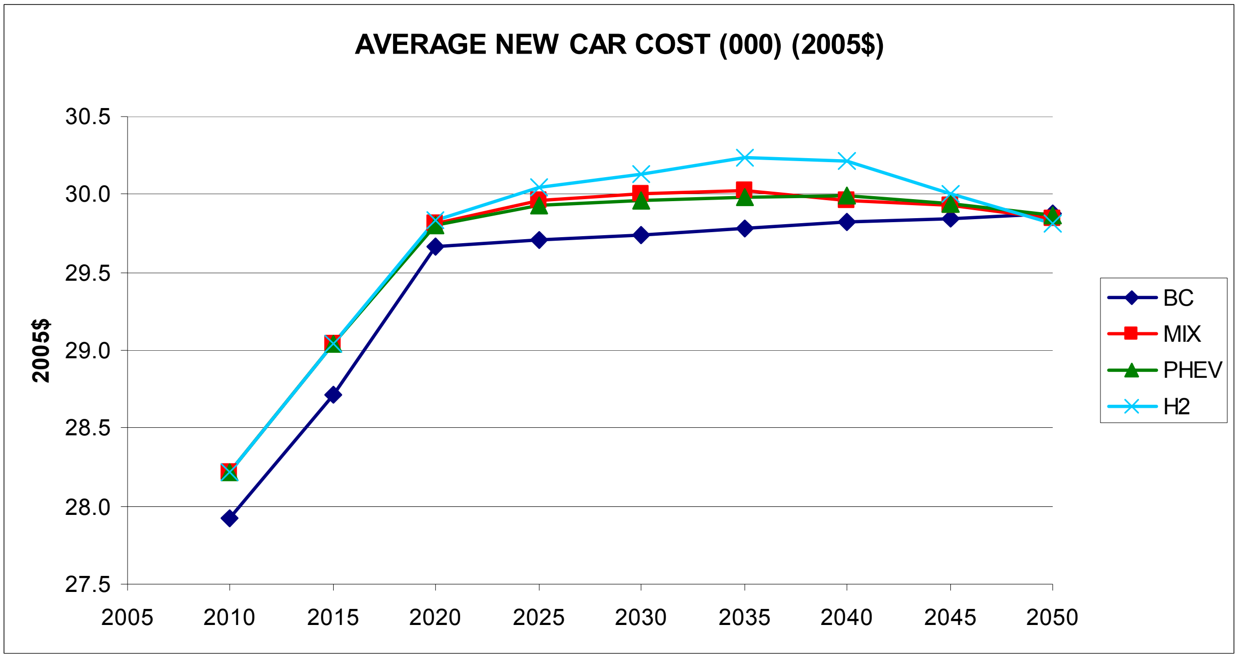

FIGURE E-58 Average New Car Prices (Program Goals, No Subsidies)

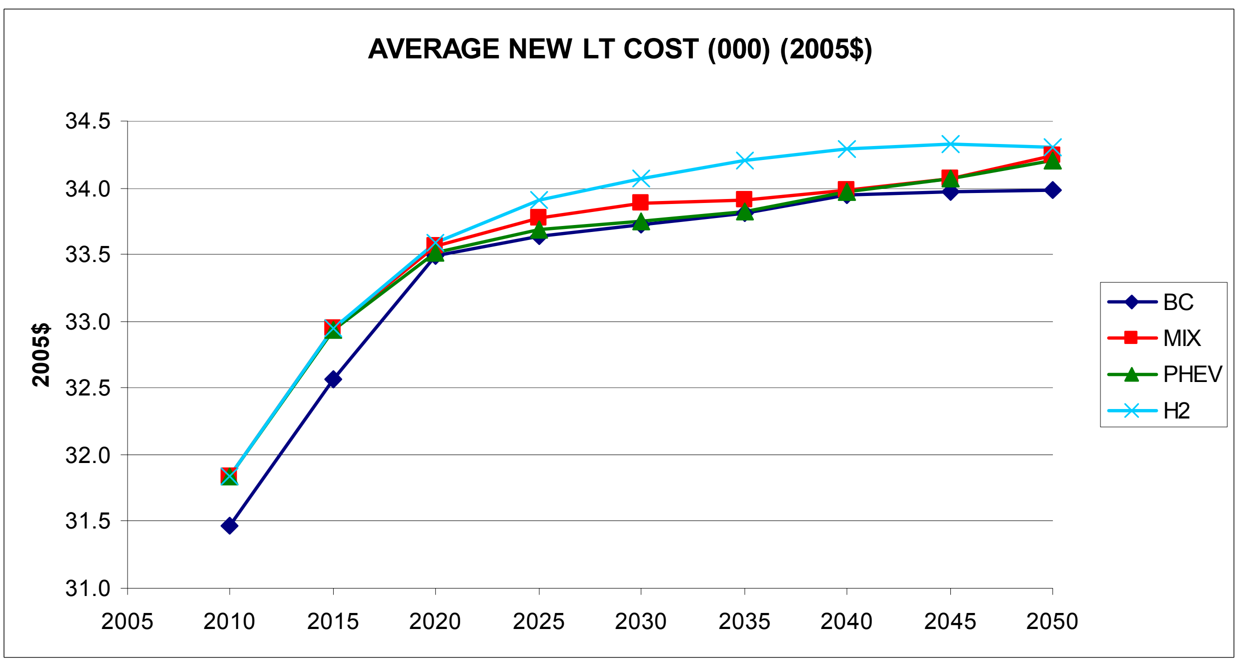

FIGURE E-59 Average New LT Prices (Program Goals, No Subsidies)

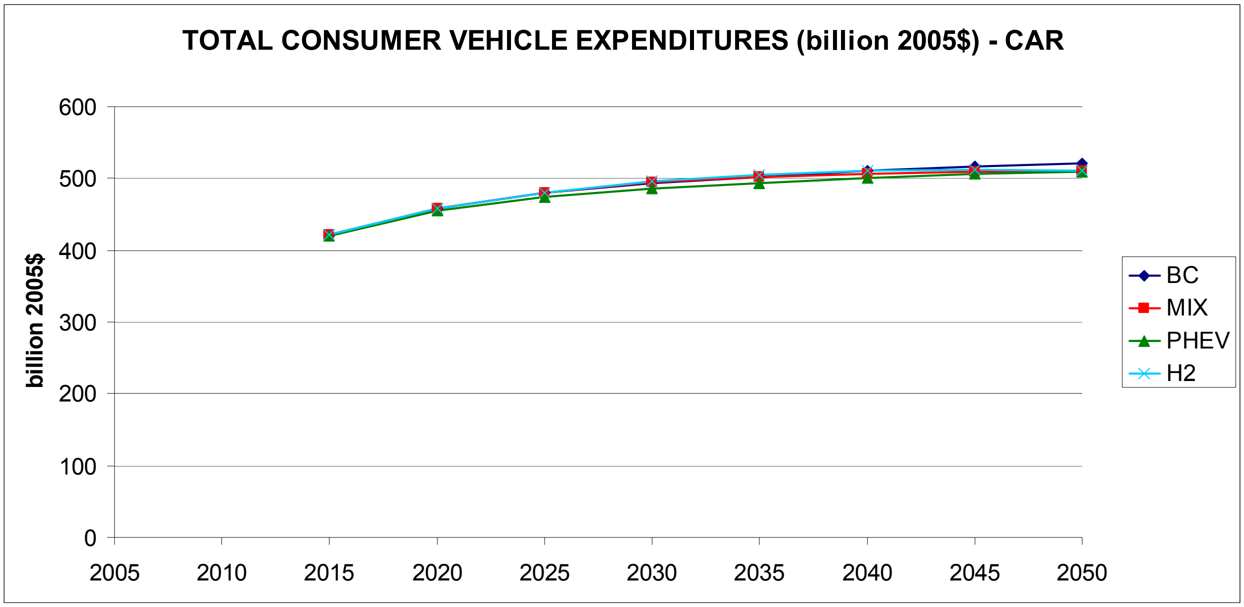

FIGURE E-60 Total Consumer Car Expenditures (Program Goals, No Subsidies)

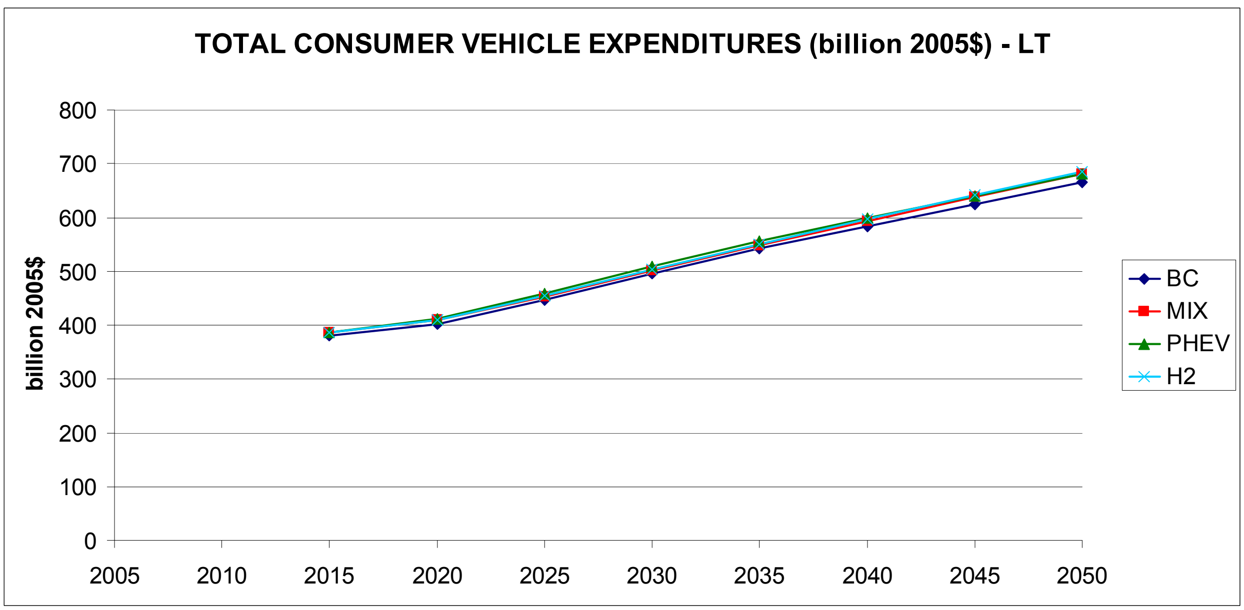

FIGURE E-61 Total Consumer LT Expenditures (Program Goals, No Subsidies)

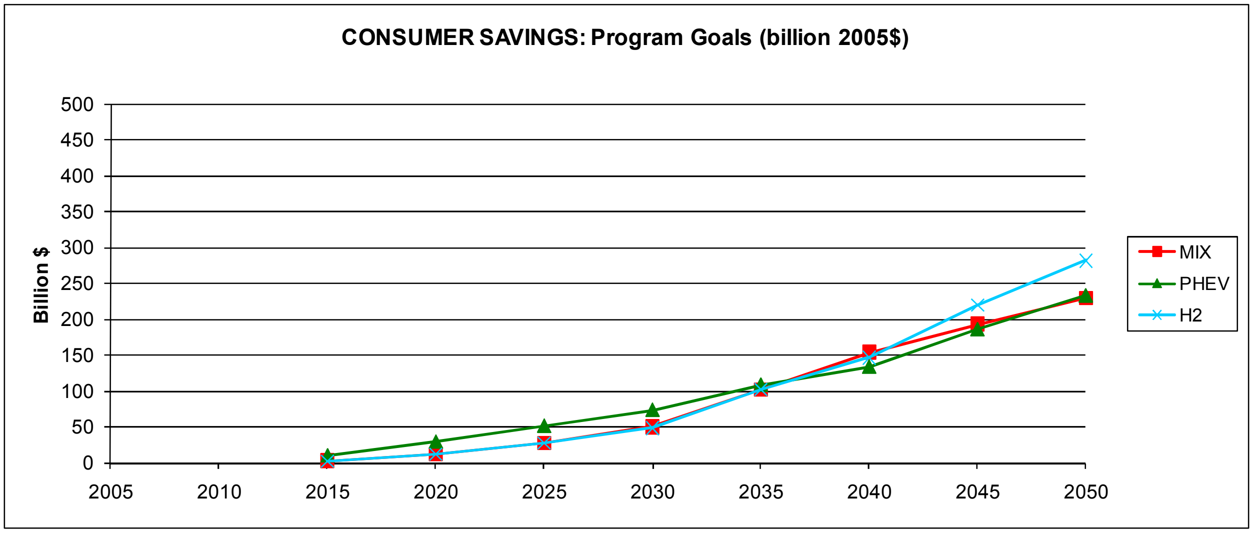

FIGURE E-62 Total Consumer Savings (Program Goals, No Subsidies)

LITERATURE REVIEW WITH SUBSIDIES SCENARIOS: GRAPHICAL RESULTS

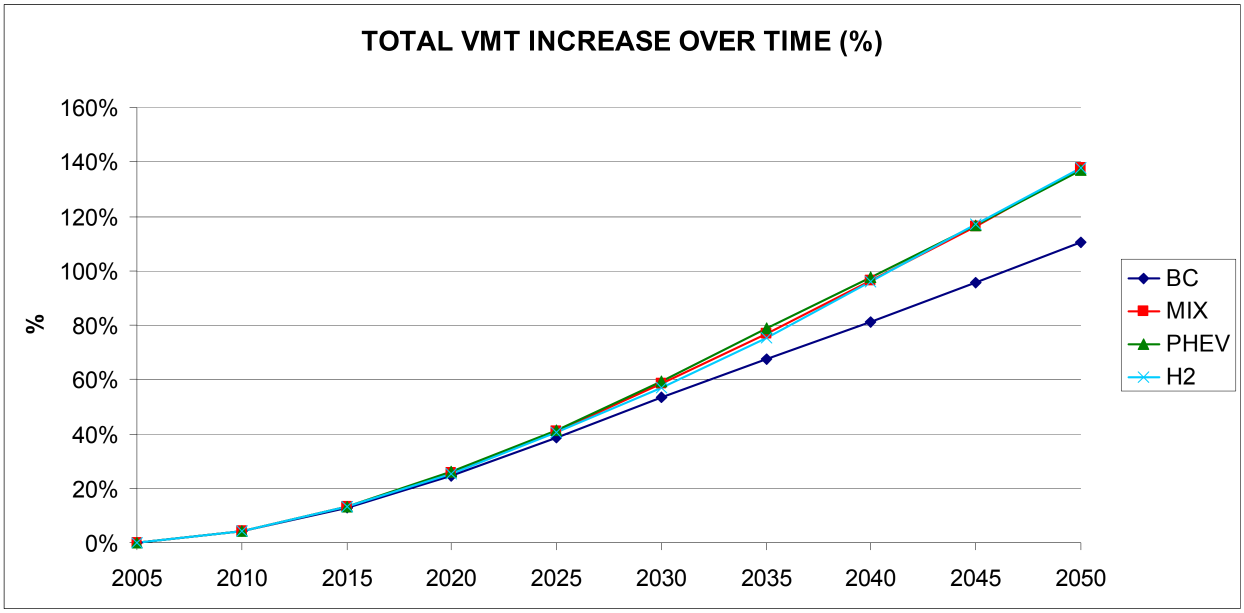

FIGURE E-63 Total VMT Increase over Time (Literature Review with Subsidies)

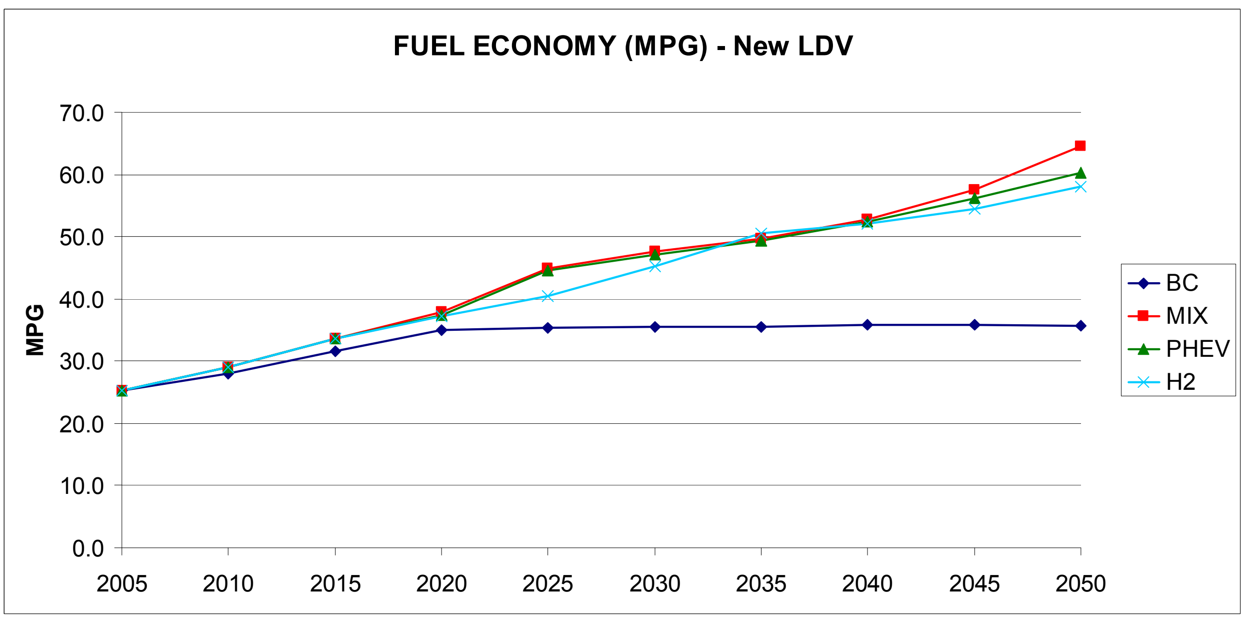

FIGURE E-64 New LV Fuel Economy (Literature Review with Subsidies)

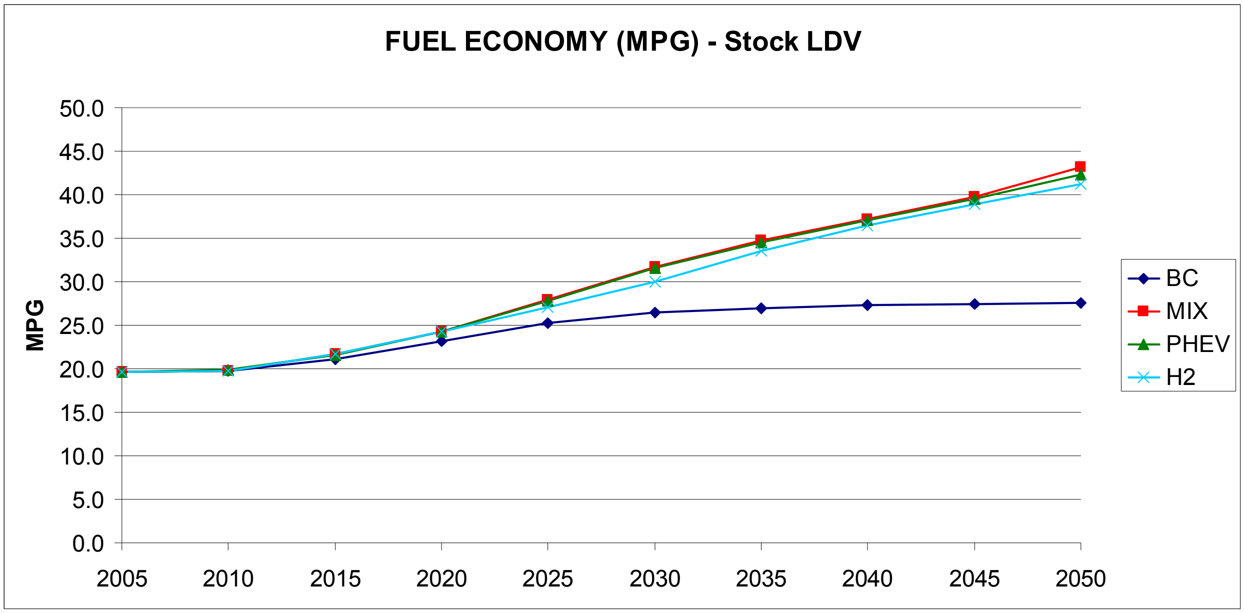

FIGURE E-65 LV Stock Fuel Economy (Literature Review with Subsidies)

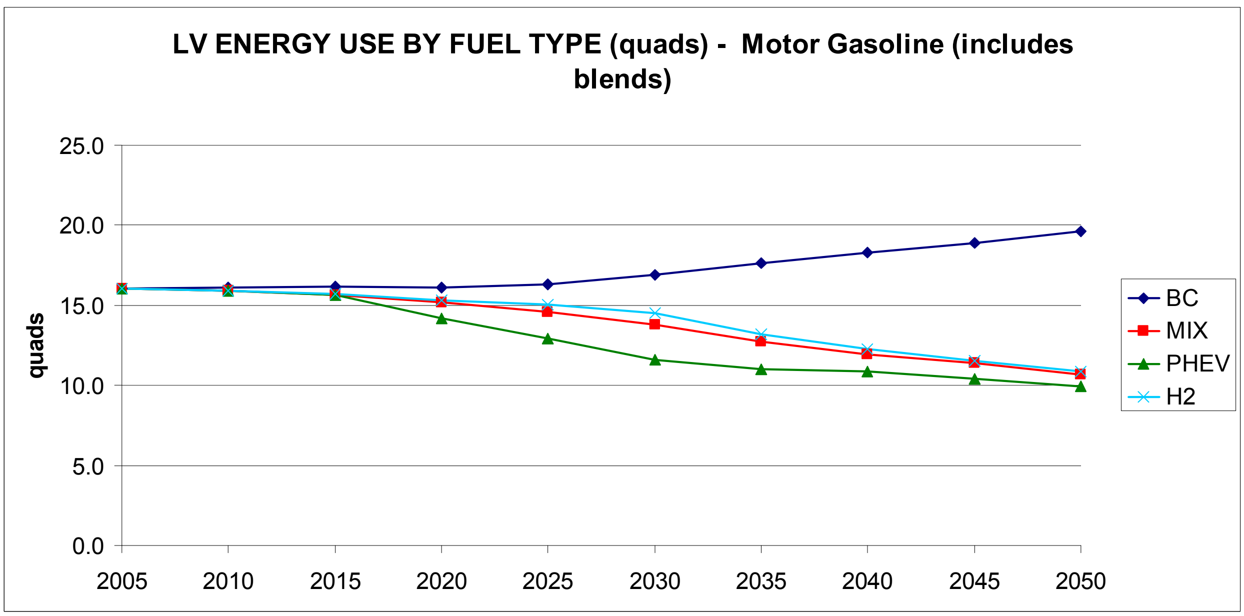

FIGURE E-66 LV Motor Gasoline Demand (Literature Review with Subsidies)

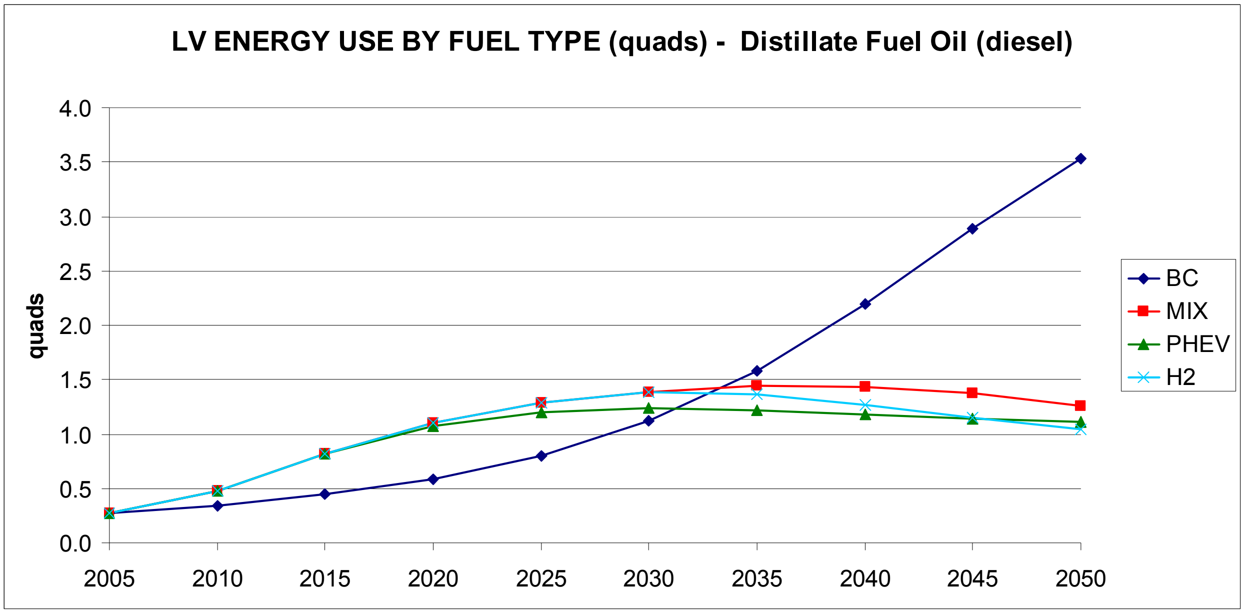

FIGURE E-67 LV Diesel Fuel Demand (Literature Review with Subsidies)

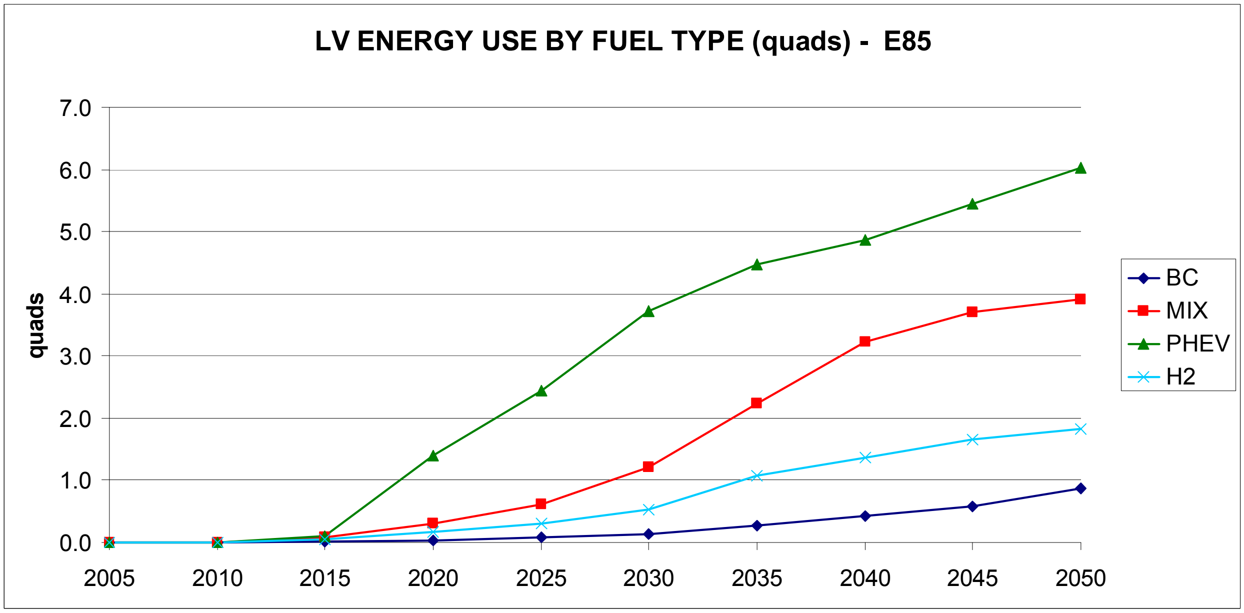

FIGURE E-68 LV E85 Demand (Literature Review with Subsidies)

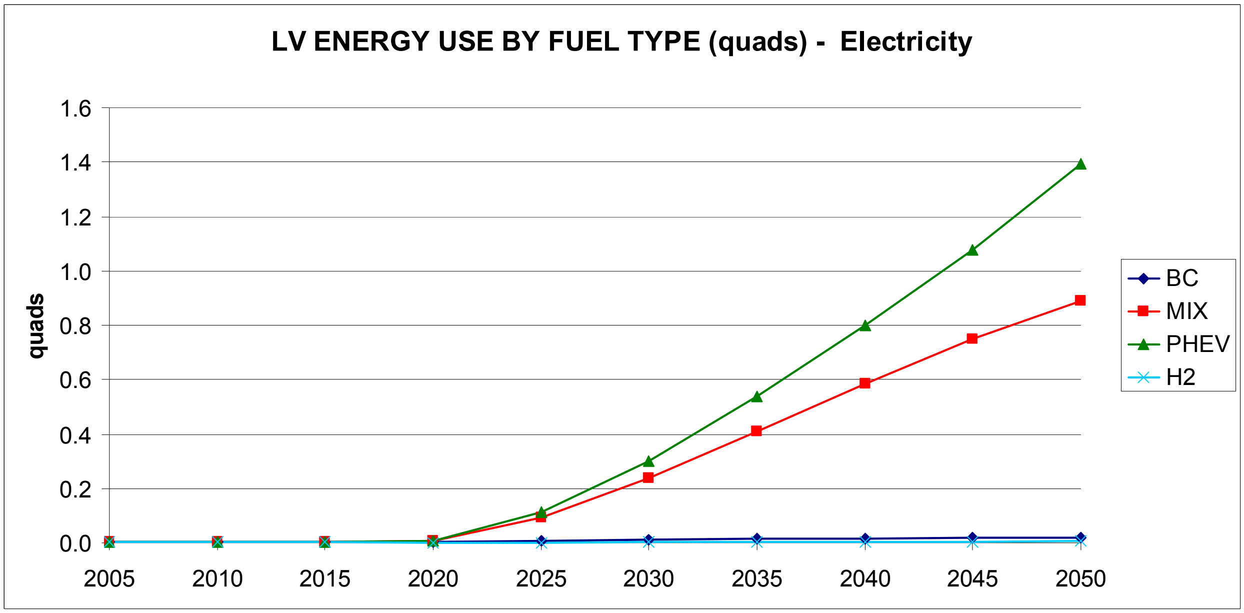

FIGURE E-69 LV Electricity Demand (Literature Review with Subsidies)

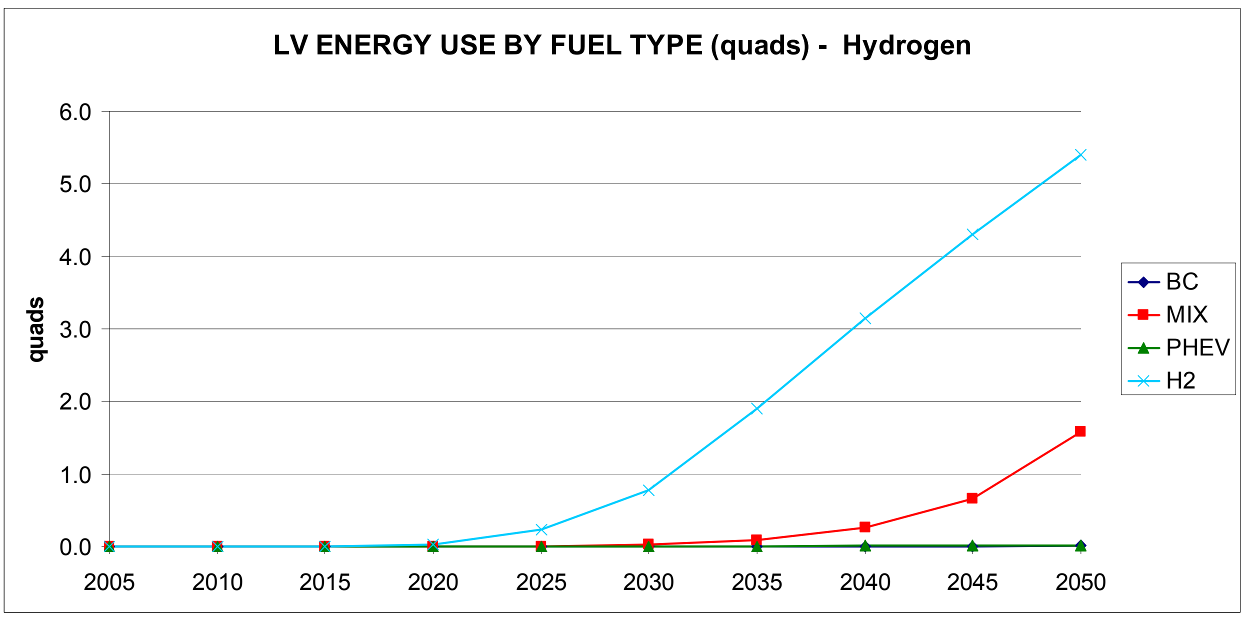

FIGURE E-70 LV H_2 Demand (Literature Review with Subsidies)

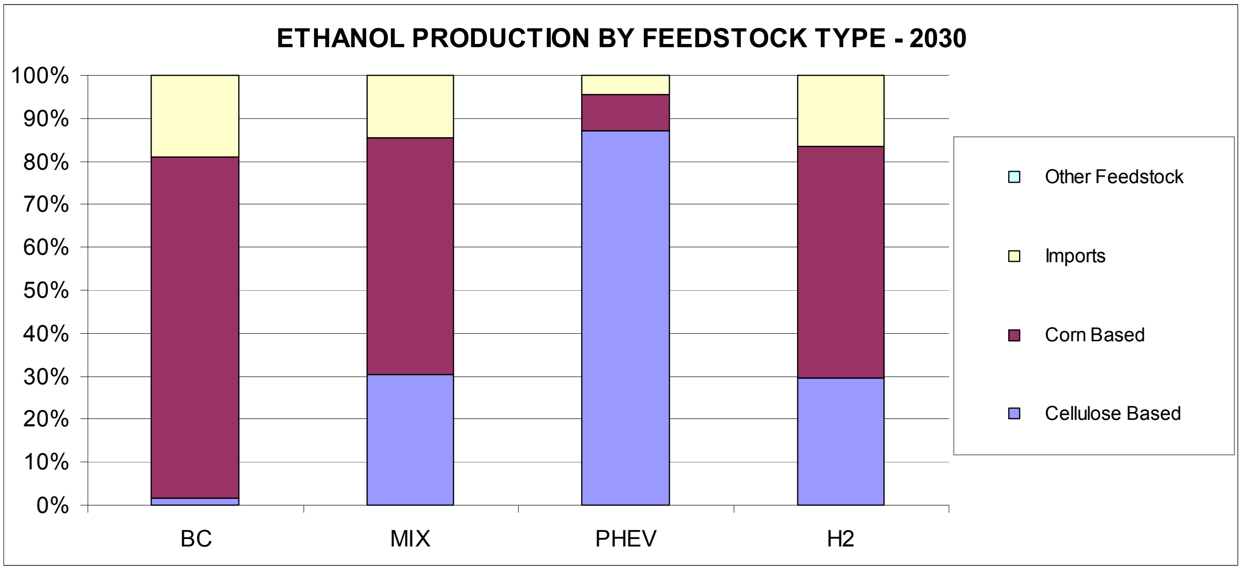

FIGURE E-71 Ethanol Production by Feedstock Type in 2030 (Literature Review with Subsidies)

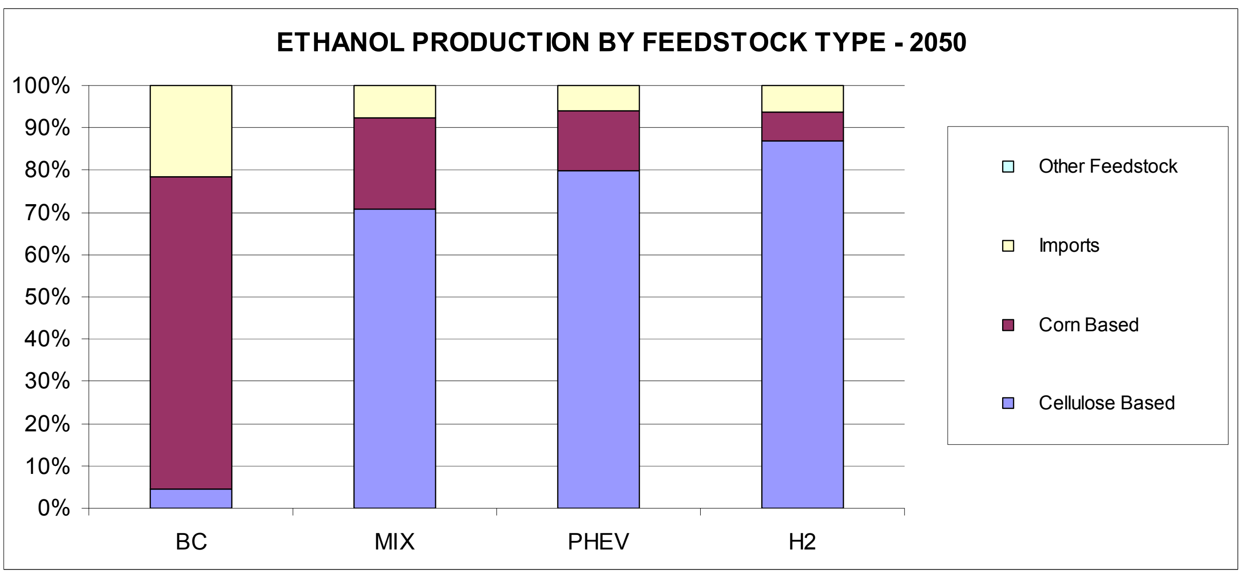

FIGURE E-72 Ethanol Production by Feedstock Type in 2050 (Literature Review with Subsidies)

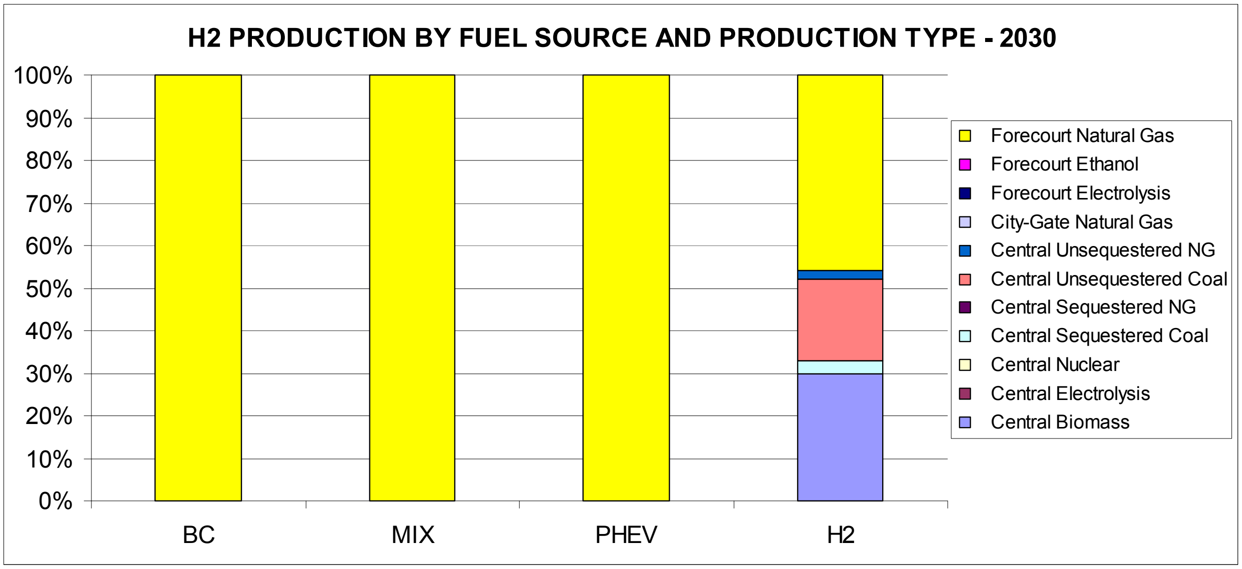

FIGURE E-73 H_2 Production by Fuel Source and Production Type in 2030 (Literature Review with Subsidies)

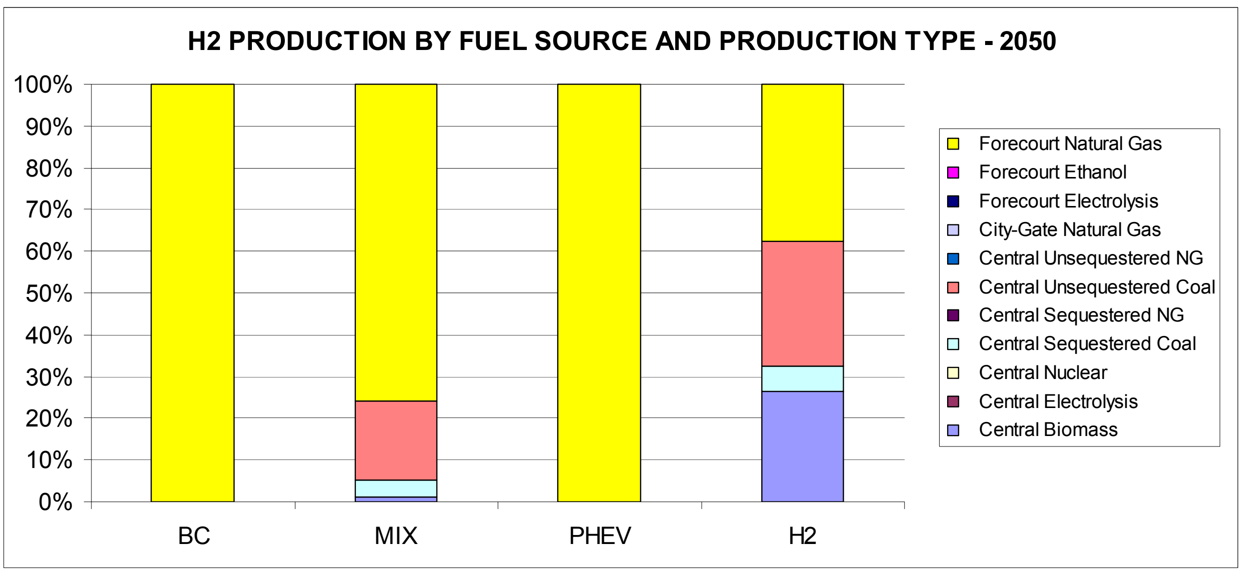

FIGURE E-74 H_2 Production by Fuel Source and Production Type in 2050 (Literature Review with Subsidies)

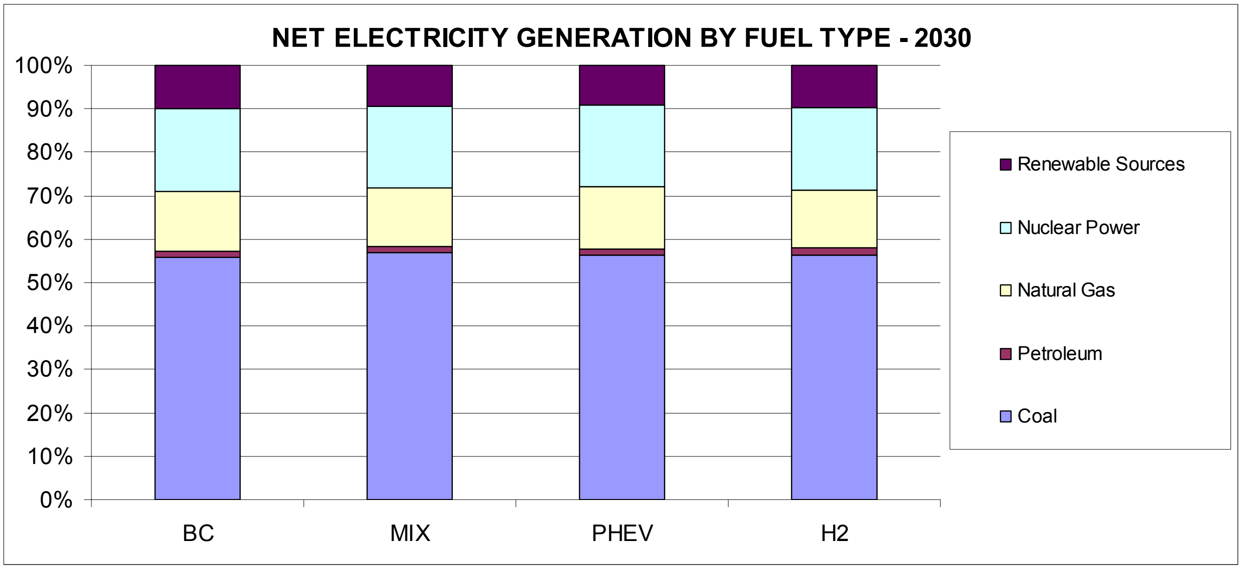

FIGURE E-75 Net Electricity Generation by Fuel Type in 2030 (Literature Review with Subsidies)

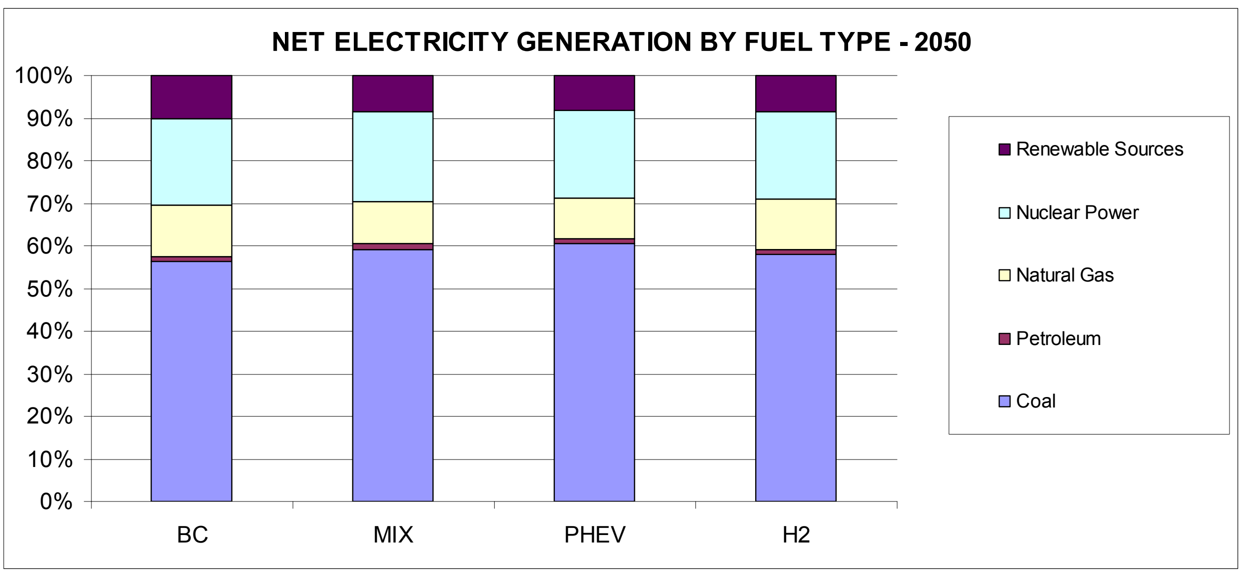

FIGURE E-76 Net Electricity Generation by Fuel Type in 2050 (Literature Review with Subsidies)

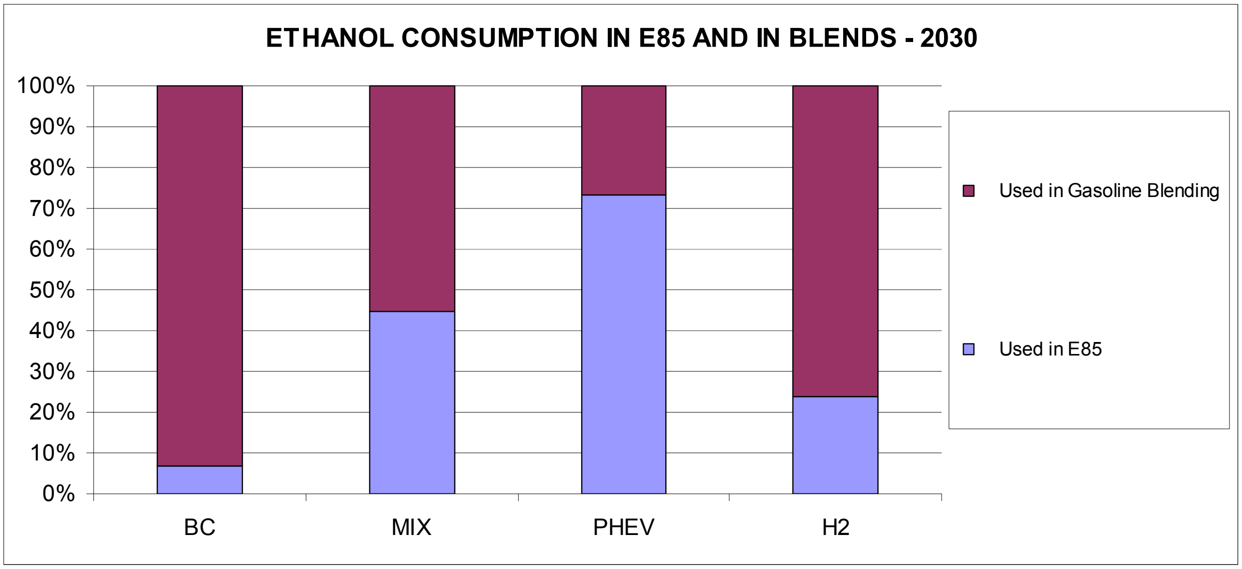

FIGURE E-77 Ethanol Consumption in E85 and Blends in 2030 (Literature Review with Subsidies)

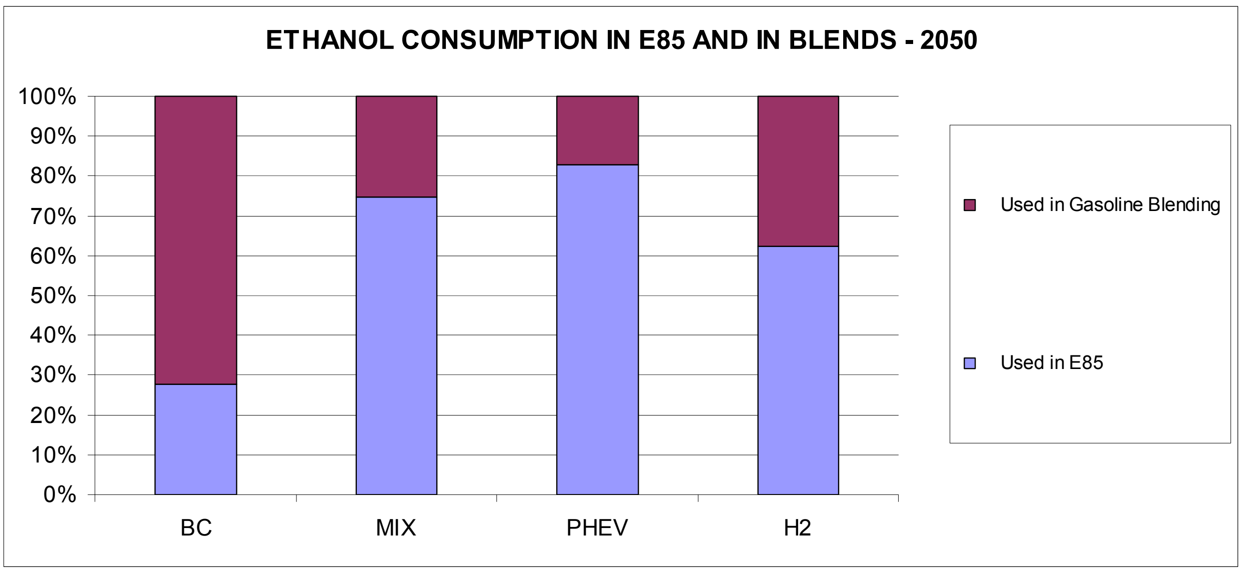

FIGURE E-78 Ethanol Consumption in E85 and Blends in 2050 (Literature Review with Subsidies)

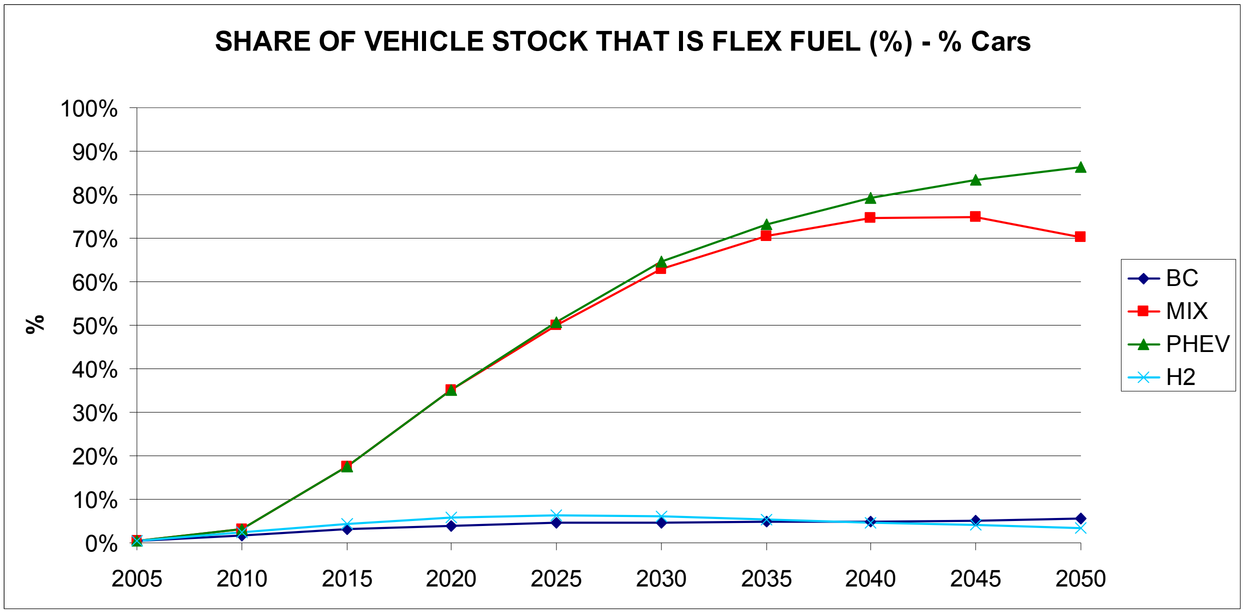

FIGURE E-79 Flex Fuel Share of Car Stock (Literature Review with Subsidies)

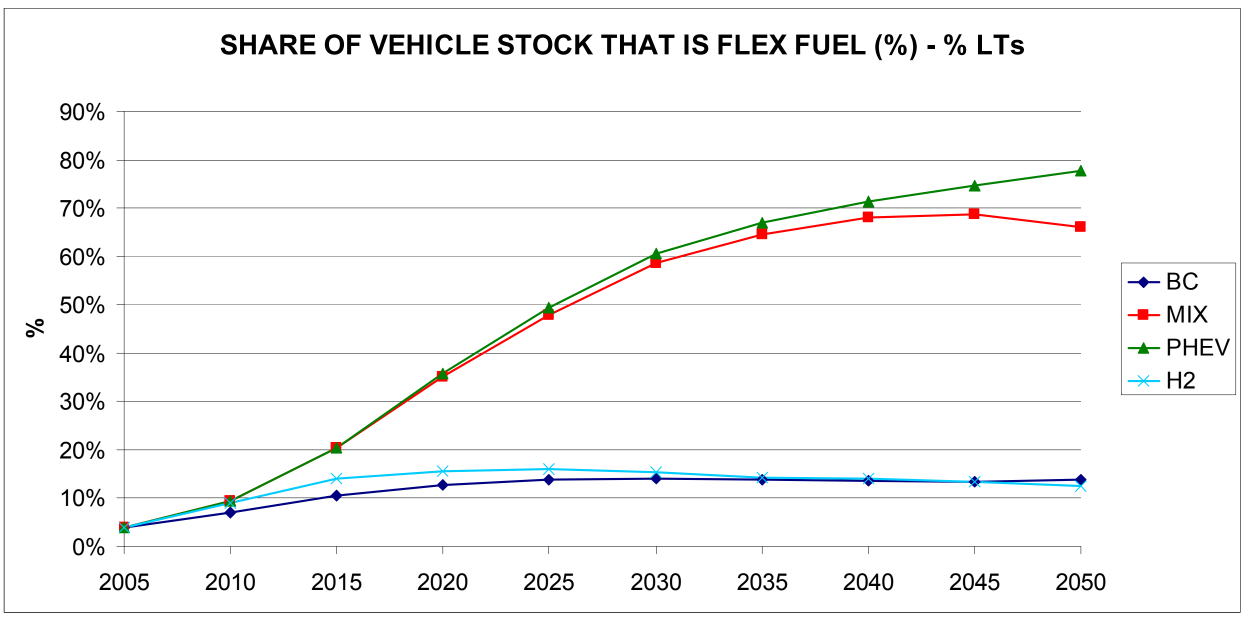

FIGURE E-80 Flex Fuel Share of LT Stock (Literature Review with Subsidies)

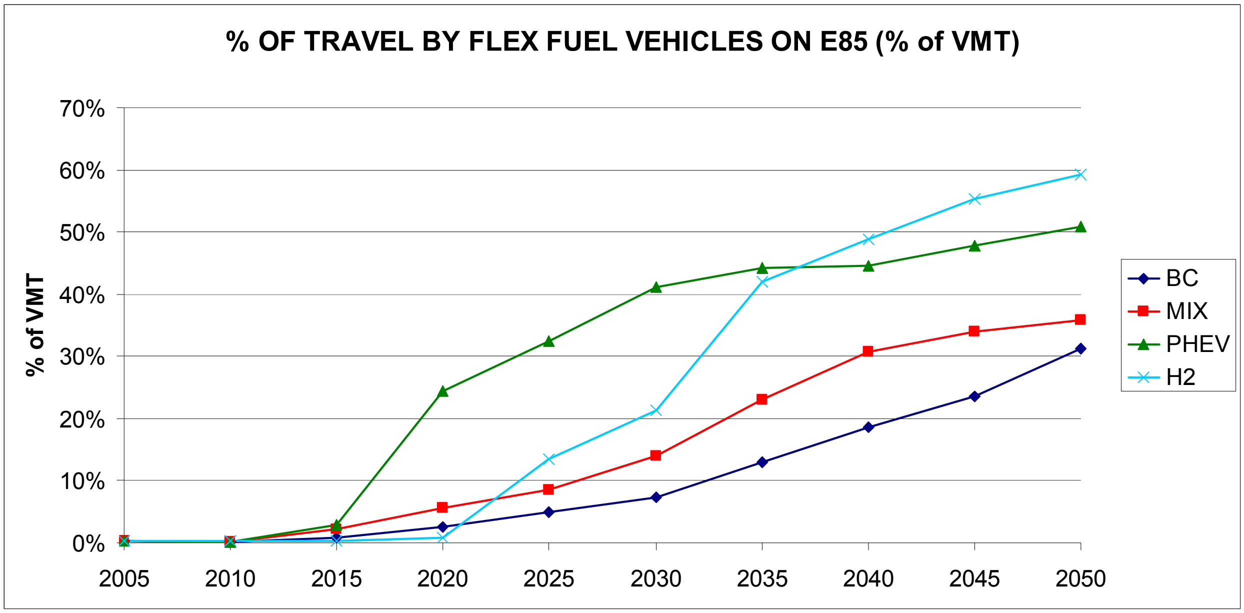

FIGURE E-81 Percent of Travel by Flex Fuel Vehicles on E85 (Literature Review with Subsidies)

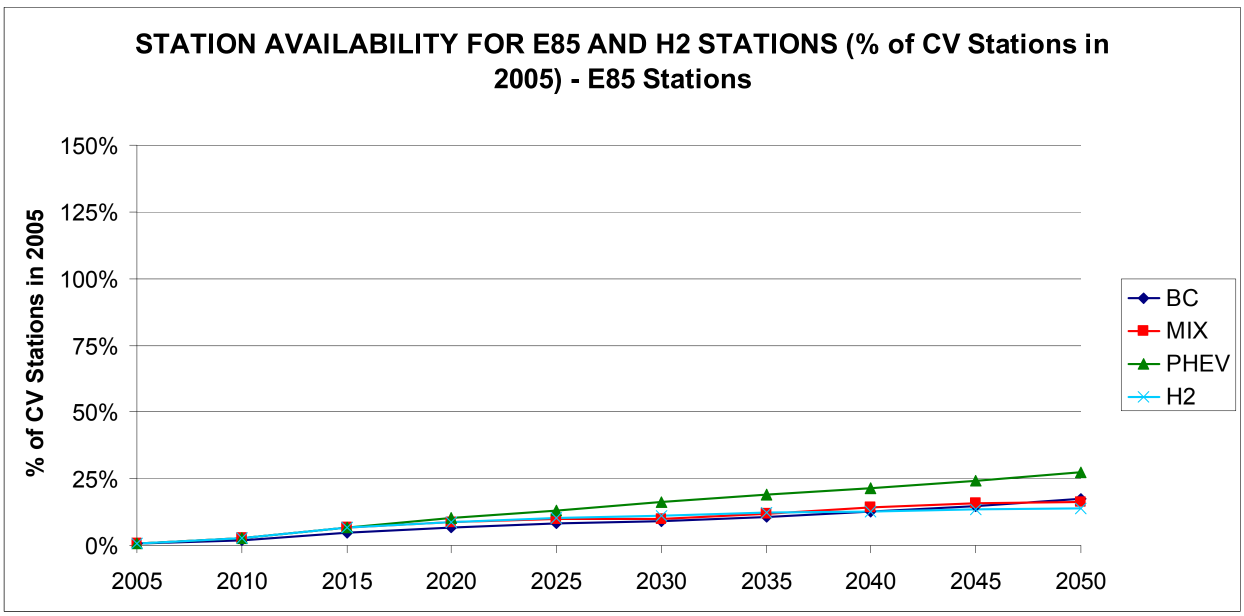

FIGURE E-82 E85 Station Availability (Literature Review with Subsidies)

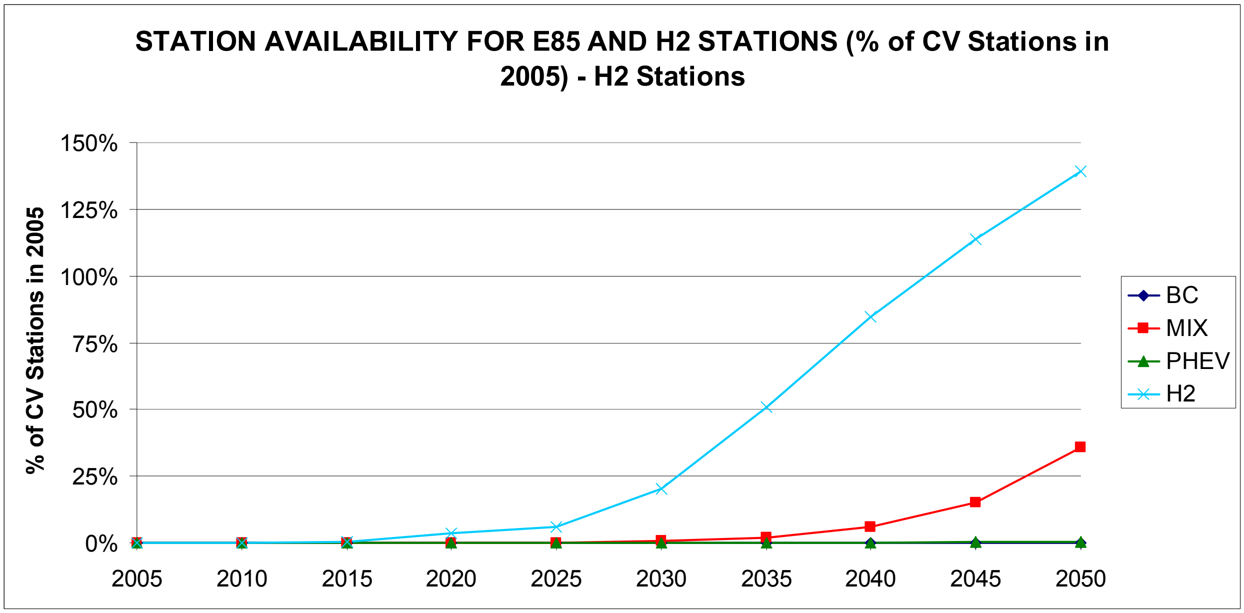

FIGURE E-83 H_2 Station Availability (Literature Review with Subsidies)

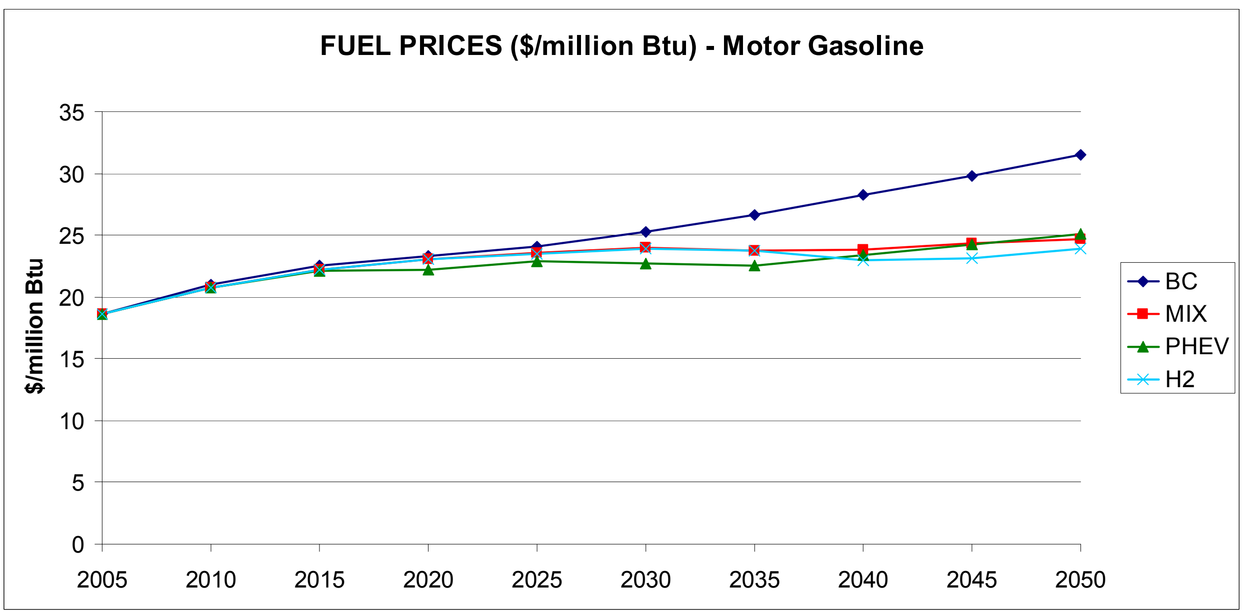

FIGURE E-84 Motor Gasoline Fuel Prices (Literature Review with Subsidies)

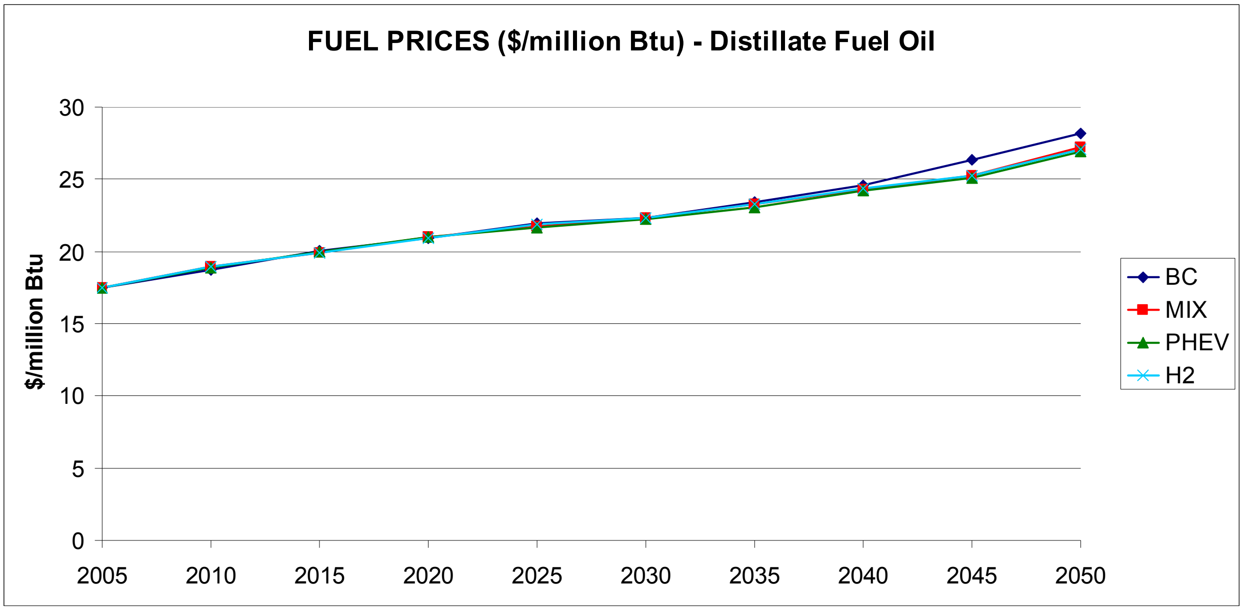

FIGURE E-85 Diesel Fuel Prices (Literature Review with Subsidies)

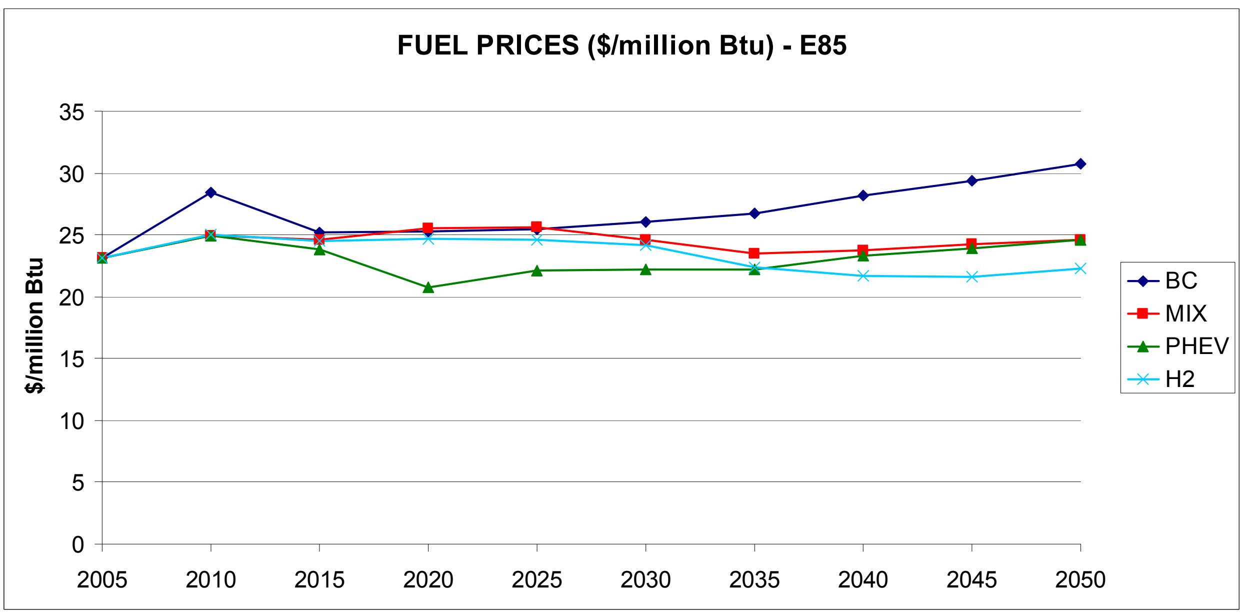

FIGURE E-86 E85 Fuel Prices (Literature Review with Subsidies)

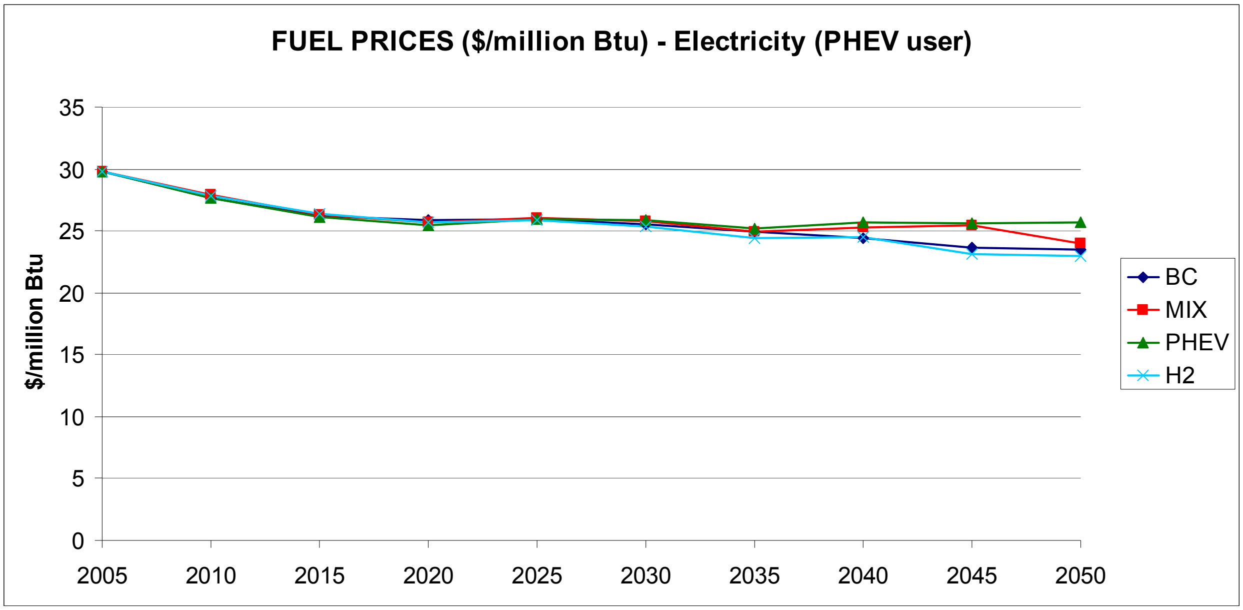

FIGURE E-87 Electricity Prices for the PHEV User (Literature Review with Subsidies)

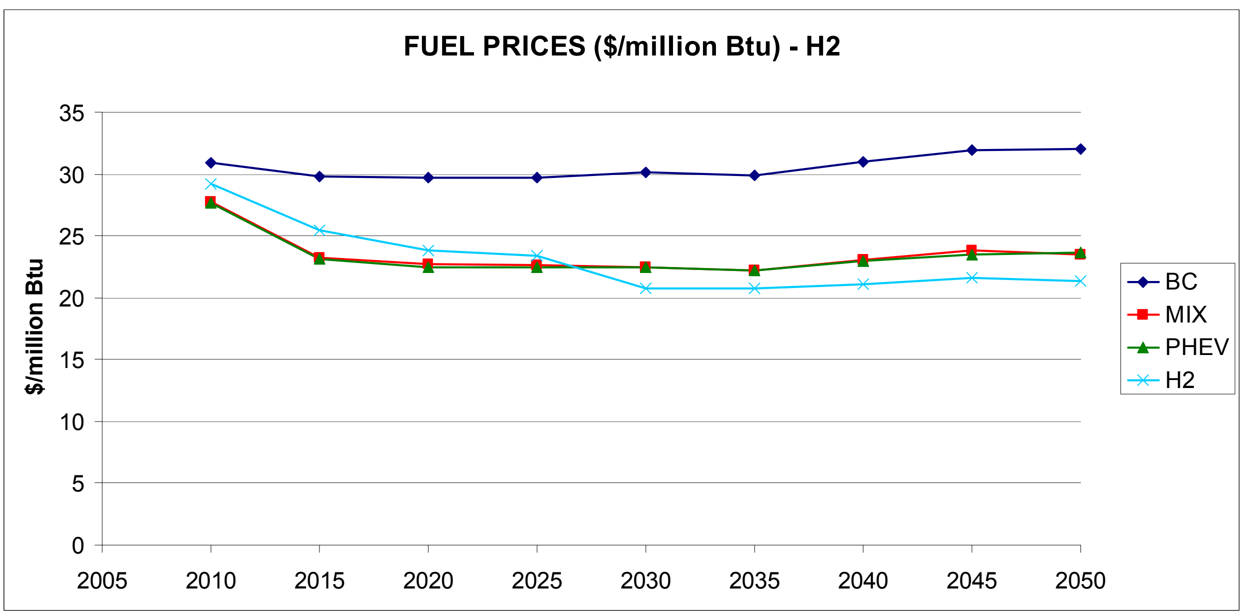

FIGURE E-88 H_2 Fuel Prices (Literature Review with Subsidies)

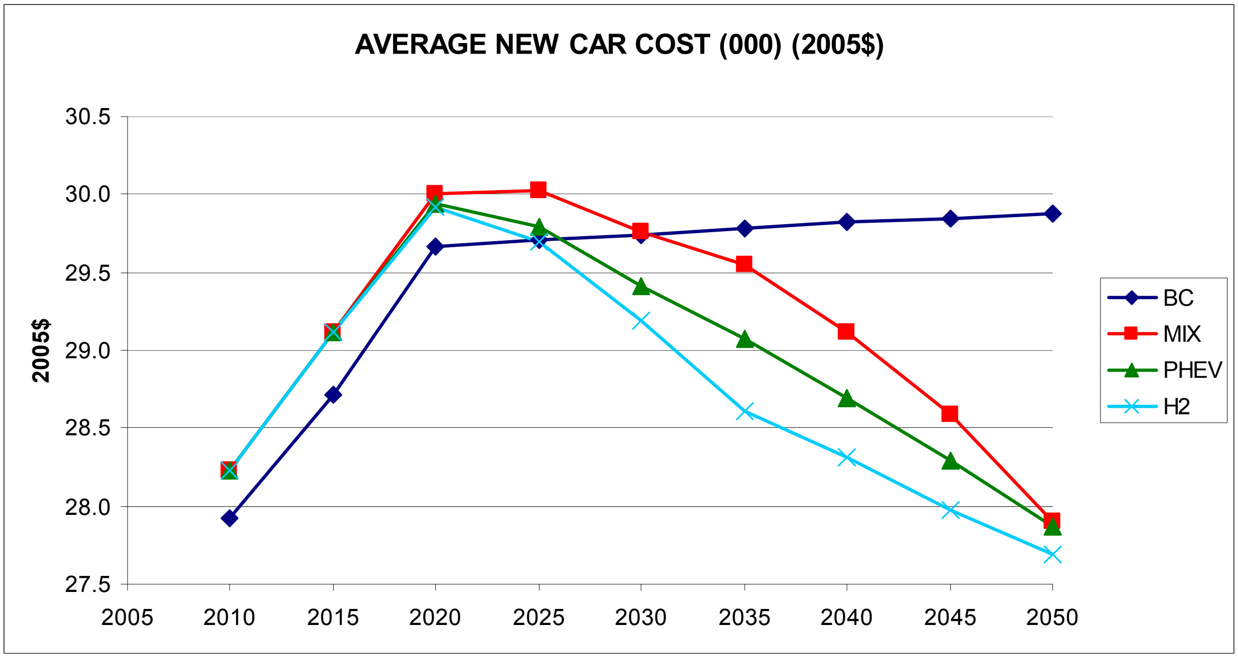

FIGURE E-89 Average New Car Prices (Literature Review with Subsidies)

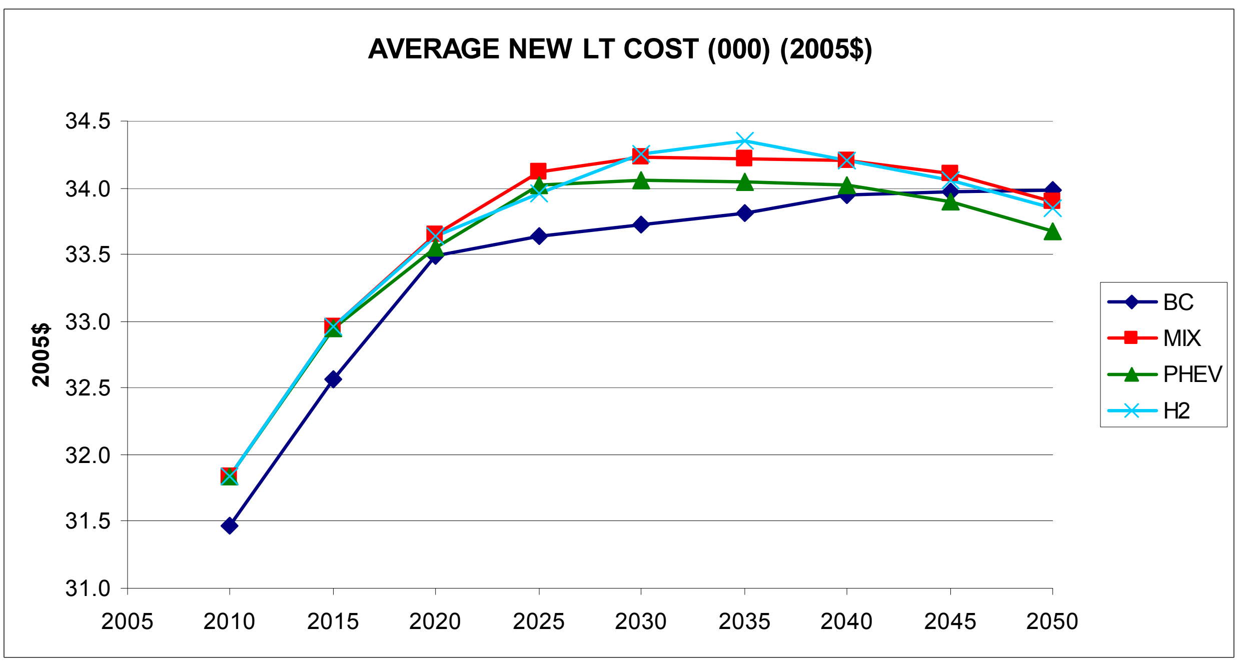

FIGURE E-90 Average New LT Prices (Literature Review with Subsidies)

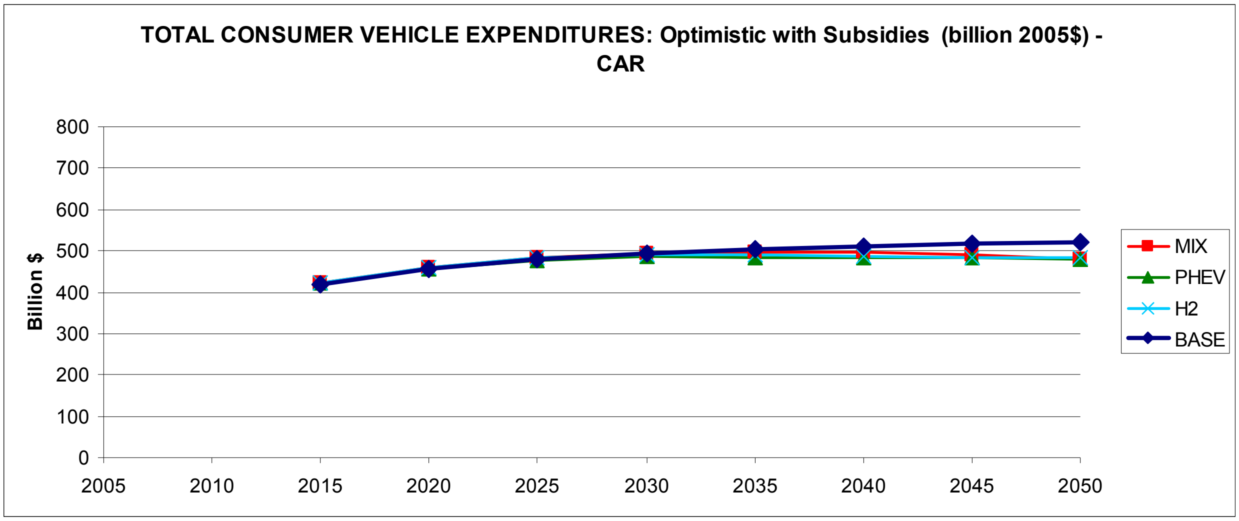

FIGURE E-91 Total Consumer Car Expenditures (Literature Review with Subsidies)

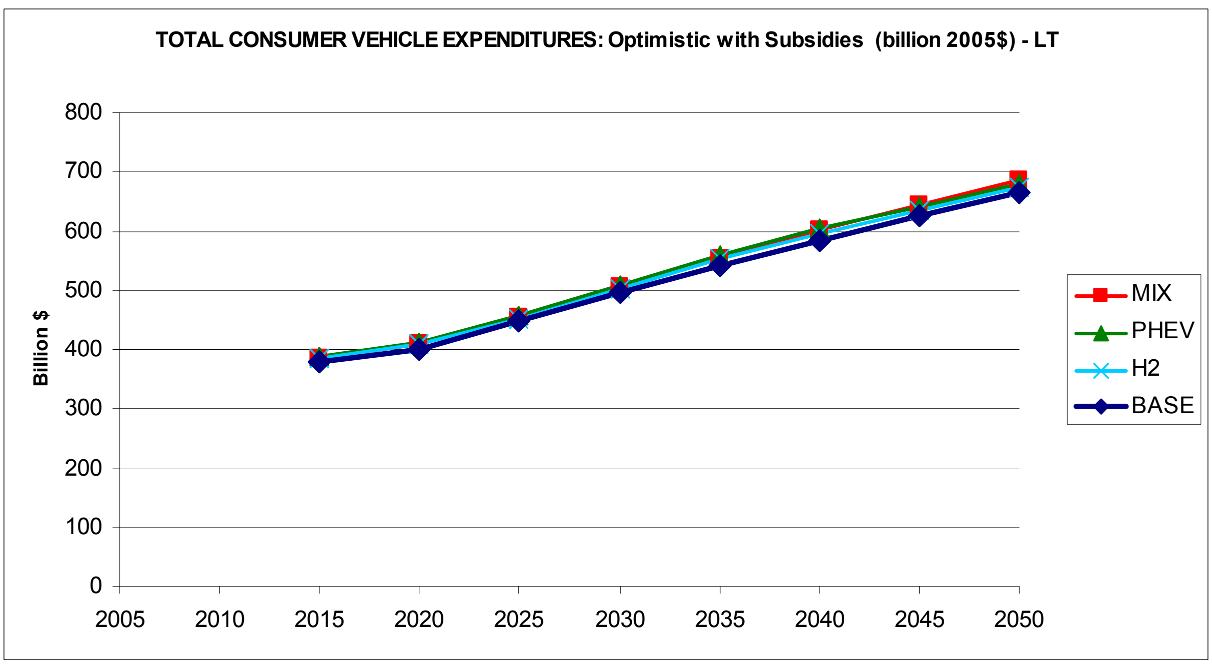

FIGURE E-92 Total Consumer LT Expenditures (Literature Review with Subsidies)

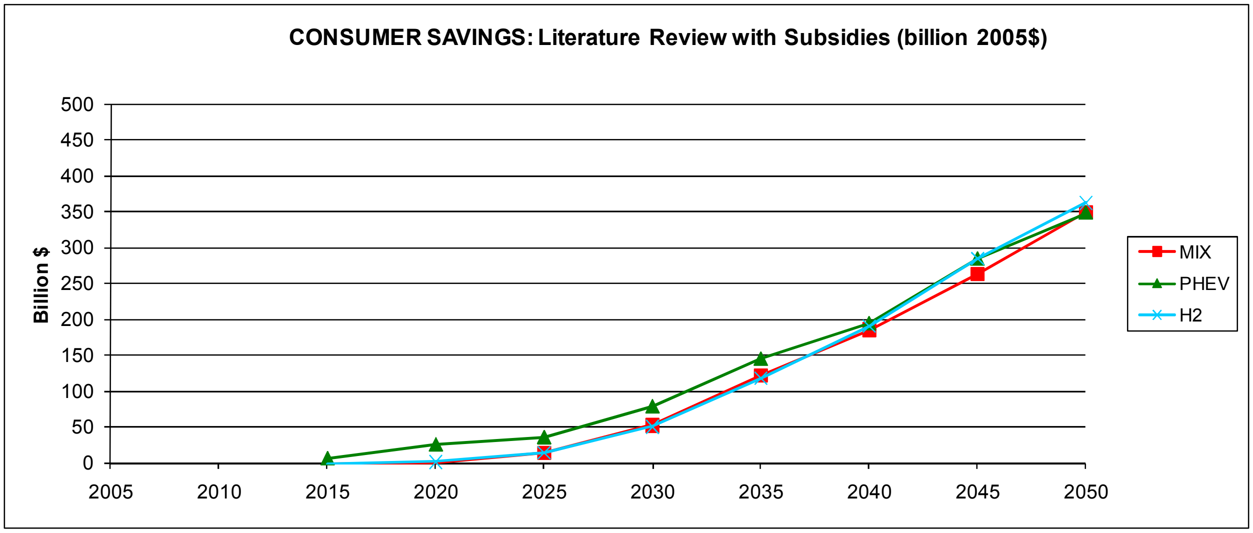

FIGURE E-93 Total Consumer Savings (Literature Review with Subsidies)

PROGRAM GOALS WITH SUBSIDIES SCENARIOS: GRAPHICAL RESULTS

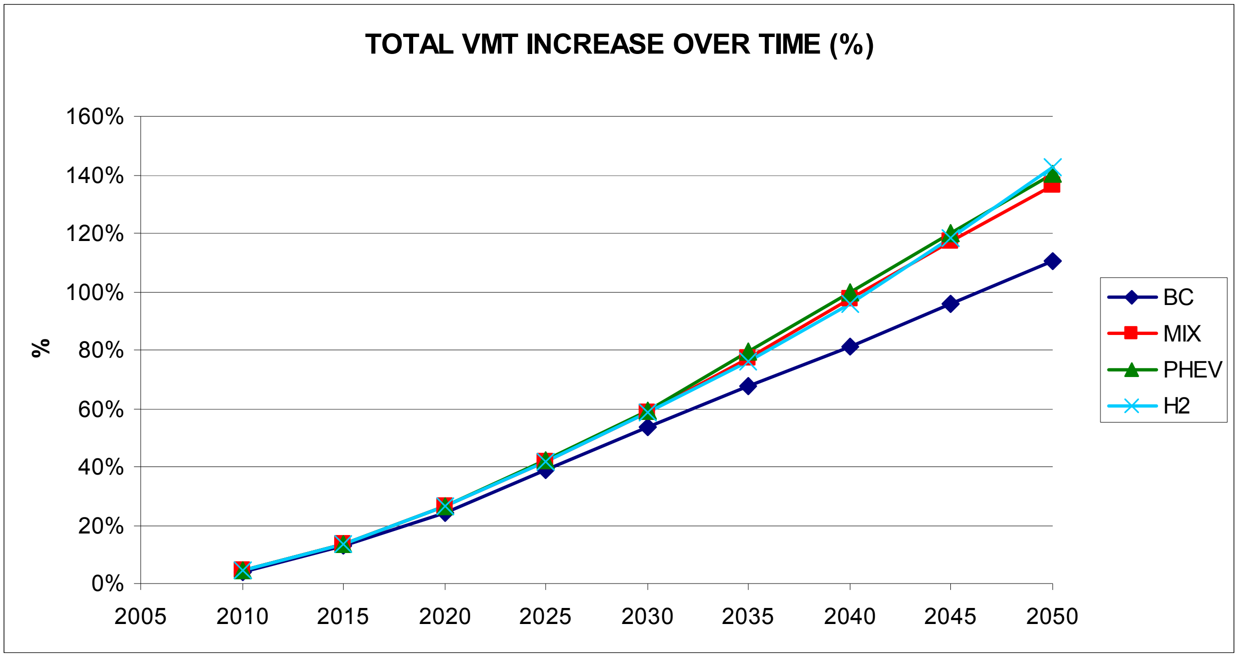

FIGURE E-94 Total VMT Increase over Time (Program Goals with Subsidies)

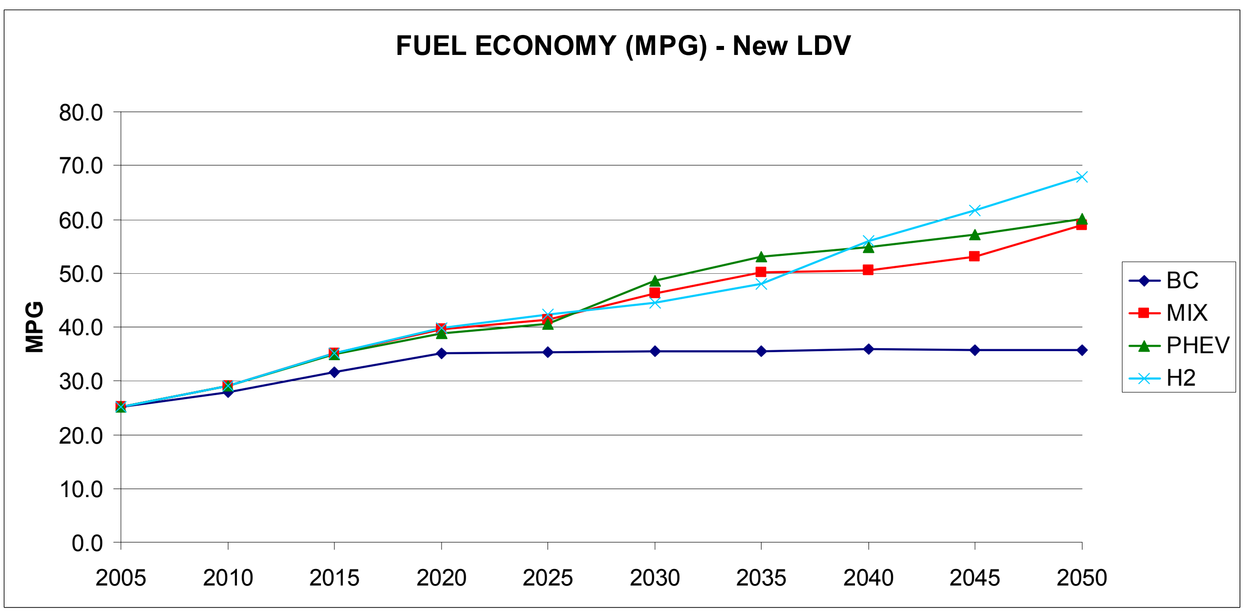

FIGURE E-95 New LV Fuel Economy (Program Goals with Subsidies)

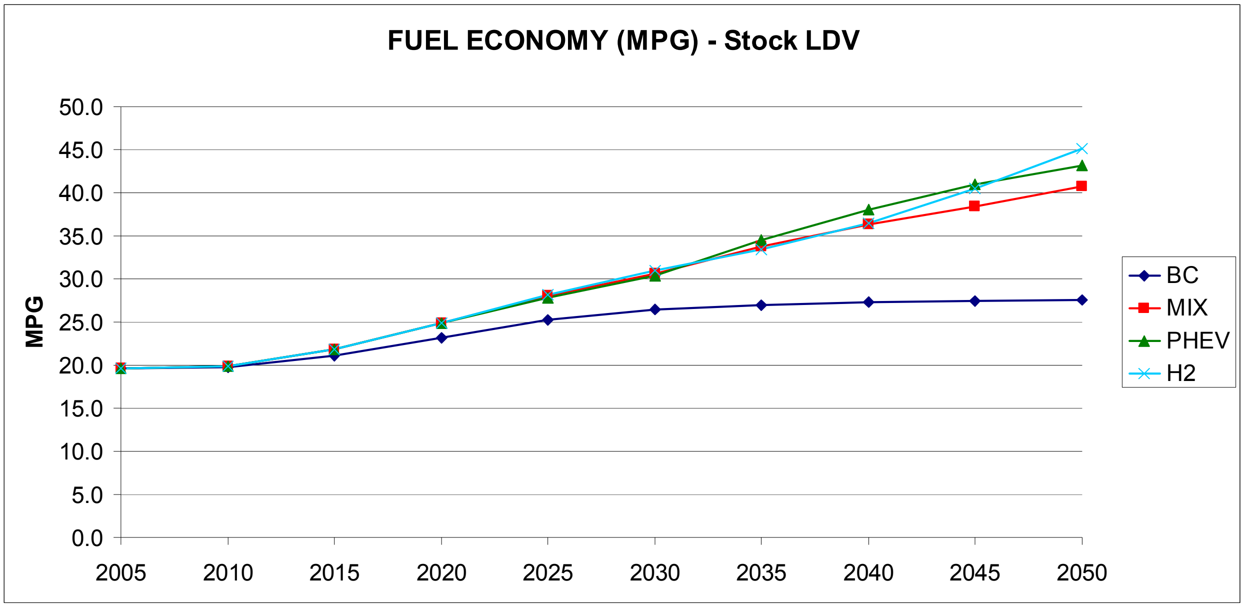

FIGURE E-96 LV Stock Fuel Economy (Program Goals with Subsidies)

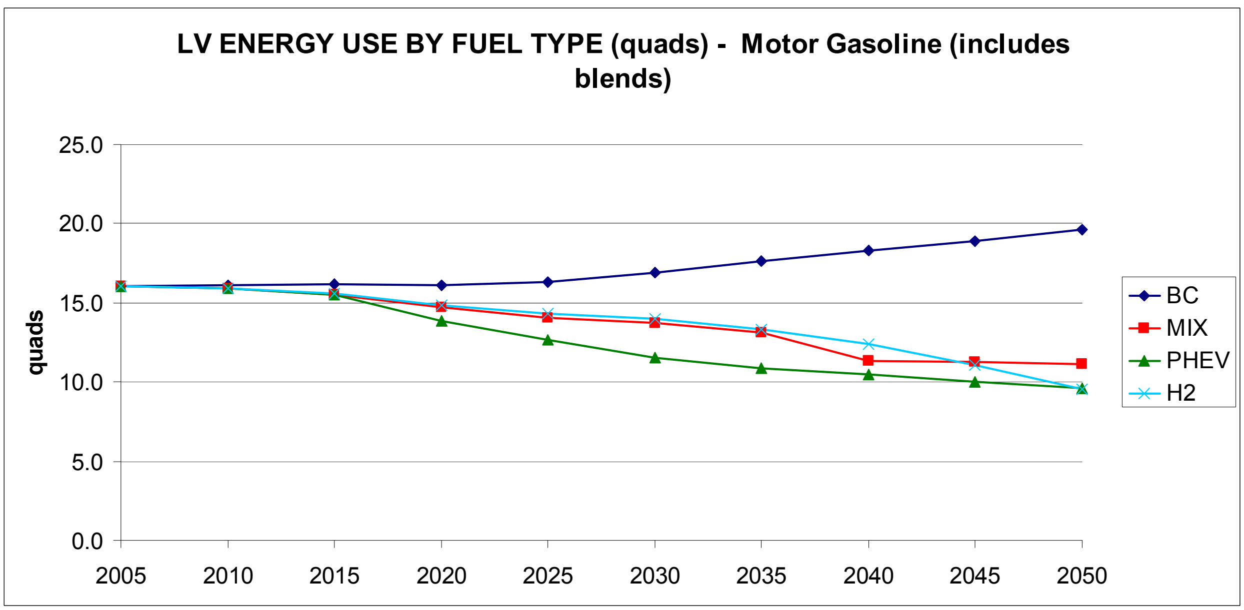

FIGURE E-97 LV Motor Gasoline Demand (Program Goals with Subsidies)

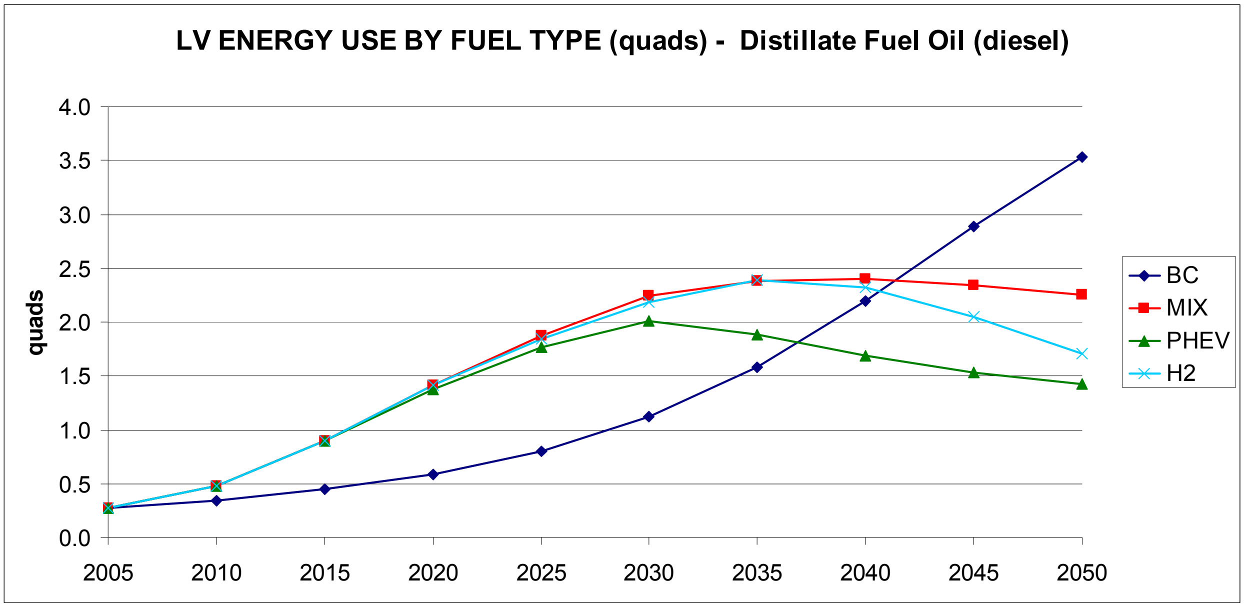

FIGURE E-98 LV Diesel Fuel Demand (Program Goals with Subsidies)

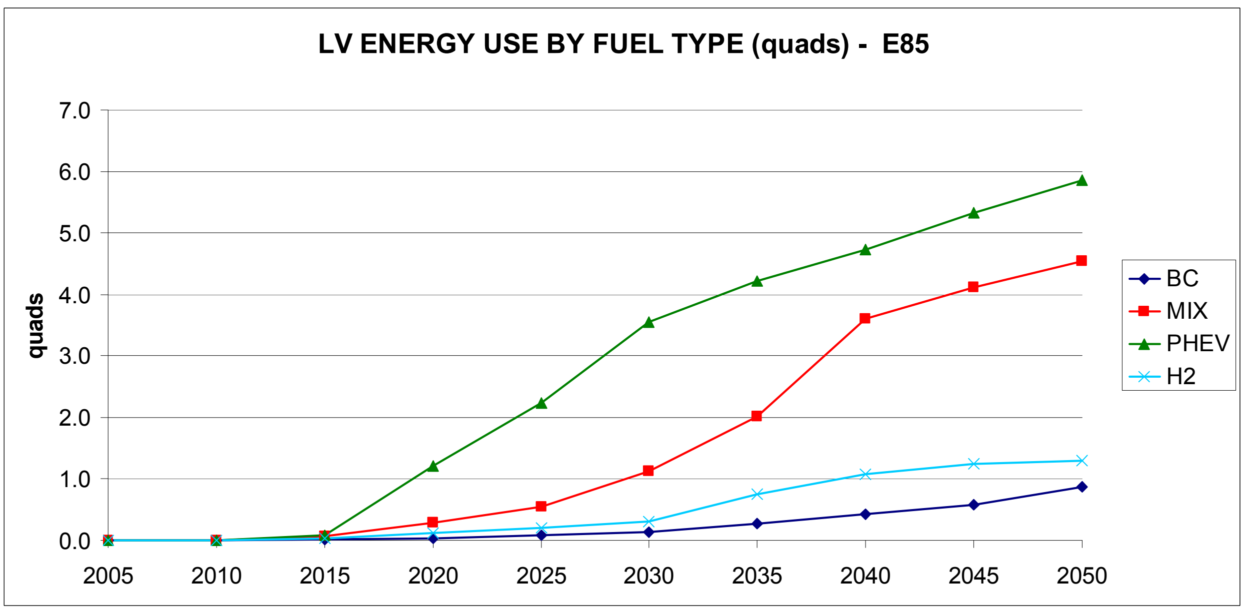

FIGURE E-99 LV E85 Demand (Program Goals with Subsidies)

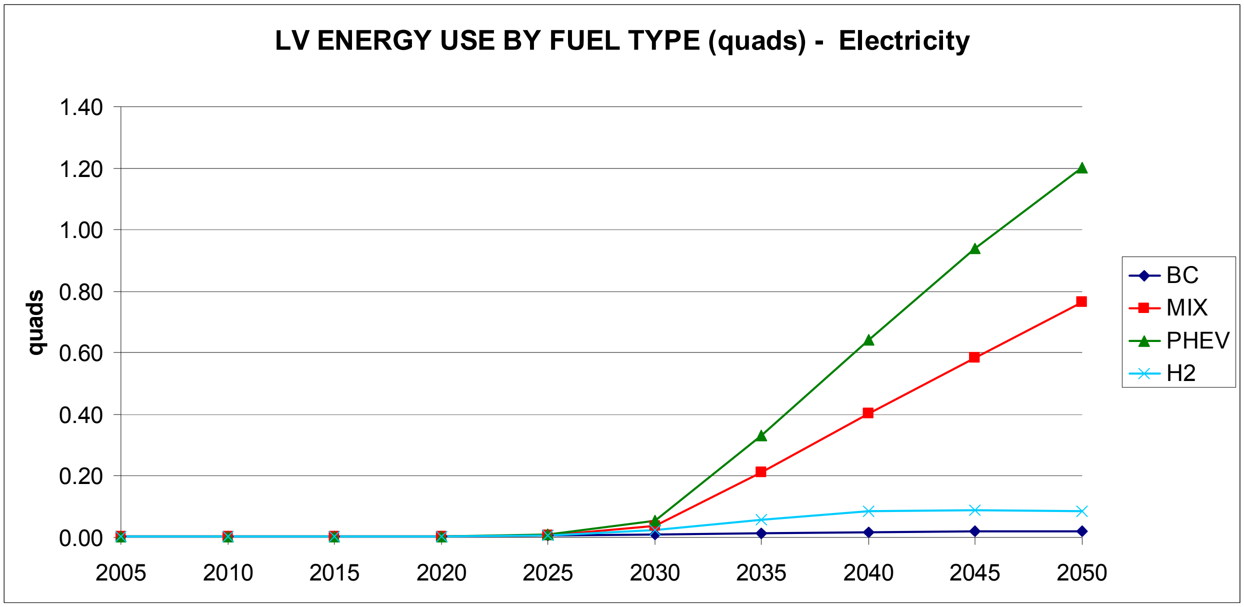

FIGURE E-100 LV Electricity Demand (Program Goals with Subsidies)

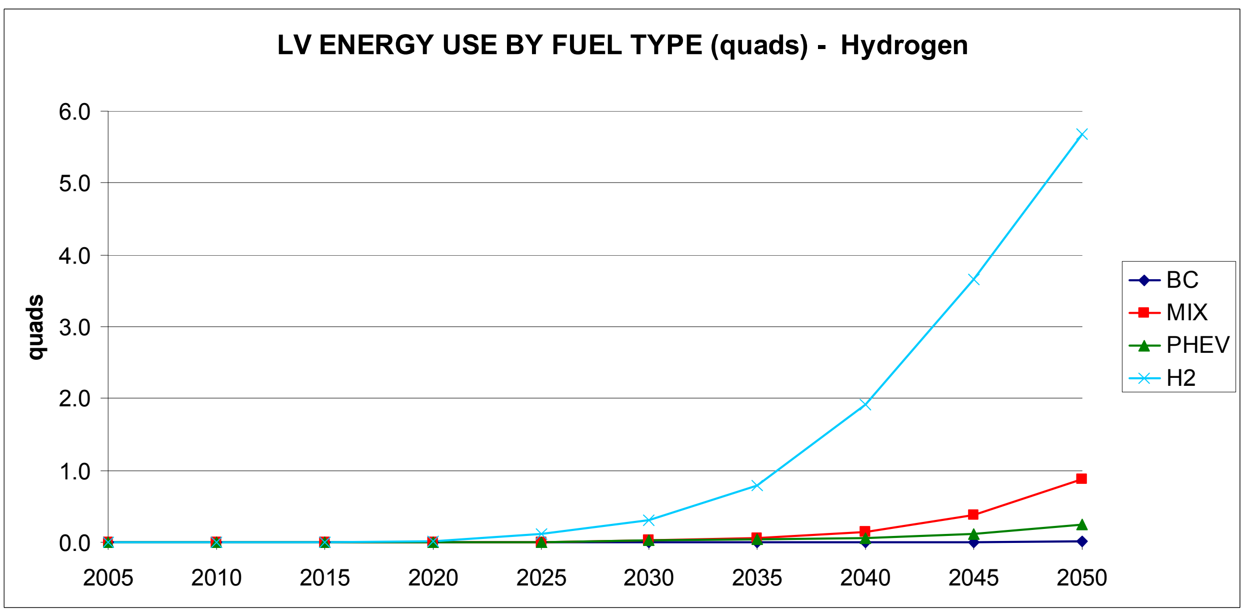

FIGURE E-101 LV H_2 Demand (Program Goals with Subsidies)

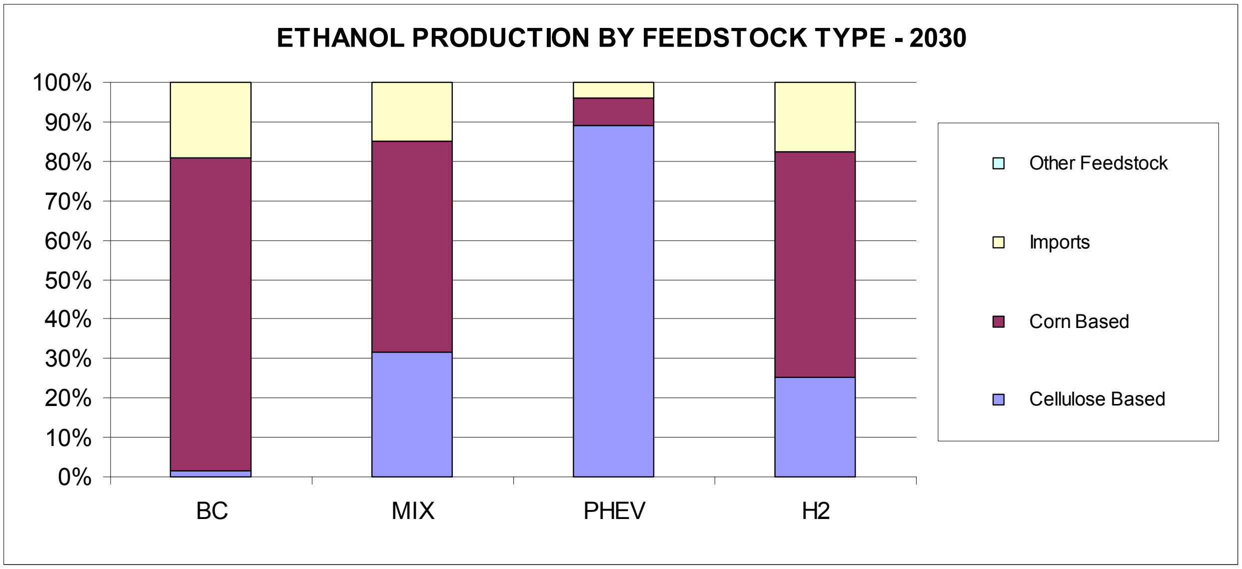

FIGURE E-102 Ethanol Production by Feedstock Type in 2030 (Program Goals with Subsidies)

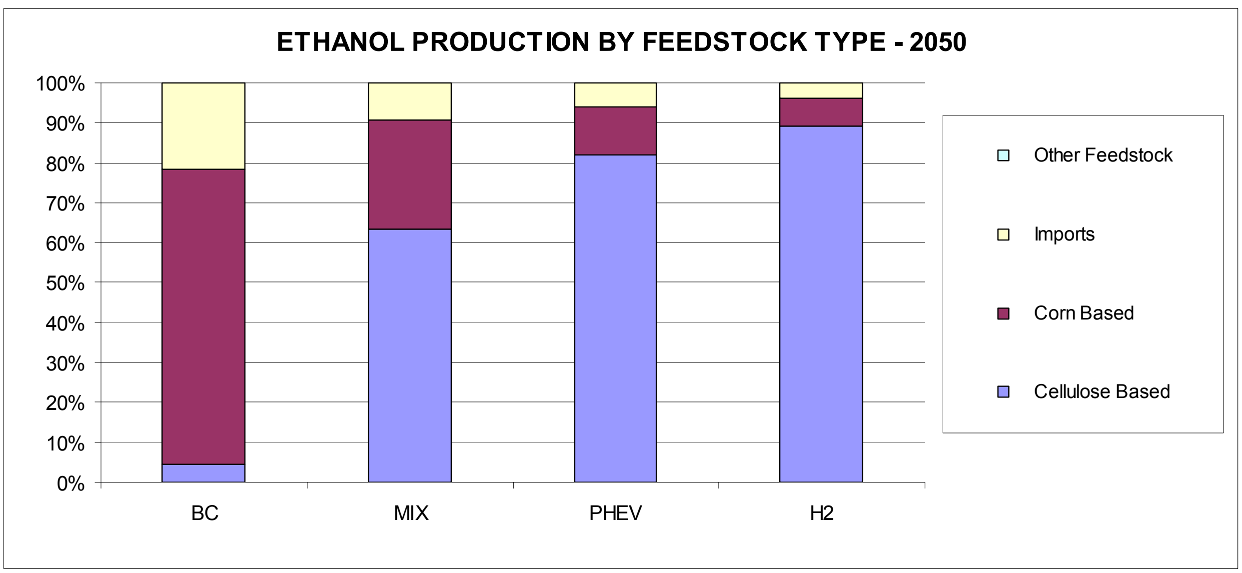

FIGURE E-103 Ethanol Production by Feedstock Type in 2050 (Program Goals with Subsidies)

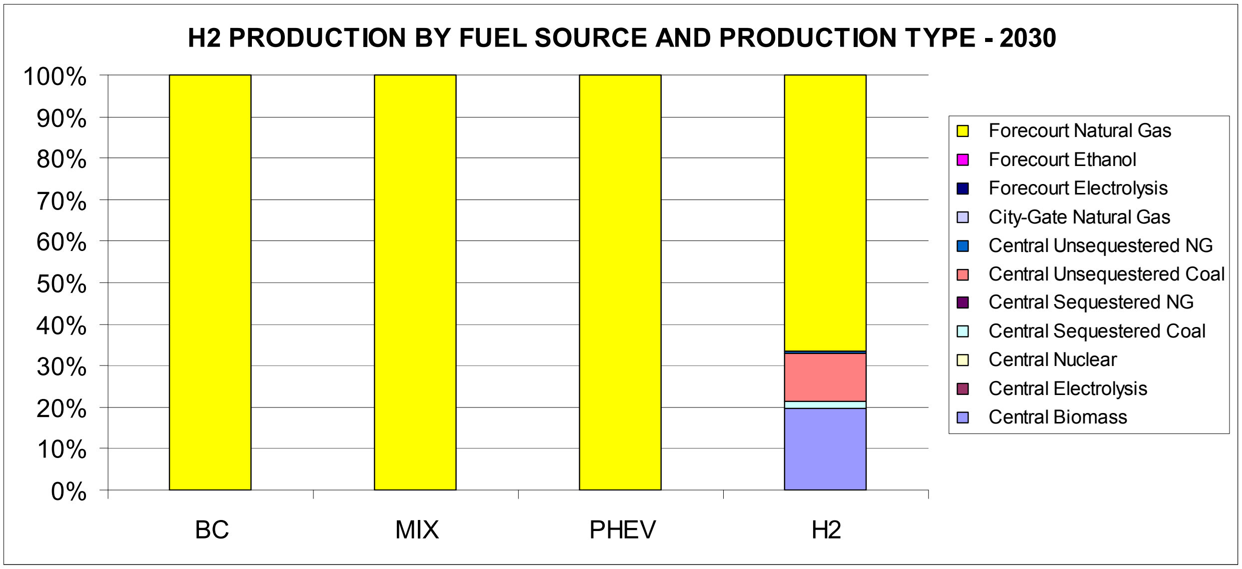

FIGURE E-104 H_2 Production by Fuel Source and Production Type in 2030 (Program Goals with Subsidies)

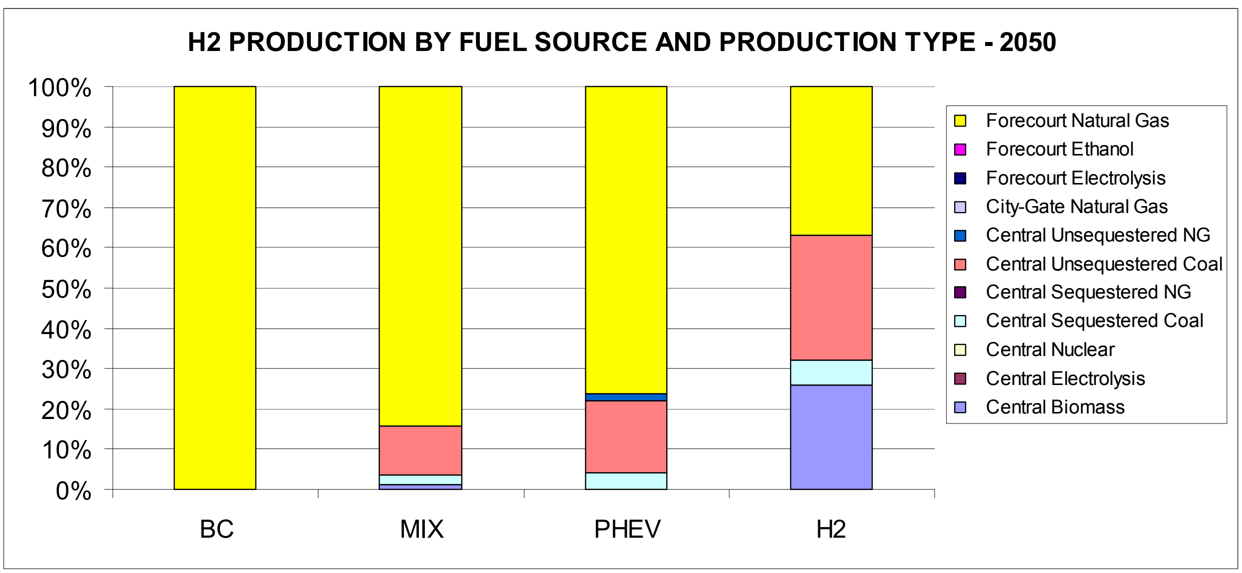

FIGURE E-105 H_2 Production by Fuel Source and Production Type in 2050 (Program Goals with Subsidies)

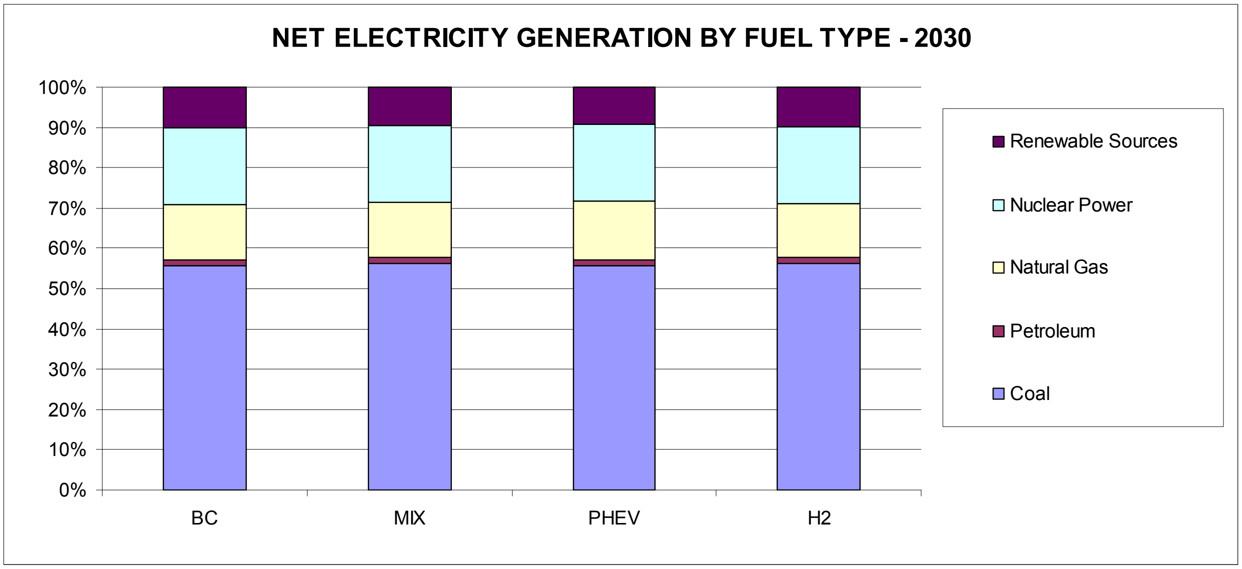

FIGURE E-106 Net Electricity Generation by Fuel Type in 2030 (Program Goals with Subsidies)

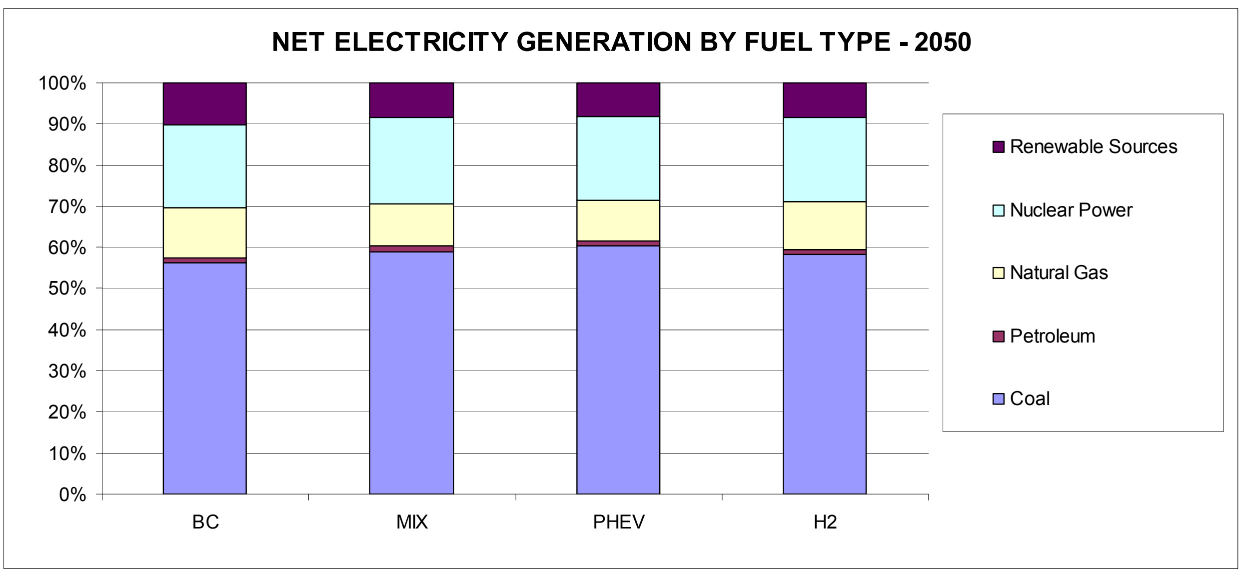

FIGURE E-107 Net Electricity Generation by Fuel Type in 2050 (Program Goals with Subsidies)

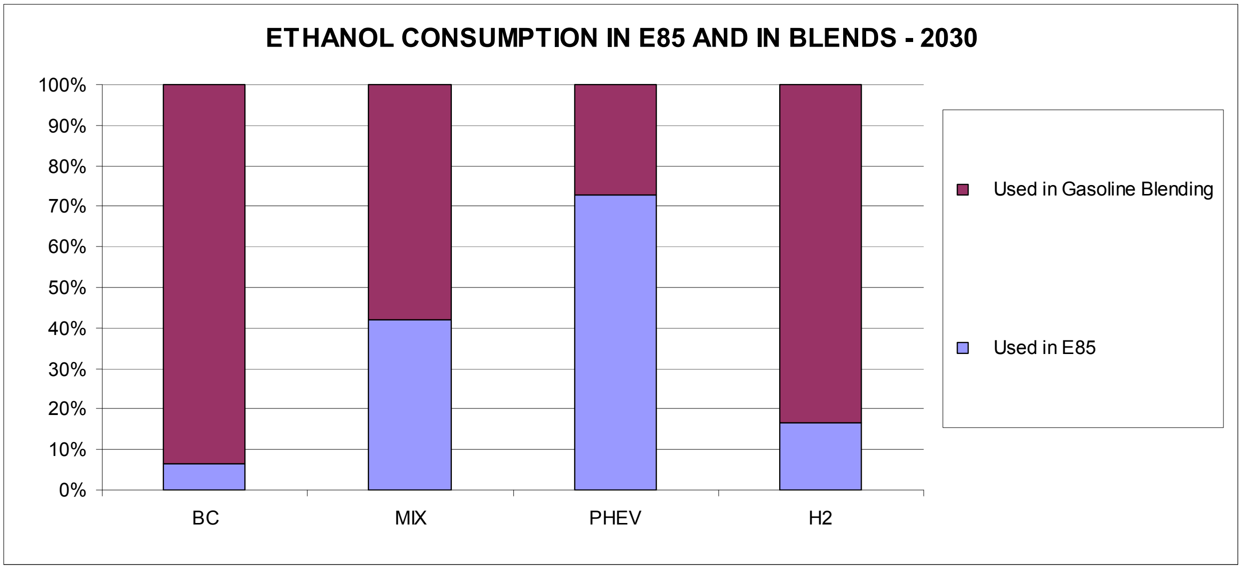

FIGURE E-108 Ethanol Consumption in E85 and Blends in 2030 (Program Goals with Subsidies)

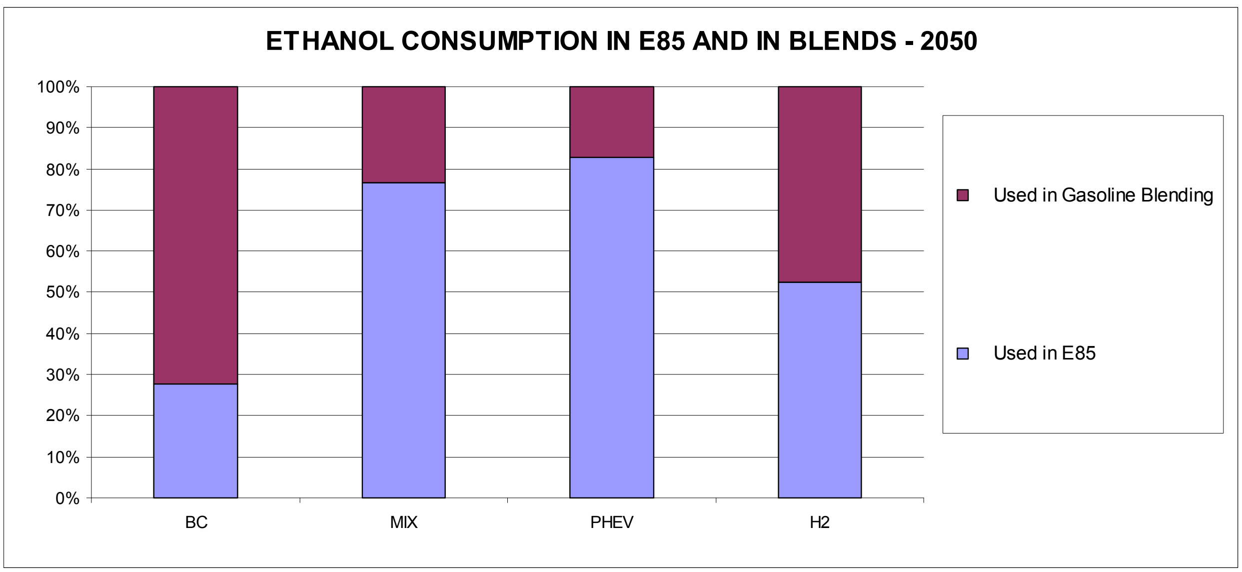

FIGURE E-109 Ethanol Consumption in E85 and Blends in 2050 (Program Goals with Subsidies)

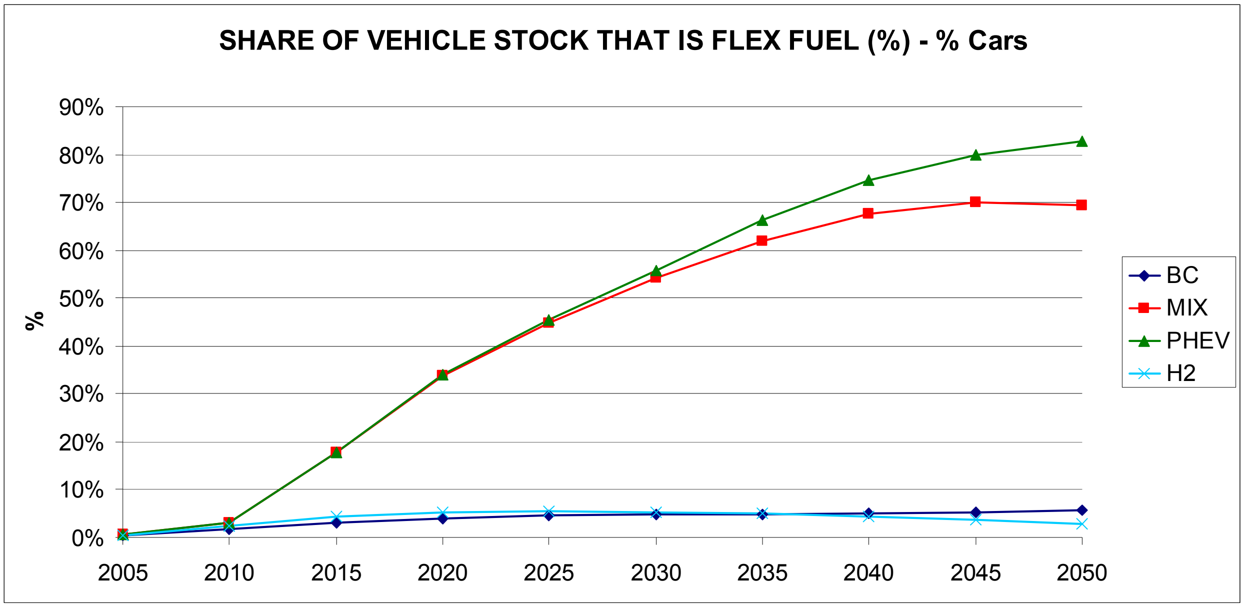

FIGURE E-110 Flex Fuel Share of Car Stock (Program Goals with Subsidies)

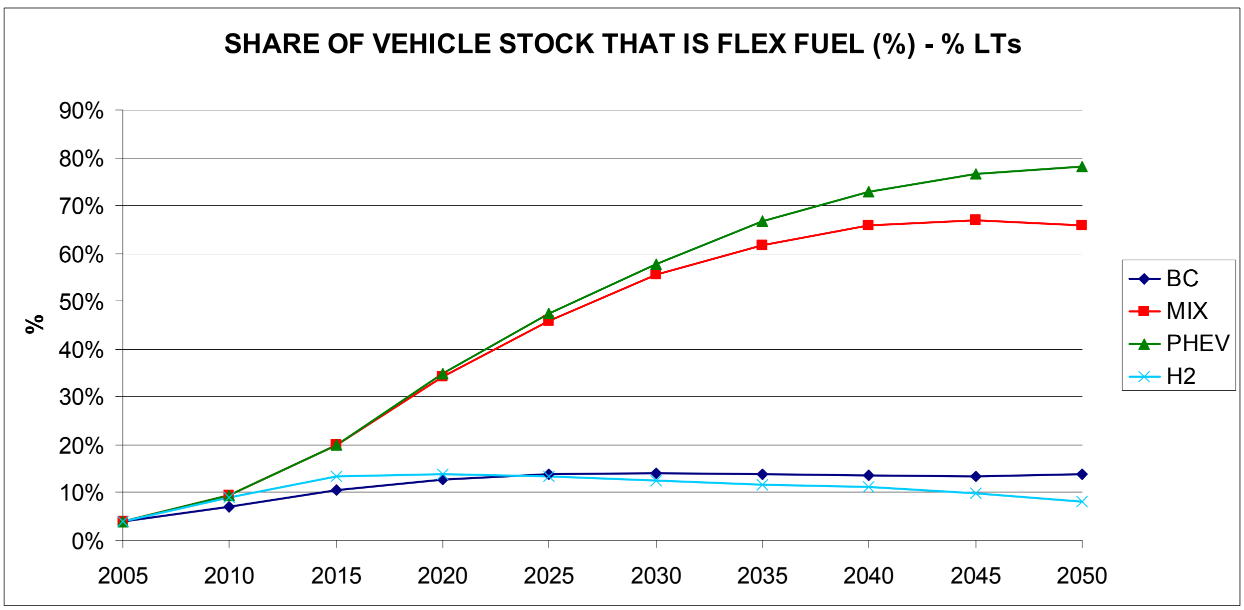

FIGURE E-111 Flex Fuel Share of LT Stock (Program Goals with Subsidies)

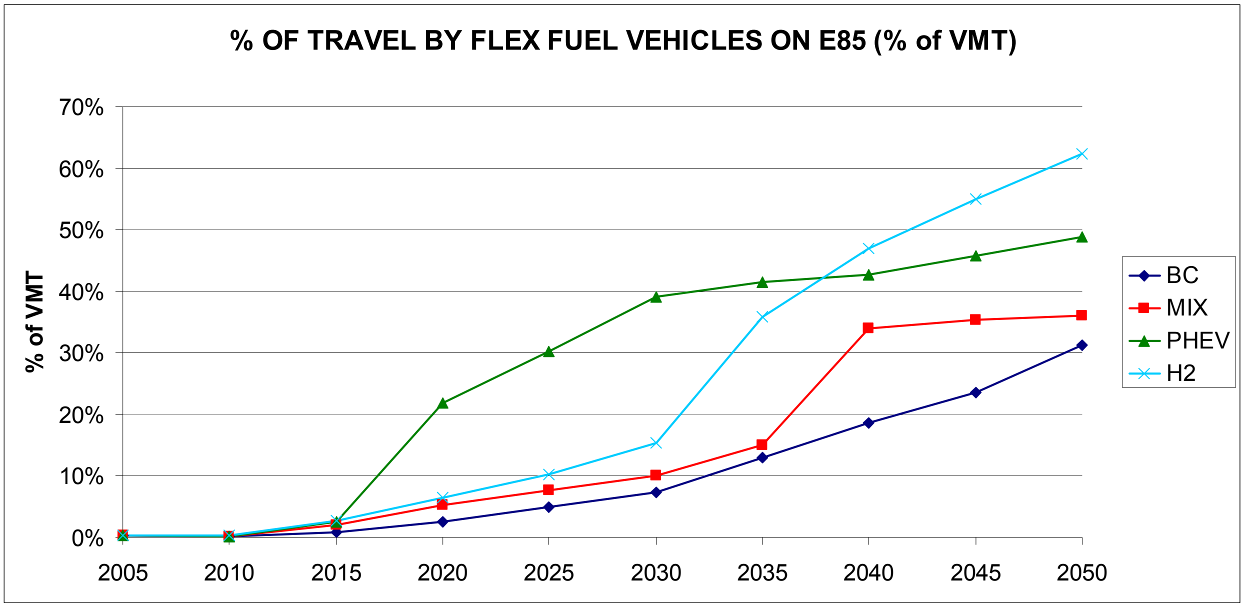

FIGURE E-112 Percent of Travel by Flex Fuel Vehicles on E85 (Program Goals with Subsidies)

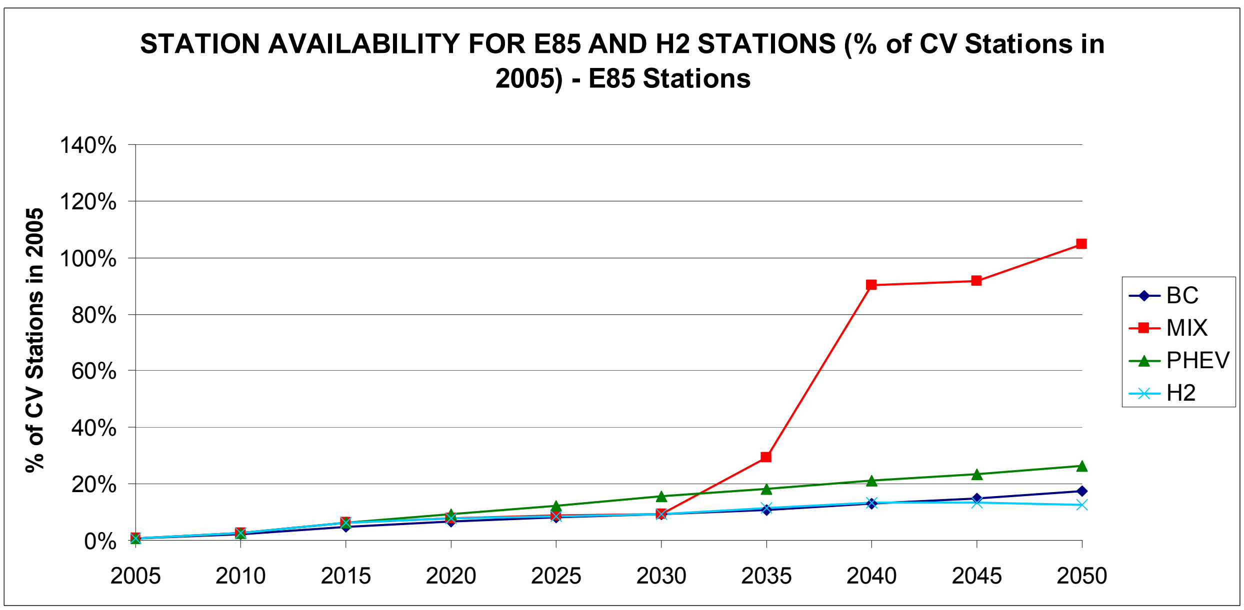

FIGURE E-113 E85 Station Availability (Program Goals with Subsidies)

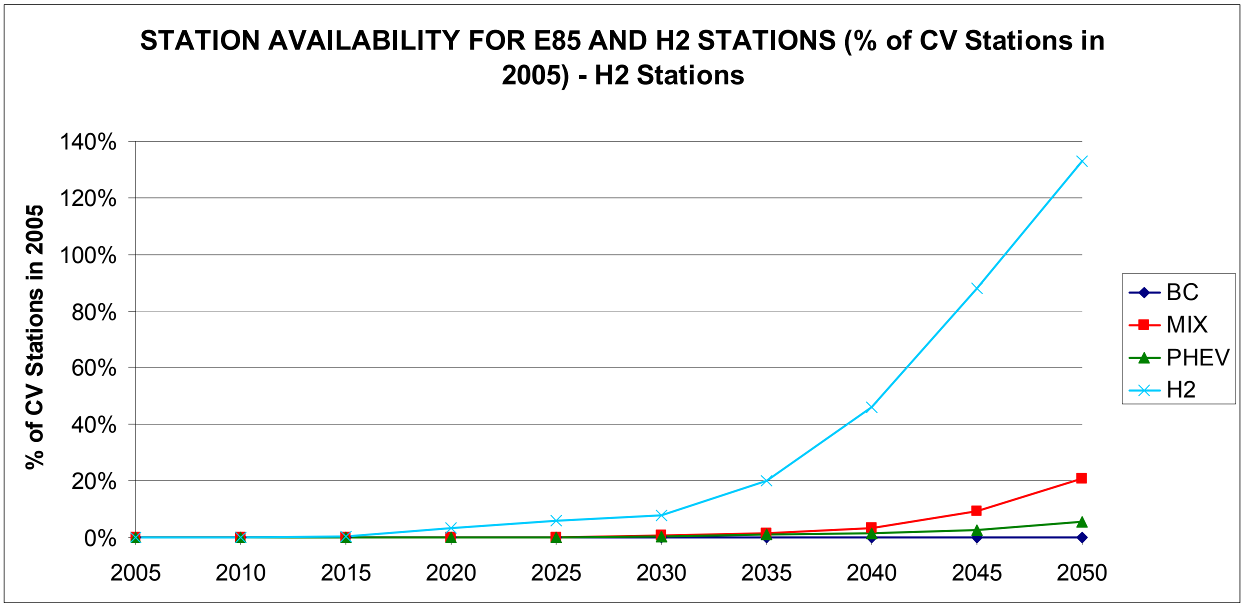

FIGURE E-114 H_2 Station Availability (Program Goals with Subsidies)

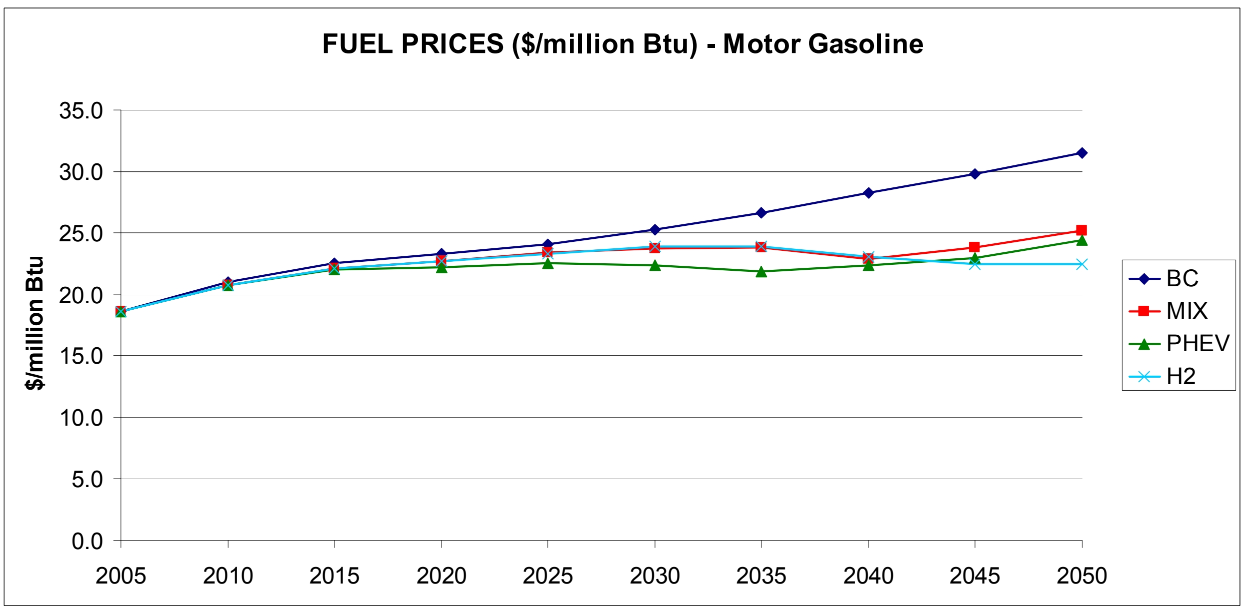

FIGURE E-115 Motor Gasoline Fuel Prices (Program Goals with Subsidies)

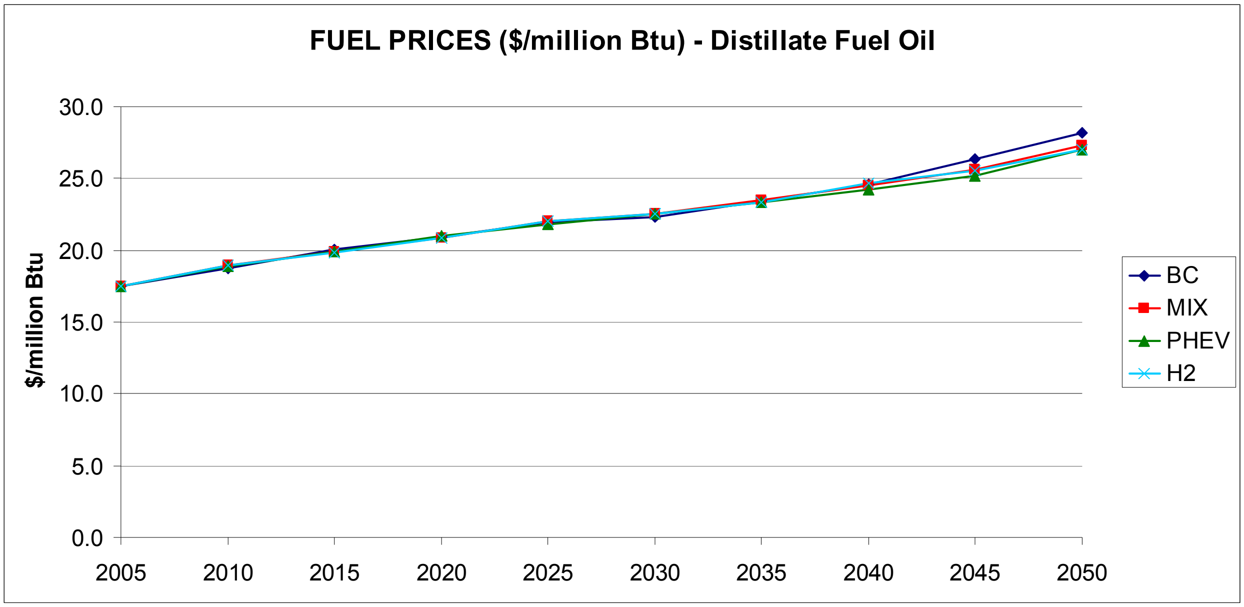

FIGURE E-116 Diesel Fuel Prices (Program Goals with Subsidies)

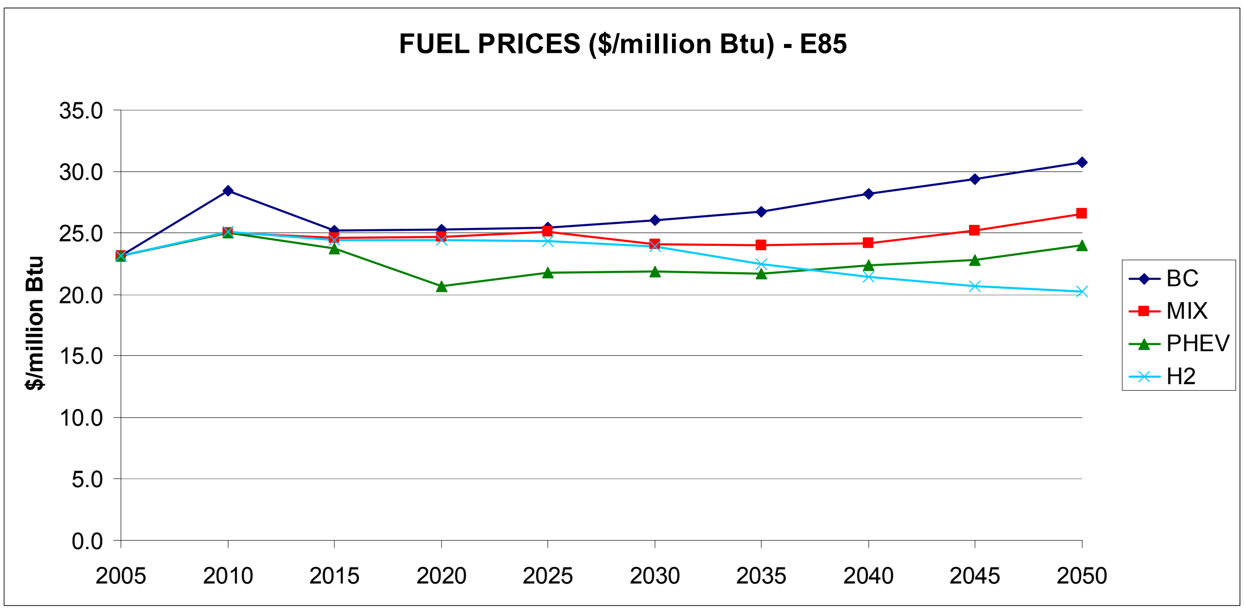

FIGURE E-117 E85 Fuel Prices (Program Goals with Subsidies)

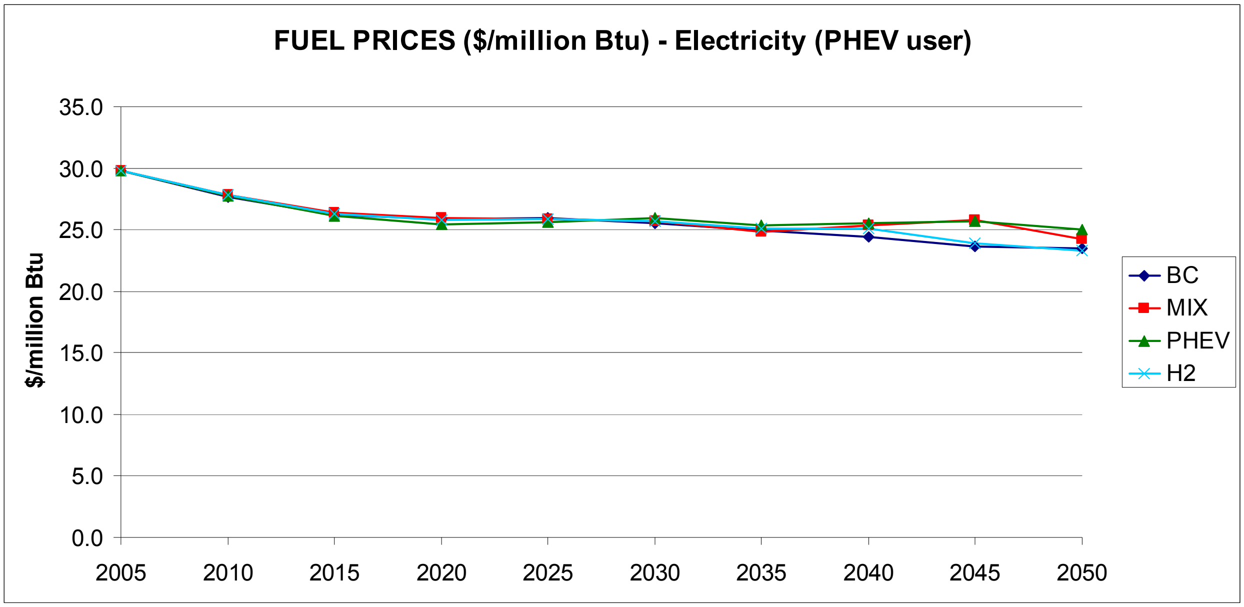

FIGURE E-118 Electricity Prices for the PHEV User (Program Goals with Subsidies)

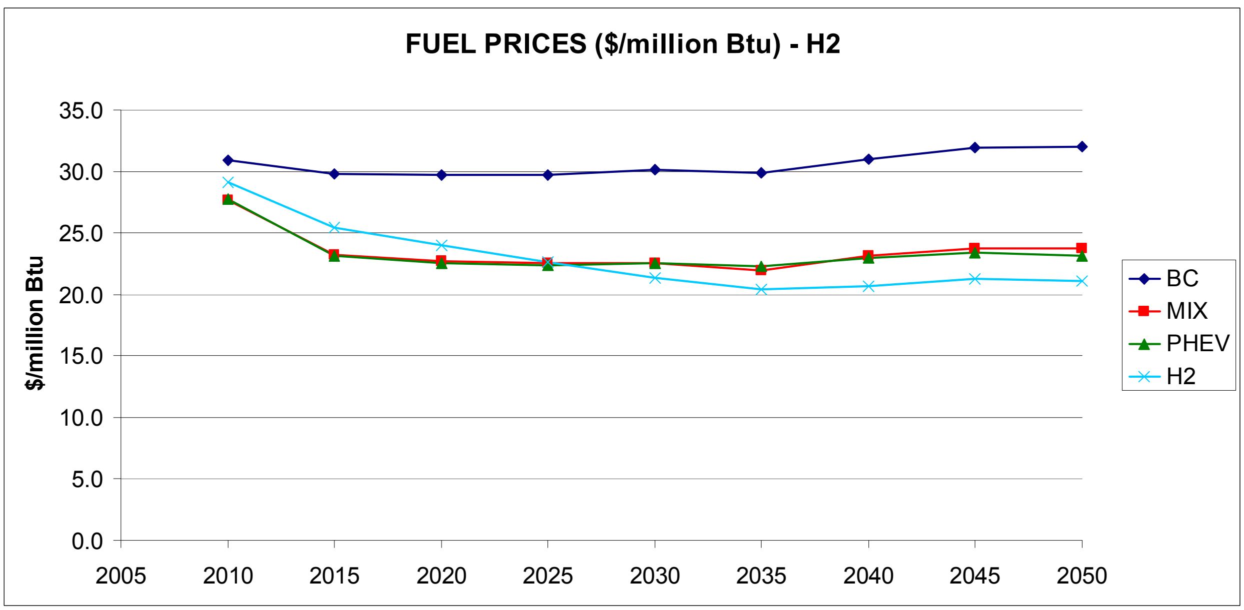

FIGURE E-119 H_2 Fuel Prices (Program Goals with Subsidies)

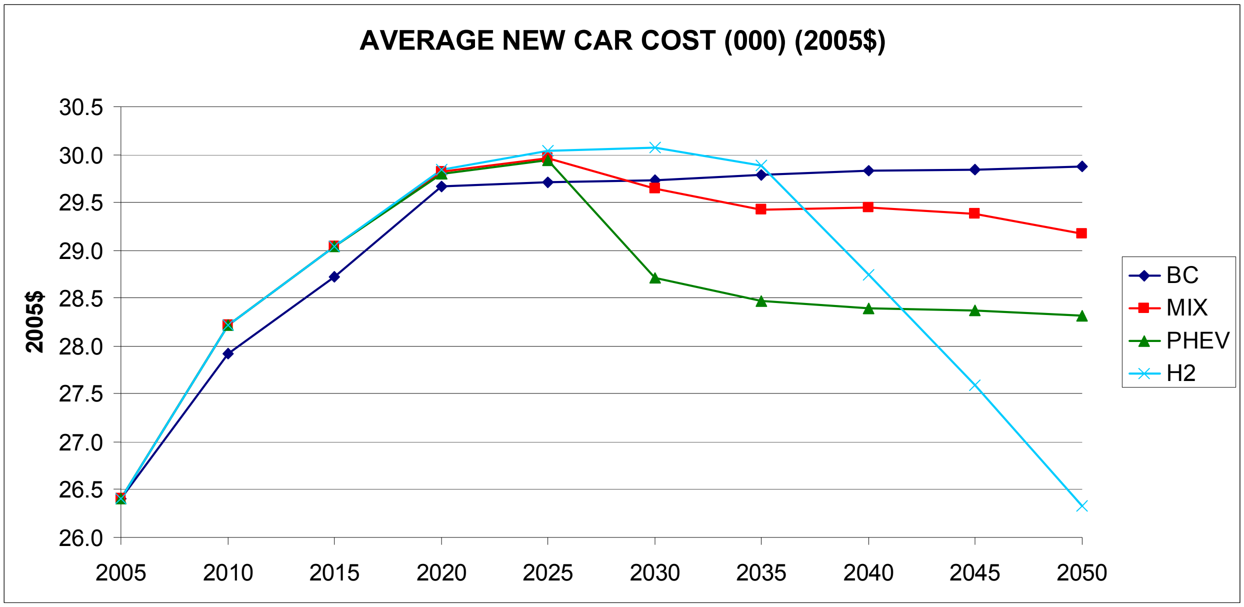

FIGURE E-120 Average New Car Prices (Program Goals with Subsidies)

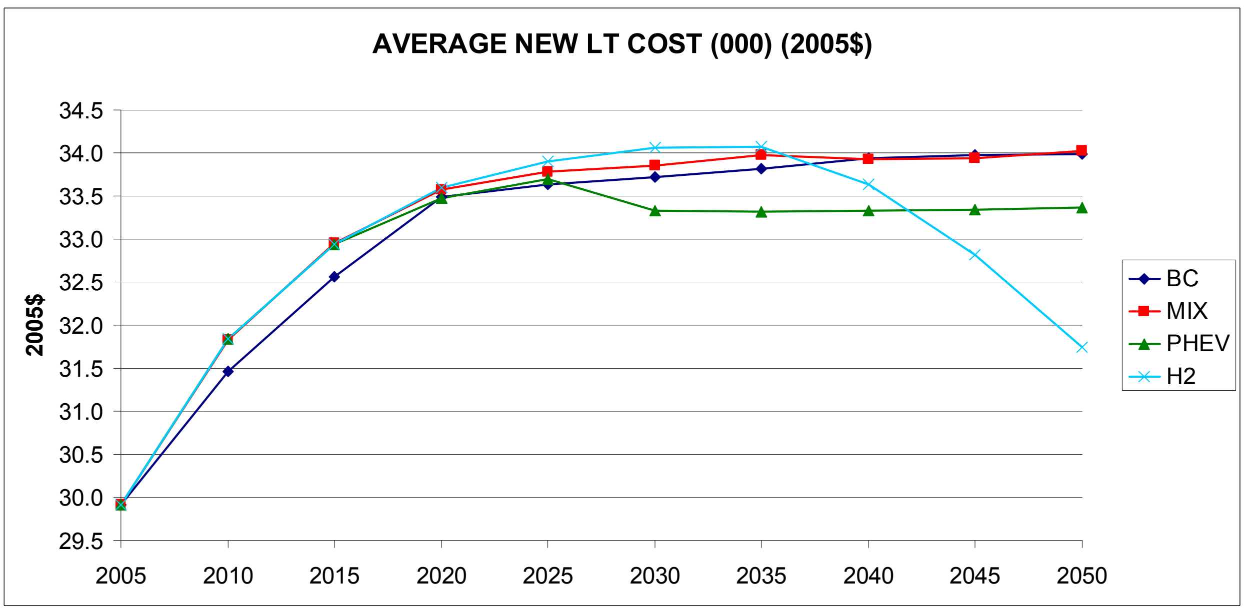

FIGURE E-121 Average New LT Prices (Program Goals with Subsidies)

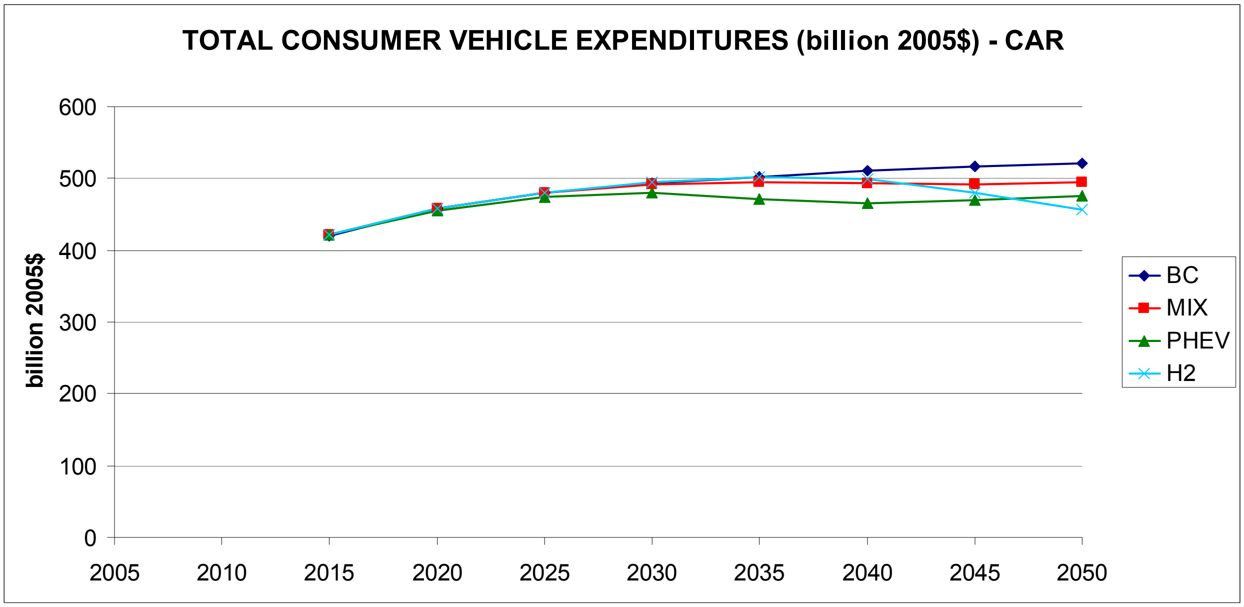

FIGURE E-122 Total Consumer Car Expenditures (Program Goals with Subsidies)

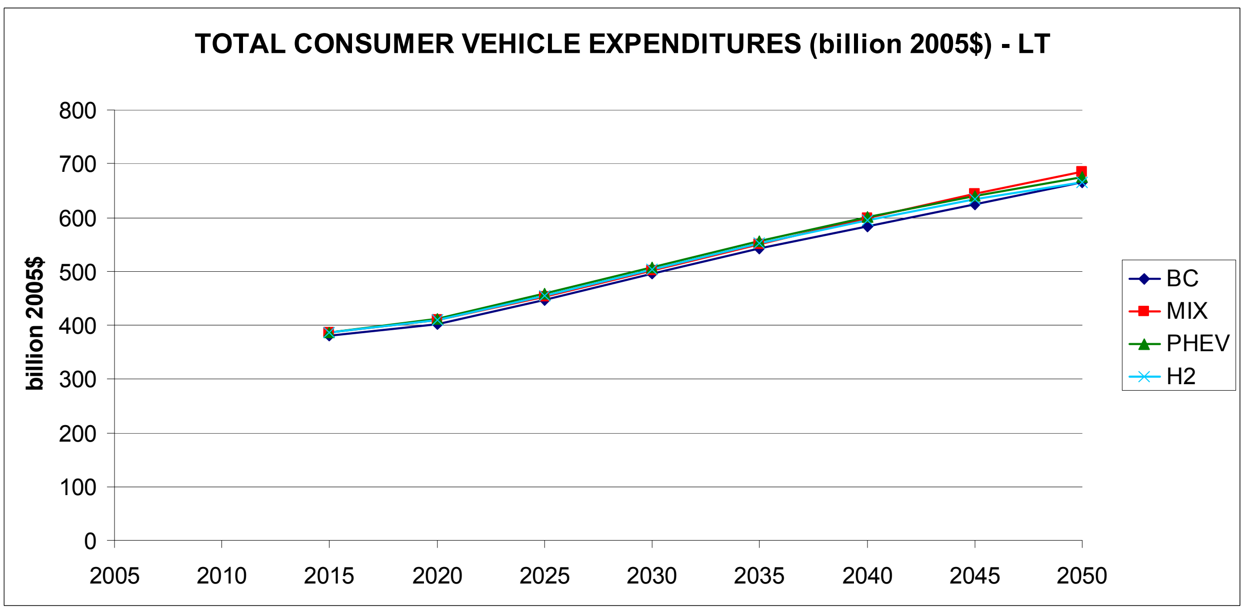

FIGURE E-123 Total Consumer LT Expenditures (Program Goals with Subsidies)

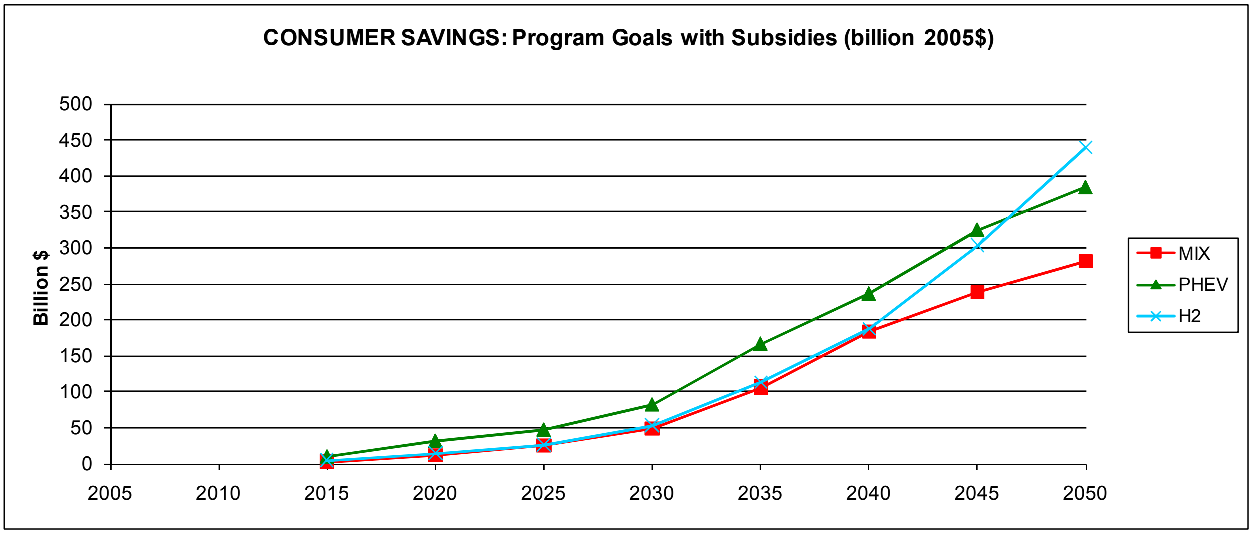

FIGURE E-124 Total Consumer Savings (Program Goals with Subsidies)

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