Southwest Energy Efficiency Project Statement In Support of Amended HB 1331

Executive Summary.

The Southwest Energy Efficiency Project (SWEEP) is dedicated to supporting the development of energy policies needed to achieve the Climate Action Plan goals adopted by the Ritter Administration. These include reducing CO_2 emissions 20% below 2005 levels by 2020, and 80% by 2050.

Transportation accounts for nearly one-third of CO_2 emissions in Colorado. SWEEP's assessment of strategies available to reduce CO_2 emissions has identified the need to convert 40% of the vehicle fleet to plug-in hybrid technology by 2040 to make progress toward the climate goals. To achieve this objective, the State's tax credit for alternative fueled vehicles must be reformed to focus on the market penetration of plug-in technology.

Many of the changes proposed by HB 1331 will improve the AFV Tax Credit program, but can be improved even further. SWEEP recommends the following improvements to HB 1331—

- The new tax credit creates a separate Category 1 for plug-in hybrids which would receive the highest tax credit. But the tax credit would be cut more than half from 2012 to 2013 from 75% to 35%. SWEEP recommends that the credit be retained at current levels (85%) until sales of plug-in hybrids reach levels that would exceed program cost targets.

- HB 1331 removes some low efficiency models from the program, but retains mid-range efficiency vehicles during 2010 and 2011. SWEEP recommends that in 2010 the program focus only on the most efficient vehicles (Category 6-- those with fuel efficiency ratings over 40 mpg) and the advanced plug-in technologies capable of even higher fuel efficiency (Category 1) as soon as they come to market (planned for late 2010).

- Beginning in 2012, SWEEP recommends that the program be limited to plug-in hybrids to focus Colorado's limited resources on the technology that can achieve the greatest progress toward meeting Climate goals.

- SWEEP urges adding a modest fee for new low efficiency vehicles that would pay for most of the program cost until new plug-in sales reach targeted levels. A fee of $81/vehicle for vehicles attaining less than 25 mpg would generate about $10 million annually to offset revenues foregone through the tax credit.

- SWEEP recommends that the program be designed to be self-terminating by setting funding targets that, when reached, trigger reduced tax credit rates and rebates during the following budget year, continuing year-by-year until increased vehicle sales trigger successive annual reductions until the tax credit declines to zero %.

- With this self-termination provision, the program should be extended through 2020.

WHY PLUG-IN HYBRIDS?

Many alternative fuel technologies offer some potential reductions in CO_2 emissions, but none offer the potential to reduce CO_2 emissions as much as the plug-in hybrids. At the outset, the first original manufacture plug-in hybrid promised by GM to be commercially available in 2010, the Chevy Volt, will meet the California CO_2 emission standards that first apply to the 2020 model year[i]. This is a 44% reduction from the California standards for 2010, and 46% lower emissions than the national fuel efficiency standards expected to apply to the 2011 model year.

Plug-in HEVs offer significant decreases in CO_2 emissions compared to traditional internal combustion engine vehicles. Based on Colorado's electricity mix, which is approximately two-thirds coal, we estimate that each Plug-in HEV on the road will reduce CO_2 emissions by 2-3 metric tons annually compared to a new gasoline powered vehicle[ii]. As the average Colorado citizen is responsible for approximately 25 metric tons of CO_2 emissions annually, three tons is a significant (12%) reduction in each person's carbon footprint.

The Volt's fuel efficiency measured in miles per gallon starts at 50 mpg if the vehicle is operated 100% of the time from the on-board gasoline generator used to charge the batteries. No gallons of liquid fuel are required if the vehicle is operated less than 40 miles between each charge from the grid. The average vehicle in Colorado is driven 11,500 miles annually. At 50 miles per day, about 75% of these miles driven by a plug-in can be operated on power drawn from the grid. When operated in this manner, a plug-in can cover approximately 200 miles on one gallon of gasoline. By reducing average liquid fuel consumption by 75%, the plug-in technology offers the opportunity to virtually eliminate US reliance on imported oil which currently supplies 58% of US transportation fuel[iii]. Owners of plug-in hybrids should also expect to save approximately $1,000 annually in fuel costs compared to a traditional gasoline powered vehicle[iv].

Another benefit of plug-ins is zero emissions of the air pollutants responsible for ozone and PM2.5 during the 40 miles per day when the vehicle is operating from the battery charge. For the average vehicle miles of travel, these emissions will also be reduced about 75% per day. Achieving these emissions reductions from motor vehicles should eliminate the public health damage associated with ozone and fine particles in metropolitan areas.

Plug-in hybrids offer other important advantages. First, the fuel infrastructure needed to support the complete replacement of the current fleet of personal vehicles is in place. Because the vehicles can be refueled at any gasoline pump, or from any 120 volt electrical outlet, fuel sources are readily available throughout the range of expected vehicle use. If the entire light duty vehicle fleet became plug-in hybrids the national electricity generation would increase by 12%, while more than 50% of electrical generating capacity is still available for additional generation.[v] As long as plug-in hybrids are charged during evening and off-peak hours, there would be no need for additional electrical capacity to be added to the system[vi] and thus no new major infrastructure investments required.

The system-ready feature of plug-in hybrid technology offers the additional benefit of achieving additional long-term reductions in CO_2 emissions as the existing fuel sources are "greened." As coal is displaced by renewable sources of electricity (wind, solar, geothermal, wave power), the CO_2 emissions per mile when the vehicle fleet is powered by electricity will drop proportionally. And as gasoline is displaced by bio-fuels, the emissions per mile when the vehicle fleet operates off the on-board generator will also drop proportionally. Thus once the fleet is converted to the plug-in technology currently being prepared for market, significant further CO_2 reductions will be available without requiring another conversion of the vehicle fleet to a different technology to achieve the 80% reduction target set by the Governor for 2050.

No other source of alternative energy to fuel the vehicle fleet can be implemented without first making large investments in new fuel production, transport, storage and/or fueling infrastructure. Compressed natural gas technology is currently available, but is only being used for centrally garaged fleets because of the lack of convenient fueling stations. Manufacturers are not willing to mass produce these vehicles because public acceptance is limited by the lack of convenient fueling infrastructure. The installation of a national fueling infrastructure for CNG is estimated to cost $60 to 100 billion[vii]. It is also estimated that a reliable, affordable supply of natural gas may be limited to 40 years. Fueling the national vehicle fleet would increase demand by 58%, cutting the economically useful life of the supply by 36%. Conversion of the national vehicle fleet to CNG now would require the replacement of the fleet again within 20-40 years.

Bio-fuels also offer encouraging possibilities for reducing CO_2 emissions from the transportation sector, but not from current technologies. The International Food Policy Research Institute estimates that conversion of human food crops (corn, sugar, soy) into motor fuels has driven up the price of these food sources (and related food grains) by as much as 30% during 2008[viii]. The World Bank estimates that higher food prices have resulted in over 100 million more people being pushed into poverty worldwide[ix]. The world cannot afford to divert food sources to fuel motor vehicles.
In addition, ethanol distilled from corn in the US offers no net reduction in CO_2emissions when the heat and power used in the distilling process is obtained from coal[x]. Even if distilling is powered by an

average electricity mix, the net reduction is only 19%. This system does not achieve the kinds of reductions needed to meet climate goals.

Bio-fuels derived from non-food sources, such as cellulosic ethanol, can achieve significant reductions in CO_2 emissions because the fuel is harvested from perennial plants that are lightly cultivated and do not require fertilizer. But this technology has yet to be demonstrated on a commercial scale. Once developed, these fuels can be adapted to plug-in hybrids to further reduce the CO_2 from vehicles, but the reductions currently available from plug-ins do not depend on the development of new fuel technologies.

For these reasons, SWEEP recommends that public policies focus on the rapid adoption of plug-in hybrids as the technology of choice to replace vehicles powered by traditional internal combustion engines.

Comparison of Non-fossil Fuels and Advanced Vehicle Technologies

	Infrastructure Required for Public Access	**% Reduction in CO_2 emissions compared to gasoline/diesel**	**Current Availability?**	**Other Considerations**
Non-fossil Fuels				
Corn Ethanol	Significant	19%	Yes, but only 10% blend compatible with current fleet	Competes with food supply
Cellulosic Ethanol	Significant	86%	No	
Biodiesel (B20)	Significant	15%	In small amounts and can be used in existing engines	Competes with food supply-clearing of forests for biofuel crops has negative climate impact
Biodiesel (B100)	Significant	75%	In small amounts but requires slight engine modifications	
Advanced Vehicles				
CNG light duty	Significant	10-25%	In small numbers	
CNG heavy duty	Significant		In small numbers	
Plug-in Hybrid	Minimal	35-47%	Available 2010-2011	Reductions for Plug-ins, reflect Colorado's current electricity mix, which is 66% coal; further reductions are expected as more electricity is generated from renewables
Hybrid	None	25-47%	Yes	
Heavy Duty Hybrid Truck	None	24%	In very small numbers	
BEV Heavy Duty	Minimal	16%		

All of the non-fossil fuels and advanced vehicle technologies discussed below have barriers to overcome before they will significantly displace the current gasoline-internal combustion engine based system. Each one is evaluated on its: reduction of emissions, the timeframe over which it can have an impact, the infrastructure necessary to support it, its current feasibility and any other pertinent factors.

Ethanol

- Ethanol derived from corn competes with food supply
- Large investments needed for new infrastructure to transport and distribute fuel because ethanol cannot be transported in existing pipeline networks.
- Current vehicles can use up to 10% blend but only 3% of the current fleet can accept higher blends without engine modification.
- Corn ethanol reduces CO_2 emissions by 19% on average because fossil fuels are used to plant, fertilize, harvest, transport crop and distill ethanol. If coal is used to power ethanol plants there is a 3% increase in lifecycle CO_2 emissions.
- Cellulosic ethanol not yet developed for commercial scale production
- Cellulosic ethanol could reduce CO_2 emissions by 86%
- Cellulosic ethanol can be long term solution

Biodiesel

- Biodiesel from soy competes with food supply
- Large investments needed for production, transportation and distribution of fuel
- Cultivation of soy and other feedstocks in developing countries resulting in negative climate impacts, habitat loss and other environmental degradation from clear cutting and burning of forests and loss of CO_2 sinks--
    - Tropical deforestation is responsible for 20% of human CO_2 emissions[xi], so expansion of biofuel feedstock production in tropical climates will lead to increased CO_2 emissions
- Engines must be modified to accept blends higher than 20% biodiesel
- Reduces CO_2 emissions by 15 to 75% depending on the percentage blended, not accounting for emissions from converting forest carbon to CO_2

Compressed Natural Gas

- Significant infrastructure investments (estimates range between $30 and $100 billion) necessary to establish nationwide refueling capacity.
- Very limited availability of new CNG-capable vehicles. New vehicle fleets need to be built, but manufacturers unwilling to build because fuel infrastructure not available, which seriously limits public acceptance.
- Reduces Greenhouse Gas Emissions by 10-25%
- Competes with primary source of residential heating; will accelerate expected depletion of affordable fuel supply. Medium Term Solution (estimated 20-40 years), requiring additional conversion of vehicle fuel system before 2050.

Plug-in Hybrid Electric Hybrids

- New vehicle fleets need to be built (commercially available 2010).

- Established refueling infrastructure, some improvements necessary such as charging capacity at rental properties which may cost $5 to $10 billion
- Reduces CO_2 emissions by 35-47% depending on assumptions concerning the all electric range and the efficiency of the electric and gasoline engines. Basic power train design needs no further modification to reduce net CO_2 emissions from Plug-in HEVs to near zero as electric power generation is converted to renewable and gasoline is displaced by cellulose-derived liquid fuels.
- Medium to Long Term Solution – significant CO_2 reductions available at rate current internal combustion engines can be replaced with plug-in HEVs. No long term limitations to affordable fuel supply.

Hybrid Electric Vehicles

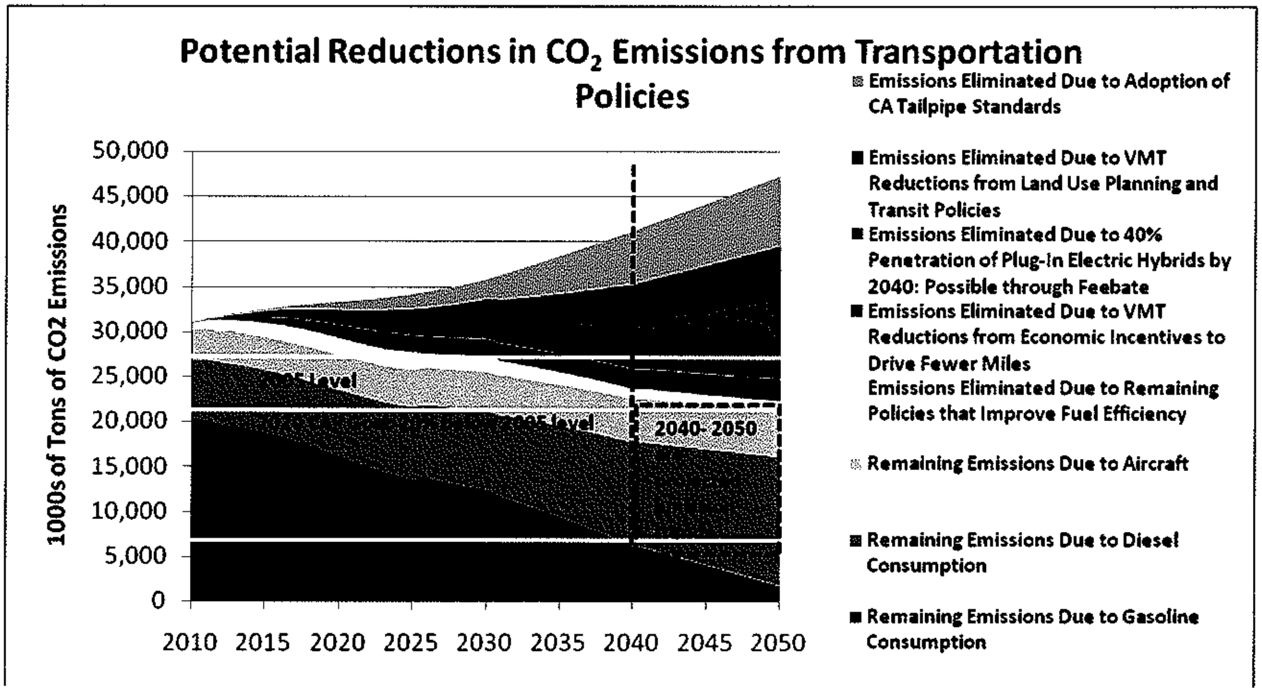
- Existing technology
- Uses existing refueling infrastructure
- Reduces CO_2 emissions by 25-47% depending on the vehicle's fuel efficiency.
- Heavy Duty Hybrid Truck can reduce CO_2 by 24%
- Short to Medium Term Solution – immediately available to expand market share, can contribute to additional future emissions reductions as fossil liquid fuels are displaced by cellulose-based fuels.

100% Battery Electric Vehicles

- Very limited availability of electric vehicles
- Heavy Duty Electric Trucks can reduce CO_2 emissions by 16% if electricity is generated mostly from coal (as is the case in Colorado), with potential for future reductions as the more electricity is generated by renewables.
- Medium to Long Term Solution-commercial vehicles must increase their market penetration over the next 10-20 years before having a significant impact.

The Challenges of Reducing CO_2 From the Transportation Sector.

SWEEP has investigated all the strategies identified in State climate action plans, and evaluated their potential for achieving CO_2 reductions if applied in Colorado. These strategies offer the potential for offsetting the expected emission increases that will occur as a result of population and VMT growth, but significant reductions below 2005 emissions will be difficult to achieve. The following graphic demonstrates the expected emission trend without any policies to reduce emissions, and the potential reductions if all identified policies are implemented.



The three policies with the greatest potential to reduce CO_2 emissions are 1) California emission standards (orange), 2) expanded transit service linked to land use (blue), and 3) plug-in electric hybrids (green), while other policies (red and yellow) are grouped together by strategy.

- Adoption of the California Tailpipe Emission Standards (orange)
  - Will achieve 16% of the reductions needed to meet Climate Action Plan (CAP) goal in 2040
- Smart Growth and Land Use Planning Policies that channel 80% of new development into walking and biking distance from FasTracks stations in DRCOG planning area, and similar transit oriented land use policies in North Front Range and Pikes Peak planning areas (blue)
  - Will achieve 11% of the reductions needed to meet CAP goal in 2040

- **A Feebate policy to increase the market penetration of Plug-in Hybrid vehicles to 40% by 2040 (green)**
  - Will achieve 14% of the reductions needed to meet CAP goal in 2040

Together, these three strategies could achieve 46% of the reductions needed by 2040. All of the strategies are critical if the state of Colorado intends to reduce its carbon-dioxide emissions from transportation. Even with all these aggressive policies we forecast that by 2020 Colorado will only be able to keep CO_2 emissions to just above 2005 levels rather than cutting 20% below that level by 2020 which is the goal of the state's Climate Action Plan (CAP). After 2020, even with these strategies in place CO2 emissions are expected to remain relatively stable. Making further progress to reach the final goal of the CAP -- reducing emissions by 80% below 2005 levels by 2050 – will require that all light duty and medium duty vehicles be converted from internal combustion to electric powered technologies. Plug-in hybrid technologies offer the possibility of achieving this goal.

The primary obstacles to achieving the reductions needed to meet CO_2 targets are 1) continuing future growth in vehicle miles of travel, and 2) the lack of effective measures to significantly reduce CO_2 emissions from medium and heavy duty trucks. While new technologies, emission standards, transit and land use policies effectively reduce emissions from gasoline powered personal vehicles, more aggressive policies must be considered to reduce emissions from medium and heavy duty trucks. Plug-in Hybrid technology for trucks may become available for trucks in local short-haul service. Long-haul truck emissions could be reduced by developing electric mag/lev technologies to supplement highway and rail freight service. But the potential CO_2 emission benefits of these options are not calculated because these options are not planned, and remain uncertain. For now, plug-in hybrids will be available for light duty vehicle applications beginning in 2010, and must be promoted to become a significant portion of the vehicle fleet.

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[i] The Volt's CO2 emissions are estimated to be 175 grams/mile for the gasoline engine and 173 grams/mile for the electric engine. 175 grams/mile is the standard set by the California tailpipe standards for new small vehicles by 2020. A new small gasoline powered vehicle in 2010 would be allowed to emit only 310 grams/mile.

[ii] Using the design features of the Chevy Volt as an example, the vehicle is designed to travel 40 miles per charge before using the liquid fuel engine to recharge the battery. Assuming the average Volt owner travels the average annual VMT for Colorado drivers (11,500 mi/yr, and that 75% of daily travel can be accomadted by the all electric engine, the vehicle will be driven 40 mi/day on battery and 12 mi/day on liquid fuel if no daytime charging station is available. To charge a Plug-in Hybrid nightly for one year will require approximately 1,750 kWh of electricity, which with Colorado's current electricity generating mix would result in 1.4 tons of CO2 emissions. To drive 25% of miles traveled using gasoline (approximately 3,000 miles) would require 58 gallons of gasoline, resulting in .6 tons of CO2 emissions. A driver of an average new internal combustion engine vehicle would require 429 gallons of gasoline to travel the same distance which would emit 4.2 tons of CO2. Therefore, the average plug-in HEV driver should emit over two tons less per year than the average gasoline powered vehicle.

[iii] http://www.eia.doe.gov/oiaf/aeo/pdf/trend_4.pdf

[iv] Fuel savings are estimated based on gasoline costs of $3.21 per gallon (its average price in CO in 2008) and electricity costs of $0.102 per kilowatt hour (the average residential price in CO). Please see endnote ii above for assumptions made about plug-in hybrids. To charge a Plug-in Hybrid nightly for one year will require approximately 1,750 kWh of electricity, which would cost the consumer approximately $175. To drive 25% of miles traveled using gasoline would cost approximately $185 due to the high fuel efficiency of the fossil-fueled engine (an estimated 50 mpg). A driver of an average new internal combustion engine vehicle would require 429 gallons of gasoline at a cost of $1,380 to travel an equal number of miles. Therefore, the average plug-in HEV driver should save approximately $1,000 annually at 2008 fuel costs for their vehicle. This will allow purchasers of plug-in HEVs to payback the remaining incremental cost of the vehicle in two to three years and provide annual cost benefits for the remaining lifetime of the vehicle.

[v] If the average plug-in hybrid used 2.000 kwh/year, then upon conversion of the entire 230 million light-duty vehicle fleet, approximately 500 TWh of electricity would be required to power the fleet. The United States currently generates over 4,000 TWh of electricity and has the capacity to hypotheticaly produce almost 9,000 TWh of electricity annually.

[vi] A study conducted by NREL on Xcel Energy's Colorado service area showed that even if plug-in hybrids made up 30% of the light duty vehicle fleet, as long as they were charged during off-peak hours no additional capacity would

be necessary and that such a charging pattern would actually be beneficial to the utility's operations. http://www.nrel.gov/docs/fy07osti/41410.pdf

[vii] http://www.afdc.energy.gov/afdc/pdfs/ng_market_development_5.pdf

[viii] Biofuels, International Food Prices and the Poor. Von Braun, Joachim. Testimony before the United States Senate Committee on Energy and Natural Resources. June 12, 2008. http://www.ifpri.org/pubs/testimony/vonbraun20080612.asp

[ix] Implications of Higher Global Food Prices for Poverty in Low-Income Countries. Ivanic, Marcos and Martin, Will. The World Bank. April 2008. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2008/04/16/000158349_20080416103709/Rendered/PDF/wps4594.pdf

[x] http://www.iop.org/EJ/article/-search=51073775.3/1748-9326/2/2/024001/erl7_2_024001.pdf?request-id=84d2d7e2-f164-4575-bc7a-2f1fcca81b67

[xi] Lewis et al. "Increasing Carbon Storage in Intact African Tropical Forests." Nature 457. 1003-1006. February 19, 2009.