



Gap Analysis for AB 118

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Identification of Funding Gaps to Commercialize Cleaner, More Efficient Transportation Technologies

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AB118 Investment Plan

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The objective of this work is to identify funding that is already committed or being spent on the development and commercialization of cleaner, more efficient technologies for the transportation sector.

- ◆ Perform a quick literature review and construct table/matrix of funding being committed or supplied for each alternative fuel or advance vehicle technology
 - Including vehicle efficiency, biofuels, natural gas and propane, PEM fuel cells, and electric drive technologies (i.e., BEVs and PHEVs)
 - In the categories of R&D, Demonstration, Infrastructure (fuel production, storage, distribution, and dispensing), Incentives, and Commercialization¹
- ◆ Contact key government and industry stakeholders/experts to confirm the funding information, obtain an update on their programs, and get their perspectives on the barriers and needs to overcome these barriers
- ◆ Ask stakeholders to identify best use of CEC funding to accelerate the use of advanced technologies in transportation to reduce GHG emissions
 - Leverage current efforts
 - Develop incentives to accelerate use of technologies

As used here the transportation sector includes on and off road applications, except for aircraft.

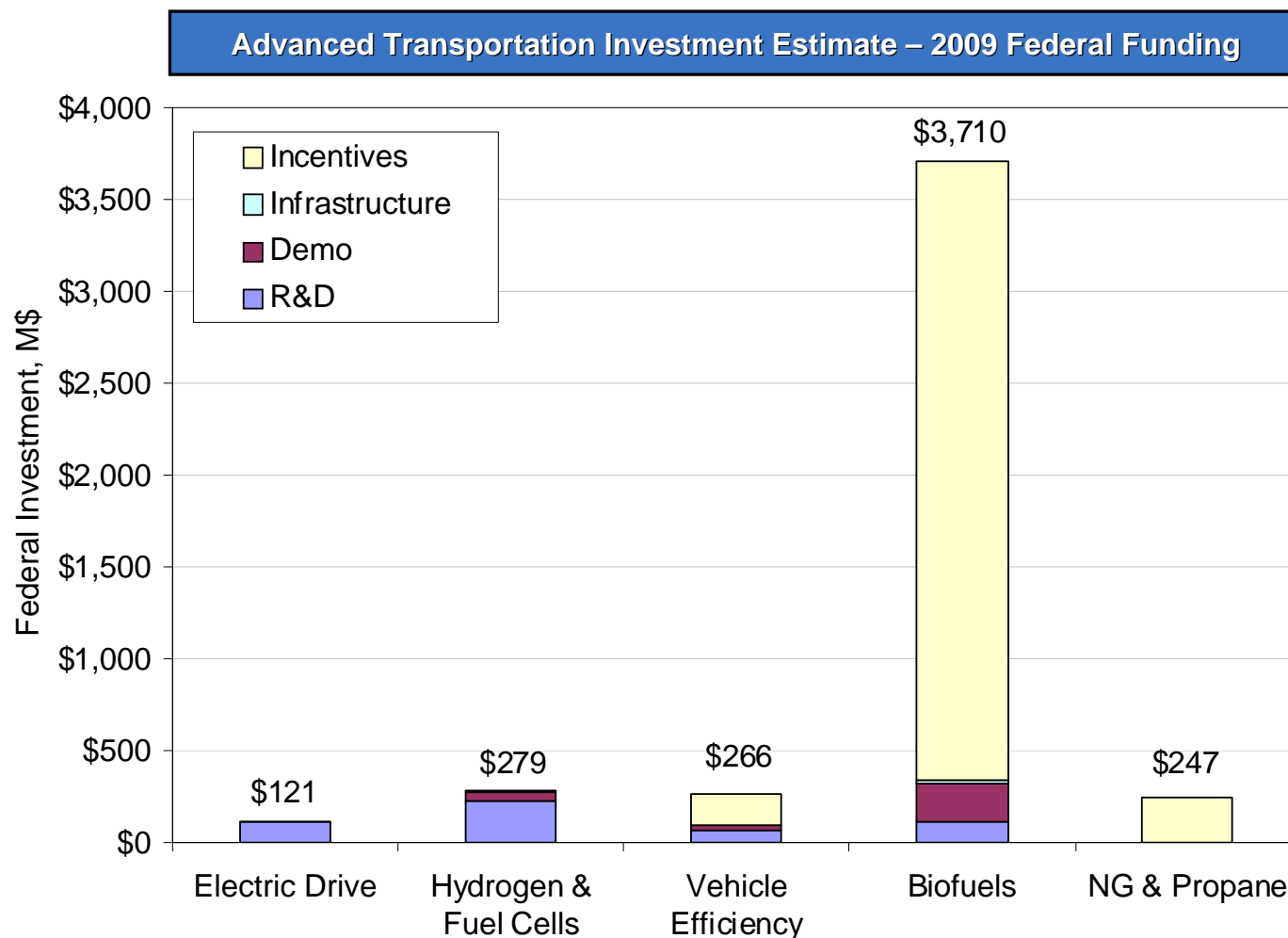
A number of possible alternative fuel pathways were identified in the process of developing California's Alternative Fuel Plan

Mile Stone Year	2012		2017		2022	
	Fuel Use	GHG avoided	Fuel Use	GHG avoided	Fuel Use	GHG avoided
Propane	47.7	<0.1	173	0.1	282	0.2
Natural Gas	306.1	1.5	518	2.5	885	4.4
E-10 GGE (MW Corn)	1394	3.8	1354	3.8	1327	3.6
E-85 GGE (CA Poplar	83	0.7	434	3.9	738	6.6
Hydrogen	40	0.3	80	0.6	440	4.4
Electricity	86	2.1	187	5.1	376	6.7
XTLs	320	0	530	0	630	0
Renewable Diesel	130	1	310	2.4	530	4.2
Dimethyl Ether	13	0	62	0	101	0
Total	2360	10	3565	18	5220	30

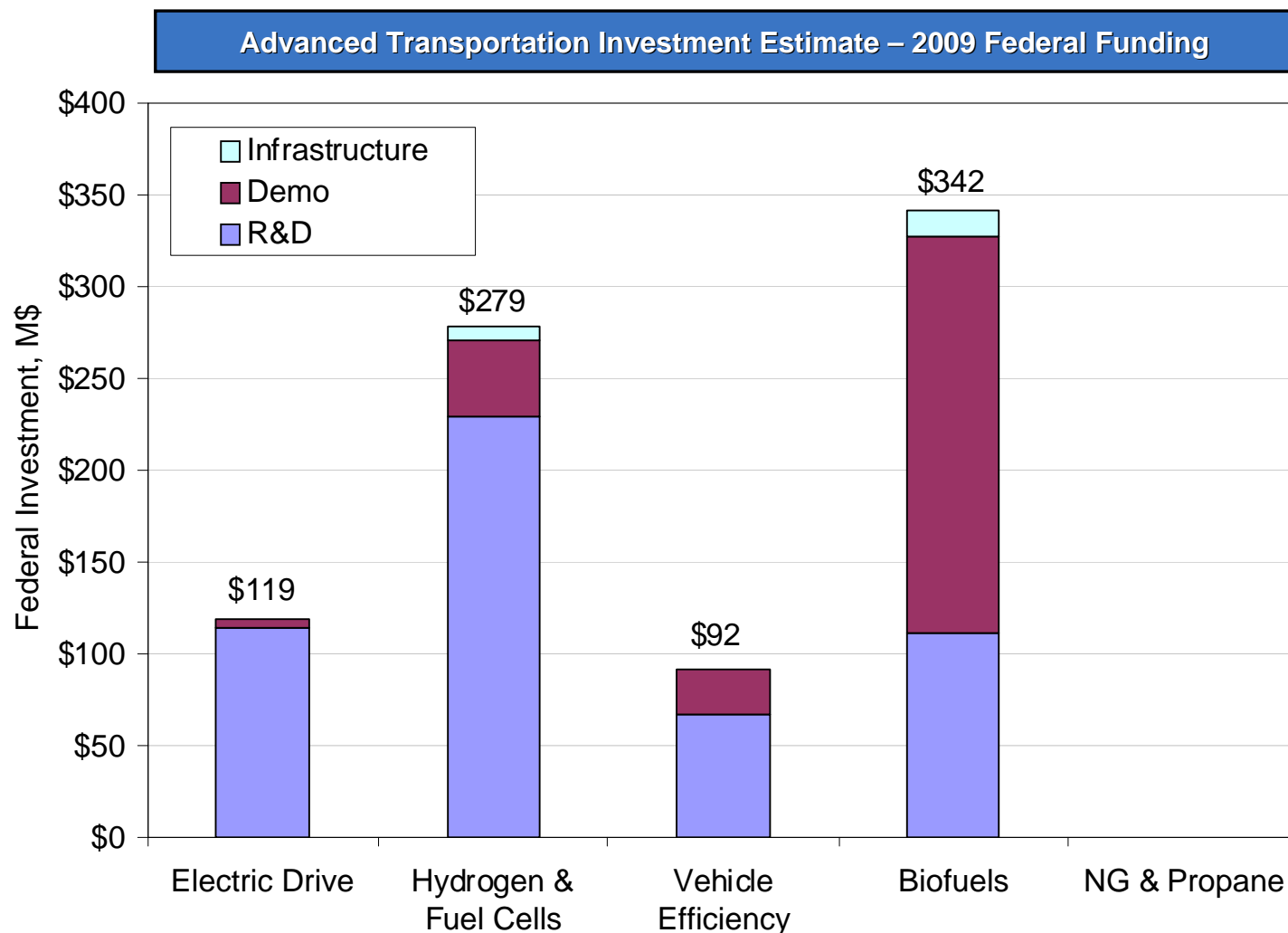
Fuel Use is measured in million gasoline gallon equivalent (GGE).
GHG is measured in million metric tons per year.

Source: State Alternative Fuels Plan, Adopted December 5, 2007.

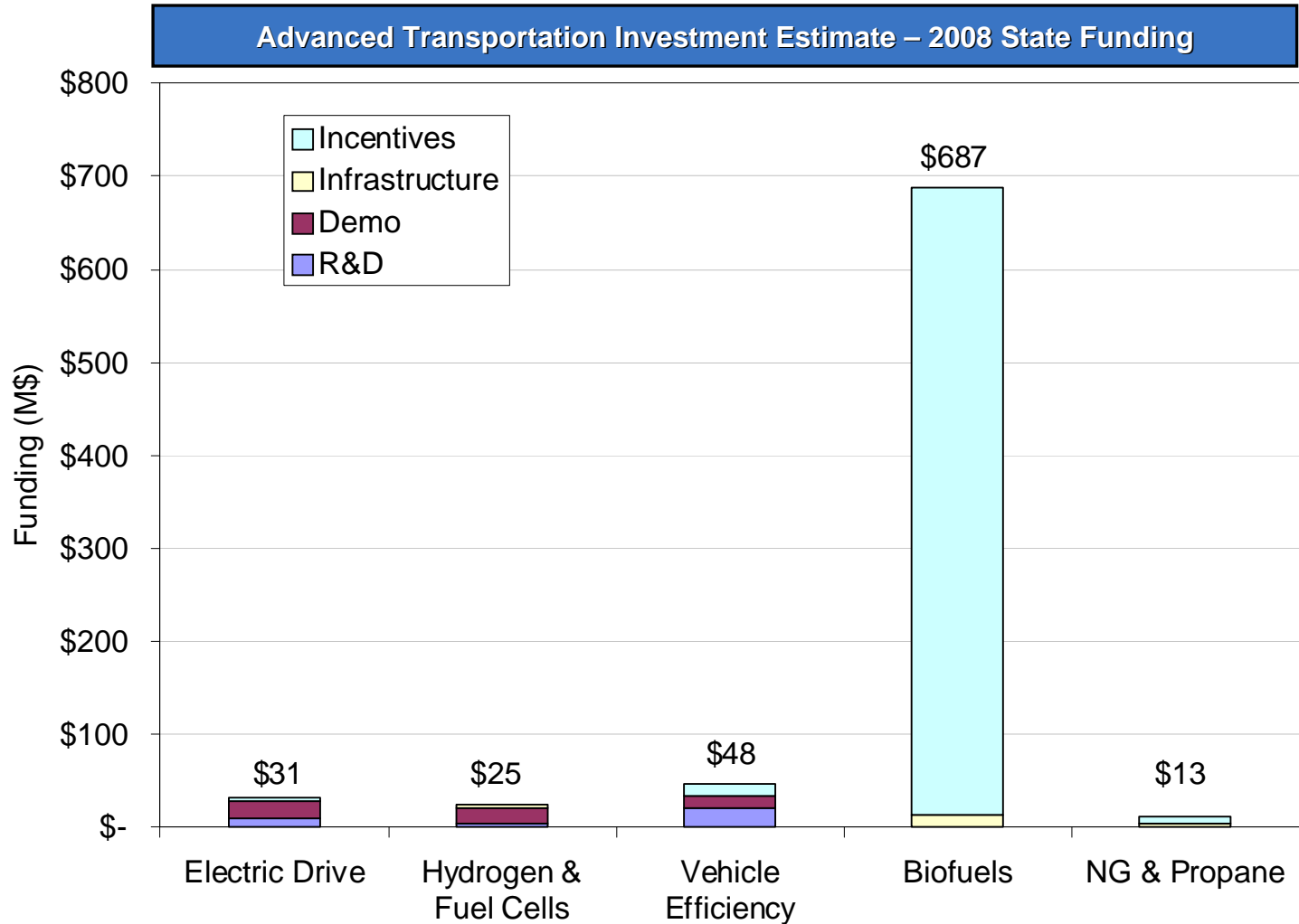
According to our literature review, the bulk of federal investment is directed towards biofuel producer incentives, primarily for ethanol blending.



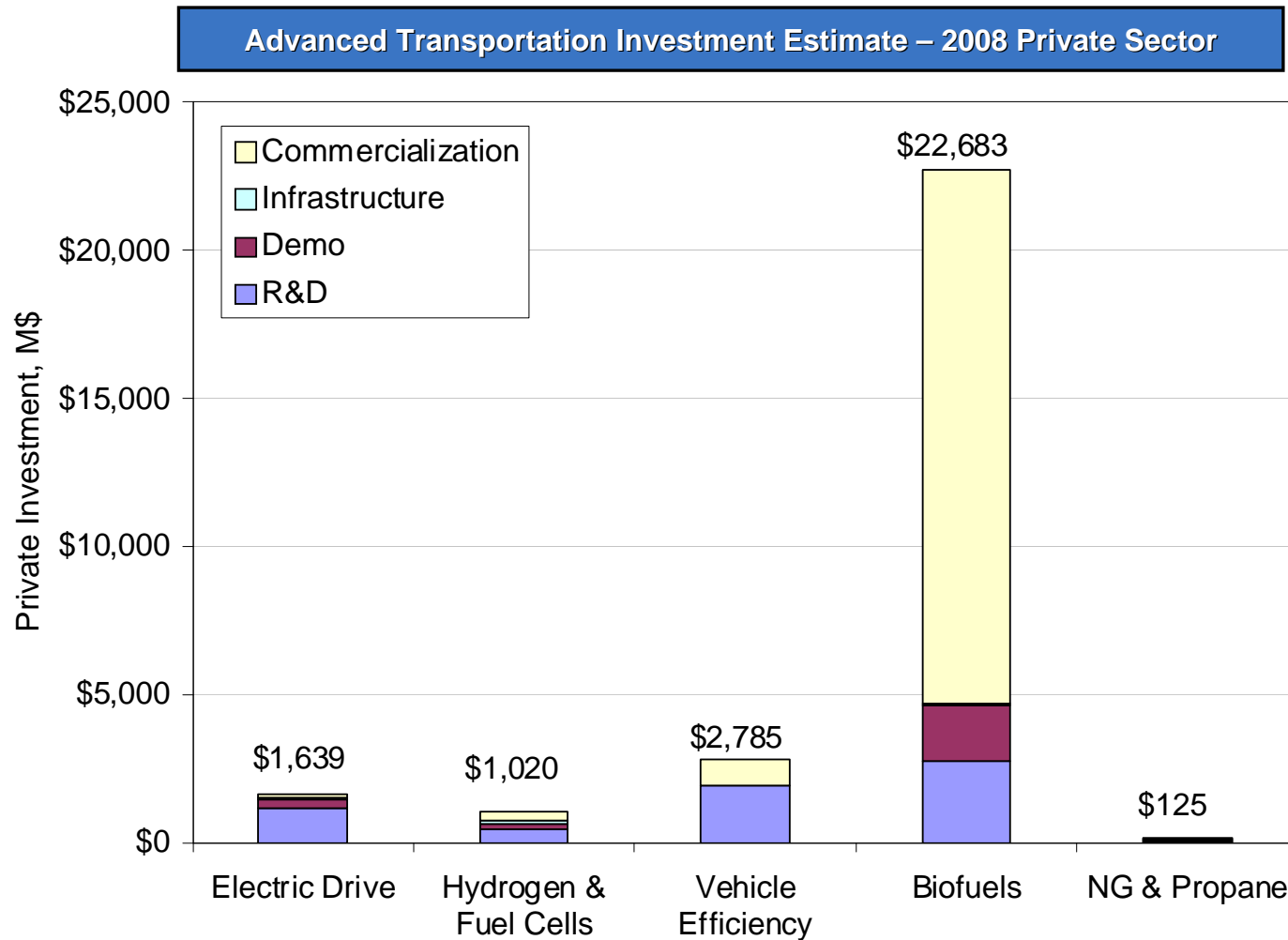
Even without commercialization incentives, biofuels receive the largest fraction of federal investment.



Most state investment comes in the form of biofuel blending credits; not including these incentive programs, most state investment focuses on vehicle demonstration.



Most private sector investment is directed towards biofuel commercialization.



Key findings from our literature review are summarized below.

- ◆ Biofuels dominate the investment landscape in both a public and private context
 - Tax credits and capital investment focused on Generation I biofuels¹
 - Significant private and public sector R&D directed towards Generation II biofuels¹
- ◆ Investment in high-efficiency vehicles focuses on rolling out hybrid and clean diesels across different vehicle platforms
 - Technologies that focus on road-load reduction (e.g., light-weighting and aerodynamic improvements) and heavy-duty vehicles are less heavily funded
- ◆ Battery technology is an active area of research at the corporate level and VC level, but public sector investment in electric drive vehicles lags significantly behind the private sector
- ◆ Hydrogen fuel cells are funded primarily at the federal level
 - Much of the private sector investment is focused on nearer-term, non-transportation applications such as portable power
- ◆ Judging by the ratio of public to private investment, electric drive vehicles offer the highest leverage sector for spurring investment in new vehicle technologies

The following government and industry stakeholders were contacted to confirm the funding information and get their perspectives on the barriers and needs.

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- ◆ Vehicle Technologies Program
 - Patrick Davis; Acting Program Manager
 - Phil Patterson, Chief Analyst
 - Rogelio Sullivan, Hybrids and Materials Team Leader
- ◆ Office of Hydrogen, Fuel Cells, and Infrastructure Technologies
 - Sunita Satyapal; Acting Program Manager / Hydrogen Storage Team Lead
 - Fred Joseck; Systems Analysis Team Lead
- ◆ Office of the Biomass Program
 - Valri Lightner; Strategic Planning, DFO / Integrated BioRefinery Team Lead
 - Valerie Reed, PhD; Conversion Technologies / Outreach Platforms Team Lead

National Labs

- ◆ National Renewable Energy Laboratory
 - Dale Gardner; Renewable Fuels Science and Technology Director
- ◆ National Energy Technology Laboratory
 - Geo Richards; Focus Area Leader for Energy System Dynamics

USDA

- ◆ Rural Development
 - Mike Kossey; Special Assistant to the Administrator of the USDA's Utilities Program

Other Organizations

- ◆ Chevron Technology Ventures LLC
 - Puneet Verma; Biofuels and Hydrogen Program Manager
- ◆ Southern California Edison
 - Dean Taylor; Electric Transportation
- ◆ Great Plains Institute
 - Rolf Nordstrom; Executive Director
- ◆ American Council on Renewable Energy (ACORE)
 - Bill Holmberg; Chairman of the Biomass Coordinating Council
- ◆ American Honda Motors
 - Ben Knight, Vice President North America Research & Development

Stakeholders identified “working through the transition period” as the key barrier to commercialization and suggested the following potential actions.

- ◆ Support fuel infrastructure development during the transition period (e.g., fund demonstrations, provide tax incentives, streamline permitting/licensing) and create an “early mover” advantage
- ◆ Fund multiple technologies to hedge bets and recognize technologies aren’t mutually exclusive (e.g., fuel cell or biofuel PHEV)
 - Increase the size of the advanced vehicle funding pie – need major commitment
 - Fund multi-fuel stations (e.g., H₂ and biofuels)
 - Funding should be spent in relation to viability, environmental performance/sustainability, and potential to meet total demand and GHG reduction goals
- ◆ Focus funds on deployment rather than R&D for most technologies
- ◆ Collaborate with national partnerships, OEMs and the federal government on planning, testing, C&S and vehicle and infrastructure demonstrations

Stakeholders also identified actions for each advanced transportation technology considered.

◆ Electric Drive

- Support domestic battery production
- Evaluate grid impacts and benefits
- Collaborate with industry on testing and C&S
- Demonstrate vehicles and infrastructure (e.g., smart metering, off-peak charging)
- Work with utilities and OEMs to figure out a value proposition for deployment in the next 2-3 years

◆ Hydrogen and Fuel Cells

- Fund infrastructure to support the roll-out of vehicles
- Help overcome sometimes negative public perception (i.e., Trojan Horse for Big Oil and Gas)

◆ Vehicle Efficiency

- Fund R&D for HD Trucks (e.g., bottoming cycles, fuel cell APUs)
- Demonstrate light-weight vehicles and carbon fiber recycling/reuse

Stakeholders also identified actions for each advanced transportation technology considered (concluded).

◆ Biofuels

- Conduct a definitive study on sustainability including lifecycle land use, water and soil vitality to make sure biofuels are “clean” and help overcome negative public perception (i.e., corn-ethanol backlash)
- Support biofuel infrastructure and high-blend (e.g., E30+, B20+) utilization
- Support production from biomass/coal mixtures with CCS

◆ Natural Gas and Propane

- Need for more product
- Continue incentives for deployment of infrastructure and fleet vehicles
- Fund Gas-to-Liquids if GHG emissions are low enough

Considerable investments in alternative fuels and vehicle technologies are being made to bring these advanced technologies into the market place.

- ◆ TIAX will continue to refine estimates of current spending by federal and state agencies as well as private industry
- ◆ Will provide more detail breakdown of current spending and will provide estimates of authorizations, e.g. 2008 Farm Bill, 2007 EISA, and EPAct
- ◆ Caveats on current estimates
 - Current federal spending easiest estimates to find
 - State spending estimated based on number of programs in place
 - Private spending very difficult to estimate – we used aggregate global estimates which were disaggregated based on trends and judgment
- ◆ We believe that the estimates can be used to help develop the investment plan for AB118