Appendix I

This Appendix contains a table of recommendations related to technology development from the original February 2008 ETAAC report. The purpose of including this table here is to provide background to this 2009 update report. This table includes both the sectors covered by this 2009 report as well as other sectors that were included in the February 2008 report but outside the scope of this report. This table is not intended to prioritize the February 2008 recommendations but rather list those that are most focused on technology development. Please see www.etaac.org or http://www.arb.ca.gov/cc/etaac/etaac.htm to download the original February 2008 report.

ETAAC Report Recommendations Related to Advanced Technology Development

Sector	Page	Recommendation
Introduction	1-4	create a balanced portfolio of economic and technology policies
Finance	2-7	encourage RD&D (see also p9-4)
	2-11	support demonstration finance
	2-12	target RD&D funding for carbon reductions
	2-18	cleantech workforce training
Transportation	3-6	increase transportation sector RD&D
	3-23	new vehicle technology improvements
	3-26	low carbon fleet standards and procurement policies
Industrial, Commercial, Residential Energy Use	4-3	rebates for load reduction
	4-6	distributed renewable energy: solar PV
	4-11	industry-government partnerships to reduce industrial energy intensity
	4-12	revolving fund for technology demonstration projects
Electricity/ Natural Gas	5-5	aggressive LED energy efficiency
	5-12	renewable energy technology assessments
	5-15	electricity storage as enabling technology for renewable energy
	5-19	smart grid as enabling technology for renewables & vehicles
	5-21	carbon capture and storage
Agriculture	6-3	manure-to-energy
	6-6	enteric fermentation
	6-7	agricultural biomass utilization
	6-11	soil carbon sequestration
	6-17	fertilizer use and water management efficiency
Forestry	7-7	forest sector RD&D needs

Appendix II

California and Other Programs That Support Technologies to Reduce Climate Change Emissions: An Update to Appendix III in the ETAAC 2008 Report

The purpose of this Appendix is to update the summaries of technology development programs contained in the original February 2008 ETAAC report Appendix III. The purpose of this update is to provide additional details on programs related to development of technologies to reduce climate change.

The programs listed herein support four functions on the path from research to commercial application for technologies that can reduce global-warming emissions. The functions are:

1. Basic technology research
2. Development (R&D) of new or improved technology
3. Demonstration of new or improved technology
4. Installation or operation of proven technology (including site-specific projects to reduce energy use)

The list does not include grant programs for education, training, or market development for new technologies.

This list includes some programs funded at least in part by the American Recovery and Reinvestment Act (ARRA) of 2009. Often, funds from that act are short-term augmentations to pre-existing programs on the list. However, much of the funds from the act are offered via new one-time solicitations by the US DOE's Office of Energy Efficiency and Renewable Energy. That office's ARRA program can be read at www1.eere.energy.gov/recovery/. A few of the solicitations by that office are included in this list, but most are most efficiently viewed by going to that web site. Many have already been closed, while some have not yet been announced.

For functions 1, 2, and 3, the support offered by a listed program may be offered as grants (usually), contracts, or investments. For the installation or operation of technology, the support may be offered as loans but is usually offered as subsidies.

Each listed program supports projects in prescribed technical areas, industries, and/or types of emission sources. These are shown in the table "Summary of Programs" in the column "Eligible Business/Technical Areas"

The economic sectors wherein the supported technologies may be applied are classified as:

- Agriculture and forest products
- Energy production
- Energy use
- Transportation

- Industrial

Some of the listed programs are directed against global-warming emissions, specifically. Others (e.g., the Carl Moyer Program) are directed at other types of emission problems but also can foster reductions of global-warming emissions. Some of the listed entities are program directories, rather than actual support programs, *per se*.

All the listed programs are available at regional (multi-county), state, or national levels. The list does not cite individually the incentive (subsidy) programs run by cities, counties, municipal utility districts, or (with a few exceptions) the large regulated utilities. These local and utility programs are catalogued at "California Incentives for Renewables and Efficiency", www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=CA, which provides web links to them.

Except as specifically noted, the information shown here was obtained from the web sites cited for the programs in the Summary table and web documents linked from those sites.

Program: **Alternative and Renewable Fuel and Vehicle Technology Program (**AB 118)
http://www.energy.ca.gov/altfuels/

Sponsor: California Energy Commission

Funding source: Vehicle registration fees

Eligible business and technology areas: See "funding"

Functions supported: No information

Type of support: *Economic sectors affected:* Transportation, energy production

Geographic limits:

Funding:	Electric Drive	$46 million
	Hydrogen Fueling Stations	$40 million
	Biodiesel	$6 million
	Ethanol	$12 million
	Natural Gas	$43 million
	Propane	$2 million
	Market & Program Development	$27 million

Grant amount: No information

Grants as % of applications: No information

Overview

Assembly Bill 118 (Núñez, 2007) created the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission to spend up to approximately $120 million per year over seven years to "develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies."

The statute, amended by Assembly Bill 109 (Núñez, 2008), directs the Energy Commission to create an advisory committee to help develop and adopt an Investment Plan to determine priorities and opportunities for the program, and describe how funding will complement existing public and private investments, including existing state and federal programs. The Energy Commission will use the Investment Plan as a guide for awarding funds. The statute calls for the Investment Plan to be updated annually.

Program: **California Clean Energy Fund** (CalCEF, "Fund 1") www.calcef.org

Sponsor: CalCEF (non-profit)

Funding source: PG&E bankruptcy settlement

Eligible business & technical areas: Renewable fuels, energy efficiency, energy storage, clean fossil fuels, green buildings

Functions supported: Business finance

Type of support: Investment (venture capital)

Economic sectors affected: Energy production, energy use, transportation

Geographic limits: PG&E service territory

Funding: $30 million (total)

Grant amount: No information

Grants as % of applications: No information

Overview

CalCEF is a non-profit organization that makes equity investments in emerging clean-energy technology companies. Funds are invested in private companies that are creating technologies or products that should reduce reliance on non-renewable fuels. These include companies that focus on renewable energy, better energy efficiency, and energy storage. They also include companies that provide products and services, such as software, that are designed to enhance some aspect of the clean-energy sector. CalCEF acts as a critical funding source for emerging clean-energy companies that are too young to access traditional venture capital.

The Fund arises from the PG&E bankruptcy settlement negotiated by the California Public Utilities Commission. CalCEF invests in companies located in PG&E's service territory and elsewhere that are developing technology or products that could benefit the service territory.

Measures of Effectiveness

No information

Program: **California Solar Initiative** www.gosolarcalifornia.ca.gov/

Sponsors: Calif. Public Utilities Commission (CPUC)

Funding source: Rate-payers of PG&E, SDG&E, and SCE

Eligible business & technical areas: Photovoltaics and solar heating in commercial buildings and existing homes

Functions supported: Installation

Type of support: Incentives (subsidies)

Economic sectors affected: Energy production

Geographic limits: Service territories of PG&E, SDG&E, and SCE

Funding: $2.16 billion over 10 years (2007-2016)

Grant amount: For >100 kW: $.03 - $.50 / kW-hr; for <100 kW: $0.20 - $3.25 / W

Grants as % of applications: First come, first served

Overview

CPUC's California Solar Initiative, provides subsidies for installing or using photovoltaic power systems in existing residential homes and existing and new commercial, industrial, and agricultural properties. All utility customers who do not receive subsidies for distributed generation, do not pay at interruptible power rates, and do not resell power are eligible.

Measure of Effectiveness

The goal for the program is 3,000 MW of new photovoltaic capacity installed by 2017. Thirteen percent of the goal has been installed.

For systems > 50 kW, payments are made per kW-hr produced. Thus, payment is for "performance".

Program: **California Solar Initiative R&D** (proposal) www.calsolarresearch.org/

Sponsor: California Public Utilities Commission (PUC)

Funding source: Utility rate payers

Eligible business & technical areas: Photovoltaic distributed generation

Functions supported: Mostly demonstration; also R&D and deployment

Type of support: Grants, incentives

Economic sectors affected: Energy production

Geographic limits: California

Funding: $50 million

Grant amount: $0.2 to $3 million

Grants as % of applications: No experience yet

Overview

The PUC will initiate a program to promote photovoltaic distributed generation. The intended outcomes are to:

- Move the market from the current retail solar price of $9/watt or about 30 cents/kWh to levels that are comparable to the retail price of electricity.
- Install increasing volumes of solar DG that build from the current range of 160 MW per year to 350 MW or more per year.

The current (first) solicitation offers up to $15 million for the integration of photovoltaics into the utility grid.

Measures of Effectiveness

First grant awards to be announced December 2009

Program: **Carl Moyer Memorial Air Quality Standards Attainment Program**
www.arb.ca.gov/msprog/moyer/moyer.htm

Sponsor: State of California (administered by AQMDs and CARB)

Funding source: Vehicle registration fees, State grants

Eligible business & technical areas: NOx, PM, and ROG reductions from commercial and government vehicle fleets

Functions supported: Replacement and retrofitting

Type of support: Incentives(subsidies)

Economic sectors affected: Agriculture & forest products, transportation

Geographic limits: California

Funding: $140 million per year

Grant amount: Buses, farm equipment, agricultural. pumps--$12,000 per unit (avg.)
Marine vessels, construction equipment--$50,000 per unit (avg.)

Grants as % of applications: No information

Overview

The Carl Moyer Program provides subsidizes the incremental cost of cleaner-than-required engines and equipment. ("Cleaner" is in reference to emissions of ozone precursors and PM. Greenhouse gases are not addressed. However, to the extent that fuel economy is improved by replacing or retrofitting old engines, the program indirectly provides reduced CO_2 emissions.) Eligible projects include cleaner engines for on-road and off-road vehicles, marine vessels, locomotives, and stationary agricultural pumps, as well as for forklifts, airport ground support equipment, and auxiliary power units. The program also supports light-duty vehicle scrapping. Grants are based on the cost-effectiveness of the capital cost of achieving super-regulatory emission reductions. Determinations vary by air-quality management district.

Measures of Effectiveness

The Carl Moyer Program measures reductions of criteria and toxic pollutants achieved in excess of reductions that are occurring from regulatory compliance. Grants are based in part upon the emission reductions to be achieved according to prescribed procedures of calculation. Those reductions must cost less than prescribed amounts, per ton of reduction.

Calculations and statistics for cost per ton have not been kept for reductions of greenhouse gas emissions that have been incidental to reduced criteria and toxic emissions.

Program: **Driveclean.CA.gov** (directory of programs)
www.driveclean.ca.gov/en/gv/driveclean/demoprog.asp

Sponsors: Several government agencies

Funding source: Particular to the agency providing the incentive

Eligible business & technical areas: Electric, hybrid, and CNG vehicles

Functions supported: Purchase and use

Type of support: Incentives (subsidies)

Economic sectors affected: Transportation

Geographic limits: Particular to the agency providing the incentive

Funding: Particular to the agency providing the incentive

Grant amount: Particular to the agency providing the incentive

Grants as % of applications: No data available

Overview

Various incentives for purchasing EVs, hybrids & CNG vehicles, their fueling infrastructures, and parking such vehicles are available from governmental agencies. These are provided by federal, regional, local governments.

Measures of Effectiveness

No information

Program: **Electric Drive Programs in Asia**

China Electric Drive Vehicle Programs

Purpose: China wants to raise its annual production capacity to 500,000 hybrid or all-electric cars and buses by the end of 2011 from 2,100 in 2008. (By comparison, CSM Worldwide, a consulting firm that does forecasts for automakers, predicts that Japan and South Korea together will be producing 1.1 million hybrid or all-electric light vehicles by then and North America will be making 267,000.)[1]

China is also seeking to reduce dependence on foreign oil imports.

Barriers Targeted: Capital costs, infrastructure (such as charging stations).

Funding Level & Source(s): No information on total funding has been located.

Geographic scope: Vehicle purchase incentives are targeted to specific cities as described below.

Description:

- *Infrastructure*. The state electricity grid has been ordered to set up electric car charging stations in Beijing, Shanghai and Tianjin.

- *Purchase incentives:* Subsidies of up to $8,800[2] are being offered to taxi fleets and local government agencies in 13 Chinese cities for each hybrid or all-electric vehicle they purchase.

- *Manufacturers:* China has a $1.5 billion dollar (10 billion yen) program to help the industry with automotive innovation.[3] Shanghai Automotive Industrial Corportaion (SAIC) will invest more than $1.7 Billion US (12bn Yuan) in hybrid and electric power-trains with municipal government support through subsidies, purchasing and helping SAIC and the local supply chain in R&D and training.[4]

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[1]New York Times, April 1, 2009, China Vies to be World's Leader in Electric Cars", by Keith Bradsher, accessed at http://www.nytimes.com/2009/04/02/business/global/02electric.html?_r=1&scp=1&sq=china%20electric%20vehicle&st=cse
http://economistonline.blogspot.com/2009/04/chinas-electric-car-ambition.html

[2] http://www.businessweek.com/globalbiz/content/apr2009/gb20090421_725638.htm

[3] "China Outlines Plans for Making Electric Cars", New York Times April 10, 2009, by Keith Bradsher. Accessed at http://www.nytimes.com/2009/04/11/business/energy-environment/11electric.html?scp=3&sq=china%20electric%20vehicle&st=cse

[4] Automotive Wold.com Environment, July 2009, p8.

Success Overcoming Barriers:
Due to the recent or in-progress nature of these programs, it is not yet possible to judge their ultimate success.

A report by McKinsey & Company last autumn estimated that replacing a gasoline-powered car with a similar-size electric car in China would reduce greenhouse emissions by only 19 percent. It would reduce urban pollution, however, by shifting the source of smog from car exhaust pipes to power plants, which are often located outside cities.

Japan Next Generation Battery Development Project

Purpose: Program goals for the Next Generation Battery Development Project include reduced oil consumption & imports, technology development, and protecting Japan's competitive advantage manufacturing advanced technology batteries.

Barriers Targeted: Capital costs, infrastructure (such as charging stations), standards (safety& regulatory).

Funding Level & Source(s): Funding levels for 2008 are a sub-set of the overall $470 million US ($45 billion yen) funding for both battery-electric and fuel cell vehicles.

Geographic scope: National, implemented by the New Energy and Industrial Technology Development Organization (NEDO).

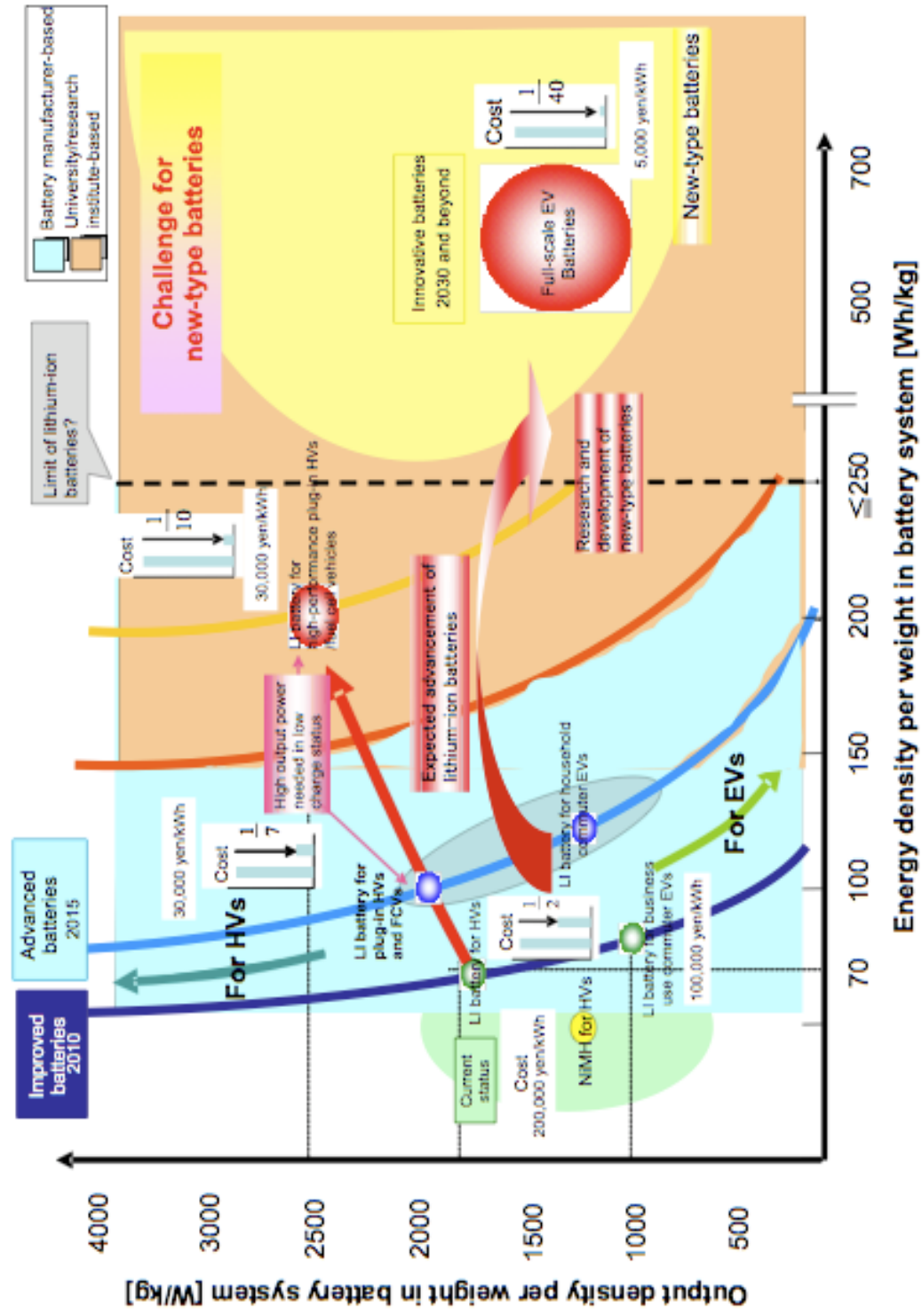
Description:

- *Infrastructure*. The program addresses safety standards, battery interface with charging stations, rate structures for electricity used to power vehicles, financial support for battery charging infrastructure. The program also supports battery mass-production, and incentives for next-generation vehicles.[5]
- *R&D*. The program will focus on industry-government-academia collaboration on research and development for producing low-cost/high-performance batteries for next-generation vehicles and renewable electricity.

Success Overcoming Barriers:

No information has been located.

[5] Source for graphic & information: NEDO 2006


Battery manufacturer-based
University/research institute-based
Challenge for new-type batteries
Limit of lithium-ion batteries?
Innovative batteries 2030 and beyond
Cost 1/40
Full-scale EV Batteries
5,000 yen/kWh
New-type batteries
Cost 1/10
30,000 yen/kWh
High output power needed in low charge status
Expected advancement of lithium-ion batteries
Research and development of new-type batteries
Advanced batteries 2015
Improved batteries 2010
30,000 yen/kWh
Cost 1/7
For HVs
LI battery for plug-in HVs and FCVs
LI battery for household commuter EVs
Cost 1/2
LI battery for HVs
Current status
Cost 200,000 yen/kWh
NiMH for HVs
LI battery for business use commuter EVs
100,000 yen/kWh
For EVs
Output density per weight in battery system [W/kg]
4000
3000
2500
2000
1500
1000
500
Energy density per weight in battery system [Wh/kg]
70
100
150
200
≦250
500
700

Korea Electric Drive Vehicle Programs

Purpose: There are several programs for the development of electric-drive vehicles.

Barriers Targeted: Capital costs, infrastructure (such as charging stations)

Funding Level & Source(s): Total amount is assumed to be about 30 million dollars per year funded by the government's Ministry of Commerce and Ministry of Science and Technology) for development of electric-drive vehicles

Geographic scope: Vehicle purchase incentives are targeted to specific cities as described below.

Description: The infrastructure and demonstration program for the EV will start from next year. A preliminary project is being conducted now.

Consumer incentives for EV and PHEV are not available yet but are under development. Incentive programs for the HEVs are in operating now. Up to US $2,500 (3,100,000 won) can be deducted from the national tax and/or district tax.

A consultative group of government institutions and manufacturers involved in the auto industry will reportedly be launched for electric car development and infrastructure, while LG Chem separately announced that it will invest approximately $800 million (1 trillion won) to manufacture EV batteries for GM.[6]

Success Overcoming Barriers:
Due to the recent or in-progress nature of these programs, it is not yet possible to judge their ultimate success.

[6]Automotive Wold.com Environment, July 2009, p4

Program: **Electric Drive Programs in Europe**

United Kingdom Low Carbon Vehicle Innovation Platform

Purpose: The purposed of this program is to promote low carbon vehicle research, development and demonstration in the United Kingdom (UK) and deliver:

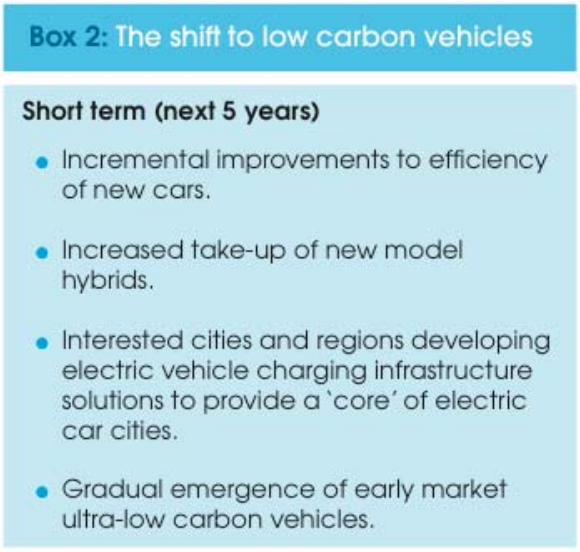
- Carbon reduction in domestic and international vehicle markets
- Introduction of low carbon vehicles faster than markets would deliver on their own
- Benefits to the UK automotive sector from growing domestic and international demand.[7]

Barriers Targeted: Demonstration, infrastructure, capital costs, as well as R&D barriers.

Funding Level & Source(s): The UK government has about $660 million US (£400 million) for the development & deployment of ultra-low carbon vehicles, with additional funding from industry sources, and another approximately $3.8 billion US (£2.3 billion) to assist automaker transitioning to zero and low carbon vehicles.

Geographic scope: National.

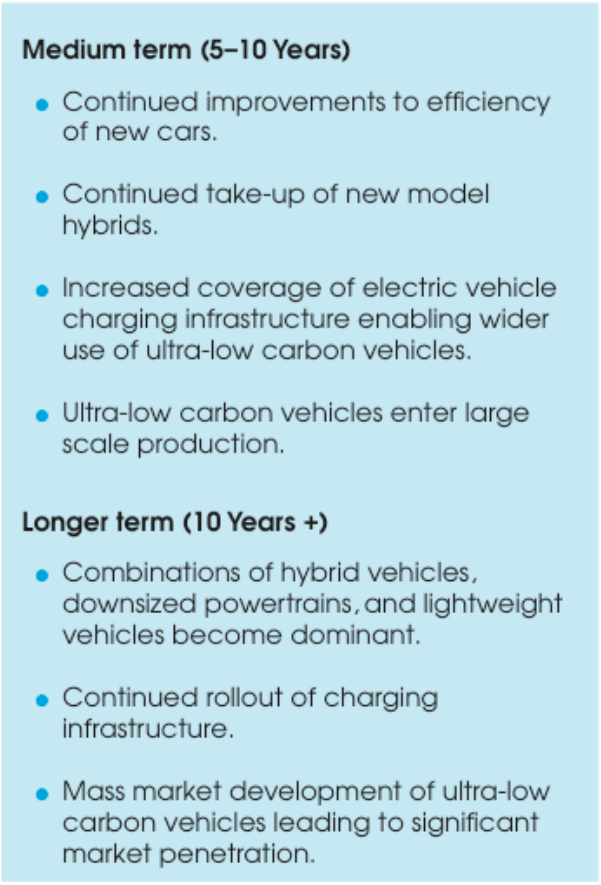
Description: First, about $40 million US (£25m) in R&D awards have been issued for internal combustion engines, hybrid and hybrid-electrics, and technologies that improve the efficiency of vehicles in general (such as lightweight materials). Additional applications for funding applications for electric and hybrid vehicle market development are under review (Note that hydrogen fuel cells for both stationary and transportation applications are covered by a different program.[8])



Second, the "Integrated Delivery Programme" is a new £200m investment jointly funded by Government and business to help speed up the introduction of new low carbon vehicles onto Britain's roads. The Programme will co-ordinate the UK's low carbon vehicle activity from initial strategic research through collaborative research and development, leading to the production of demonstration vehicles, through:

[7] http://www.innovateuk.org/ourstrategy/innovationplatforms/lowcarbonvehicles.ashx
[8] http://www.innovateuk.org/_assets/pdf/competition-documents/fuel%20cells%20and%20hydrogen%20technologies_071008.pdf

- University-based research targeted towards future technologies with good long-term commercialization prospects.
- An industry-led advisory panel of representatives of leading elements of the UK automotive industry and low carbon vehicle technology developers, as well as relevant academic experts
- Flexible rolling opportunities for industry to seek support for high quality collaborative research and development proposals which take technology through to system or vehicle concept readiness
- Funding to support demonstration of particularly innovative lower carbon vehicle options.



Third, the associated ultra low carbon vehicle demonstration competition aims to demonstrate new and emerging low carbon vehicle technology in real world situations. £25m in funding to demonstrate 340 vehicles was announced in June and provided some of the costs for business-led demonstration projects of vehicles with tailpipe emissions of 50g CO2/km or less and a significant zero tailpipe emissions range. Most of these vehicles will be on the road by the end of 2010.

The program is intended to reduce prices of electric and plug-in hybrid vehicles by £2000-£5000, or up to approximately $8,000 US, and compliment approximately $3.8 billion US (£2.3 billion) in assistance to the automotive industry for transitions to zero and low carbon vehicles.

In addition, the London congestion charge, which exempts electric vehicles, is an additional incentive for electric vehicles in that region.

Success Overcoming Barriers:
Due to the recent or in-progress nature of these awards, it is not yet possible to judge their ultimate success.

Sources: http://www.berr.gov.uk/files/file51017.pdf, http://www.innovateuk.org/ourstrategy/innovationplatforms/lowcarbonvehicles.ashx

German Vehicle Electrification

Purpose: The German government has set a goal of putting one million vehicles with electric car technology on the road by 2020 and becoming a leader in electric car technology.[9]

Barriers Targeted: Infrastructure, capital costs; consumer incentives for market development receive a significantly lower funding level

Funding Level & Source(s): The German government has allocated over $700 million US (€500 million) for electric and hydrogen vehicles plus a $200 US (€140) tax exemption for purchases of electric cars[10]. Industry partners are expected to contribute approximately $530 million US (€360 million) for battery research.

Geographic scope: National

Description: The plan includes a large amount of economic stimulus funding for advanced battery development, investment in an electric car charging infrastructure, and tax credits for the adoption of electric cars and plug-in hybrids. Conceived by four separate German agencies — the departments of Economics, Transport, Environment, and Education/Research — the plan is on track to be signed into actual law at the beginning of the next German legislative session. The funding is aimed at industry rather than individual consumers.

German auto manufacturers have been developing electric and plug-in hybrids over the last several years. Mini is the first German auto manufacturer to come to market with an electric car, the Mini E, but both Daimler (electric Smart car) and VW (Golf Twin Drive) have electric or plug-in hybrid vehicle prototypes as well.[11]

By 2015 scientists working under the umbrella of the "Innovation Alliance" are to develop a new generation of powerful, affordable, safe, long-life batteries. The Federal Ministry of Education and Research (BMBF) is contributing approximately $100 million US (60 million Euro) to promote the development of this "highly attractive, forward-looking technology". Partners in industry will be investing about another $530 million US (360 million Euro) in the research program. The Federal Ministry of Education and Research (BMBF) is now funding a consortium of selected universities and non-university research institutions in southern Germany coordinated by Forschungszentrum Karlsruhe and will

[9] http://www.bloomberg.com/apps/news?pid=20601130&sid=aoAKCL5tpAeU

[10] http://www.businessweek.com/globalbiz/content/apr2009/gb20090421_725638.htm

[11] http://gas2.org/2008/11/28/germany-wants-one-million-electric-cars-on-the-road-by-2020/

be granted 20 million Euros from the Economic Stimulus Package II for Germany to reach a top level in international electrochemistry research again.[12]

In addition an e-mobility project will provide some 500 charging points in Berlin from RWE. Daimler will provide more than 100 electric cars from Mercedes-Benz and Smart. Users will pay for the electricity via a special in-car communication system, probably an RFID chip, and the intelligent charging point. The project is being supported by the German federal government as well.[13] The German government also signed an MOU with automakers and other industrial partners to develop hydrogen fueling infrastructure.

Success Overcoming Barriers:
Due to the recent or in-progress nature of these programs, it is not yet possible to judge their ultimate success.

France

Purpose: Develop and deploy electric-drive vehicles and electric charging stations.

Barriers Targeted: infrastructure, market development, capital costs.

Funding Level & Source(s): $500 million US (€400 million) from the national government.

Geographic scope: National

Description: French carmakers Renault SA and PSA Peugeot Citroen have announced separate agreements with energy company Electricite de France (EdF) to develop and market green vehicles. In a joint statement with EdF, Peugeot Citroen said that their scheme will support the development of electric vehicles (EVs) and plug-in hybrids. Meanwhile, the Renault agreement will advance the development of an EV charging infrastructure, enabling a country-wide vehicle launch in 2011.[14]

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[12] http://www.germanyandafrica.diplo.de/Vertretung/pretoria__dz/en/__PR/2009__PR/03/03__Electric__Cars.html and http://www.nanowerk.com/news/newsid=11765.php

[13] http://www.ridelust.com/e-mobility-berlin-the-german-electric-car-infrastructure/ and http://news.cnet.com/8301-11128_3-10034960-54.html

[14] Andrew Williams, October 9, 2008, Red Green and Blue, web: http://redgreenandblue.org/2008/10/09/france-invests-549-million-in-electric-and-hybrid-cars/: last accessed October 6, 2009.

And "France to build electric car infrastructure by 2011", Tom Young, October 13, 2008, BuisinessGreen, web: http://www.businessgreen.com/business-green/news/2228114/france-electric-carn last accessed October 6, 2009

According to Nissan, the Renault Nissan Alliance aims to become the world's leading manufacturer of zero-emission vehicles.[15]

[15]Nissan, web at http://www.nissan-global.com/EN/NEWS/2008/_STORY/081009-01-e.html?rss, last accessed Octobe 6, 2009.

Program: **Emerging Renewables Program**
www.consumerenergycenter.org/erprebate/index.html

Sponsors: California Energy Commission (CEC)

Funding source: Regulated utility rate-payers

Eligible business & technical areas: Small wind turbines & hydrogen fuel cells for utility customers

Functions supported: Installation

Type of support: Incentives (subsidies)

Economic sectors affected: Energy production

Geographic limits: Regulated utility service areas

Funding: $118 million over 5 years

Grant amount: $1.5 to $3 per watt

Grants as % of applications: No experience

Overview

CEC Emerging Renewables Program provides rebates to consumers who install qualifying renewable energy systems (small wind or fuel cell electricity systems) on their property. The incentive varies according to the system size, technology, and installation method.

Measures of Effectiveness

No information

Program: **Energy Efficiency Financing Program**
www.energy.ca.gov/efficiency/financing/index.html

Sponsors: California Energy Commission (CEC)

Funding source:

Eligible business & technical areas: Reduced power use & renewable power generation by public institutions

Functions supported: Installation

Type of support: Loans

Economic sectors affected: Energy production, energy use

Geographic limits: California

Funding: $24 million in 2009

Grant amount: up to $3 million

Grants as % of applications:

Overview

The CEC's Energy Efficiency Financing Program provides financing for schools, hospitals, and local governments through low-interest loans for feasibility studies and the installation of energy-saving measures. Some of the eligible expenses are:

- Lighting
- Motors or variable frequency drives and pumps
- Building insulation
- Heating and air conditioning modifications
- Automated energy management systems/controls
- Energy generation including renewable energy projects and cogeneration
- Streetlights/LED traffic signals

The interest rate is 3%, fixed for the term of the loan. The repayment schedule is negotiable up to 15 years and will be based on the annual projected energy cost savings from the project.

Measures of Effectiveness

Average annual return on loans to nine reported government agencies has been 22% per year (annual saving/loan).

Program: **Energy Efficiency and Conservation Block Grants Program** (EECBG)
http://www.eecbg.energy.gov/about/default.html

Sponsors: U.S. DOE

Funding source: U.S. Treasury

Eligible business & technical areas: Any wherein renewable energy or energy conservation can be done

Functions supported: Installation, retrofitting, process modification

Type of support: Grants to states, cities, and tribes

Economic sectors affected: energy production, energy use, transportation

Geographic limits: California

Funding: $351 million allocated as of July 2009

Grant amount: average $1.3 million allocated to CA cities

Grants as % of applications: n/a

Overview

The EECBG program assists state, local, and tribal governments in implementing strategies to reduce fossil fuel emissions; reduce total energy use; and improve energy efficiency in the transportation, building, and other appropriate sectors. Additional purposes of the program are to spur economic growth and create and/or retain jobs under the American Recovery and Reinvestment Act of 2009.

Grants can be used for energy efficiency and conservation programs and projects community wide, and renewable energy installations in or on government buildings. Activities eligible for use of funds include:

- Development of an energy efficiency and conservation strategy
- Building energy audits and retrofits, including weatherization
- Financial incentive programs for energy efficiency such as energy savings performance contracting, on-bill financing, and revolving loan funds
- Transportation programs to conserve energy
- Building code development, implementation, and inspections
- Installation of distributed energy technologies including combined heat and power and district heating and cooling systems
- Material conservation programs including source reduction, recycling, and recycled content procurement programs
- Reduction and capture of greenhouse gas emissions generated by landfills or similar waste-related sources
- Installation of energy efficient traffic signals and street lighting

- Installation of renewable energy technologies in or on government buildings
- Any other appropriate activity that meets the purposes of the program and is approved by DOE

Measures of Effectiveness

Recovery Act programs must meet specific goals and targets, and contribute to improved performance on broad economic indicators. For EECBG program funds, grantees are required to report regularly to DOE on jobs created and/or retained, energy savings, renewable energy capacity installed, greenhouse gas emissions reduced, and funds leveraged.

Program: **Energy Efficiency Program for Commercial/Industrial Large Business Customers**
www.socalgas.com/business/efficiency/largeBusinessCustomers.html

Sponsors: SoCal Gas Company

Funding source: Regulated utility rate-payers

Eligible business & technical areas: Reducing natural gas use by large customers

Functions supported: Retrofitting

Type of support: Incentives (subsidies)

Economic sectors affected: Energy use

Geographic limits: SoCal gas service area

Funding: No information

Grant amount: Up to $1 million per year per project

Grants as % of applications: No information

Overview

The program provides incentives up to $2,000,000 per premise per year for qualifying energy-efficient equipment retrofits and process re-designs that can save more than 200,000 therms per year..

There are no pre-determined measures for EEGP; however, electric generation natural gas savings projects are not eligible to participate in EEGP.

Measures of Effectiveness
No information

Program: **Federal Tax Credits for Energy Efficiency -- Commercial**
www1.eere.energy.gov/buildings/tax_commercial.html

Sponsors: Internal Revenue Service

Funding source: U.S. Treasury

Eligible business & technical areas: Heating, cooling, lighting

Functions supported: Installation or retrofit

Type of support: Tax rebates

Economic sectors affected: Energy use

Geographic limits: none

Funding: unlimited

Grant amount: Up to $1.80 per square foot for energy savings over 50%

Grants as % of applications: n/a

Overview

A tax deduction of up to $1.80 per square foot is available for buildings that save at least 50% of the heating and cooling energy of a building that meets ASHRAE Standard 90.1-2001. Partial deductions of up to $.60 per square foot can be taken for measures affecting: the building envelope, lighting, or heating and cooling systems. This act extends the deduction through December 31, 2013.

Buildings must be within the scope of ASHRAE Standard 90.1 and within the control of the building designer. Retrofit of existing buildings is also eligible for the tax deduction.

Measures of Effectiveness

No information

Program: **Federal Tax Credits for Energy Efficiency -- Residential**
www.energystar.gov/index.cfm?c=tax_credits.tx_index#s1

Sponsors: Internal Revenue Service

Funding source: U.S. Treasury

Eligible business & technical areas:

Functions supported: Purchase or installation in homes

Type of support: Tax rebates

Economic sectors affected: Energy production, energy use

Geographic limits: none

Funding: unlimited

Grant amount: Up to $1,500 per tax return for 2009 and 2010

Grants as % of applications: n/a

Overview

Tax credits up to $1,500 can be claimed on IRS returns for 2009 and 2010 for the domestic installation of energy-efficient building materials, appliances, solar heating, biomass heating, photovoltaics, wind turbines, microturbines, and fuel cells and for the purchase of electric, hybrid, and fuel-cell-powered vehicles. Domestic installations must qualify under ENERGY STAR.

Measures of Effectiveness

No information

Program: **Grants.gov** www.grants.gov/search/category.do

Sponsor: Multiple federal agencies

Funding source:	|
Eligible business & technical areas:	|
Functions supported:	|
Type of support:	|
Economic sectors supported:	| -- All particular to the granting agency
Geographic limits:	|
Funding:	|
Grant amount:	|
Grants as % of applications:	|

Overview

This is a directory of all federal grant programs

Measures of Effectiveness

No information.

Program: **High Penetration Solar Development**
www1.eere.energy.gov/solar/financial_opps_detail.html?sol_id=258

Sponsor: US DOE

Funding source: US Treasury

Eligible business and technology areas: Integration of photovoltaics into power grids

Functions supported: R&D and demonstrations

Type of support: Grants

Economic sectors affected: Energy production

Geographic limits: none.

Funding: $37.5 million in 2009/10

Grant amount:

Overview

This project will accelerate the placement of high levels of photovoltaic (PV) penetration into existing or newly designed distribution circuits. By facilitating increased growth of grid-tied PV installations, this project supports the acceleration of widespread commercialization of clean solar energy technologies in the United States. The three goals are:

- Develop modeling tools and database of experience with high penetration scenarios of PV on a distribution system
- Develop monitoring, control, and integration systems to enable cost-effective widespread deployment of small modular PV systems
- Demonstrate integration of PV and energy storage into Smart Grid applications.

The project's success will require both modeling tools and actual performance and validation data, so the focus will be in four R&D areas: improved modeling tools development, field verification of high-penetration levels of PV into the distribution grid, modular power architecture, and demonstration of PV and energy storage for Smart Grids.

Measures of Effectiveness

No information

Program: **Innovative Clean Air Technologies (ICAT) Grant Program**

(Suspended for 2009)
www.arb.ca.gov/research/icat/icat.htm

Sponsor: Air Resources Board (CARB)

Funding source: Research Division of CARB

Eligible business and technology areas: New technologies for reducing criteria, toxic, or global-warming emissions

Functions supported: Demonstrations

Type of support: Grants (cost-share up to 50%)

Economic sectors affected: All

Geographic limits: US. Supported technologies must be useful in California.

Funding: ~ $1 million per year

Grant amount: Average $200,000

Grants as % of applications: 5% to 10%

Overview

ICAT co-funds practical demonstrations of innovative technologies that can reduce air pollution, including GHGs. Its purpose is to advance such technologies toward commercial application in California, thereby reducing emissions and helping the state's economy. ICAT seeks technologies that are not yet marketed but are substantially ready for practical demonstrations of their utility to potential users. It focuses on co-funding such demonstrations. It does not support research, R&D that is not intrinsic to performing a particular demonstration, or marketing activities.

Measures of Effectiveness

The following table compares statistics from ICAT and four grant programs by various State and federal agencies. The statistics can be viewed as measures of the effectiveness of grant funds or of the quality of the technologies that were selected for support.

Table 1. Program Evaluation Statistics

	Annual Grants (MM$/yr)	Sample Size	Commer-cialization Rate	Time to Sale #	Benefit: Cost ^	Annual Revenue / $ Granted	Grants leveraged funds	Grants critical to projects
SBIR		100's	25% *	~4 yrs				
ATP	145	100's			8:1		33%	16%
PIER	62	34			1.3 to 3.4:1			
CalTIP	~5	75	31%	2 yrs		3 /yr	>38%	31%**
ICAT	*~0.9*	*15*	*53%*	*1.7 yrs*		*1 /yr ^^*	*37%*	*50%*

* >$300,000 revenue

\# Defn of "Time 0" varies.

^ Defn of "benefit" varies.

** derived by staff from data in CalTIP report

^^ $1.2 million revenue in 2004 among 6 grantees who received $1.1 million in grants

SBIR = Small Business Innovation Research (see page Appendix II – 36)

ATP = Advanced Technology Program, National Institute of Standards and Technology (program ceased in 2007)

PIER = Public Interest Energy Research of California Energy Commission (see page Appendix II – 31)

CalTIP = California Technology Investment Partnership of California Technology, Trade and Commerce Agency (agency now defunct)

Program: **Low-Emission School Bus Program**
www.arb.ca.gov/msprog/schoolbus/schoolbus.htm

Sponsor: CARB

Funding source: State bond

Eligible business and technology areas: Diesel school buses

Functions supported: Replacement and retrofit

Type of support: Incentives (subsidies)

Economic sectors affected: Transportation

Geographic limits: California

Funding: $200 million

Grant amount: No information

Grants as % of applications: No information

Overview

The program provides grant funding for new, safer school buses and to put air pollution control equipment (i.e., retrofit devices) on buses that are already on the road. The Proposition 1B bond act approved in November 2006 authorizes $200 million for replacing and retrofitting school buses. ARB has allocated $191,000,000 to local air districts for grants to school districts. However, disbursements by the State have been mostly suspended.

Measure of Effectiveness

The measure is expected to reduce emissions by 3,000 tons NOx, 200 tons PM, 22,000 tons CO2 through 2020.

Program: **New Solar Homes Partnership**
www.gosolarcalifornia.ca.gov/nshp/index.html

Sponsor: California Energy Commission (CEC)

Funding source: CEC

Eligible business and technical areas: Photovoltaics in new homes

Functions supported: Installation

Type of support: Incentives (subsidies)

Economic sectors affected: Energy production

Geographic limits: Service areas of PG&E, SDG&E, SCE, & Bear Valley Electric

Funding: $400 million over 10 years

Grant amount: No experience yet

Grants as % of applications: No experience yet

Overview

The CEC has a 10-year, $400 million program to encourage photovoltaics in new home construction. Strict standards for energy efficiency are applied. Depending on the total installed photovoltaic capacity in the state, the proposed subsidy will be $0.25 to $2.60 per watt.

Measures of effectiveness

The goal for the program is 400 MW of new photovoltaic capacity installed by 2016. 4.8 MW have been installed as of November 2009.

Program: **Public Interest Energy Research Program (PIER)**
www.energy.ca.gov/pier/index.html

Sponsor: California Energy Commission (CEC)

Funding source: Investor-owned utility ratepayers

Eligible business and technical areas: Production and use of energy

Functions supported: Research, R&D, and demonstration

Type of support: Grants and contracts

Economic sectors affected: All

Geographic limits: US

Funding: $62 million per year

Grant amount: Varies by program area

Grants as % of applications: No information

Overview

PIER supports energy research, development and demonstration (RD&D) projects that will bring environmentally safe, affordable and reliable energy services and products to the marketplace. PIER Program partners with RD&D organizations including individuals, businesses, utilities, and public or private research institutions. PIER supports these RD&D program areas, some with contracts and some with grants:

- Buildings End-Use Energy Efficiency
- Climate Change Program
- Energy Innovations Small Grant Program
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally-Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Natural Gas Research
- Renewable Energy Technologies
- Transportation Research

Grant programs are administered separately in these areas.

Supported technologies should:

- Reduce the cost of electricity and increase the value
- Increase the reliability of the electric system
- Reduce the environmental impacts of electricity generation, distribution and use
- Enhance California's economy
- Demonstrate a connection to the market

- Advance science and technology not provided by competitive and regulated markets

In 2009, CEC is offering up to $21 million (of the annual $62.5 million) of PIER funds as co-funding to awardees of federal funding under the American Recovery and Reinvestment Act.

Measures of Effectiveness

From *Independent PIER Review Panel Interim Report* (March 2004):

> "Since PIER's inception in 1998, a total of about $260 million has been encumbered for research contracts. A review of contracts completed through 2002 revealed a total of 20 commercialized products with projected benefits of $221 to $576 million. The benefits are significant in comparison to the total contract disbursements of about $125 million between 1998 and 2002, resulting in a benefit-to-cost ratio between 2 and 5 to 1.
>
> . . .
>
> The IRP believes that except for minor issues the current PIER research portfolio is well focused, addresses issues relevant to California as outlined in the Energy Action Plan, meets PIER objectives and is well balanced."

Also, see the table on the page for ICAT grant program.

Program: Recovery Act funding for biofuels
http://apps1.eere.energy.gov/news/daily.cfm/hp_news_id=164

"As part of the ongoing effort to increase the use of domestic renewable fuels, U.S. Secretary of Energy Steven Chu today announced plans to provide $786.5 million from the American Recovery and Reinvestment Act to accelerate advanced biofuels research and development and to provide additional funding for commercial-scale biorefinery demonstration projects.

The $786.5 million in Recovery Act funding is a mix of new funding opportunities and additional funding for existing projects. It will be allocated across four main areas:

$480 Million Solicitation for Integrated Pilot- and Demonstration-Scale Biorefineries -- Projects selected under this Funding Opportunity Announcement will work to validate integrated biorefinery technologies that produce advanced biofuels, bioproducts, and heat and power in an integrated system, thus enabling private financing of commercial-scale replications.

DOE anticipates making 10 to 20 awards for refineries at various scales and designs, all to be operational in the next three years. The DOE funding ceiling is $25 million for pilot-scale projects and $50 million for demonstration scale projects.

These integrated biorefineries will reduce dependence on petroleum-based transportation fuels and chemicals. They will also facilitate the development of an "advanced biofuels" industry to meet the federal Renewable Fuel Standards.

$176.5 Million for Commercial-Scale Biorefinery Projects -- $176.5 million will be used to increase the federal funding ceiling on two or more demonstration- or commercial-scale biorefinery projects that were selected and awarded within the last two years.

The goal of these efforts is to reduce the risk of the development and deployment of these first-of-a-kind operations. These funds are expected to expedite the construction phase of these projects and ultimately accelerate the timeline for start up and commissioning.

$110 Million for Fundamental Research in Key Program Areas -- The Biomass Program plans to use $110 million to support fundamental research in key program areas, distributed in the following manner:

- Expand the resources available for sustainability research through the Office of Science Bioenergy Research Centers and establish a user-facility/small-scale integrated pilot plant ($25 million)
- Create an advanced research consortium to develop technologies and facilitate subsequent demonstration of infrastructure-compatible biofuels through a competitive solicitation ($35 million)

- Create an algal biofuels consortium to accelerate demonstration of algal biofuels through a competitive solicitation ($50 million).

This funding will help to develop cutting-edge conversion technologies, including generating more desirable catalysts, fuel-producing microbes, and feedstocks.

$20 Million for Ethanol Research -- The Biomass Program is planning to use $20 million of the Recovery Act funding in a competitive solicitation to achieve the following:

- Optimize flex-fuel vehicles operating on high octane E85 fuel (85% ethanol, 15% gasoline blend)
- Evaluate the impact of higher ethanol blends in conventional vehicles
- Upgrade existing refueling infrastructure to be compatible with fuels up to E85.

$564 Million from ARRA -- U.S. Department of Energy Secretary Steven Chu and Agriculture Secretary Tom Vilsack on December 4, 2009 announced the selection of 19 integrated biorefinery projects to receive up to $564 million from the American Recovery and Reinvestment Act to accelerate the construction and operation of pilot, demonstration, and commercial scale facilities. The projects – in 15 states – will validate refining technologies and help lay the foundation for full commercial-scale development of a biomass industry in the United States (http://www.energy.gov/8352.htm).

Program: Rural Energy for America Program Grants/ Renewable Energy Systems / Energy Efficiency Improvement Program

http://www.rurdev.usda.gov/rbs/busp/9006grant.htm

Sponsor: US Department of Agriculture (USDA)

Funding source: US Treasury

Eligible business and technical areas: Renewable energy production and energy efficiency projects in agriculture and rural small businesses

Functions supported: Installation and retrofit

Type of support: Incentives & guaranteed loans; < $250,000 for energy efficiency; < $500,000 for renewable energy; <25% of project cost

Economic sectors affected: Agriculture and forest products, energy use, energy production

Geographic limits: Rural US

Funding: No information

Grant amount: No information

Grants as % of applications: No information

Overview

The REAP/RES/EEI Grants Program provides grants for energy audits and renewable energy development assistance. It also provides funds to agricultural producers and rural small businesses to purchase and install renewable energy systems and make energy efficiency improvements.

The program is designed to assist farmers, ranchers and rural small businesses that are able to demonstrate financial need. All agricultural producers, including farmers and ranchers, who gain 50% or more of their gross income from the agricultural operations are eligible. Small businesses that are located in a rural area can also apply. Rural electric cooperatives may also be eligible to apply.

Most rural projects that reduce energy use and result in savings for the agricultural producer or small business are eligible as energy efficiency projects. These include projects such as retrofitting lighting or insulation, or purchasing or replacing equipment with more efficiency units. Eligible renewable energy projects include projects that produce energy from wind, solar, biomass, geothermal, hydro power and hydrogen-based sources. The projects can produce any form of energy including, heat, electricity, or fuel.

Measure of Effectiveness:

No information

Program: **Small Business Innovation Research (SBIR) & Small Business Technology Transfer (STTR)** www.science.doe.gov/sbir

Sponsor: Eleven large federal agencies (DOE is highlighted here); coordinated by the federal Small Business Agency

Funding source: Agency R&D budgets

Eligible business and technical areas: Broad spectrum of DOE's research and R&D programs

Functions supported: Research, R&D

Type of support: Grants

Economic sectors affected: All

Geographic limits: US

Funding: SBIR -- 2.5% of each agency's research budget STTR -- 0.3%

Grant amount: Research -- up to $100,000 R&D -- up to $750,000

Grants as % of applications (DOE): Research -- 20% R&D -- 50%

Overview

SBIR and STTR are U.S. Government programs in which federal agencies with large research and development (R&D) budgets set aside a small fraction of their funding for competitions among small businesses only. The major difference between the programs is that STTR projects must involve substantial (at least 30%) cooperative research collaboration between the small business and a non-profit research institution. Small businesses that win awards in these programs keep the rights to any technology developed and are encouraged to commercialize the technology.

Each year, the federal agencies that participate in SBIR and STTR set aside 2.5% and 0.3%, respectively, of their extramural (outside of the agency) R&D budgets. For the DOE in FY 2005, these set-asides correspond to $102 million and $12 million, respectively.

Each year (typically around the beginning of October), DOE issues a solicitation inviting small businesses to apply for SBIR/STTR Phase I grants. It contains technical topics in such research areas as energy production (Fossil, Nuclear, Renewable, and Fusion Energy), Energy Use (in buildings, vehicles, and industry), fundamental energy sciences (materials, life, environmental, and computational sciences, and nuclear and high energy physics), Environmental Management, and Nuclear Nonproliferation. Grant applications submitted by small businesses MUST respond to a specific topic and subtopic during an open solicitation.

SBIR and STTR have three distinct phases. Phase I explores the feasibility of innovative concepts with awards up to $100,000 for about 9 months. Only Phase I award winners may compete for Phase II, the principal R&D effort, with awards up to $750,000 over a

two-year period. There is also a Phase III, in which non-Federal capital is used by the small business to pursue commercial applications of the R&D. Also under Phase III, Federal agencies may award non-SBIR/STTR-funded, follow-on grants or contracts for products or processes that meet the mission needs of those agencies, or for further R&D.

Measures of Effectiveness

SBIR measures "success" in terms of the fraction of "Phase 2" products that have provided at least $300,000 in revenue. The recent success rate is reported to be 25%. The post-grant time until revenues occur is "often … about four years".

SBIR also mentions an "environmental metric" that would count "pollutant reductions" &/or cost savings, but that apparently is not put into practice. No general protocol for producing such a metric is presented in the material that ARB staff have received.

Program: **Self-Generation Incentive Program**
www.cpucwww.cpuc.ca.gov/PUC/energy/DistGen/sgip/

Sponsor: California Public Utilities Commission (CPUC)

Funding source: Regulated utility rate-payers

Eligible business and technical areas: Microturbines, fuel cells, & wind turbines

Functions supported: Installation

Type of support: Incentives (subsidies)

Economic sectors affected: Energy production

Geographic limits: California

Funding: $75 million in 2007

Grant amount: $1.50 to $4.50 per Watt

Grants as % of applications: No information

Overview

SGIP is a statewide program to provide incentives for the installation of certain renewable and clean generation. The SGIP provides rebates for systems sized up to 3 MW. Generation technologies involved in the SGIP include photovoltaic (solar) systems, microturbines, fuel cells, and wind turbines. Incentives vary by technology and fuel type. The intent is to reduce the average cost for a 50 kW photovoltaic system from $450,000 to $300,000.

Measure of Effectiveness

1200 projects have been funded. Through 2006, 190 MW had been installed at a program cost of $100 million.

Program: **Solar Water Heating Pilot Program**
http://www.cpuc.ca.gov/PUC/energy/Solar/swh.htm

Sponsor: California Public Utilities Commission (CPUC)

Funding source: Regulated utility rate-payers

Eligible business and technical areas: Solar water heating

Functions supported: Installation

Type of support: Incentives (subsidies)

Economic sectors affected: Energy use

Geographic limits: San Diego Gas & Electric service area

Funding: $1.5 million

Grant amount: See below

Grants as % of applications: No information

Overview

SWHPP provides incentives to business and customers who install qualifying solar water heating systems. These incentives will go to qualified, licensed contractors to promote the installation of clean, renewable solar water heating systems. The California Center for Sustainable Energy (CCSE) is administering the program. The program includes residential, commercial, and industrial electricity customers of SDG&E. To be eligible to participate, customers must provide SDG&E billing data, allow their systems to be monitored, and consent to being interviewed or surveyed during program evaluation.

For residential systems, the maximum incentive is $1500 per dwelling and varies according to the system installed and other installation details.

For larger systems, the incentive is a function of collector area:

- $15/sq ft for open-loop systems
- $20/sq ft for closed-loop systems
- Pool and spa heating systems are not eligible
- Maximum incentive is $75,000.

Measures of Effectiveness

No information

Program: **Stanford Global Climate and Energy Project (GCEP)**
http://gcep.stanford.edu/research/areas.html

Sponsor: Stanford University

Funding source: ExxonMobil, General Electric, Schlumberger, and Toyota

Eligible business and technology areas: Energy production & storage; carbon sequestration

Functions supported: Research

Type of support: Subcontracts for research by Stanford

Economic sectors affected: Energy production, industrial, transportation

Geographic limits: None, but only academic entities are eligible

Funding: $225 million over 10 years

Grant amount: $1.2 million, average

Grants as % of applications: No information

Overview

The Project's sponsors will invest a total of $225 million over a decade or more as GCEP explores energy technologies that are efficient, environmentally benign, and cost-effective when deployed on a large scale. GCEP's specific goals include:

- Identify promising research opportunities for low-emissions, high-efficiency energy technologies.
- Identify barriers to the large-scale application of these new technologies.
- Conduct fundamental research into technologies that will help to overcome these barriers and provide the basis for large-scale applications.
- Share research results with a wide audience.

GCEP sponsors research at Stanford and other leading universities and research institutions. It does not sponsor research by businesses or individuals.

Measures of Effectiveness

14 patent applications

Program: **Technology Advancement Program**
www.aqmd.gov/tao/About/index.html

Sponsor: South Coast Air Quality Management District (AQMD)

Funding source: Vehicle registration fees, regulatory violation settlements, State & federal grants

Eligible business and technology areas: Criteria and toxic emissions from processes and fuels

Functions supported: R&D, demonstration

Type of support: Cost-sharing

Economic sectors affected: Industrial, transportation

Geographic limits: South Coast Air Basin

Funding: $9 to $15 million per year

Grant amount: Range -- $6,000 to $3 million

Grants as % of applications: Varies by type of solicitation; overall: ~40%

Overview

The Technology Advancement Program expedites the development, demonstration and commercialization of cleaner technologies and clean-burning fuels. It uses cooperative partnerships with private industry, academic and research institutions, technology developers, and government agencies to cosponsor projects intended to demonstrate the successful use of clean fuels and technologies that lower or eliminate emissions. The supported technologies are chosen to provide emission reductions in the AQMD in the context of the AQMD's emission-reduction strategies.

Typically, the public-private partnership enables the AQMD to leverage its public funds with an average of $3 from outside sources for every dollar contributed by the AQMD.

Awards are made to both proposals made in response to RFPs with specific objectives and to unsolicited proposals for new technologies.

Measures of Effectiveness

In 2008, the AQMD Governing Board approved 72 new projects or studies and modified 6 continuing projects, with contributions exceeding $11.3 million. AQMD's contributions leveraged support from other government organizations, private sector, academia and research institutes for total project costs exceeding $57 million.

SUMMARY OF PROGRAMS

Program	Web Page	Sponsor	Funding Source	Eligible Business / Technical Areas	Function Supported	Type & Terms of Support	Program	Economic Sectors of Application: Ag. & Forest	Energy Prod.	Energy Use	Indus-trial	Trans-port.	Funding / period	Avg. Grant	Annual grants / applicants
Advanced Technology Program DISCONTINUED	www.atp.nist.gov/	National Institute of Standards & Technol. (NIST)	NIST	Materials, chemi-cals, biotechnology, manufacturing	Early R&D (not product development)	< 50% cost share	*Advanced Technology Program DISCONTINUED*				x		$155 M / year	$2.5 M	11%
Agriculture & Food Industries Loan Program DISCONTINUED	www.energy.ca.gov/process/agriculture/loansolicitation/	CEC		Specific power-generation and demand-reducing technologies	Installation	Loans at 3.2%, up to $500,000	*Agriculture & Food Industries Loan Program DISCONTINUED*	x					$3 million in 2007	No experience yet	
California Clean Energy Fund (CalCEF) (Fund 1)	www.calcef.org	CalCEF	PG&E bankruptcy settlement	Renewable fuels, energy efficiency & storage, clean fossil fuels, green bldgs.	R&D	Business investment	*California Clean Energy Fund (CalCEF) (Fund 1)*		x	x		x	$30 M (total funds)		
California Solar Initiative	www.gosolarcalifornia.ca.gov/	CPUC	Investor-owned utility ratepayers	Photovoltaics & sol-ar heating in comm'l blgs. & homes	Installation	Incentives: Grant ≤ $.50 / kW-hr or $3.25 / watt	*California Solar Initiative*		x	x			$2.2 B / 10 yrs	n/a	First-come, first-served
California Solar Initiative RD&D	http://www.cpuc.ca.gov/PUC/energy/Solar/rdd.htm	CPUC	Investor-owned utility ratepayers	Photovoltaic distributed generation	Research, R&D, demonstration, deployment	Grants of $0.2 to $3 million	*California Solar Initiative RD&D*		x				$50 M / 10 years	No experience yet	
Clean Energy Angel Fund	http://www.calcefangelfund.com/	CalCEF	PG&E bankruptcy settlement	Clean/alternative energy, energy effi-ciency, green bldgs.	Potentially profitable businesses	Business investment	*Clean Energy Angel Fund*		x	x				$0.3 to $0.5 M (expected)	two investments to date
Carl Moyer Program	www.arb.ca.gov/msprog/moyer/moyer.htm	CARB & air quality manage-ment districts	Vehicle reg. fees, tire disposal fees, "Smog-check" fees, State grants	Commercial & gov't fleets of vehicles & equipment	Purchase of clean industrial & vehicular engines	Incentives: Grant ≤ value of emission reduction.	*Carl Moyer Program*	x				x	$1.4B / 10years	Buses, agr. eq. & pumps: $12K/unit Marine & constr. equip.: $50K/veh	
Driveclean (directory of incentives)	www.driveclean.ca.gov/en/gv/driveclean/demoprog.asp	Federal, regional, and local gov'ts	Particular to the agency offering incentives	Electric, CNG & hybrid vehicles	Purchase	Incentives particular to the agency	*Driveclean (directory of incentives)*					x		Particular to the agency offering incentives	
Emerging Renewables Program	www.consumerenergycenter.org/erprebate/index.html	CEC		Small wind turbines and H fuel cells for utility customers	Installation	Incentives: Grants of $1.50 to $3 / W	*Emerging Renewables Program*		x				$118 million over 5 years	No experience yet	
Energy Efficiency Financing Program	www.energy.ca.gov/efficiency/financing/index.html	CEC		Power generation & use by public institutions	Installation	Loans at 3%, up to $3 million	*Energy Efficiency Financing Program*		x	x			26 million in 2007	No experience yet	
Energy Efficiency and Conservation Block Grants Program	www.eecbg.energy.gov/about/default.html	U.S. DOE	U.S. Treasury	Any wherein renew-able energy or ener-gy conservation can be done	Installation, retrofitting, process modification	Grants to states, cities, and tribes	*Energy Efficiency and Conservation Block Grants Program*		x	x		x	$351 million allocated for California	$1.3 million avg. allocation among CA cities	n/a
Energy Efficiency Program for Commerci-al / Industrial Large Business Customers	www.socalgas.com/business/efficiency/largeBusinessCustomers.html	So. Cal Gas Co.	Investor-owned utility ratepayers	Nat'l gas use by large customers	Retrofitting to reduce NG use by ≥200,000 therms/yr	Incentives up to $1 million per project.	*Energy Efficiency Program for Commerci-al / Industrial Large Business Customers*			x					
Federal Tax Credits for Energy Efficiency-- residential	www.energystar.gov/index.cfm?c=tax_credits.tx_index#s1	IRS	U.S. Treasury	Solar heat, photo-voltaics, wind tur-bines, fuel cells, EVs, hybrid vehicles	Purchase or installation in homes	30% tax credits up to $1,500. Installations must qualify under ENERGY STAR	*Federal Tax Credits for Energy Efficiency-- residential*		x	x					
Federal Tax Credits for Energy Efficiency-- commercial	www1.eere.energy.gov/buildings/tax_commercial.html	IRS	U.S. Treasury	Heating, cooling, lighting	New construction & retrofits	Tax deduction up to $1.80 per sq. ft. for 50% energy saving	*Federal Tax Credits for Energy Efficiency-- residential*			x					
Grants.gov (directory of federal grants)	www.grants.gov/search/category.do	Various federal agencies		---------- Various ----------			*Grants.gov (directory of federal grants)*	All sectors affected						Particular to the agency offering grants	
High Penetration Solar Development	http://www1.eere.energy.gov/solar/financial_ops_detail.html?sol_id=258	US DOE	U.S. Treasury	Modeling, monitoring, control & integration of photovoltaic systems into distribution grids	R&D and demonstration	Grants	*High Penetration Solar Development*		x				$37.5 million in 09/10		
Innovative Clean Air Technolgies (ICAT) (on hiatus 2009)	www.arb.ca.gov/research/icat/icat.htm	CARB	Research Division	Innovations in con-trol of criteria, toxic & G-W emissions	Field demon-stration	≤ 50% cost share	*Innovative Clean Air Technolgies (ICAT) (on hiatus 2009)*	All sectors affected					$1M / year	$200,000	5% to 10%

Program	Web Page	Sponsor	Funding Source	Eligible Business / Technical Areas	Function Supported	Type & Terms of Support	Program	Economic Sectors of Application: Ag. & Forest	Energy Prod.	Energy Use	Indus-trial	Trans-port.	Funding / period	Avg. Grant	Annual grants / applicants
Low Emission School Bus Program	www.arb.ca.gov/msprog/schoolbus/schoolbus.htm	CARB	State bond, federal stimulus money	Existing diesel school buses	Replacement & retrofit	Incentives via AQMDs	*Low Emission School Bus Program*					x	$200M (total) ($191 million allocated)		
New Solar Homes Partnership	www.gosolarcalifornia.ca.gov/nshp/index.html	CEC		Photovoltaics in new homes	Installation	$0.25 to $2.6 per installed watt	*New Solar Homes Partnership*		x				$400 M / 10years	$7,000 per system	77%
Public Interest Energy Research (PIER)	www.energy.ca.gov/pier/index.html	CEC	Investor-owned utility ratepayers	Production and use of energy	Research, R&D, demonstration	Grants & contracts; co-funding of fed'l ARRA projects	*Public Interest Energy Research (PIER)*	All sectors affected					$62M / year	Varies by program area programs)	(10
Recovery Act funding for biofuels	http://apps1.eere.energy.gov/news/daily.cfm/hp_news_id=164	US DOE	U.S.Treasury	Production of biofuels	Research, pilot plants, demonstrations, commercial plants		*Recovery Act funding for biofuels*		x				$787 million		
Renewable Energy Systems & Energy Efficiency Improvements Program DISCONTINUED	www.rurdev.usda.gov/rbs/farmbill/what_is.html	USDA	U.S.Treasury	Renewable energy systems & energy eff'cy by agr. & rural small businesses	Installation	Incentives: Grant < 25% of project cost Loan < 50% of project cost	*Renewable Energy Systems & Energy Efficiency Improvements Program DISCONTINUED*	x		x			$23 million / year	Grants: $150,000 Loans: $5 million	
Rural Energy for Ameri-ca Program Grants/ Renewable Energy Systems / Energy Efficiency Improve-ment Program	http://www.rurdev.usda.gov/rbs/busp/9006grant.htm	USDA	U.S.Treasury	Energy efficiency & renewable energy in agriculture & rural small business	Installation and retrofit	Incentives < $250,000 for energy efficiency < $500,000 for renewable energy; <25% of project cost	*Rural Energy for Ameri-ca Program Grants/ Renewable Energy Systems / Energy Efficiency Improve-ment Program*	x	x	x				20% of grants must be for less than $20,000	
SBIR & STTR	www.science.doe.gov/sbir	US DOE	2.8% of DOE's extra-mural R&D budget	Broad spectrum of DOE's R&D programs	Research, R&D	Grants	*SBIR & STTR*	All sectors affected					$102M / 2005	Res'rch: <$100K R&D: <$750K	Varies by agency
School Facility Program - Modernization Grants	http://www.opsc.dgs.ca.gov/Programs/SFProgams/Mod.htm	CA Dept. of General Services		Photovoltaics in old school buildings	Intallation	Incentives	*School Facility Program - Modernization Grants*		x						
Self-Generation Incentive Program	www.cpuc.ca.gov/PUC/energy/DistGen/sgip/	CPUC		Microturbines, fuel cells, & wind turbines.	Installation	Incentives: $1.50 to $4.5 / W up to 3 MW	*Self-Generation Incentive Program*		x				$75 million in 2007		
Solar Water Heating Pilot Program	www.cpuc.ca.gov/PUC/energy/Solar/swh.htm	CPUC	SDG&E ratepayers	Solar water heating in SDG&E service area	Installation	Incentives. Residential: < $1500 Commer'l: < $75,000	*Solar Water Heating Pilot Program*			x			$1.5 million	No experience yet	
Stanford GCEP	gcep.stanford.edu/research/areas.html	Stanford University	Toyota, GE, Exxon-Mobil, Schlumberger	Energy production & storage; carbon sequestration	Research	Recipients are sub-contractors to Stanford. Supports only academic research.	*Stanford GCEP*		x		x	x	$225 / 10years	$1.2 million	
Supplemental Energy Payments (SEPs)	www.energy.ca.gov/2007publications/CEC-300-2007-006/CEC-300-2007-006-ED3-SD.PDF	CEC	Renewable Energy Public Goods Charge funds	Renewable power producers	Power production bought by electric utilities	Subsidy of above-market power costs	*Supplemental Energy Payments (SEPs)*		x				$734 million over five years	No experience yet	
Technology Advance-ment Program	www.aqmd.gov/tao/About/Index.html	SCAQMD	Vehicle reg. fees, violation settlements, State & fed'l grants	Criteria & toxic emissions from processes & fuels	R&D, demonstration, commer-cialization	Cost sharing	*Technology Advance-ment Program*		x		x	x	$9M-$15M / year	range:$6,000 to $3 million	Varies by type of solicitation. Overall: ~40%
Technology Incentive Program	www.pge.com/biz/rebates/2007_incentive_application/index.html	PG&E	Investor-owned utility ratepayers	Demand response technology for large power customers	Installing equip-ment & software	Incentives	*Technology Incentive Program*			x					
Incentive programs of localities, municipal utility districts & regulated utilities	www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=CA&RE=1&EE=1	- - - - - - - - - - - - See web site - - - - - - - - - - - -			Installations & operation	Incentives	*Incentive programs of localities, municipal utility districts & regulated utilities*	- - - - - - - - - - - - See web site - - - - - - - - - - - -							
Alternative & Renew-able Fuel & Vehicle Technology Program	www.energy.ca.gov/altfuels/	CEC	Vehicle reg. fees	(See "Overview")	TBD	Grants and loans	*Alternative & Renew-able Fuel & Vehicle Technology Program*		x			x	TBD	No information	

Appendix III - Current Biofuel Pathways

Biofuels have become a major focus in achieving compliance with the Low Carbon Fuel Standard of California. Provided that full lifecycle GHG emissions from growing, harvesting and processing biomass are low, biofuels provide an attractive option for reducing GHG emissions since CO_2 emissions from biofuel combustion are counter-balanced by carbon sequestered during the biomass growth. There are a wide array of biomass types that can be utilized for biofuel production such as sugar/starch crops, oil seeds, dedicated energy crops, agriculture residues, municipal solid waste, waste grease and fat, and algae. Depending on the conversion technologies utilized, biofuels with different characteristics, carbon intensity and final use can be obtained. Broadly speaking, there are five conversion technology pathways: (1) fermentation (2) thermochemical conversion (3) hydrotreatment (4) trans-esterification and (5) biomethane production.

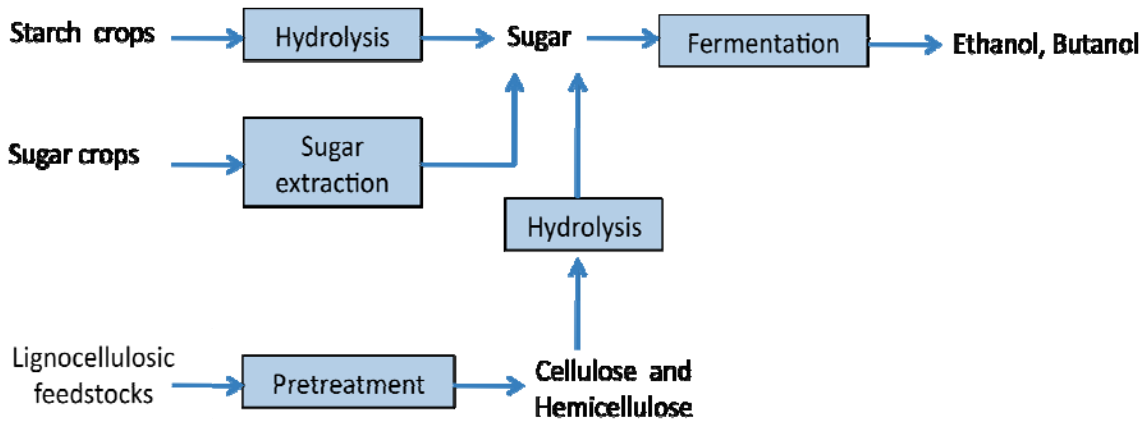

Fig. 1 Butanol and ethanol production via hydrolysis and fermentation

Fermentation technologies can be used to produce ethanol and butanol from starch, sugar or lignocellulosic feedstocks (Fig. 1). Butanol has higher energy content and lower vapor pressure than ethanol, and can be shipped through pipelines in blended form. A butanol multimedia assessment is currently underway to determine whether butanol can be a legal fuel component in California fuels. While sugar crops can readily be fermented, starch crops require an additional step before fermentation to hydrolyze starch into sugars using enzymes. Due to established agricultural feedstock supply and mature fermentation technologies, sugar and starch crops have grown rapidly and currently supply the bulk of biofuels produced worldwide. With growing concerns about GHG emissions from land use changes, direct and indirect, and potential food-fuel conflicts, the attention has now been shifted to encouraging commercialization of ethanol and butanol from lignocellulosic feedstocks.

However, lignocellulose cannot be directly converted into sugars. Pretreatments are required to separate lignin from cellulose and hemicellulose and make these carbohydrates amenable to hydrolysis (Fig. 1). Successful commercialization of cellulosic ethanol and butanol hinges on significantly improving the pretreatment and hydrolysis steps. It is projected that lignocellulosic technology can produce 115 gallons of cellulosic ethanol per dry ton of biomass (West et al., 2009).

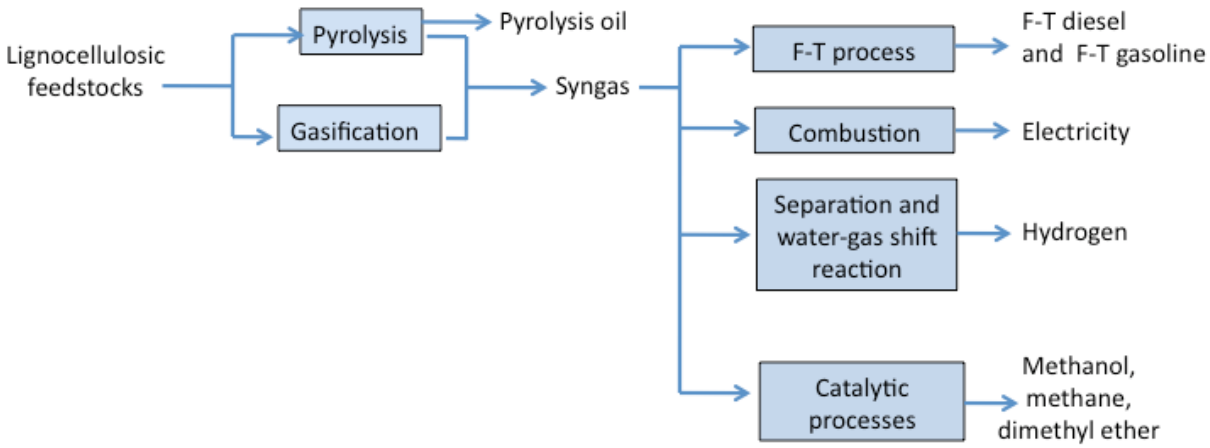

Fig. 2 Biofuel production via thermochemical conversions

Thermochemical conversion technologies are attractive because they can provide a wide range of fuels that include hydrogen, electricity, diesel, gasoline, and methanol (Fig. 2). Thermochemical conversions are more suitable for lignocellulosic feedstocks and start with either pyrolysis or gasification. Gasification results in syngas whereas pyrolysis results in both oils and syngas. Syngas is primarily a mixture of carbon monoxide, carbon dioxide, and hydrogen. The amounts of pyrolysis oils and syngas produced depend on how pyrolysis is done. For example, flash pyrolysis produces more oils than syngas. Syngas can be directly combusted to produce electricity, or it can be subjected to additional processing to convert it into other valuable fuels:

- Hydrogen can be created by subjecting syngas to water-gas shift reaction and hydrogen separation.
- F-T diesel and F-T gasoline can be produced using the Fischer-Tropsch process from syngas. The Fischer-Tropsch process was originally used to produce diesel from coal and later on from natural gas.
- Syngas can be converted to methanol, methane, and dimethyl ether using catalytic processes.

Although thermochemical conversions are more versatile than hydrolysis and fermentation, their applications to lignocellulosic feedstocks for biofuel production are still in the research and development phase.

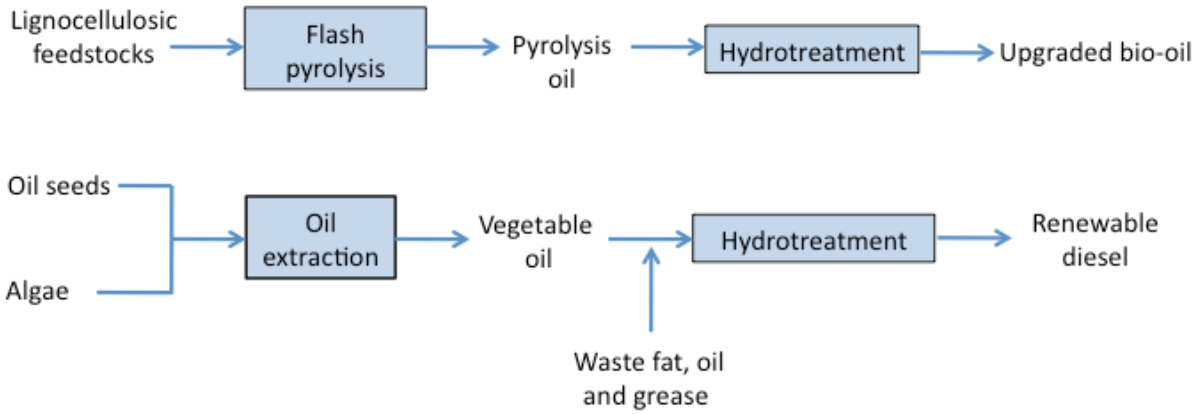

Fig. 3 Bio-oil and renewable diesel production using hydrotreatment.

Hydrotreatment provides an alternative pathway for producing diesel like renewable fuels (Fig. 3). Oils obtained from algae, oil seeds, and waste fat and grease can be hydrotreated to produce renewable diesel. Pyrolysis oils can be upgraded using hydrotreatment to produce high quality gasoline and diesel like fuels called upgraded bio-oils.

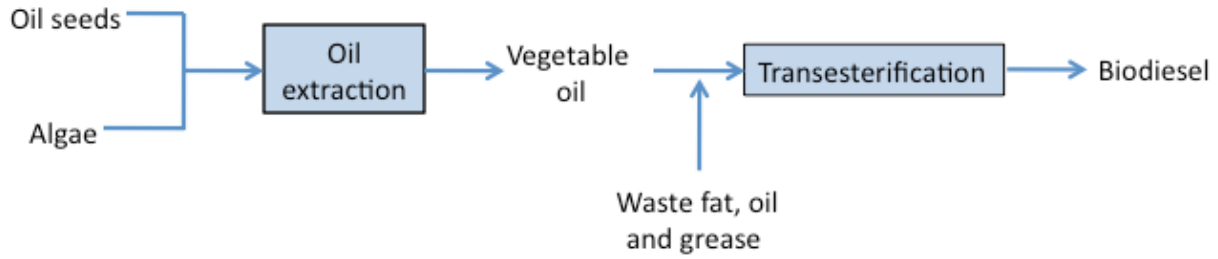

Fig. 4 Biodiesel production using trans-esterification

Biomass that contains significant amounts of lipids such as algae and oil seeds, and oils derived from animal fat, waste grease & oil can be used to produce biodiesel via trans-esterification (Fig. 4). Biodiesel comprises of mono-alkyl esters. Soybean is the main feedstock used in biodiesel production in the US whereas the rapeseed is the major feedstock for biodiesel production in Europe, but any biomass with significant amounts of lipids can be used.

Recently, there has been a growing interest in algae as a potential feedstock for the production of both renewable diesel and biodiesel. The main reason behind this interest is the higher growth rates and oil content of some naturally and genetically engineered algae. An NREL study (Sheehan et al., 1998) reported oil content as high as 59%. For comparison, soybeans, the current major source of biodiesel, have only 20% oil content. Genetically engineered algae can have an oil content of up to 80%. The per acre oil production from algae

can be 100-300 times more than that from soybean. Since algae can be grown either heterotrophically in fermenters; or phototrophically in salty water, ponds in deserts, and on marginal lands not suitable for crops; it can avoid the issues of competing with land for other uses. In a heterotrophic process, algae feed on nutrients and carbon substrates whereas in an autotrophic process algae utilizes photosynthesis for growth and deriving energy. However, several challenges remain. Diesel from algae is not yet cost competitive with conventional diesel due to high processing costs. For example, Solix Biofuel, a California based start-up, is capable of producing biodiesel at $33/gallon, which is far higher than the current diesel price (Greentech Media, 2009).

Production of diesel fuels from algae is still in the research and development phase. Several new startups and established companies such as Exxon Mobil and DOW Chemical have stated they will invest significant amounts of money in related research. Exxon Mobil expects that it would be able to commercially produce renewable diesel from algae within 5-10 years. Opportunities do exist for reducing the cost of production to $3.5/gallon in the near future.

Besides the issues of scale and economics, there are technological hurdles that need to be overcome for commercialization of biodiesel from algae. The most prominent among them are algae cultivation, harvest, oil extraction and maintaining the controlled environment for algae cultures to achieve the maximum yields (CARB, 2009).

Biomethane is one additional pathway to low carbon biofuels fuels. Biomethane can be produced from sources such as landfills, wastewater treatment plants, and agricultural waste. Methane from these sources can be used for energy recovery instead of being flared. (In some cases, methane emissions could escape directly to the atmosphere if not captured for energy recovery or destruction.) Flaring converts CH_4 into CO_2, which is less harmful to the climate, and destroys volatile organic compounds. However, flaring misses an opportunity to displace other fuels and can create some combustion contaminants. A California Energy Commission report states that biomethane has the potential to displace diesel used for transportation purposes and achieve large GHG emissions reductions.

Biomethane is well suited for applications where the producer owns natural gas powered vehicles in their fleet, as the biomethane can be utilized for energy recovery without additional infrastructure (such as a connection to a natural gas pipeline or an electricity-generating combustion device). For instance Clean Energy's McCommas Bluff landfill in Dallas produces 4 million cubic feet per day, equal to 33,000 gallons of gasoline. CO_2, sulfur compounds, and other contaminants are removed so that the fuel is essentially the same as pipeline quality natural gas.

Biomethane produced from waste products avoids issues regarding land use since no additional land is consumed to produce the feedstock. There are also competing uses for

biomethane, some of which are listed in Section 4.2 of this report on renewable electricity generation, which may reduce its availability as a transportation fuel.

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Appendix IV - Glossary

AB 32	California Global Warming Solutions Act of 2006
ARRA	American Recovery and Reinvestment Act of 2008
BC	Black Carbon
BEV	Battery Electric Vehicle
BLM	US Bureau of Land Management
Cal-EPA	California Environmental Protection Agency
CARB	California Air Resources Board
CalISO	California Independent System Operator
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CO_2	Carbon Dioxide
CPUC	California Public Utilities Commission
DG	Distributed Generation
DOE	United States Department of Energy
DWR	California Department of Water Resources
EAAC	Economic and Allocation Advisory Committee
EJAC	Environmental Justice Advisory Committee
ESA	Energy Services Agreement
ESP	Energy Service Provider
ESCO	Energy Services Company
ETAAC	Economic and Technology Advancement Advisory Committee
FCEV	Fuel cell electric vehicle
GHG	Greenhouse Gas(es)
GWP	Global Warming Potential
HAN	Home Area Network
ICAT	Innovative Clean Air Technology Program of CARB
IOU	Investor-Owned Utility
LCFS	Low Carbon Fuel Standard
LED	Light Emitting Diode
MMTCO2E	Million Metric Tons Carbon Dioxide Equivalent
MPR	Market Price Referent
MSW	Municipal Solid Waste
MW	Megawatts
MWh (or MWhr)	Megawatt-hours
NOx	Oxides of Nitrogen ($NO + NO_2$)
NEPA	National Environmental Policy Act
OBF	On-Bill Financing
PHEV	Plug-in Hybrid Electric Vehicle
PIER	Public Interest Energy Research program of CEC
PM10	Particulate Air Emissions less than 10-microns in diameter
POU	Publicly Owned Utility
PPA	Power Purchase Agreement
PV	Photovoltaic
R&D	Research and Development

RD&D	Research Development and Demonstration
RECs	Renewable Energy Credits
REO	Real Estate Owned
RETI	Renewable Energy Transmission Initiative
RPS	Renewable Portfolio Standard
RTU	Rooftop Unit
SBIR	Small Business Innovation Research
SEER	Seasonal Energy Efficiency Rating
SOx	Sulfur Oxides (SO_2 + SO_3)
ZNE	Zero Net Energy

California Environmental Protection Agency

Air Resources Board

Economic and Technology Advancement Advisory Committee Members

Alan Lloyd (Chair)
Dr. Lloyd is the President of the International Council on Clean Transportation. He served as the Secretary of the California Environmental Protection Agency from 2004 through February 2006 and as the Chairman of the California Air Resources Board from 1999 to 2004. Prior to joining ARB, Dr. Lloyd was the Executive Director of the Energy and Environmental Engineering Center for the Desert Research Institute at the University and Community College System of Nevada, Reno, and the Chief Scientist at the South Coast Air Quality Management District until 1996. Dr. Lloyd's work focuses on the viable future of advanced technology and renewable fuels, with attention to urban air quality issues and global climate change. A proponent of alternate fuels, electric drive and fuel cell vehicles eventually leading to a hydrogen economy, he was the 2003 Chairman of the California Fuel Cell Partnership and is a co-founder of the California Stationary Fuel Cell collaborative. He earned both his B.S. in Chemistry and Ph.D. in Gas Kinetics at the University College of Wales, Aberystwyth, U.K.

Bob Epstein (Vice-Chair)
Dr. Epstein is an entrepreneur and engineer with a Ph.D. from the University of California at Berkeley. He is currently the Co-Founder of Environmental Entrepreneurs, Chairman of the Board at GetActive Software, Director of New Resource Bank, Director of Cleantech Capital Group, Board Member of the Merola Opera Program, and Trustee of the Natural Resources Defense Council. Dr. Epstein co-founded Environmental Entrepreneurs (E2), a national community of professionals and business people who believe in protecting the environment while building economic prosperity. It serves as a champion on the economic side of good environmental policy by taking a reasoned, economically sound approach to environmental issues. Through active support of Natural Resources Defense Council, E2 works to influence state and national environmental policy.

Dan Adler
Mr. Adler is President of the California Clean Energy Fund (CalCEF), a nonprofit venture capital fund created to accelerate investment in California's clean energy economy. CalCEF Fund I is invested as a fund-of-funds in 40 companies covering the full range of clean energy technologies. In 2006 CalCEF founded the nation's first university center on energy efficiency, the Energy Efficiency Center at U.C. Davis, and in 2008 launched the CalCEF Clean Energy Angel Fund and an affiliated public policy and market intelligence organization, CalCEF Innovations. Mr. Adler has a B.A. in Political Science from U.C. Berkeley and an M.A. in Public Policy from Harvard University.

Jim Beno

Mr. Beno is the Directing Business Representative of District Lodge 190 of the International Association of Machinists and Aerospace Workers and a Vice President of the California Labor Federation, AFL-CIO, which represents two million workers in California. Jim Chairs the Green Jobs Labor Roundtable, an AB32 Working Group of the California Labor Federations Executive Committee. This committee was established to, among other things, explore the emerging technologies of the new Green economy and the impact and challenges this presents to our workforce in California and identifying the skill sets needed by workers in the new emerging green industries. Jim has worked for the International Association of Machinists and Aerospace Workers (a.k.a. Machinists Union) for over thirty years. He has held positions ranging from the chief financial officer of a local union to his current position as Director of one of the largest Districts in the Machinists Union in the United States. District 190 is comprised of thirteen Local Unions representing Machinists, Mechanics and Technicians working in the Automotive, Aerospace, Manufacturing and Transportation Industries in California and Nevada. Mr. Beno holds a B.S. Degree in Construction Engineering Technology from California State University Sacramento.

Jack Broadbent

As the Executive Officer/Air Pollution Control Officer, Mr. Broadbent is responsible for directing the Bay Area Air Quality Management District's programs to achieve and maintain healthy air quality for the seven million residents of the nine county region of the San Francisco Bay Area. Mr. Broadbent joined the Air District after serving as the Director of the Air Division at the U.S. Environmental Protection Agency, Region IX, where he was responsible for overseeing the implementation of the Clean Air Act as well as indoor air quality and radiation programs for the Pacific Southwest region of the United States. Previously, Mr. Broadbent was the South Coast Air Quality Management District's Deputy Executive Officer, where he directed the development of a number of landmark programs that contributed to significant improvements in air quality in the Los Angeles region. Mr. Broadbent holds a Master's degree in Environmental Administration and a Bachelor of Science degree in Environmental Science, both from the University of California at Riverside.

Marc Burgat

Marc Burgat joined the California Chamber of Commerce in November 2007 as Vice President, Government Relations. He oversees the CalChamber public policy team and serves as its chief policy advocate. Burgat has more than 15 years of experience in public policy, government, telecommunications and advocacy. Most recently, Burgat served as director of governmental affairs for the California Cable & Telecommunications Association, where he directed all state legislative activities. He previously was chief legislative representative for the City of Los Angeles and president of Strategic Communications & Advocacy, a firm specializing in public and legislative advocacy, coalition development and issues management. In his work, Burgat has represented organizations such as the California Medical Association, the American Stroke Association and Communications Workers of America. Burgat also held a position as director of public affairs for the American Heart Association and as a chief of staff and senior consultant in the California State Assembly. Burgat earned a B.A. in government from California State University, Sacramento.

Chris Busch
Dr. Busch is Director of Policy at the Center for Resource Solutions, where he promotes effective policy responses to the interrelated challenges of promoting clean energy innovation and reversing global warming. Previously, Chris held the position of Climate Economist in the Union of Concerned Scientists' Climate Program. From this post, he helped shape the group's positions on cap-and-trade program design and served as technical lead on these issues in UCS' advocacy on both implementation of California's Global Warming Solutions Act (Assembly Bill 32) and development of the Western Climate Initiative. In 2006, Chris co-authored the report Managing Greenhouse Gas Emissions in California while he was with UC Berkeley's California Climate Change Center. Prior to this, he served as Senior Research Associate in Lawrence Berkeley National Laboratory's International Energy Studies Group and worked in the Lab's Appliance and Lighting Standards Group. Chris holds two graduate degrees from the University of California, Berkeley: a Ph.D. in environmental economics from the Department of Agricultural and Resource Economics and a master's degree in public policy from the Goldman School of Public Policy.

Cynthia Cory
Ms. Cory is the Director of Environmental Affairs, Government Affairs Division, for the California Farm Bureau Federation (CFBF), a non-profit agricultural trade association with more than 91,500 members in 53 counties in California. She has been associated with the agricultural community for over thirty years; the past seventeen years have been at CFBF working on state and federal matters including air quality, biotechnology, climate change, transportation and renewable bioenergy issues. Ms. Cory has a M.S. in International Agricultural Development and a B.S. in Agronomy. She is also a member of the USDA Agricultural Air Quality Taskforce and serves on several advisory committees including the Governor's Environmental Advisory Task Force, the California Energy Commission's Climate Change Advisory Committee and their Biodiesel Working Group.

Jim Hawley
Mr. Hawley is the Vice President and General Counsel of Technology Network (TechNet), a California political and legislative strategy group, working with senior executives and government relations staff of California-based technology companies. He directed successful TechNet lobbying efforts related to green technology, litigation issues, e-commerce regulation, corporate taxation, and broadband deployment. Mr. Hawley has a B.A. Magna Cum Laude in political science from Amherst College, a JD from Georgetown University Law Center and an active member of the California Bar Association.

Roland Hwang
Mr. Hwang is the Natural Resources Defense Council's Vehicles Policy Director and works on sustainable transportation policies. Mr. Hwang has been with NRDC's San Francisco office since October 2000. He is an expert on clean vehicle and fuels technologies. He serves on various advisory panels, including for the AB 118 Alternative and Renewable Fuels and Vehicles Program, the California Hydrogen Highway Network Advisory Panel, the Automotive X Prize, and the Western Governors' Association Transportation Fuels for the Future Initiative. He is the author or contributing author of eleven NRDC reports. Before joining NRDC, Mr. Hwang was the Director of the Transportation Program for the Union of Concerned Scientists (UCS) in the Berkeley, California office. Mr. Hwang has also worked for the United States Department of Energy at Lawrence Berkeley National Laboratory (LBNL) in Berkeley, California and the California Air Resources Board (CARB) as an Air Pollution Engineer. Mr. Hwang received a Bachelors from the University of California at Davis in 1986 and Masters of Science in Mechanical Engineering from the same institution in 1988. He received a Masters degree in Public Policy from the University of California at Berkeley in 1992.

Patti Krebs
Patti Krebs is the Executive Director of the Industrial Environmental Association, a Southern California public policy trade organization that represents manufacturing, technology and research and development companies on a wide variety of legislative, regulatory and policy issues that affect their facilities and operations.

Patti currently serves on the San Diego Association of Governments Energy Working Group, the Port of San Diego's Maritime Advisory Committee, the San Diego Regional Airport Authority Technical Advisory Group and has been instrumental in the organization and founding of the San Diego Regional Sustainability Partnership. She is a past member of the Board of Directors of San Diego Transit Corporation, the San Diego Natural History Museum and the San Diego Symphony. She has served on numerous statewide technical boards and commissions including the State Water Resources Control Board Advisory Group on TMDLs and the Air Resources Board Neighborhood Assessment Group. Patti has a bachelor's degree in Communications from San Diego State University.

Ralph Moran
Ralph J. Moran is BP America's Director of West Coast Climate Change Issues. In this role, Mr. Moran is accountable for the development, management, and coordination of climate-related regulatory activities and is the BP lead representative with state and local governments on climate change policy development. Previously, Mr. Moran was BP's Director of Environmental Affairs in Washington D.C. In this previous role Mr. Moran supported BP's Western Hemisphere business segments and Communications and External Affairs group by facilitating engagements with non-governmental organizations and by managing environment-related policy issues – including federal climate change policy. Mr. Moran's previous work experience includes 20 years in both the upstream and downstream segments of the oil industry including oil field formation evaluation, site remediation and government relations. Mr. Moran holds B.S. and M.S. Degrees in Petroleum Engineering from the University of Southern California.

Dorothy Rothrock
Ms. Rothrock is Vice President of Government Relations for the California Manufacturers and Technology Association since 2000. Previously, she consulted on energy and telecommunications regulatory issues for industrial energy users, policy advocates, and economic research firms. Ms Rothrock graduated from University of Oregon and Lewis and Clark Law School, joining the Oregon Bar in 1980 and the California Bar in 1997.

Hank Ryan
Hank Ryan is currently with Efficiency Data and Development representing Small Business California. Mr. Ryan has been the lead intervenor for On Bill Financing (OBF), in the CPUC Energy Efficiency proceedings since 2004 and works closely with CA utilities currently rolling out OBF programs. He serves as Executive Director for Small Business California and is a Board Trustee for the National Small Business Association. He has been active in the commercial energy efficiency field since 1981 as an energy auditor and has operated several successful small businesses including an award winning restaurant. Mr. Ryan currently serves as the Program Manager for an EPA grant for Small Business California with a focus on Food Service Equipment and On Bill Financing.

Jan Smutny-Jones
Mr. Smutny-Jones is Executive Director of the Independent Energy Producers Association (IEP) and has represented IEP since 1987. He was a principal in the California Memorandum of Understanding and a key party in the restructuring legislation. He has served as Chair of the Governing Board of the California Independent System Operator, and as a member of the Governing Board of the California Power Exchange and the Restructuring Trusts Advisory Committee. Mr. Smutny-Jones is a graduate of Loyola Law School and is a member of the American, California State and Sacramento County Bar Associations. He did his undergraduate work at California State University, Long Beach, and has a certificate in Environmental Management from the University of Southern California.

Andrea Tuttle
Andrea Tuttle has 30 years experience in California resource policy issues. She is former Director of the California Department of Forestry and Fire Protection (CDF), and served on the California Coastal Commission and the North Coast Regional Water Quality Control Board. She was principal consultant to the Select Committee on Forest Resources in the California Senate, and has consulted on sustainable forest management in Malaysia. She currently teaches forest and fire policy in the College of Natural Resources at UC Berkeley and is a board member of The Pacific Forest Trust. She is a strong advocate for retaining working forestlands for their environmental, economic and social values, and incorporating the role of forests in a climate strategy. She has a Ph.D. in Environmental Planning from UC Berkeley and an MS in biology from the University of Washington.

Fong Wan
Mr. Wan is Senior Vice President of Energy Procurement for Pacific Gas and Electric Company (PG&E), and is responsible for gas and electric supply planning and policies, market assessment and quantitative analysis, supply development, procurement and settlement. Mr. Wan joined PG&E in 1988 and moved to Energy Trading in 1997. He served as Vice President, Risk Initiatives for PG&E Corporation Support Services, Inc and as Vice President, Power Contracts and Electric Resource Development. Mr. Wan has a Bachelor of Science degree in chemical engineering from Columbia University and a M.B.A from the University of Michigan.

Jonathan Weisgall
Mr. Weisgall is Vice President for Legislative and Regulatory Affairs for MidAmerican Energy Holdings Company, a subsidiary of Berkshire Hathaway. He also serves as Chairman of the Board of Directors of the Center for Energy Efficiency and Renewable Technologies and President of the Geothermal Energy Association. He is an Adjunct Professor of Law at Georgetown University Law Center, where he has taught a seminar on energy issues since 1990, and he has also guest lectured on energy issues at Stanford Law School and the Johns Hopkins Environmental Science and Policy Program. Mr. Weisgall earned his B.A. from Columbia College and his J.D. from Stanford Law School, where he served on the Board of Editors of Stanford Law Review.

John Weyant
Dr. Weyant is Professor of Management Science and Engineering, a Senior Fellow in the Institute for International Studies, and Director of the Energy Modeling Forum (EMF) at Stanford University. Established in 1976, the EMF conducts model comparison studies on major energy/environmental policy issues by convening international working groups of leading experts on mathematical modeling and policy development. Prof. Weyant earned a B.S./M.S. in Aeronautical Engineering and Astronautics, M.S. degrees in Engineering Management and in Operations Research and Statistics all from Rensselaer Polytechnic Institute, and a Ph.D. in Management Science with minors in Economics, Operations Research, and Organization Theory from University of California at Berkeley. Dr. Weyant was also a National Science Foundation Post-Doctoral Fellow at Harvard's Kennedy School of Government. His current research focuses on analysis of global climate change policy options, energy technology assessment, and models for strategic planning.

Rick Zalesky
Richard E. (Rick) Zalesky is General Manager of Manufacturing, Technology & Upstream Integration for Business Evaluation and Development in Global Supply & Trading of Chevron Products Company, a division of Chevron USA, Inc. A native of Los Angeles, Calif., he is a graduate of the Georgia Institute of Technology, with a bachelor's degree in Civil Engineering. Rick joined the company in 1978 as a design engineer at the Richmond refinery. In his career, he has held a variety of management positions of increasing responsibility in the downstream in refining, marketing, and technology including general manager of the Richmond refinery. Prior to his current role Rick was the Vice President of Biofuels and Hydrogen for Chevron Technology Ventures.

APPENDIX VI

U.S. Department of Energy Table
data from http://www.energy.gov/recovery/documents/recoveryactfunding.xls

see above website for updates, project descriptions, and list of individual awardees

Data is as of October 16, 2009

Program Office	Project	Authorized/ Appropriation (in $1000)	Awarded/ Obligation (in $1000)	Spent/ Outlay (in $1000)
ARPA-E	Program Funding Level	388,856	SEE BELOW	SEE BELOW
	Advanced Research Projects Agency - Energy (ARPA-E)	see program funding line	2,741	474
	Program Direction - ARPA -E	see program funding line	215	202
ARPA-E Sum:		**388,856**	**2,956**	**676**
DA	Program Funding Level	42,000	SEE BELOW	SEE BELOW
	Departmental Administration	see program funding line	20,454	3,653
	Working Capital Fund	see program funding line	0	0
DA Sum:		**42,000**	**20,454**	**3,653**
EERE	Program Funding Level	16,771,907	SEE BELOW	SEE BELOW
	Advanced Building Systems	0	0	0
	Advanced Materials RD&D in Support of EERE Needs to Advance Clean Energy Technologies and Energy-Intensive Process R&D	see program funding line	29,950	329
	Battery Manufacturing	see program funding line	168,600	0
	Buildings and Appliance Market Transformation	see program funding line	2,899	740
	Clean Cities AFV Grant Program	see program funding line	0	0
	Combined Heat and Power (CHP), District Energy Systems, Waste Heat Recovery Implementation and Deployment of Efficient Industrial Equipment	see program funding line	0	0
	Commercial Scale Biorefinery Projects	see program funding line	841	0
	Commercial Vehicle Integration (SuperTruck) and Advanced Combustion Engine R&D	see program funding line	5,500	0
	Community Renewable Energy Deployment	see program funding line	527	10
	Concentrating Solar Power	see program funding line	19,733	0
	EE Appliance Rebate Programs	see program funding line	32,100	23
	EE Conservation Block Grant Program	see program funding line	1,627,056	12,305
	EGS Technology R&D	see program funding line	13,917	46
	Enabling Fuel Cell Market Transformation	see program funding line	34,460	4,420
	Energy, Water & Emissions Reporting and Tracking System	see program funding line	4,000	48
	Enhance and Accelerate FEMP Service Functions to the Federal Government	see program funding line	13,696	178
	Fundamental Research in Key Program Areas	see program funding line	5,096	4
	Geothermal Demonstrations	see program funding line	1,500	0
	Ground Source Heat Pumps	see program funding line	0	0
	High-Penetration Solar Deployment	see program funding line	7,700	0
	Hydroelectric Facility Modernization Program	see program funding line	0	0
	Improved Energy Efficiency for Information and Communication Technology	see program funding line	0	0

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Program Office	Project	Authorized/ Appropriation (in $1000)	Awarded/ Obligation (in $1000)	Spent/ Outlay (in $1000)
	Industrial Assessment Centers and Plant Best Practices	see program funding line	1,225	0
	Integrated Biorefinery Research Expansion	see program funding line	13,433	0
	Investigation of intermediate ethanol blends, optimization of E-85 engines, and development of transportation infrastructure	see program funding line	11,578	220
	Lab Call for Facilities and Equipment	see program funding line	0	0
	Large Wind Turbine Blade Testing Facility	see program funding line	24,753	0
	Management and Oversight (EE Program Direction)	see program funding line	33,352	13,388
	Modify Integrated Biorefinery Solicitation Program for Pilot and Demonstration Scale Biorefineries	see program funding line	5,146	1,037
	NWTC Upgrades	see program funding line	9,950	0
	National Accounts Acceleration in Support of the Commercial Buildings Initiative	see program funding line	0	0
	National Geothermal Database, Resource Assessment and Classification System	see program funding line	2,569	0
	PV Systems Development	see program funding line	32,400	1,634
	Renewable Energy and Supporting Site Infrastructure	see program funding line	86,660	11
	Residential Buildings (Building America, Builders' Challenge, and Existing Home Retrofits)	see program funding line	0	0
	Solid State Lighting	see program funding line	0	0
	State Energy Program	see program funding line	3,076,750	18,550
	Transportation Electrification	see program funding line	141,500	0
	Validation of Innovative Exploration Technologies	see program funding line	0	0
	Weatherization Assistance Program	see program funding line	4,747,431	198,854
	Weatherization Innovation Pilot Program	see program funding line	0	0
	Wind Energy Consortia between Institutions of Higher Learning and Industry	see program funding line	0	0
	Wind Energy Technology R&D and Testing	see program funding line	0	0
	Wind Turbine Drivetrain Testing Facility	see program funding line	0	0
EERE Sum:		**16,771,907**	**10,154,321**	**251,797**
EM	Program Funding Level	6,000,000	SEE BELOW	SEE BELOW
	ANL Recovery Act Project	see program funding line	79,000	2,432
	BNL Recovery Act Project	see program funding line	42,355	10,528
	ETEC Recovery Act Project	see program funding line	54,162	38,541
	Hanford Central Plateau D&D Recovery Act Project	see program funding line	740,120	86,653
	Hanford Central Plateau Soil and Groundwater Recovery Act Project	see program funding line	145,780	11,737
	Hanford River Corridor D&D Recovery Act Project	see program funding line	442,265	31,000
	Hanford River Corridor Soil and Groundwater Recovery Act Project	see program funding line	77,815	2,913
	Hanford TRU Waste Recovery Act Project	see program funding line	228,520	27,526
	INL Buried Waste Recovery Act Project	see program funding line	119,300	13,830

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Program Office	Project	Authorized/ Appropriation (in $1000)	Awarded/ Obligation (in $1000)	Spent/ Outlay (in $1000)
	INL D&D Recovery Act Project	see program funding line	217,875	33,923
	INL TRU Waste Recovery Act Project	see program funding line	130,000	31,613
	LANL Defense D&D Recovery Act Project	see program funding line	64,200	1,676
	LANL Defense Soil and Groundwater Recovery Act Project	see program funding line	132,800	3,542
	LANL Non-Defense Recovery Act Project	see program funding line	14,775	845
	Liquid Waste Tank Infrastructure	see program funding line	200,000	206
	Moab Recovery Act Project	see program funding line	108,350	6,365
	Mound Operable Unit 1 Recovery Act Project	see program funding line	19,700	0
	NTS Recovery Act Project	see program funding line	44,325	8,151
	ORP Recovery Act Project	see program funding line	326,035	28,359
	Oak Ridge Defense ORNL D&D Recovery Act Project	see program funding line	111,363	7,957
	Oak Ridge Defense TRU Waste Recovery Act Project	see program funding line	78,000	5,572
	Oak Ridge Defense Y-12 D&D Recovery Act Project	see program funding line	325,000	24,840
	Oak Ridge Non-Defense Recovery Act Project	see program funding line	20,281	1,819
	Oak Ridge UE D&D Funded Recovery Act Project	see program funding line	118,200	8,421
	Paducah Recovery Act Project	see program funding line	78,800	1,333
	Portsmouth Recovery Act Project	see program funding line	118,200	5,582
	Program Direction - EM - Defense Environmental Management	see program funding line	9,020	2,214
	Program Direction - EM - Non-Defense Environmental Management	see program funding line	1,030	195
	Program Direction - EM - Uranium Enrichment D&D Fund	see program funding line	682	7
	SLAC Recovery Act Project	see program funding line	7,925	1,326
	SPRU Recovery Act Project	see program funding line	51,775	562
	SRS D&D M & D Areas Recovery Act Project	see program funding line	104,000	2,429
	SRS D&D P & R Areas Recovery Act Project	see program funding line	478,400	35,013
	SRS D&D, Soil & Groundwater Activities Site-wide Recovery Act Project	see program funding line	292,000	52,293
	SRS TRU & Solid Waste Recovery Act Project	see program funding line	541,000	133,862
	Title X Uranium/Thorium Reimbursement Program	see program funding line	32,271	31,871
	WIPP Recovery Act Project	see program funding line	172,375	20,278
	West Valley Recovery Act Project	see program funding line	73,875	5,435
EM Sum:		**6,000,000**	**5,801,574**	**680,851**
FE	Program Funding Level	3,398,607	SEE BELOW	SEE BELOW
	Carbon Capture and Storage	see program funding line	0	0
	Expand and Extend Clean Coal Power Initiative Round III	see program funding line	50,390	1
	Geologic Sequestration Site Characterization	see program funding line	58	3
	Geologic Sequestration Training and Research Grant Program	see program funding line	208	5
	Industrial Carbon Capture and Storage Applications	see program funding line	59,269	268

U.S. Department of Energy Table
data from http://www.energy.gov/recovery/documents/recoveryactfunding.xls

see above website for updates, project descriptions, and list of individual awardees

Data is as of October 16, 2009

Program Office	Project	Authorized/ Appropriation (in $1000)	Awarded/ Obligation (in $1000)	Spent/ Outlay (in $1000)
	Program Direction - FE	see program funding line	1,572	1,354
FE Sum:		**3,398,607**	**111,497**	**1,631**
LGPO	Program Funding Level	3,970,000	SEE BELOW	SEE BELOW
	ATVM Administrative Fees Transfer	see program funding line	8,117	1,584
	Administrative Fees Section 1705	see program funding line	4,585	538
	LGPO	see program funding line	40,500	4,898
LGPO Sum:		**3,970,000**	**53,202**	**7,019**
OE	Program Funding Level	4,495,712	0	0
	Enhancing State and Local Governments Energy Assurance	see program funding line	43,387	11
	Interconnection Transmission Planning and Analysis	see program funding line	0	0
	Interoperability Standards and Framework (EISA 1305)	see program funding line	10,000	10,000
	Program Direction - OE	see program funding line	1,961	918
	Smart Grid Investment Grant Program (EISA 1306)	see program funding line	7,520	265
	Smart Grid Regional and Energy Storage Demonstration Project (EISA 1304)	see program funding line	47,651	649
	State Assistance on Electricity Policies	see program funding line	0	0
	Workforce Development	see program funding line	0	0

Authorized/ Appropriation ($K): Funds made available to DOE in the Recovery Act.
Awarded/ Obligation ($K): Funding commitments from DOE that will likely result in payments.
Spent/ Outlay ($K): Amount of awarded/obligated funds that have been paid.