Policy Initiatives and Funding Incentives

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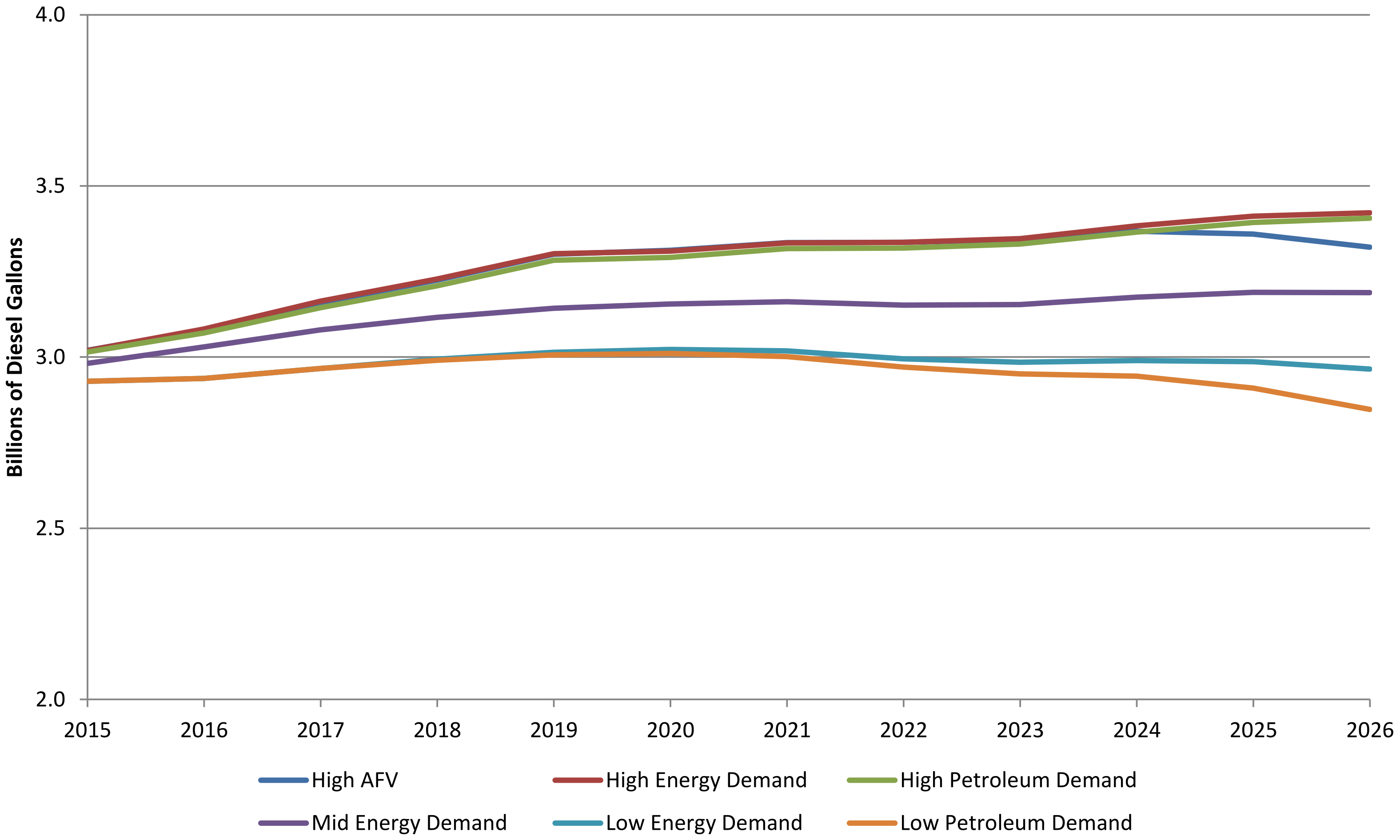
Trends That Might Impact Alternative Fuel Development and Use

- California Is Growth Market for Low CI Biofuels and Biomethane – LCFS
- Uncertainty About Federal RFS
- Petroleum Refineries Initiating Projects/Showing Interest in Biofuels
- Biomethane and Low NOx Natural Gas Engine Poised for Major Expansion in Response to Tailpipe Emissions and SLCP
- Renewable Diesel and Biodiesel Growth – Imports and In-State Development
- SB 350 and SB 1383 Regulations and Policies Combined with Incentive Funding
- Governor’s Executive Order to Ensure Infrastructure for 5 Million ZEVs

California and Federal Initiatives Related to Biomethane Transportation Energy	
California Government Initiatives	
Global Warming Act (2006)	Reduce greenhouse gas emissions to 1990 levels by 2020 and 80% below 1190 levels by 2050
Low Carbon Fuel Standard (2007)	Reduce carbon intensity of transportation fuels sold in California by 10% by 2020
Petroleum Reduction and Alternative Fuel Goals (2003) and Alternative Fuels Plan (2007)	Reduce petroleum use to 15% below 2003 levels by 2020. Increase alternative fuel use to 9% of California's fuel consumption by 2012, 11% by 2017, and 26% by 2022. Governor Office direction (2015) to reduce petroleum use by up to 50% by 2030
SB 1257 Natural Gas Challenges/Opportunities	Identifies strategies to maximize the benefits obtained from natural gas, including biomethane, as an energy source in IEPR
Funding Incentives (AB 118, AB 8, Carl Moyer, Prop1B, GGRF)	Energy Commission, ARB and local air districts provide financial incentives to vehicle, infrastructure and fuel production projects that reduce greenhouse gas emissions and air pollutants and increase the use of alternative fuels
CPUC Biomethane Pipeline Ruling	Establish standards for energy value and clean-up of contaminants for injection of biomethane in natural gas pipelines. CCST Study and five pilot pipeline interconnection projects in 2018.
SB 1383 Actions by ARB, CPUC, CEC, CalRecycle and CDFA	Requires 40% reduction of SLCP (methane) below 2013 levels by 2030. Dairy farms, landfills, waste water treatment plants are target submarkets for grant funds, regulations and other actions.
Federal Government Initiatives	
Renewable Fuels Standard	Requires annual specified levels of renewable fuels, including biomethane, as transportation fuel displacements of diesel and gasoline
National Ambient Air Quality Standards	Sets standards for tailpipe air pollutant emissions for vehicles by 2023

On-Road Diesel Demand Forecast



California Waste Stream Feedstocks

Category	Technical Potential (MM BDT/yr)	BioFuel Potential (MM gal ethanol)	BioFuel Potential (MM gal biodiesel)	Biomethane Potential (billion ft^3)	Biomethane Potential (million GGE)
Animal Manure (Dairy & Poultry)	3.4			19.5	168
Landfills	[106 billion ft^3]			53	457
Municipal Solid Waste (Food, Leaves, Grass Fraction)	1.2			12.7	109
Wastewater Treatment Plants	[11.8 billion ft^3]			7.7	66
Fats, Oils and Greases	[207,000 tons]		55.2	1.9	16
Agricultural Residues	5.3	397.5		51.8	446
Forest Residues	14.2	1,065		139	1,200
Municipal Solid Waste (Lignocellulosic Fraction)	6.7	502.5		12.7	568
Totals	**30.8+**	**1,965**	**55.2**	**351**	**3,030**

Compiled by Rob Williams, University of California, Davis. April 2014, Oct., 2015, Feb., 2016. Source material: Williams, R. B., B. M. Jenkins and S. Kaffka (California Biomass Collaborative). 2015. An Assessment of Biomass Resources in California, 2013. Contractor Report to the California Energy Commission. PIER Contract 500-11- 020. RevA., April 2016. Revised biomethane column titles. http://biomass.ucdavis.edu/publications/

Program Status Update

$748 million awarded to more than 585 projects

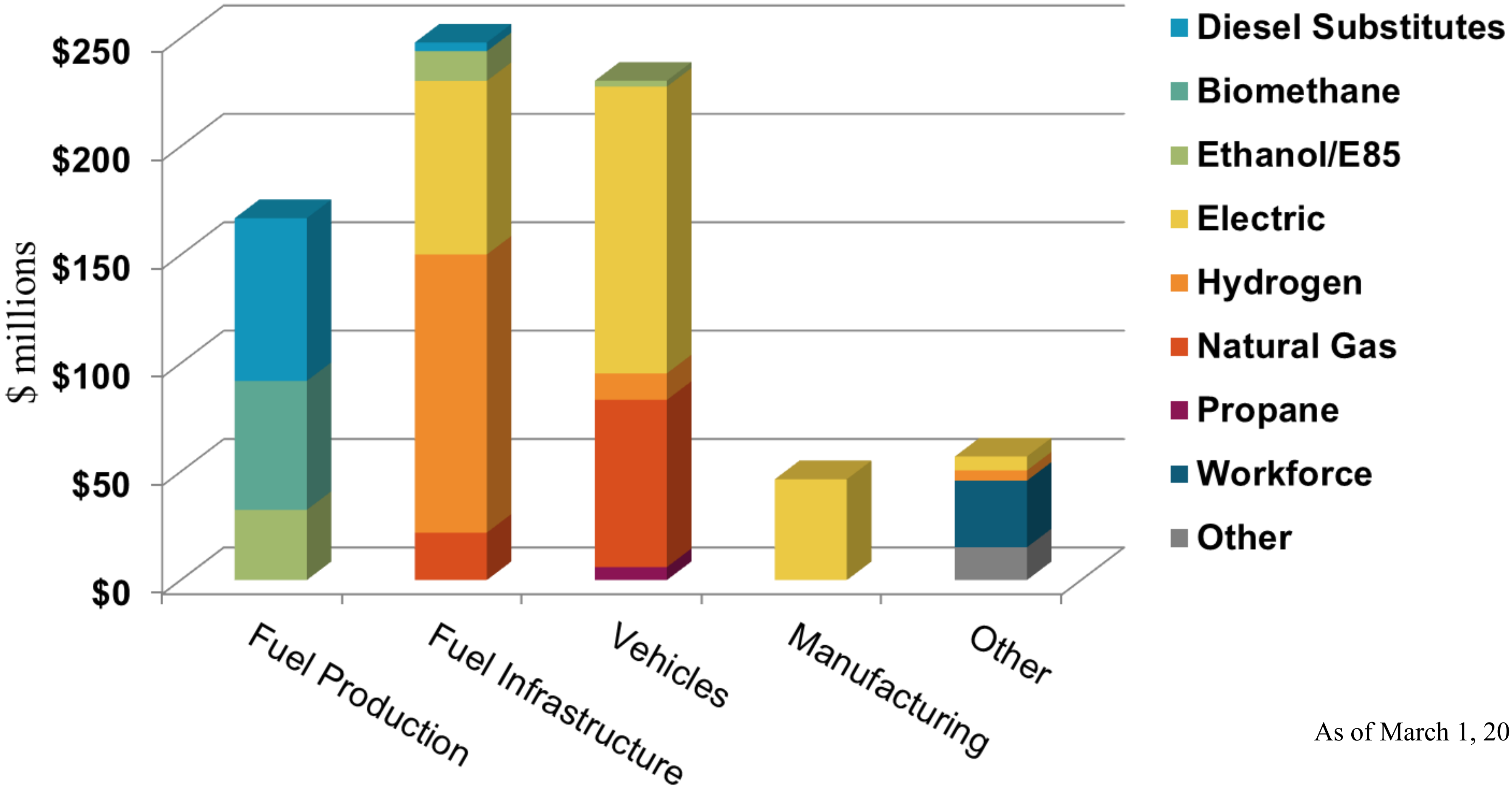
Awards include:

- 59 Biofuel Production Projects
- 64 Hydrogen Refueling Stations
- 21,000 Electric Vehicles Rebates
- 21 Manufacturing Projects
- 49 Advanced Technology Truck Demonstrations
- 7,796 EV Chargers
- 64 Natural Gas Fueling Stations
- 3,148 Natural Gas Vehicles
- 16,943 Workforce Trainees
- 40 Regional Readiness Grants

Significant reductions in GHG emissions, petroleum use, and air pollution expected from investments

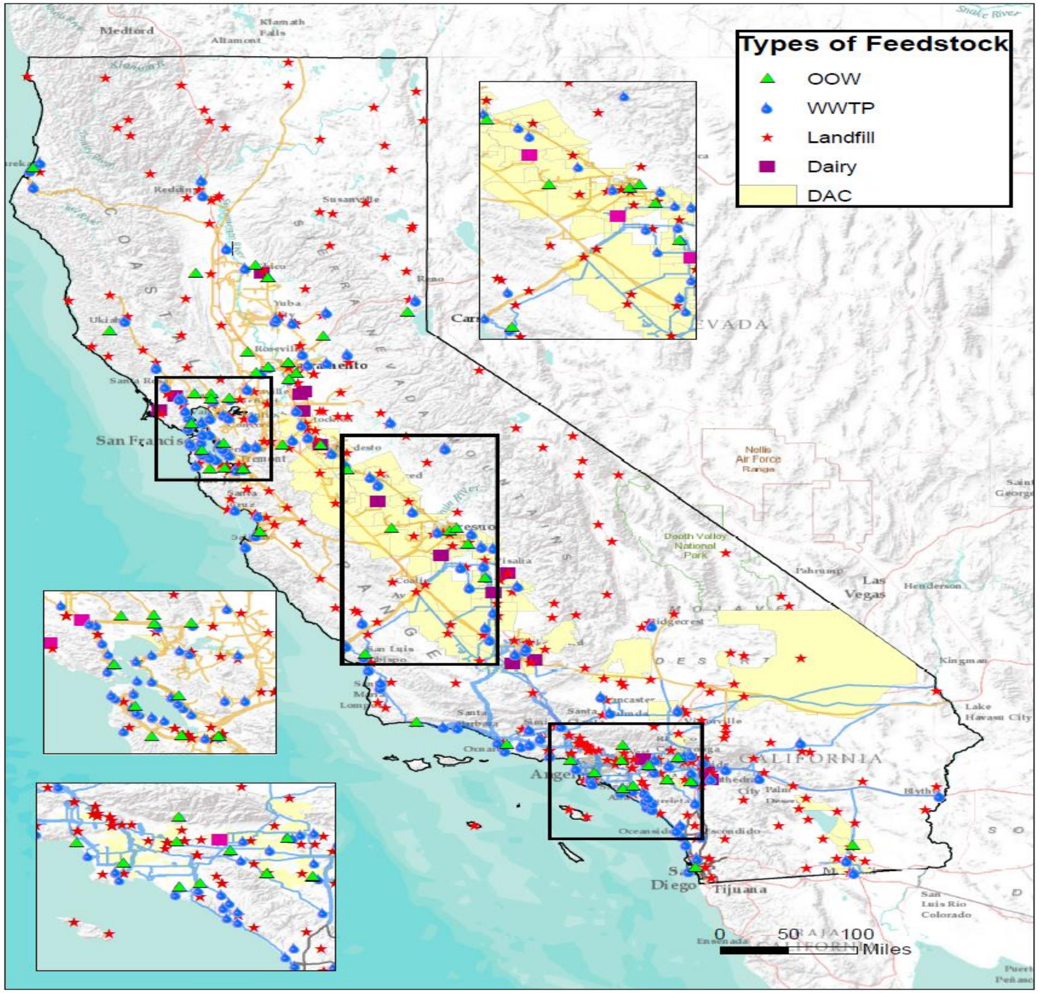
As of March 1, 2017

Projects To-Date



As of March 1, 2017

Location of Waste Resources and Disadvantaged Communities



CEC Anaerobic Digester Dairy Biogas Activities

ARFVTP

- Calgren Renewables – Pixley
- California Bioenergy – Kern Dairy Cluster
- Agriculture Waste Solutions – Moreno Valley
- Colony Energy Partners - Tulare

R&D

- Dairy Power Production Program – 10 power generation projects
- Vintage Dairy pipeline injection demonstration
- Kern Dairy Cluster
- Biomethane Roadmap

Other CEC Biomethane and Biofuel Projects

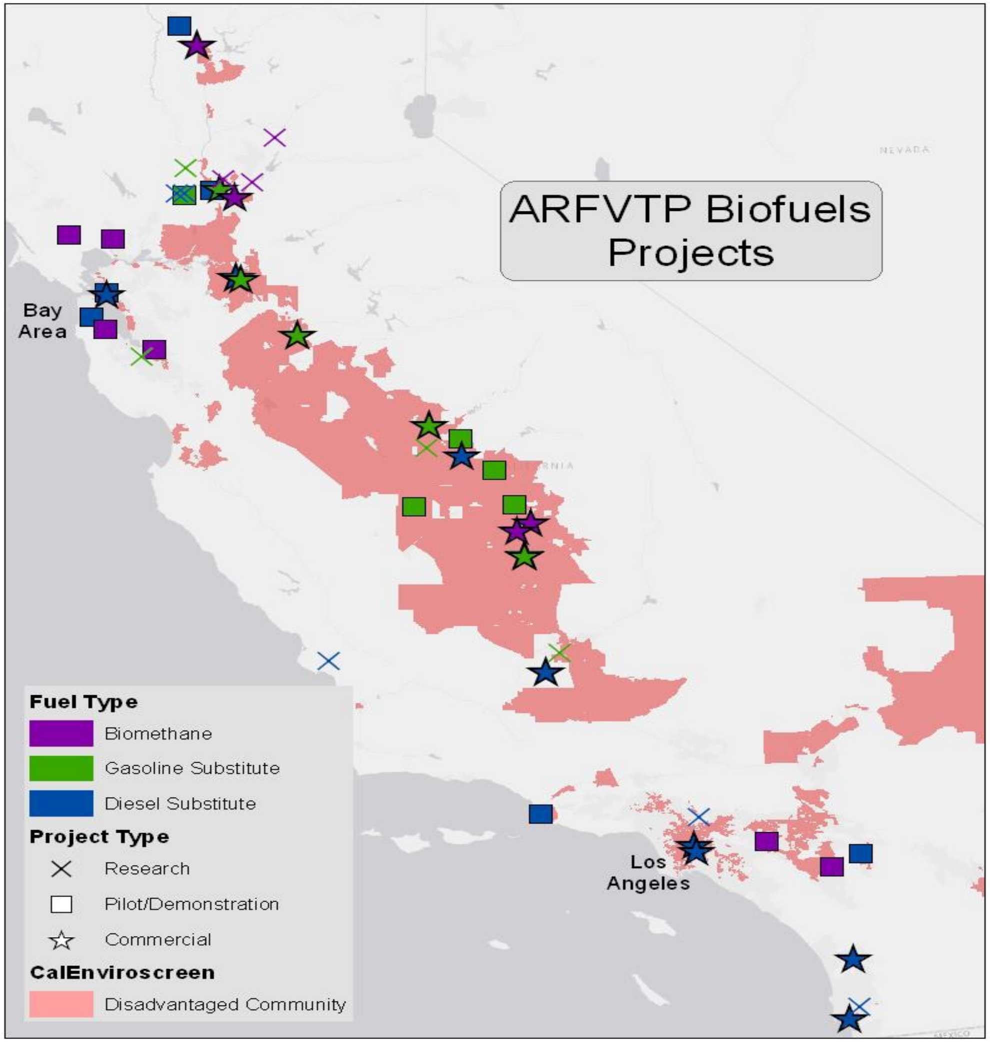
Other AD Technology Projects

- Organic Diversion
  - CR&R Waste Haulers – City of Perris/Riverside County
  - Anaergia – Rialto
  - Blue Line – South S.F.
- Waste Water Treatment
  - San Mateo
  - Petaluma

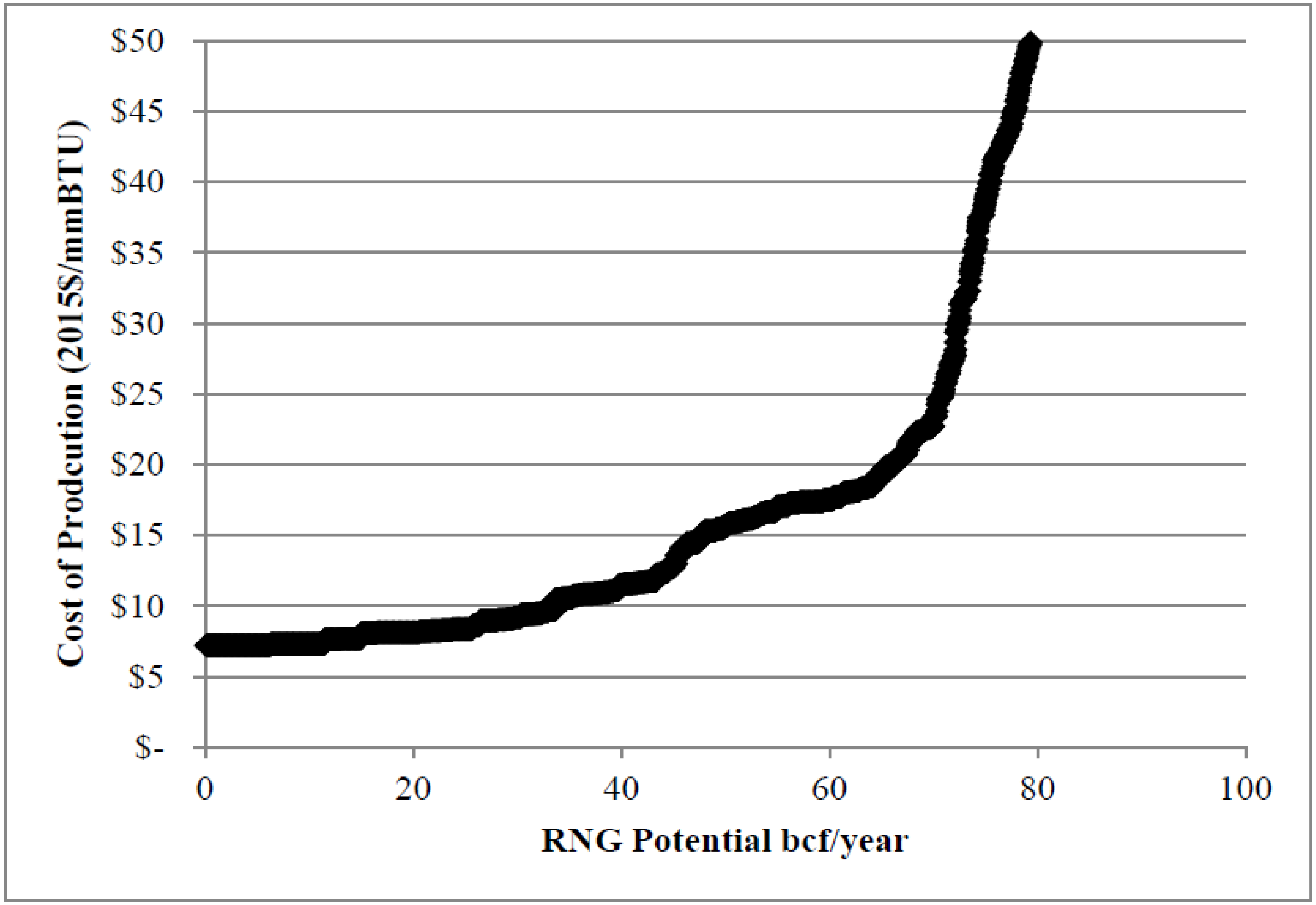
Gasification, Pyrolysis, and Emerging Technologies

- Biodico ZNEF
- Sierra Energy – Fort Liggett
- Biogas Energy – Northern California
- Lawrence Livermore Lab
- Lawrence Berkeley Lab

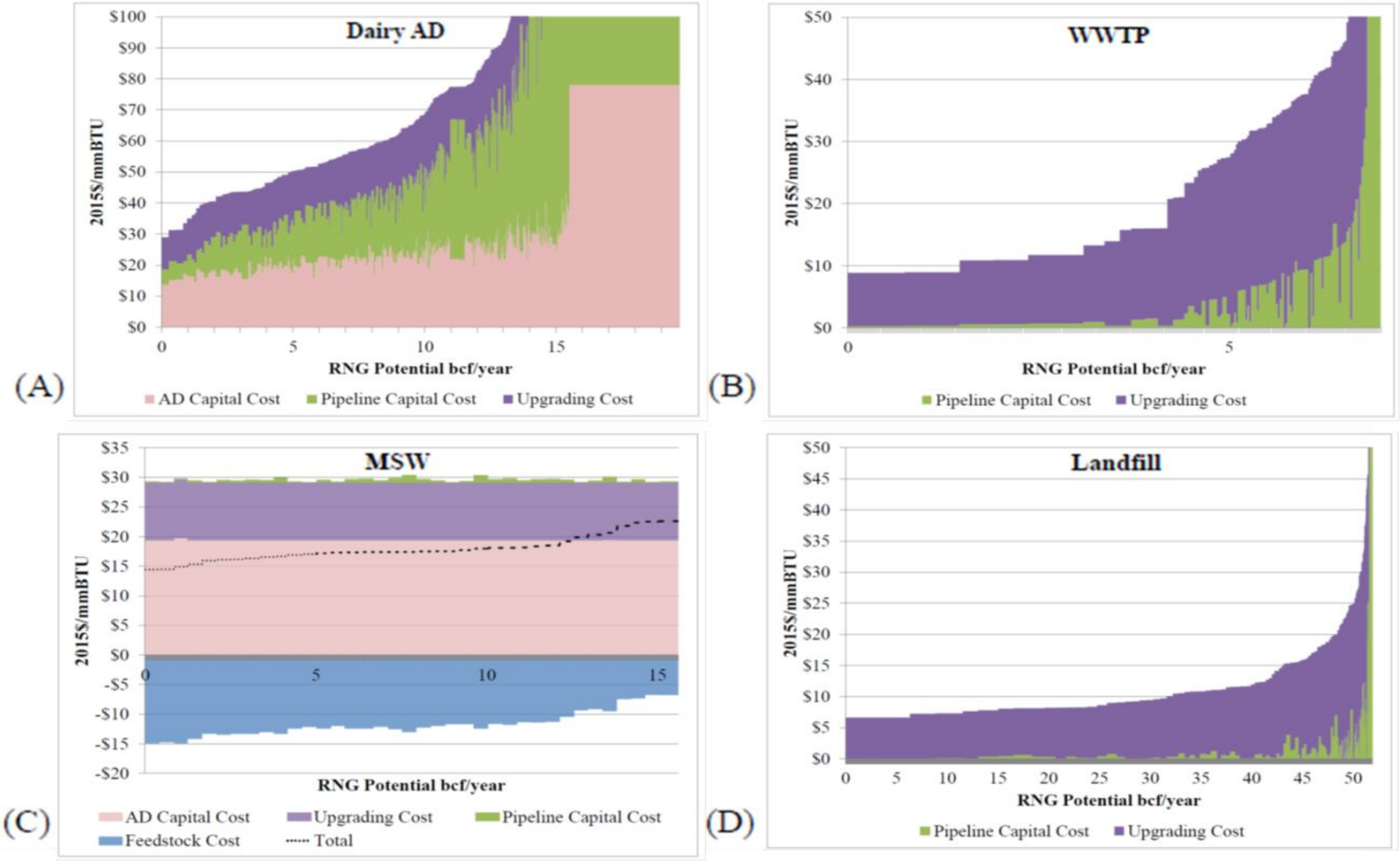
Biofuel and Biomethane Project Locations



California Potential Supply of Renewable Natural Gas (RNG) Derived from Anaerobic Digestion



Supply Curve and Component Cost for (A) Dairies, (B) WWTPs, (C) MSW, and (D) Landfills



Source California Energy Commissi

Capital Cost Ranges ($ per MMBtu per Year Capacity

[1]	Food / Urban / MSW		Dairy		Wastewater		Landfill	
	Low	High	Low	High	Low	High	Low	High
Organics Collection, Separation, and Processing Equipment	$9.5	$21	TBD	TBD	$16	$42		
Digester Technology	$68	$103	$7	$45	$220	$425		
Gas Collection System							$2	$13
Biogas Clean Up Equipment	$19	$29	$20	$55	TBD	$40	$14	$37
Facility Engineering, Construction, and Permits	$117	$177	$31	TBD	$25	$104	$12	$20
Subtotal Cost	$219	$331	$50	$230	TBD	TBD	$28	$70
Contingency (7 percent)	$15	$23	$3	$16	TBD	TBD	$2	$5
Biomethane Plant Total Cost	$236	$355	$53	$246	TBD	TBD	$29	$75

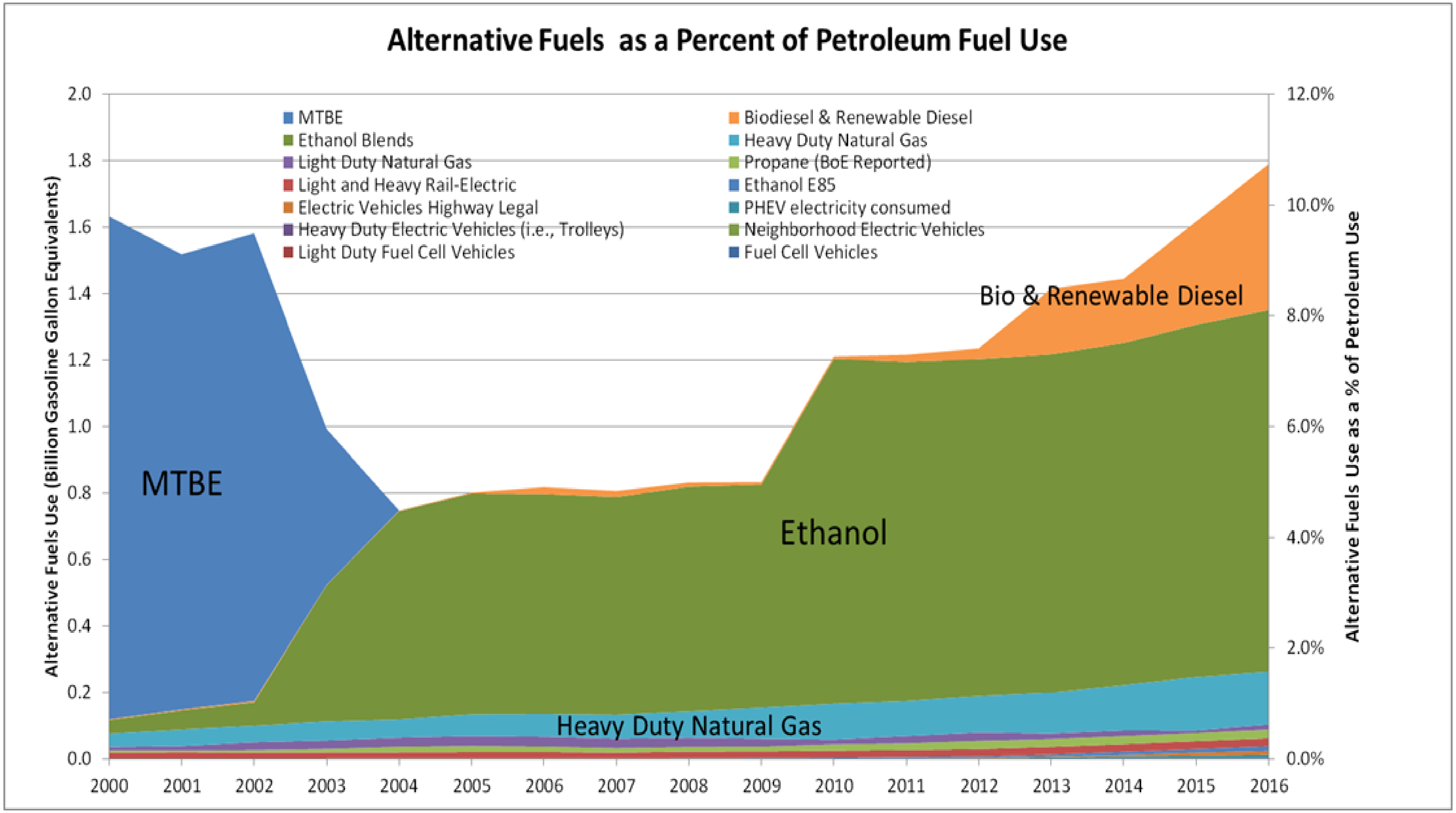
Capital Cost Ranges for Biomethane End Uses

		Capital Cost Range ($ per MMBtu per Year Capacity) *Unless otherwise stated	
		Low	High
Vehicle Fuel	CNG Fueling Station	$7.5	$12.6
	Differential Cost of 100 Vehicles (for refuse trucks)	$31	$78.5
Pipeline Injection	Biogas Gathering Lines (for centralized cleaning)	$12.5	$45
	Biogas Conditioning/Upgrading Equipment	$14.5	$75
	Natural Gas Pipeline Interconnect	$7.8	$35
Electricity Generation	Electricity Generator (Stationary Reciprocating Engine, Microturbine, Fuel Cell)	$58	$264
	Electricity Interconnect*	$3	$26

[1]

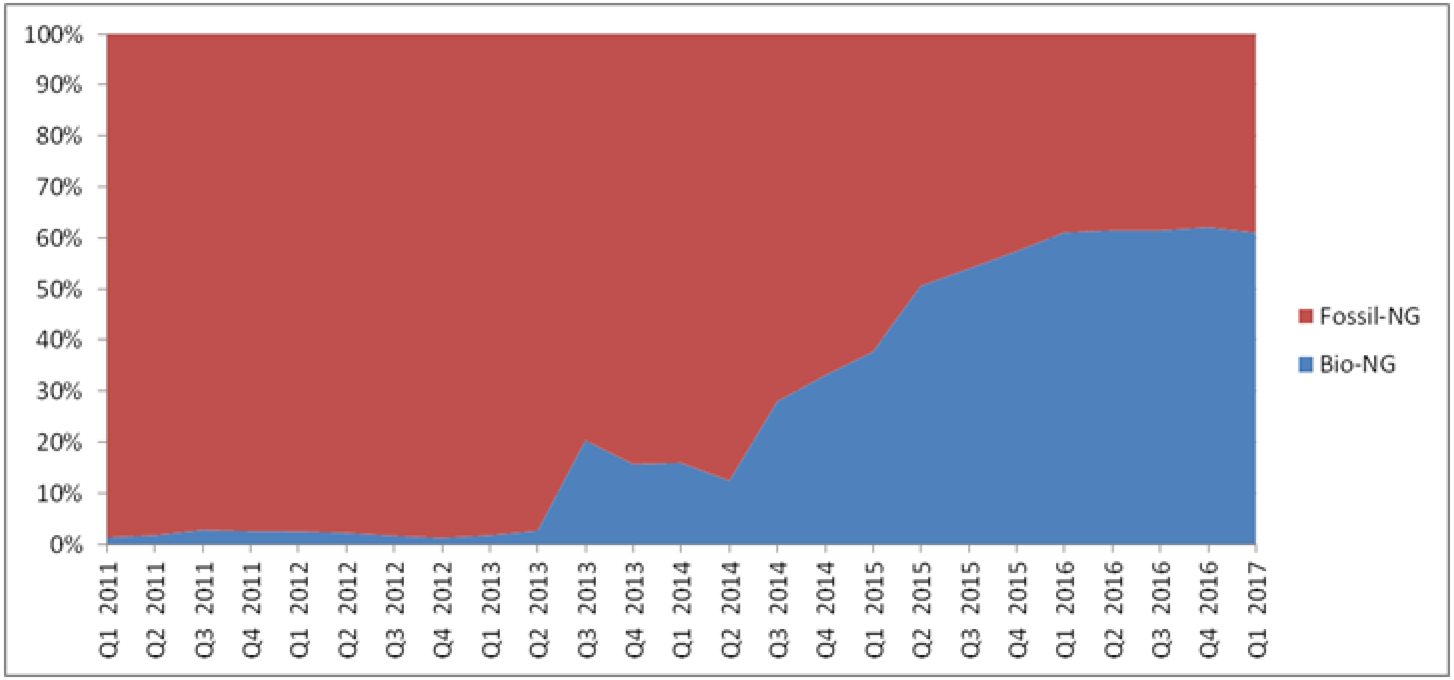
Biomethane Facility Revenue

		Revenue Range		Current Incentives Revenue (End of May 2017)
		Low	High	
CNG Vehicle Fuel	CNG Sales or Fuel Savings ($/DGE)	$1.70	$2.80	
	RFS D5 RIN Credits ($/DGE) Or [RFS D3 RIN Credits ($/DGE)]	$1.25 [$3.62]	$2.01 [$4.63]	$1.65 [$4.27]
	Cellulosic Waiver Credits ($/DGE) (cannot be earned with RFS D3 RINs, but can with D5 RINs)	$0.76	$3.31	$2.00
	LCFS Credits ($/DGE)	$0.20	$6.09	$0.63 - $3.50
Hydrogen Vehicle Fuel	Hydrogen Sales ($/kg) [$/DGE]	$10 [$11]	$18 [$20]	
	RFS D5 RIN Credits ($/DGE) [RFS D3 RIN Credits ($/DGE)]	$1.07 [$3.50]	$1.46 [$4.03]	$1.50 [$3.87]
	Cellulosic Waiver Credits ($/DGE)[38] (cannot be earned with RFS D3 RINs, but can with D5 RINs)	$0.76	$3.31	$2.00
	LCFS Credits ($/DGE)	$0.56	$4.10	$1.87 - $2.43
Electricity	Electricity PPA ($/kWh)	$0.067	$0.12	
	SGIP ($/W)	$1.00	$1.20	$1.20
	Energy Savings ($/kWh)	$0.09	$0.20	
General	Tipping Fee (for accepting feedstock material)	$35/ton	$112/ton	
	Biosolids Compost / Soil Amendment Sales	$10/ton	$16/ton	
	Liquid Fertilizer Sales	TBD	TBD	



Alternative Fuels as a Percent of Petroleum Fuel Use

LCFS Bio-Gas & Bio-LNG percent of Total Natural Gas



SB 1383 Challenges Addressed at IEPR Workshop on June 27, 2017

- How many projects are needed to achieve SB 1383 target (40% SLCP reduction by 2030)?
- Cost-effectiveness of projects varies for dairy farm, landfill, organic diversion and waste water treatment submarket deployment
- Perceived uncertainties about government programs, incentives and regulations
- Utilities balance reliability/safety with expedited and lower cost interconnection/injection
- Growth needed in vehicle product offerings
- Transportation fuel projects generate up to 4X more revenue than electricity projects from same waste residue – but need long term contracts to attract private financing

2017 IEPR Recommendations Regarding SB 1383 Challenges

- Focus on near term opportunities to reduce SLCP
- Encourage renewable gas use in state fleets
- Continue to develop LCFS amendments
- Use common feedstock collection, procurement and supply network
- Address CEQA concerns
- Prioritize DAC
- Implement policies to build commercial markets
- Develop mechanisms for long term market certainty
- Offer incentives for long term feedstock supply contracts
- Increase methods to increase landfill tipping fees
- Minimize flaring
- Consider lessons learned from BioMat
- Reduce methane through recycling
- Examine status of power to gas
- Expand natural gas R&D funding