2017 Progress Report on the Low Carbon Fuel Standard

June 22, 2017

Board Hearing

California Environmental Protection Agency

Air Resources Board

LCFS Update

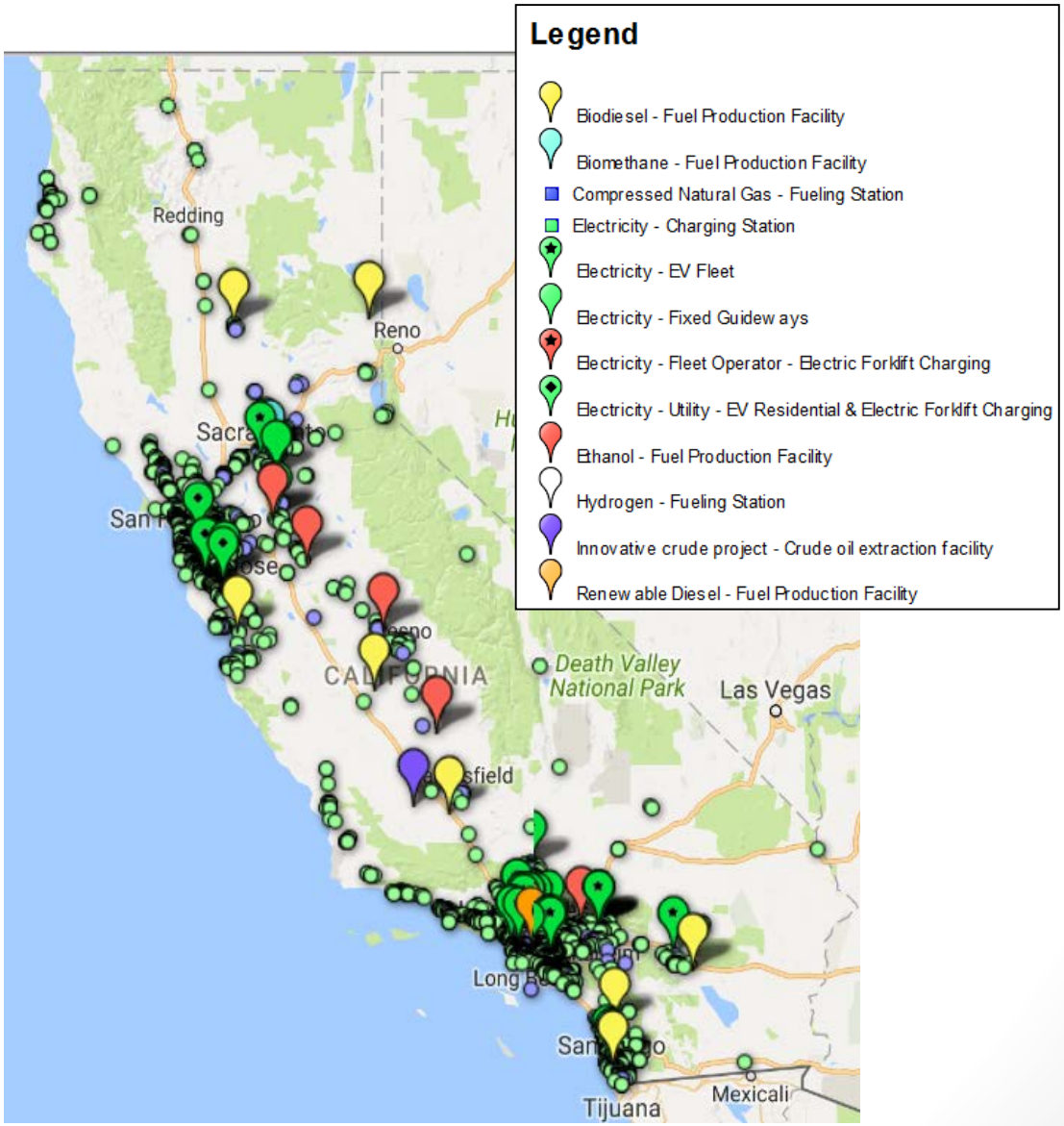
- Background on LCFS
- Current Status of LCFS and Progress against Targets
- Comparison of Actual Performance to Prior Scenario Analysis
- Availability and Use of Low Carbon Fuels
- Status of Refining and Crude Oil Crediting Provisions
- Future Work on LCFS

LCFS History

- Original adoption in 2009, first compliance year in 2011, re-adopted in 2015
- Goal: Reduce carbon intensity (CI) of transportation fuel pool by at least 10% by 2020
- Expected benefits:
  - Reduce greenhouse gases
  - Transform and diversify fuel pool
  - Reduce petroleum dependency
  - Reduce emissions of criteria pollutants and toxics

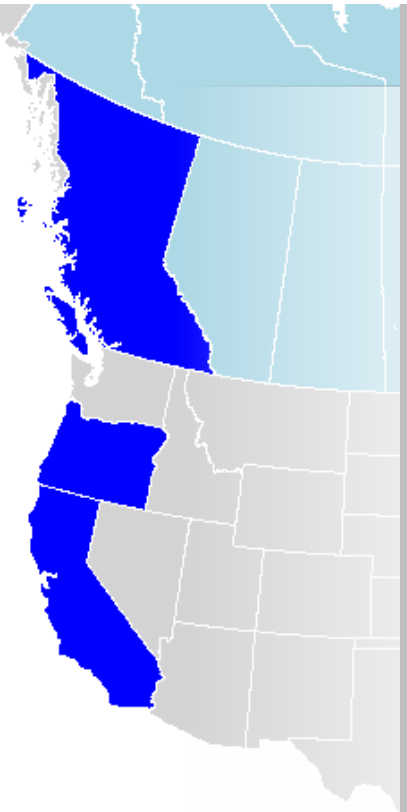
Who are the Low Carbon Fuel Industry in California?

Low Carbon Fuel is Produced and Sold Throughout CA



https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm

LCFS-like Policies Have Emerged Worldwide

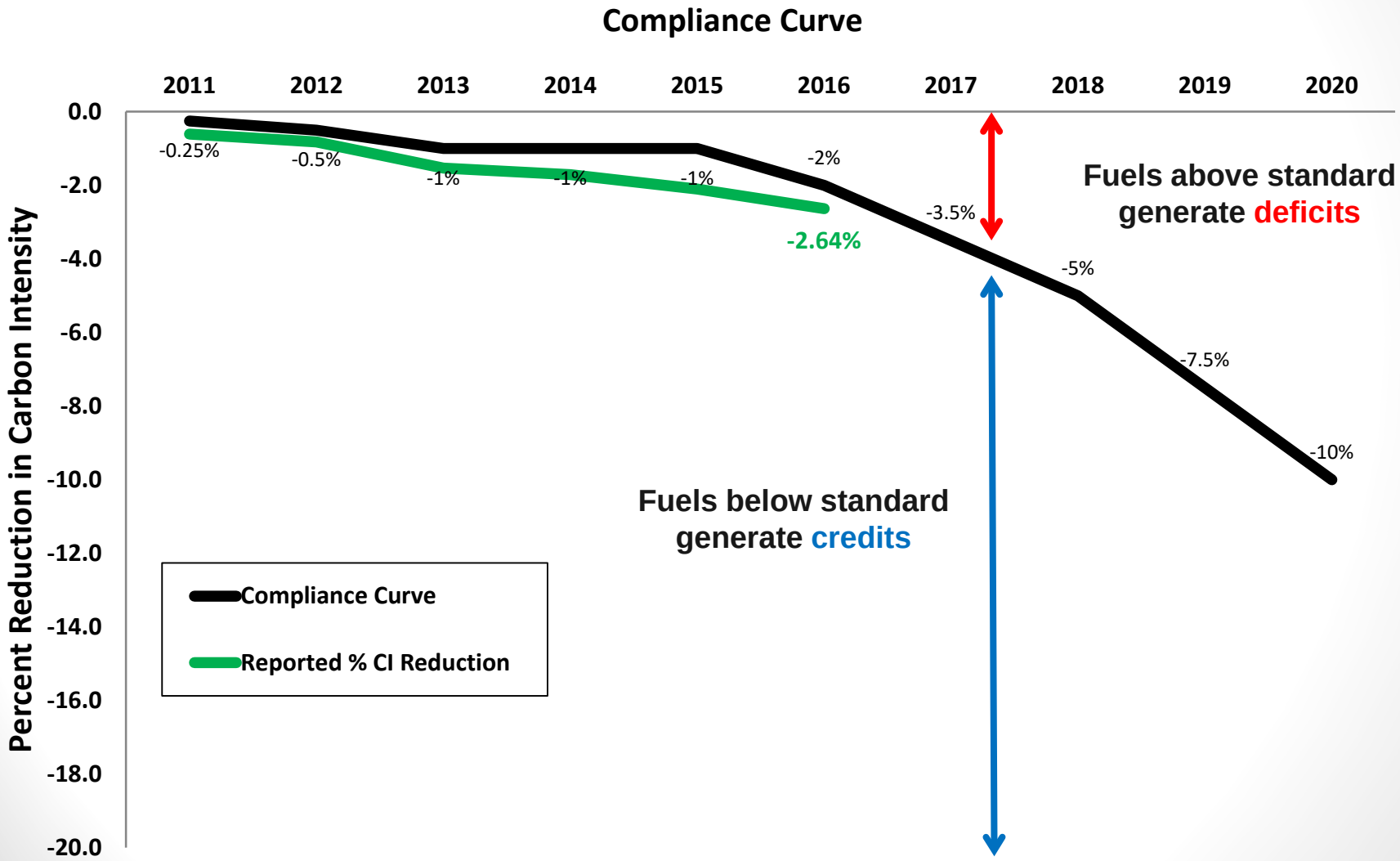


- **US EPA's Renewable Fuel Standard**
- **Pacific Coast Collaborative**
  - **Oregon's Clean Fuels Program –** Fully implemented in 2016, Requires 10% CI reduction by 2025
  - **BC's Renewable and Low Carbon Fuel Requirement –** In place since 2010, standard requires 15% reduction in CI by 2030
- **Canada's Clean Fuel Standard –** Expected in 2019
- **EU's Renewable Energy Directive**
- **Brazil considering Renova Bio 2030**

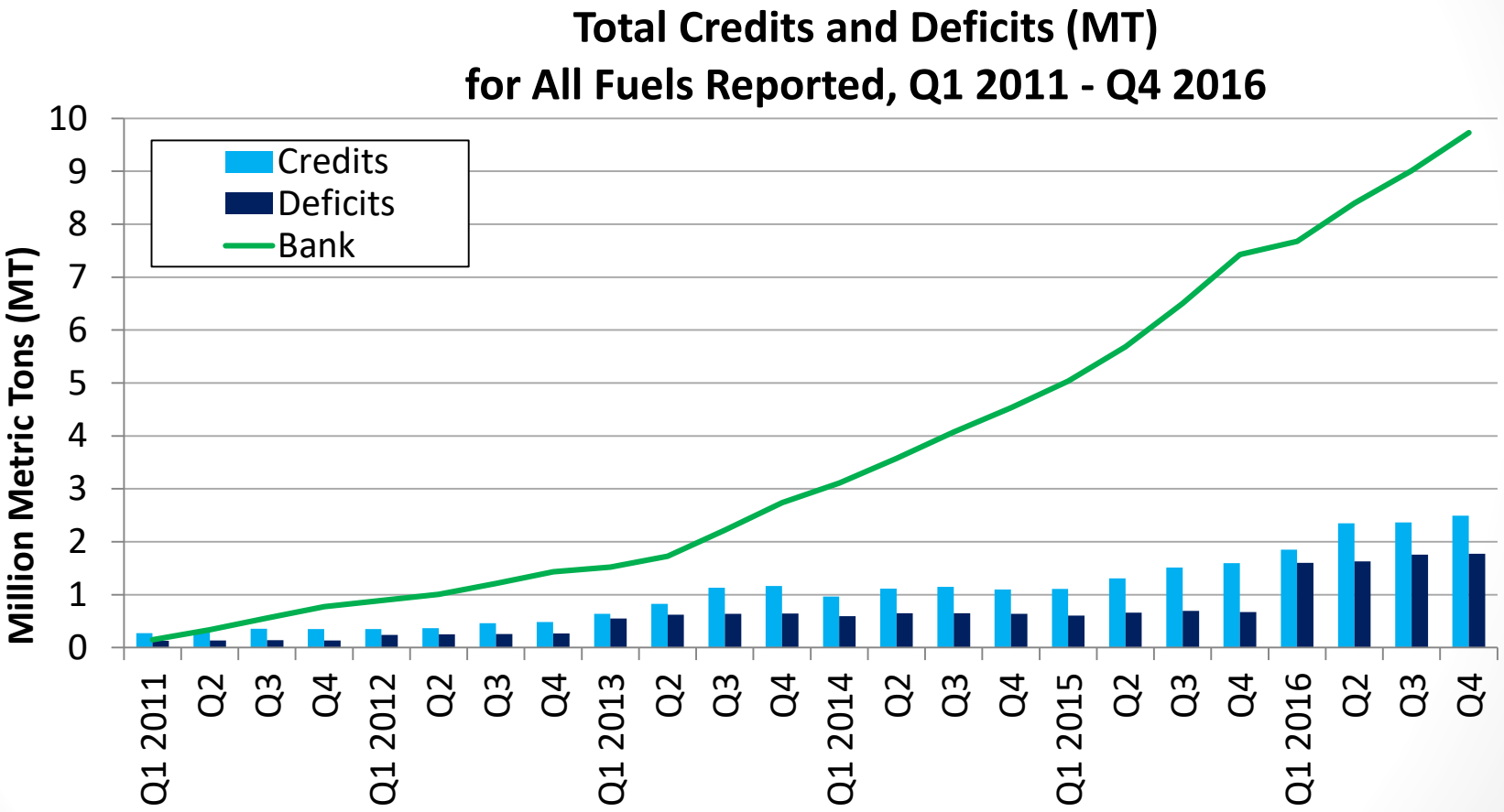
Key Requirements and Features

- Sets annual carbon intensity (CI) standards for transportation fuels (e.g., gasoline, diesel and the fuels that replace them)
- CI based on complete lifecycle analysis
- Providers in California of petroleum fuels are “regulated parties” under the LCFS
- Providers of clean fuels can “opt in” to program and earn credits
- Generated credits can be bought and sold by regulated parties

How Credits and Deficits are Calculated



Over-Compliance has Created a Significant Credit Bank



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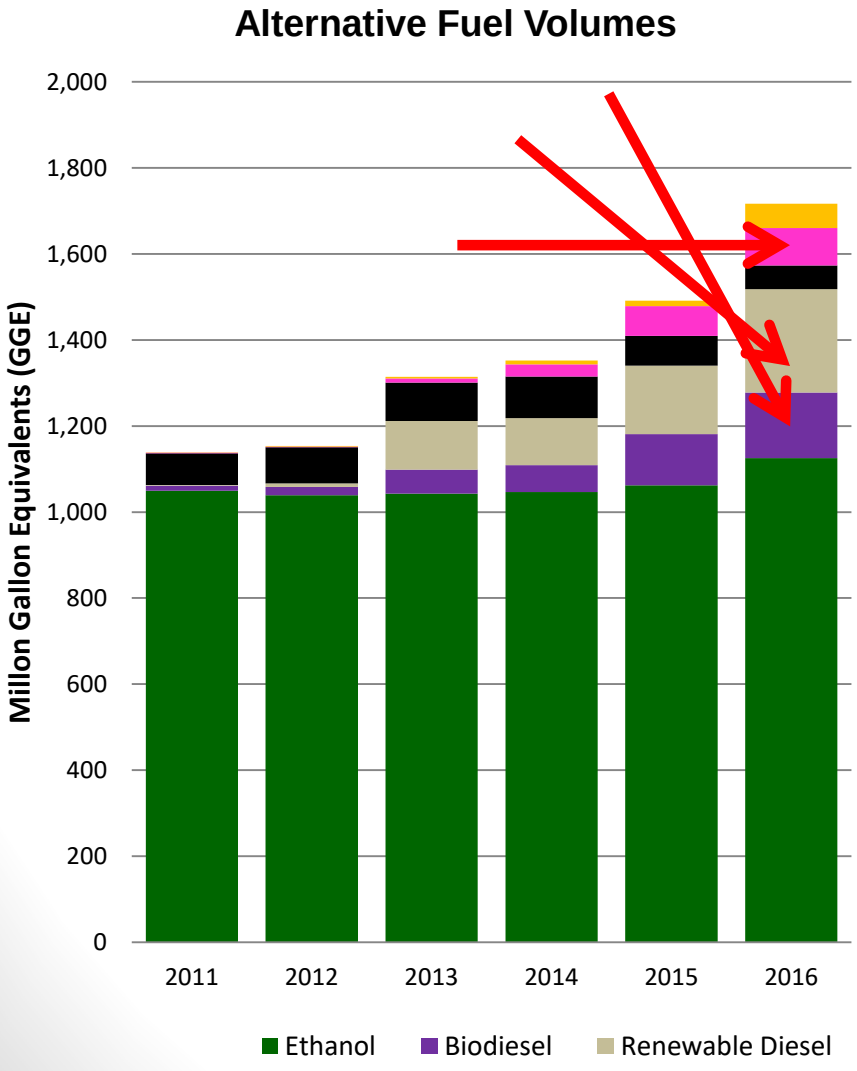
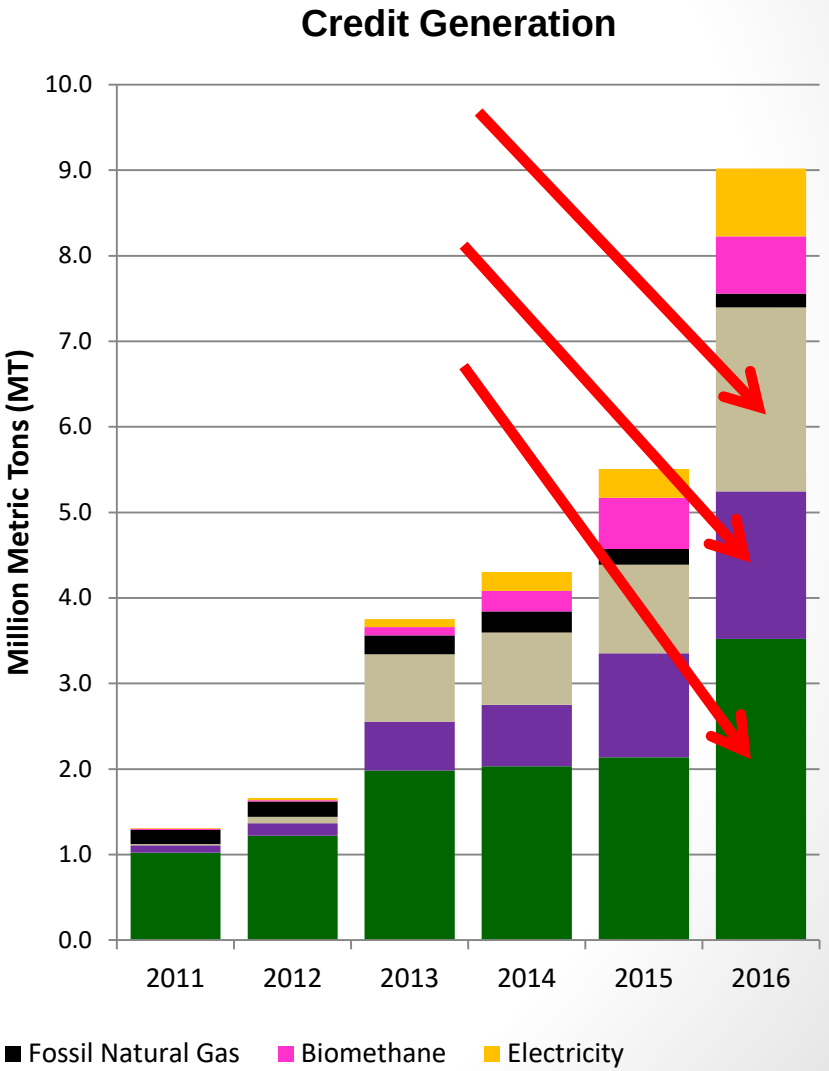
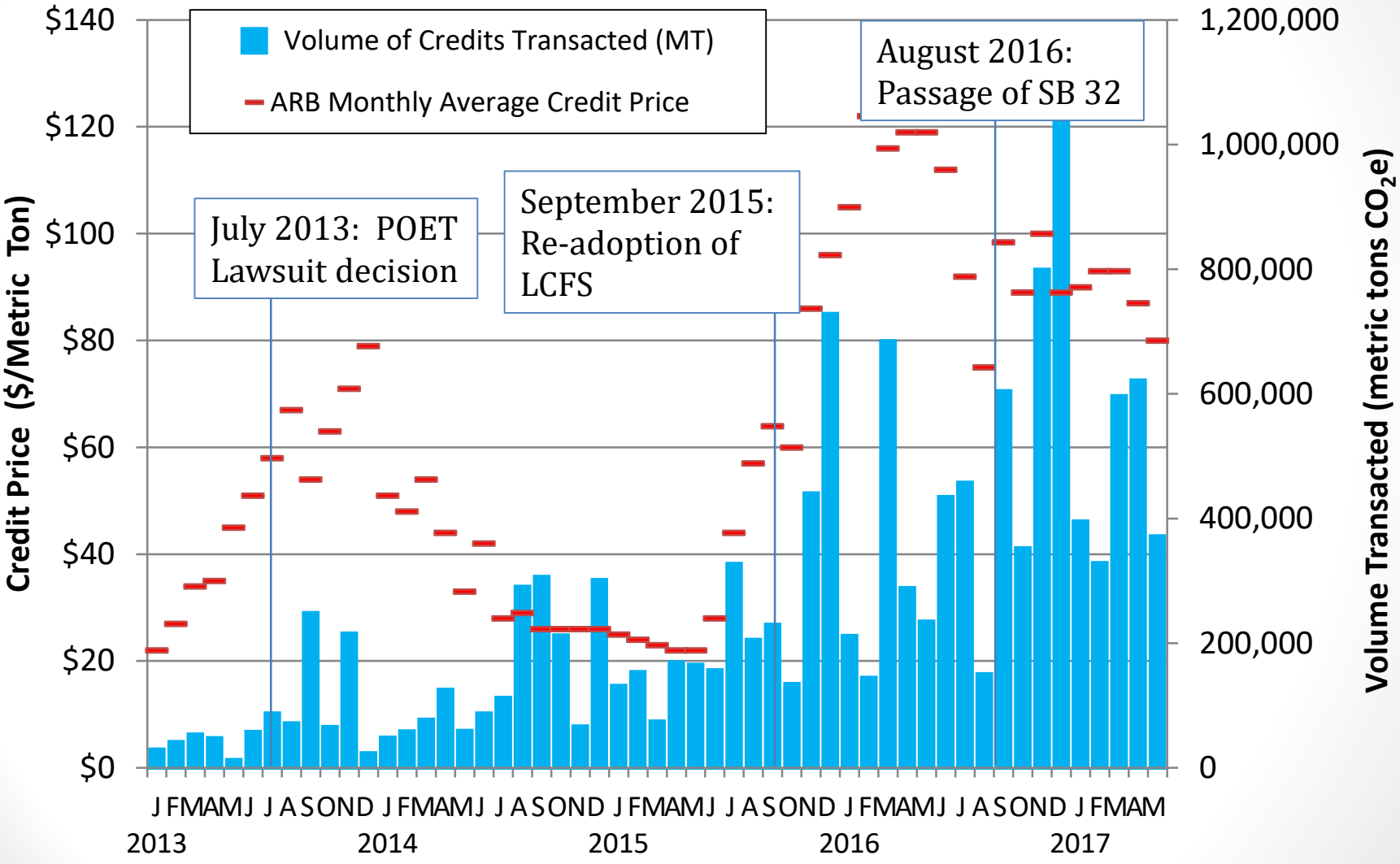
Low Carbon Fuel Use Continues to Grow. Sources of Credits Continue to Diversify.





LCFS Credit Market is Working Well



Sources: https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm

LCFS Enforcement Activities

- Undertook 16 audits with 14 facility inspections
- Initiated 3 credit adjustments under section 95495 (correcting issues arising out of inspections)
- Issued 4 Notices of Violation, including one that settled for $393,000
- One enforcement case filed for compliance violations and misreporting

Utilities Now Offering ZEV Rebates Using LCFS Credit Revenue

- EV charging generates LCFS credits
- Proceeds from the sale of these credits by utilities are returned to EV drivers
- SMUD: $599 per car
- PG&E: $500 per car
- SCE: $450 per car (up to 3 different owners)
- SDG&E: $200 per year

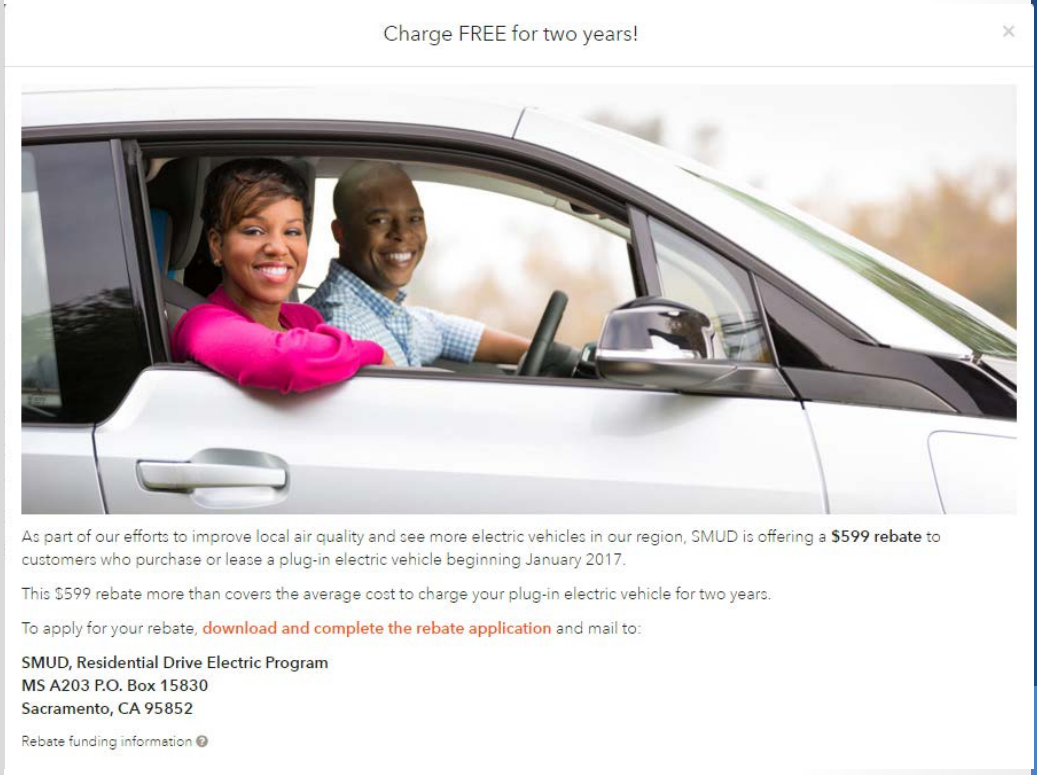


Photo Credit: SMUD

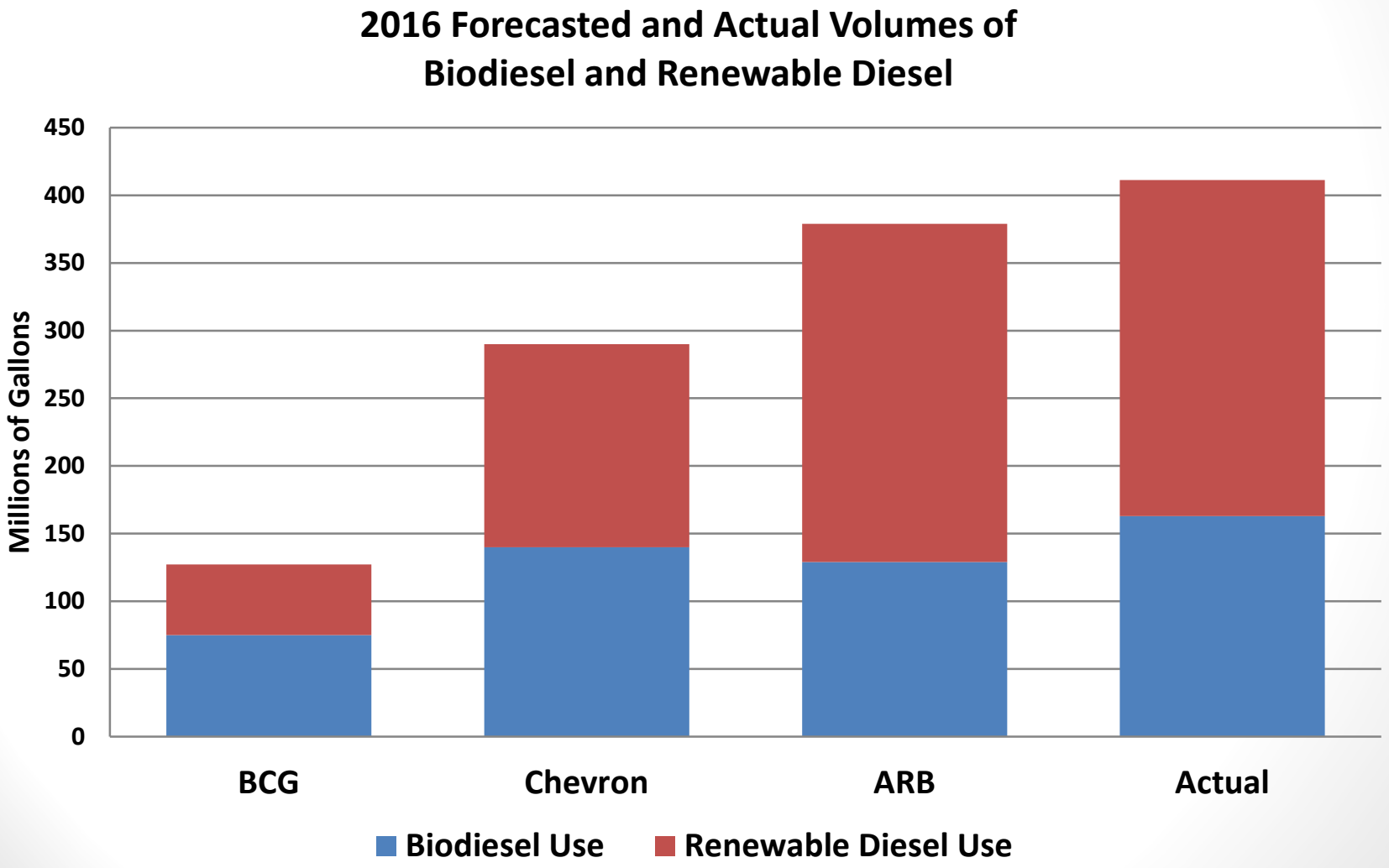
https://www.smud.org/en/residential/environment/plug-in-electric-vehicles/
https://www.pge.com/en_US/residential/solar-and-vehicles/options/clean-vehicles/electric/clean-fuel-rebate-for-electric-vehicles.page
https://www.scecleanfuel.com/
https://www.sdge.com/clean-energy/electric-vehicle-climate-credit

Comparison of Historical Scenario Analysis of the LCFS to Actual Data from 2016

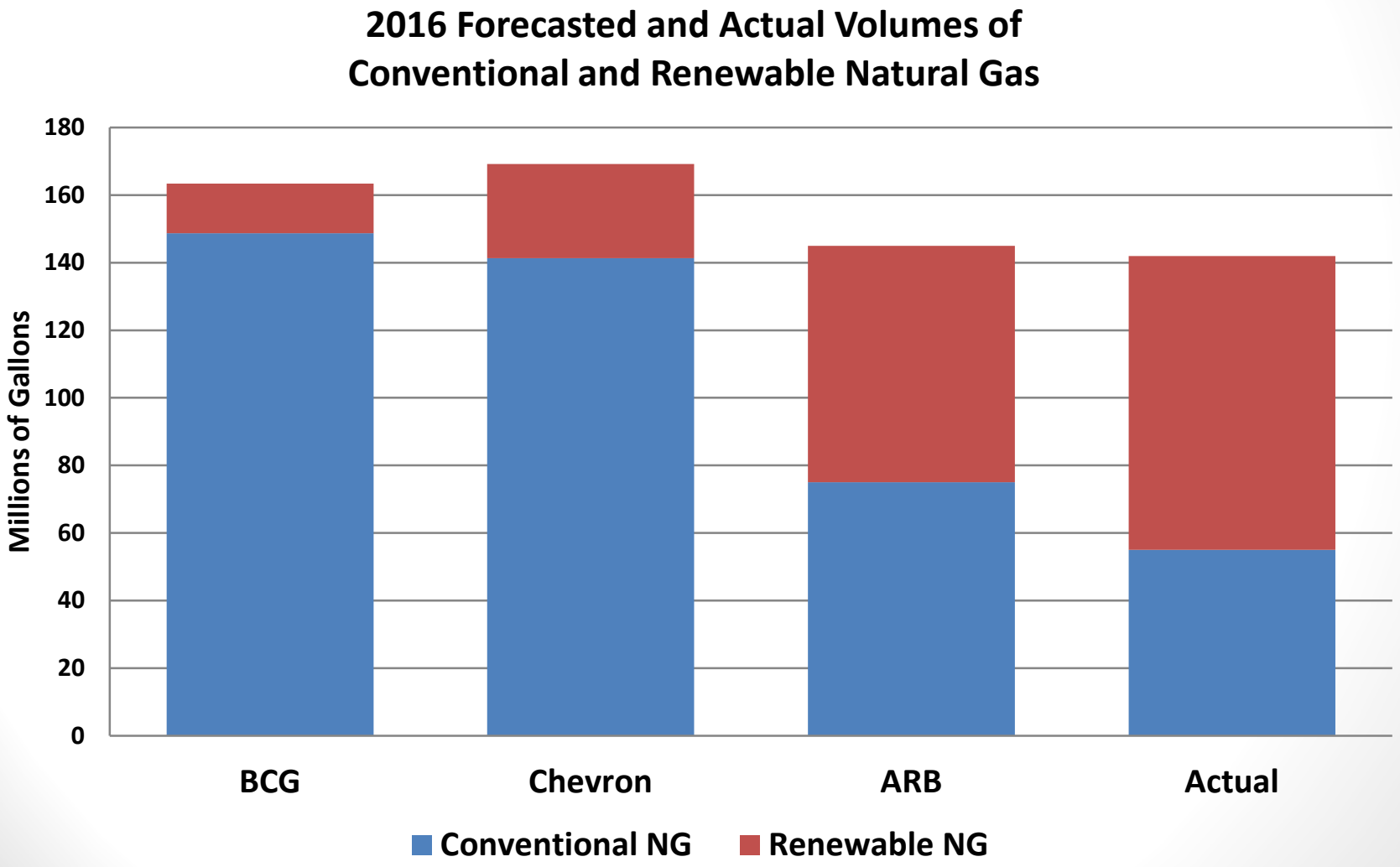
- LCFS regulation requires staff to report on:
  - Program's progress on achieving LCFS targets
  - Comparison to prior scenarios produced by staff/external parties.
- Scenarios compared:
  - ARB: April 2015 Illustrative Compliance Scenario Analysis
  - Boston Consulting Group (BCG) for the Western States Petroleum Association: August 2014 Analysis
  - Chevron: December 2014 Analysis
- Comparisons made:
  - Fuel Volumes
  - Annual and Banked Credits*

* Estimates of annual and banked credits by BCG and Chevron were adjusted to reflect the LCFS rule adopted in 2015.

Biodiesel and Renewable Diesel Exceeded all Parties' Projections

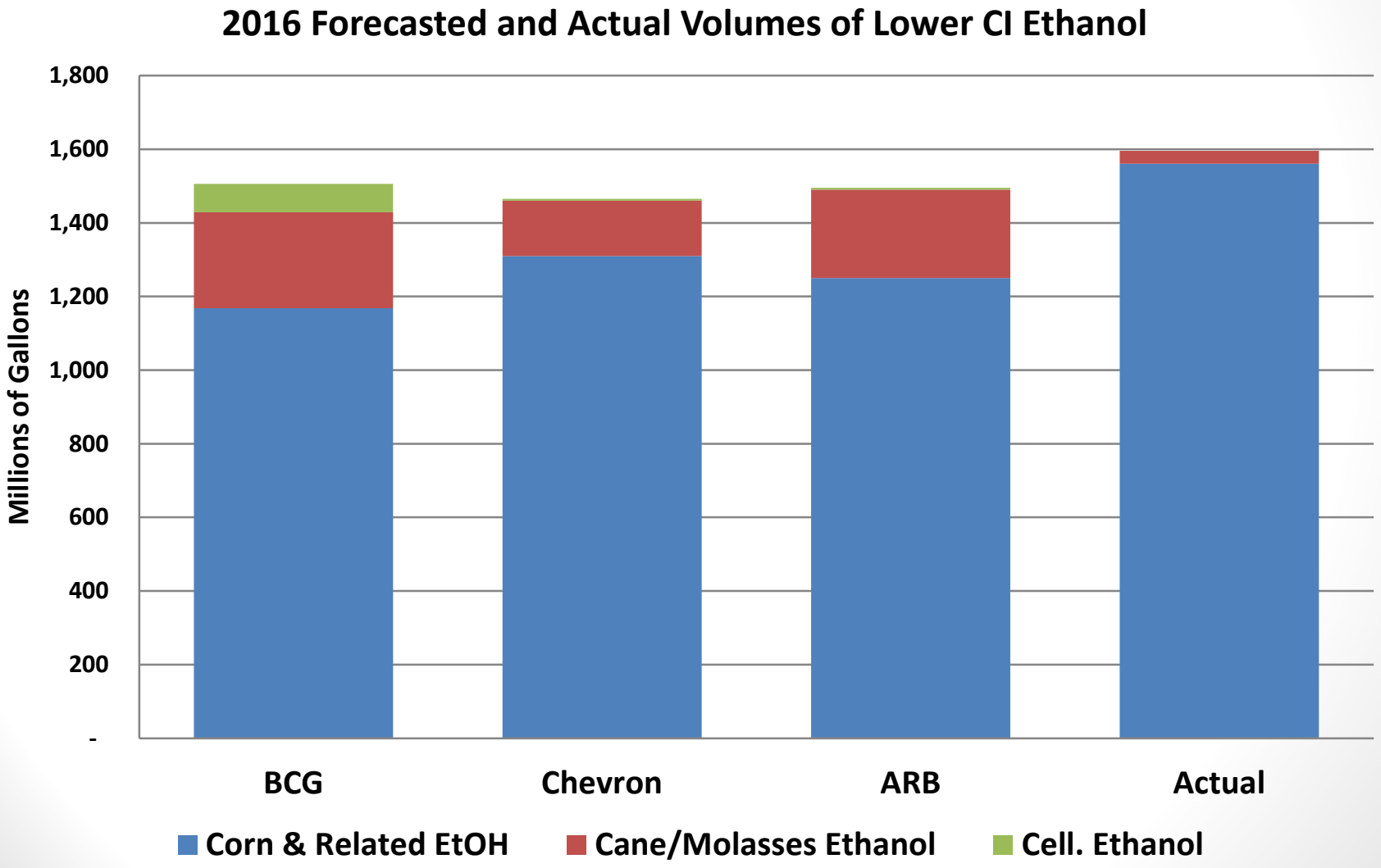


Renewable Natural Gas Growth Exceeded All Parties' Projections

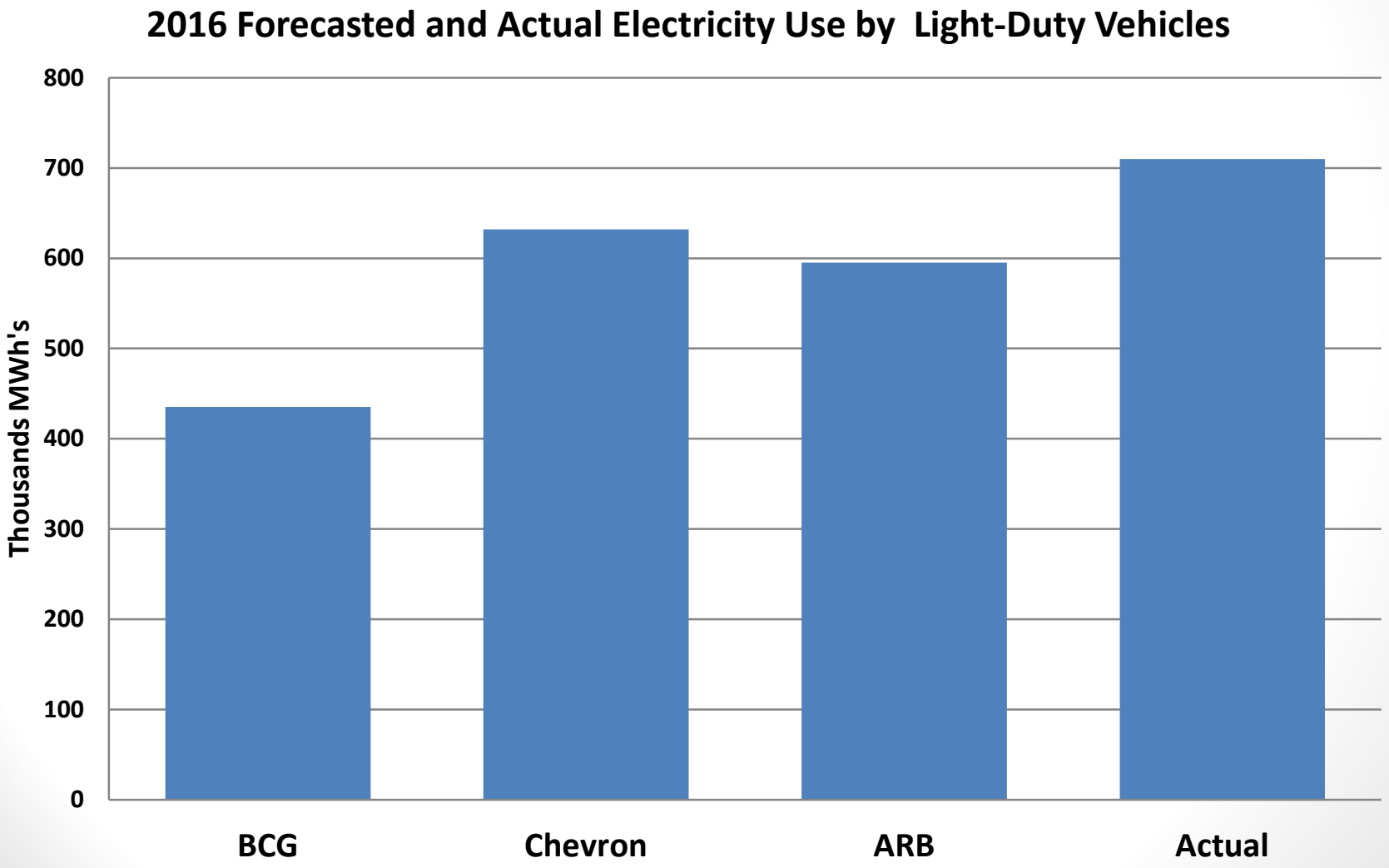


Overall Ethanol Use is Higher Due to Higher than Expected Total Gasoline Demand

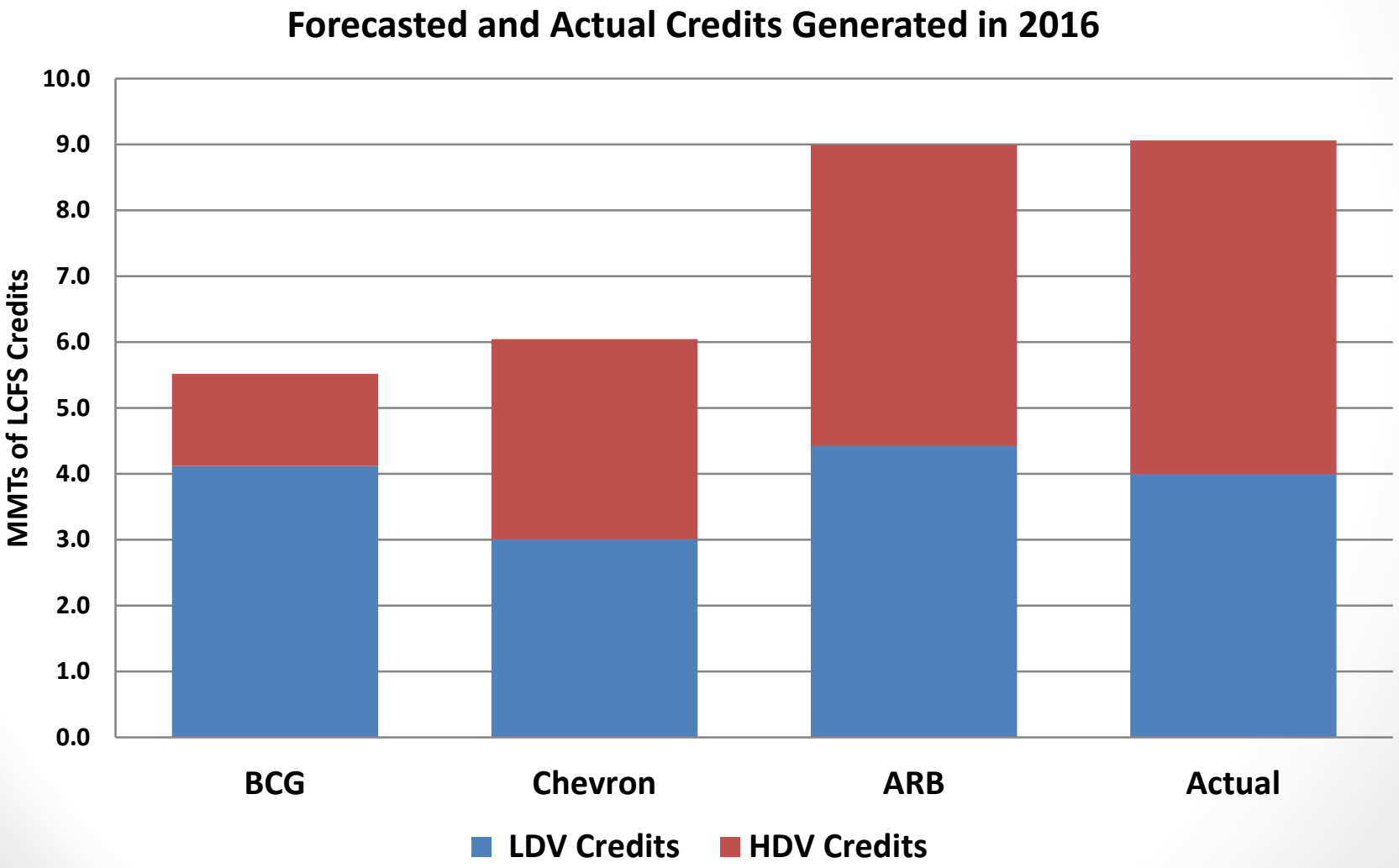
(Low CI Sugarcane and Cellulosic Ethanol Fell Short of All Parties' Expectations)



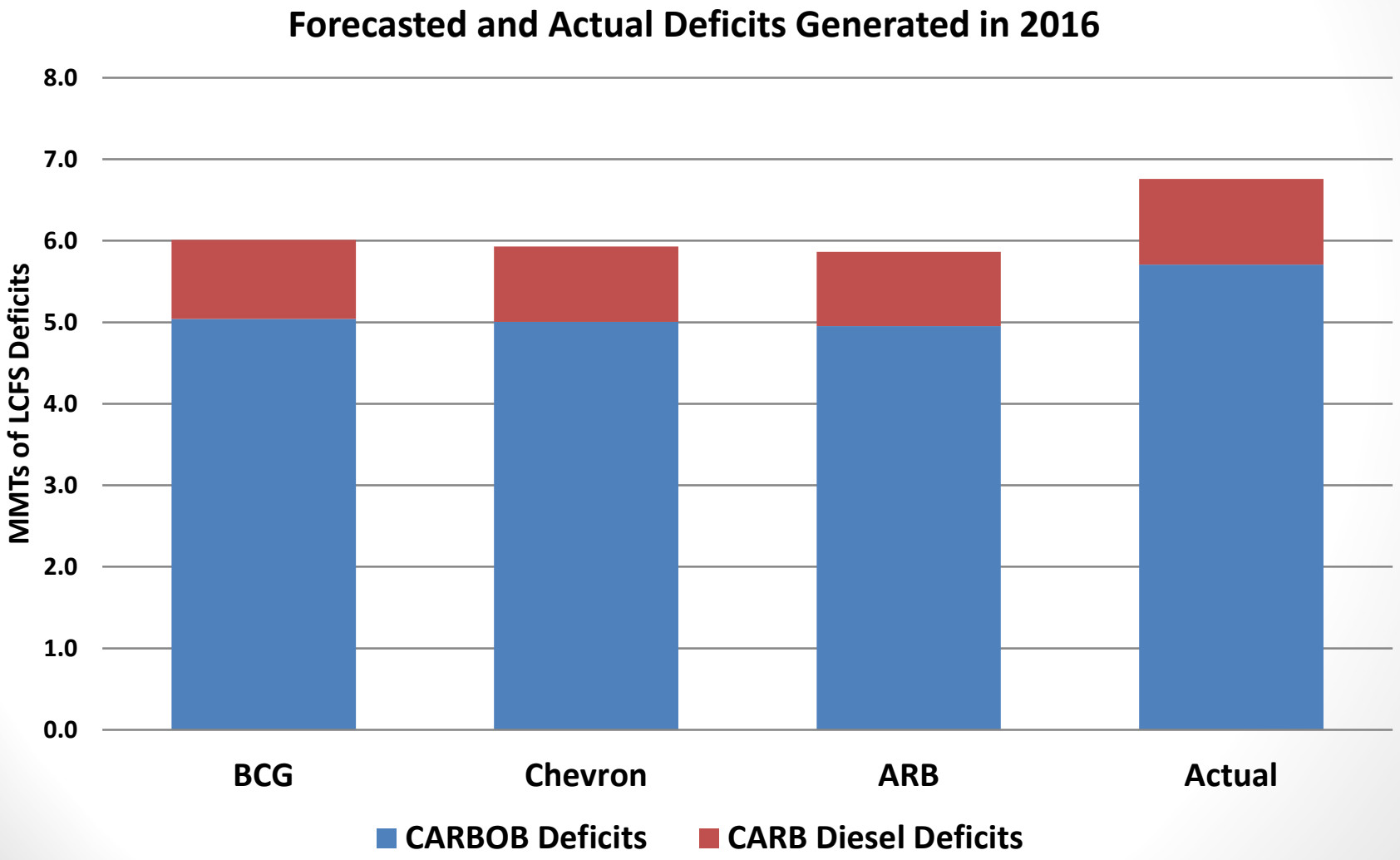
Electric Vehicle Penetration Exceeded All Parties' Expectations



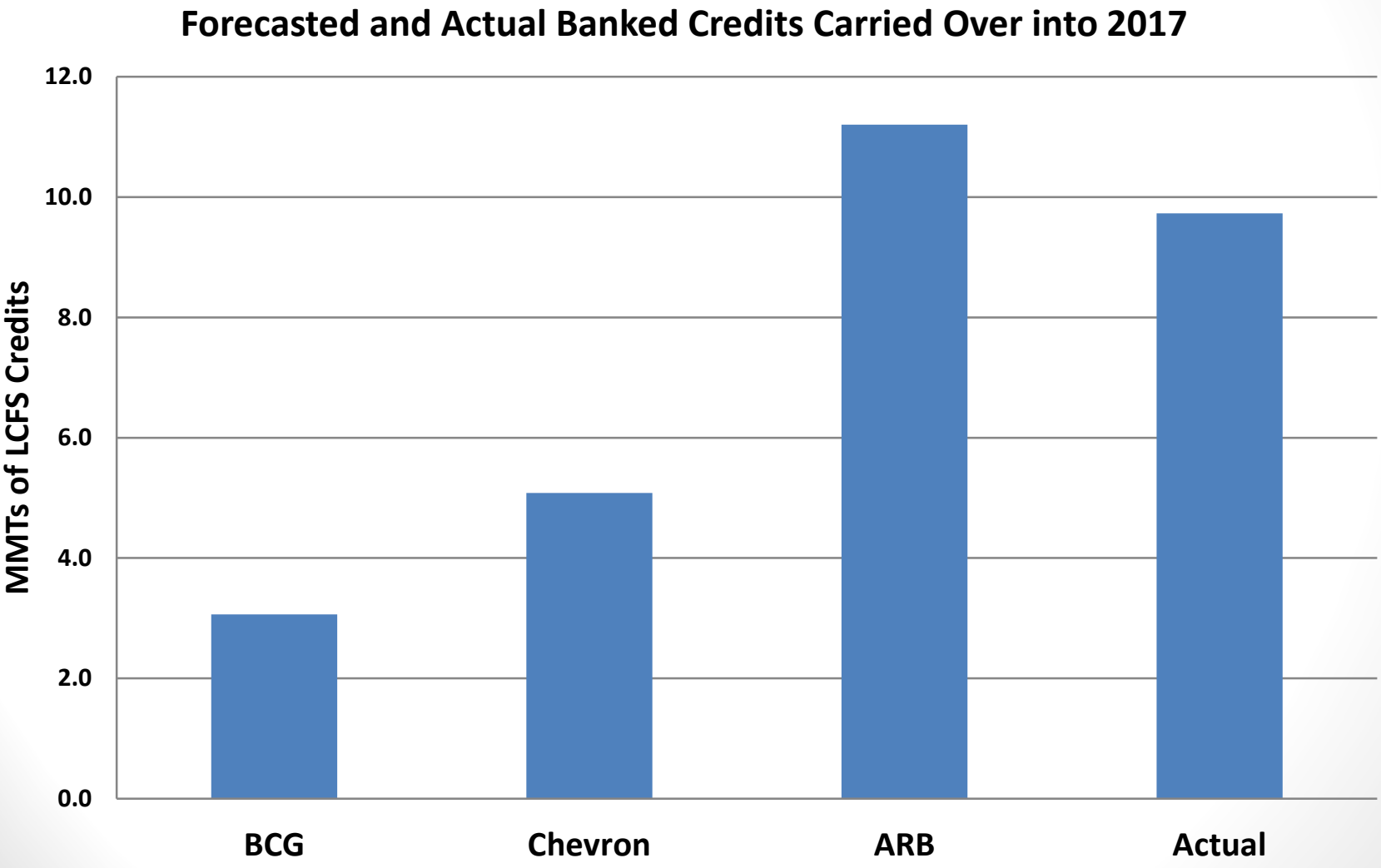
Total Credits Generated Were Close to ARB Staff Estimate



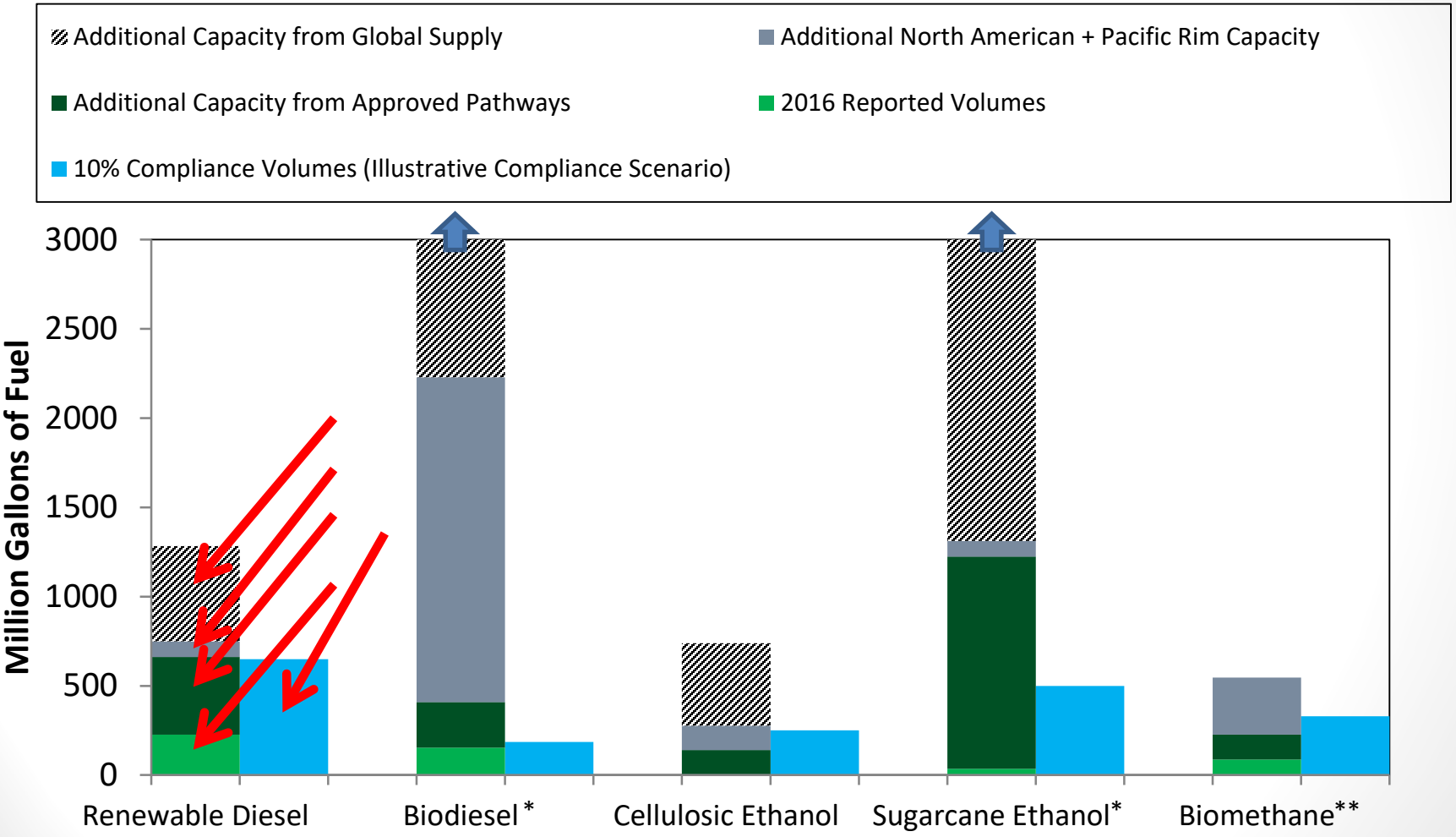
Deficit Generation Exceeded all Parties' Expectations



Banked Credits are Below ARB Expectations (but Above BCG and Chevron Expectations)



Additional Near-term Biofuel Production Capacity is Available



Volumes derived from Bloomberg, Lux, EPA LMOP, Billion Ton Study, and LRT data

* This remaining global capacity exceeds the y-axis bounds and is truncated

** The Biomethane capacity are for North American landfill projects, where the biogas is currently being upgraded to high-BTU biomethane

Refinery/Crude Crediting Options

Credit Type
Credits for producing crudes using innovative methods
Low-Complexity/Low-Energy-Use Refinery Credits
Refinery Investment Credits
Renewable Hydrogen Refinery Credits
Incremental deficits that result from increases in carbon intensity of crude

Credits for Producing Crudes using Innovative Methods

- North Midway Sunset Oil Field Solar Project (2.5 MW)
  - Seneca Resource Corporation
  - Interest in other solar electricity projects
- Potential solar steam project to be announced
- Potential for significant GHG and criteria pollutant emission reduction in San Joaquin Valley

Seneca's solar farm

GlassPoint's solar steam generation technology

Low-Complexity/Low-Energy-Use Refinery Credits

- Adopted in 2015 in response to Board resolution 11-39 to consider a provision to the LCFS to address the unique business models of small refineries
- Kern Oil Company met these criteria and will be awarded credits for operations in 2016

Renewable Hydrogen Refinery Credit Pilot Program

- Adopted in 2015 to incent GHG reductions at the refineries
- Can produce renewable hydrogen from renewable natural gas or renewable electricity
- No approved projects but interest from some refineries
- Credit generation is capped at meeting ten percent of deficits in a given year

A steam methane reforming facility.
Photo courtesy of Air Products and Chemicals Inc.

Refinery Investment Credit Pilot Program

- Adopted in 2015 to incent GHG reductions at the refineries
- No approvals but preliminary discussions with a few refineries on small projects
- Considering amendments to clarify and improve this provision
- Need continued engagement from industry to make this pilot program more workable

Carbon Capture and Storage

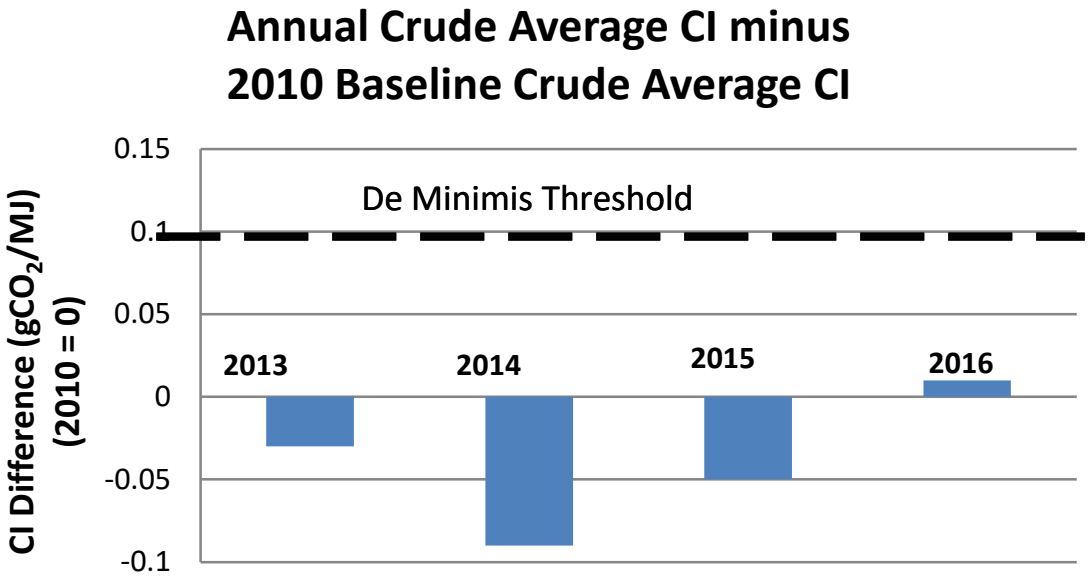
- Carbon Capture and Storage (CCS) can reduce fuel production emissions from:
  - Biofuels (e.g. ethanol or biogas)
  - Refineries
  - Crude Oil
- No CCS credits in LCFS so far
  - Staff developing a "CCS protocol" to ensure uniform quantification and permanence requirements
- Guidance for LCFS CCS credit generation:
  - Credit allocated to the capture facility
  - Fuel or crude oil supplied to California

Shell quest oil upgrader, Alberta

ADM ethanol plant, Illinois

Change in Crude Oil Carbon Intensity

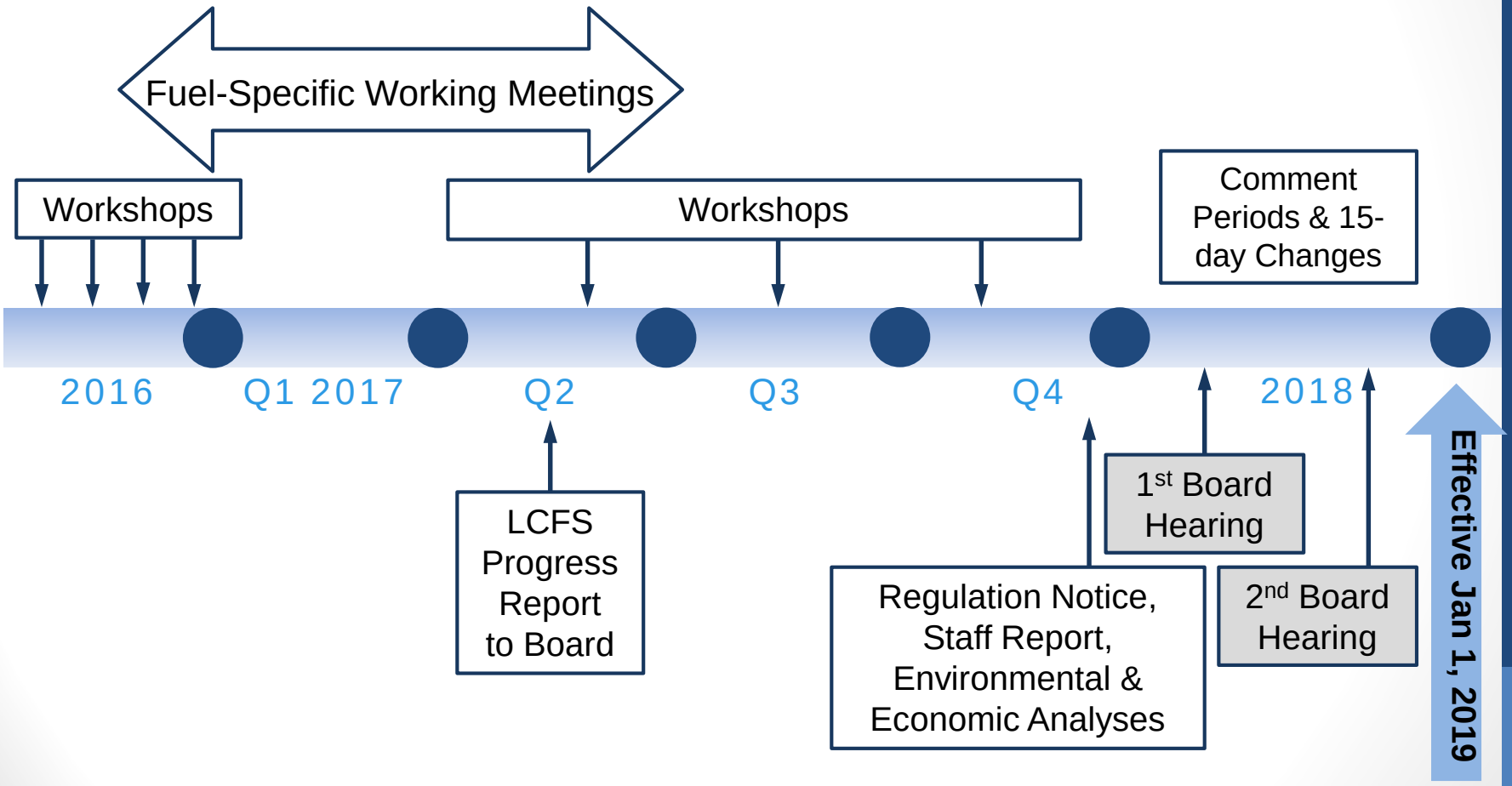
- One LCFS goal is to discourage the use of high CI crudes
- Additional deficits for gasoline and diesel are added if the average CI of crude exceeds 2010 baseline value by more than 0.1 g/MJ
- Additional deficits have not yet been assessed, but recent years show a slight upward trend in average crude CI



Developing Amendments to Strengthen and Improve LCFS

- Average carbon intensity requirements through 2030 in line with the Proposed Scoping Plan process
- Allow alternative jet fuel to generate credits
- Addition of third party verification
- Continue to streamline CI pathway application process

Public Process



In Summary…

- LCFS is ahead of schedule having achieved a 2.6% reduction in average CI so far
- Low carbon diesel substitutes made up over 12% of the energy used in heavy duty vehicles in California in 2016
- Nearly 10 million excess credits banked
- LCFS targets through 2020 ambitious but achievable
  - ARB's understanding of the low carbon fuel market is strong
  - Existing low carbon fuel supply is available in the near term but expansion of advanced low carbon fuel production capacity will be needed in the future
- Development of post-2020 program underway with Board consideration in early 2018

Thank You