Low Carbon Fuel Standard (LCFS) Analysis & Compliance Costs

Role of Alternative Fuels in California's Transportation Energy Future

Transportation Committee Workshop

November 14, 2011

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LCFS Compliance Analysis

- Primary intent of this continuation analysis is to evaluate compliance feasibility using various types of biofuels & costs
  - This scenario analysis should not be considered a forecast
- Three cases with varying assumptions
  - Availability of low carbon intensity fuels increased with each case
  - Most biofuels are currently available in commercial quantities
  - Only exceptions cellulosic biofuels, especially BTL gasoline
- Biofuel costs are introduced in the analysis
  - Biofuel selection based on least-cost, lowest carbon intensity fuels
- Adjustment for biodiesel NO_x mitigation
  - Biodiesel use above 5 percent mitigated with renewable diesel
- Primary concern is plausibility of the assumptions

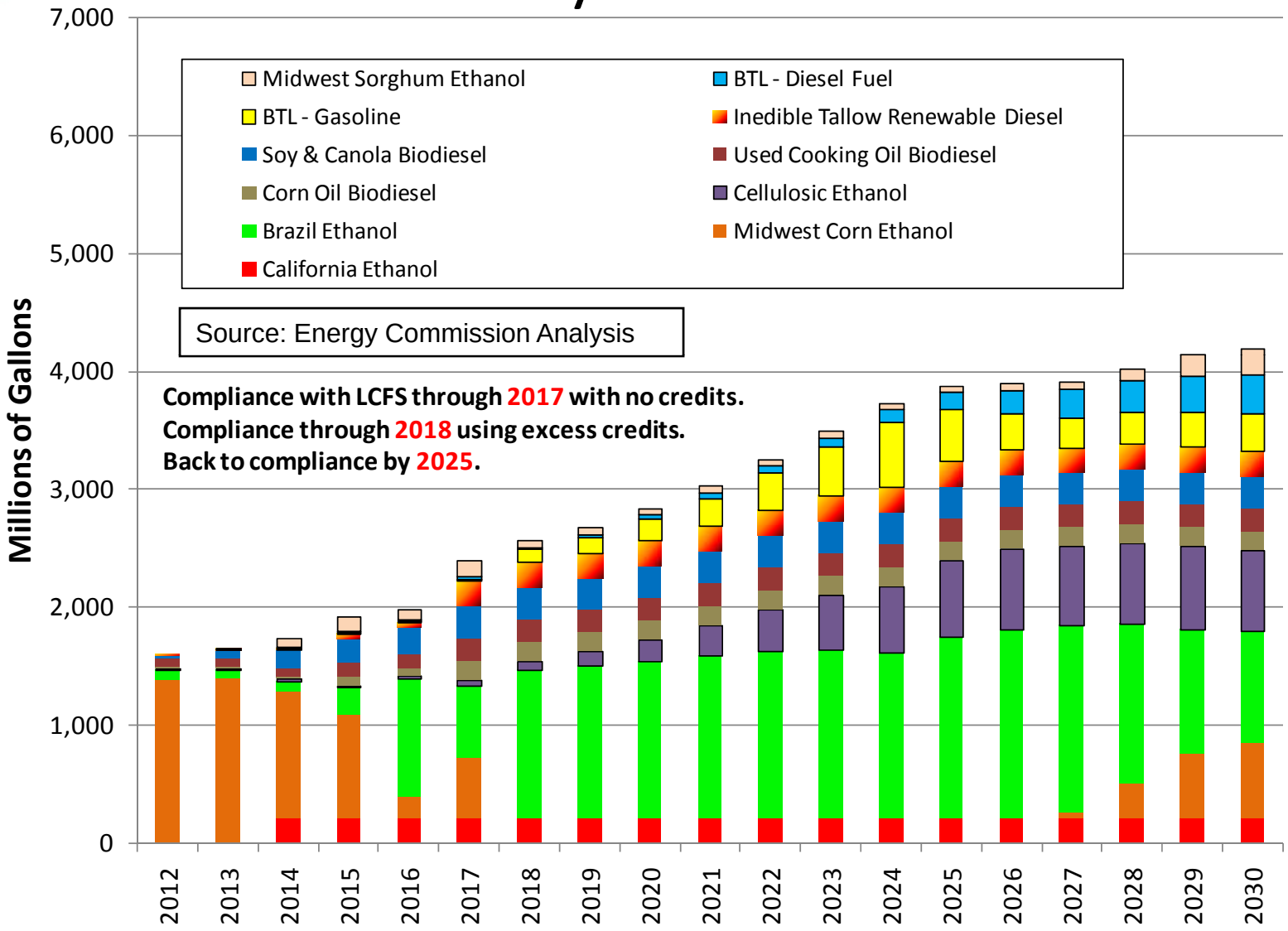
LCFS Analysis – Common Assumptions

- Biofuels with least-cost, lowest carbon intensity selected first
- Development of excess LCFS credits minimized to align with 2011 behavior of participants and LRT results
- Portion of LCFS credits generated each year are not used in subsequent years – retained by parties in anticipation of rising value
  - Non-obligated parties retain larger portion of LCFS credits compared to obligated parties – electricity and natural gas credits
  - Portion of withheld credits diminishes to zero by 2020 – when highest value of LCFS credits is assumed to be reached in the excess credit market
  - No adjustment made to exclude a portion of LCFS credits that have already been generated but my be voided due to use of high carbon intensity crude oil by some obligated parties (refiners) – quantity not known

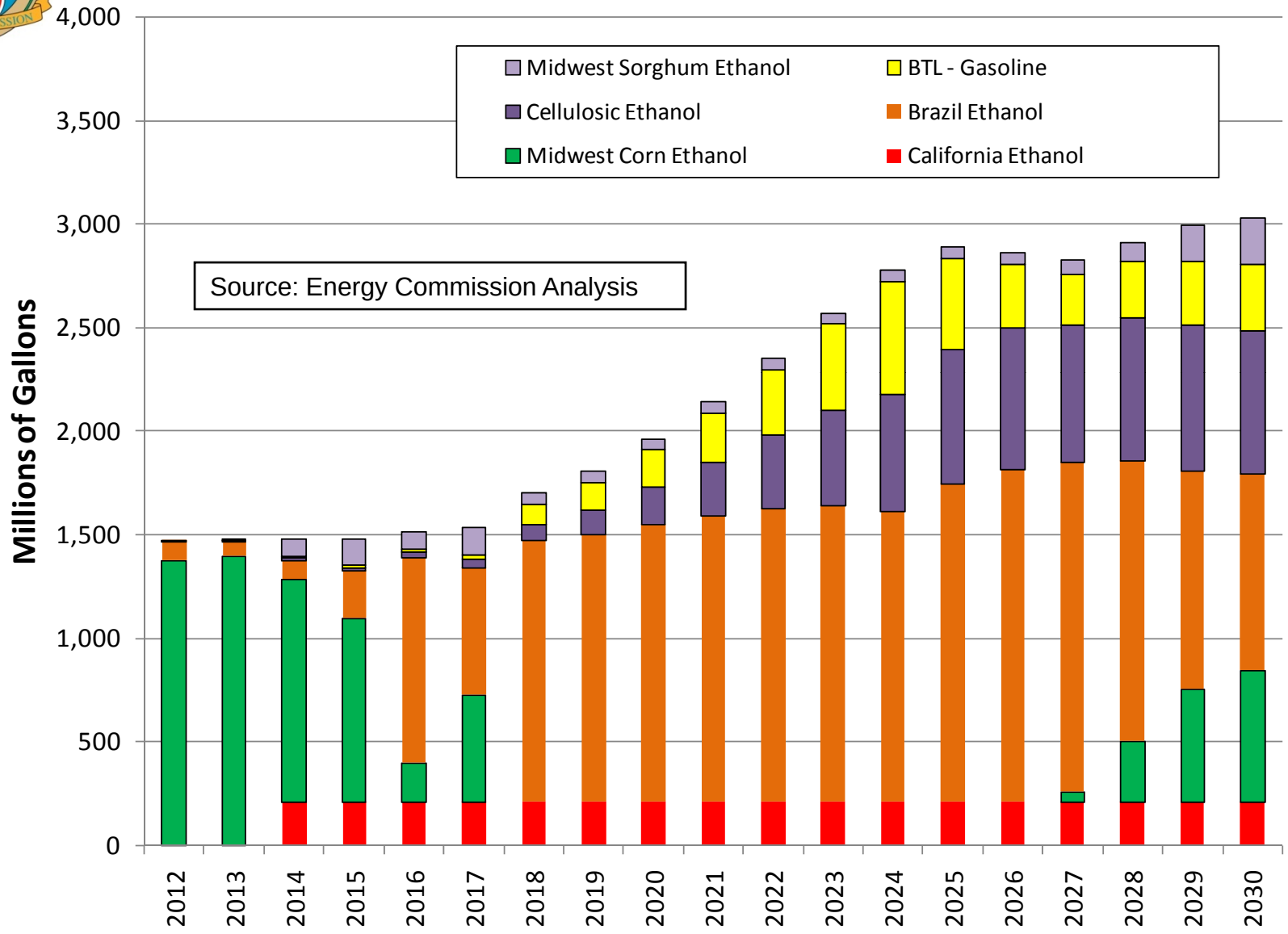
LCFS Analysis – Case 3 Assumptions

- Cellulosic fuel availability increased to 50 percent of U.S. supply
- Brazilian ethanol supply availability increased to 1.5 billion gallons beginning in 2014 – lowest CI type
- Renewable diesel fuel supply availability
  - Raised to 50 percent of U.S. supply by 2017 – 219 million gallons
  - Carbon intensity of 19.65 gCO2e/MJ
- Biodiesel from corn oil
  - Raised to 50 percent of U.S. supply by 2017 – 160 million gallons
  - Carbon intensity of 5.90 gCO2e/MJ
- Biodiesel from used cooking oil
  - Raised to 200 percent of registered facilities by 2017 – 155 million gallons
  - Carbon intensity of 11.76 gCO2e/MJ

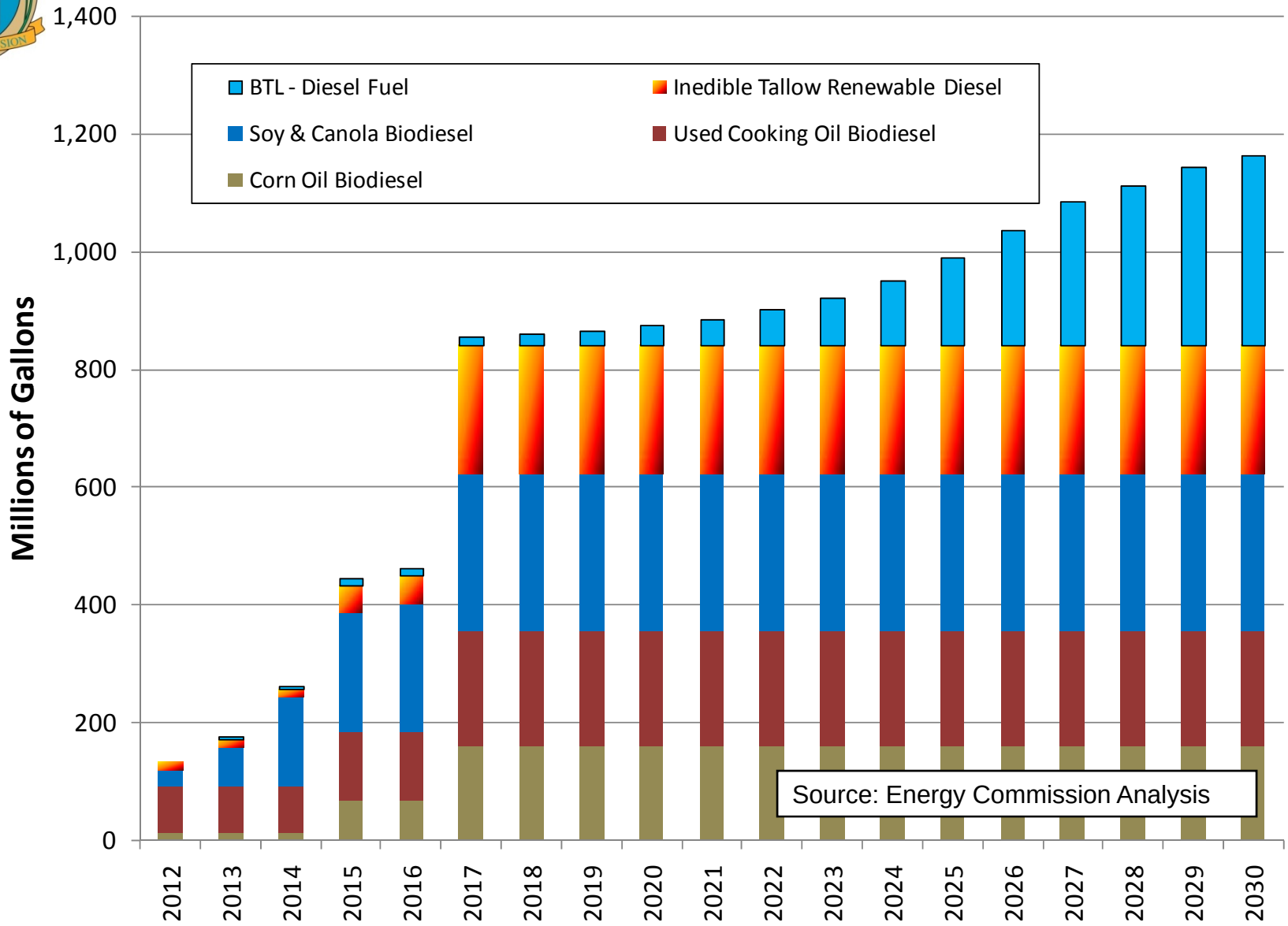
Case 3 Low Demand
Preliminary Results – All Fuels



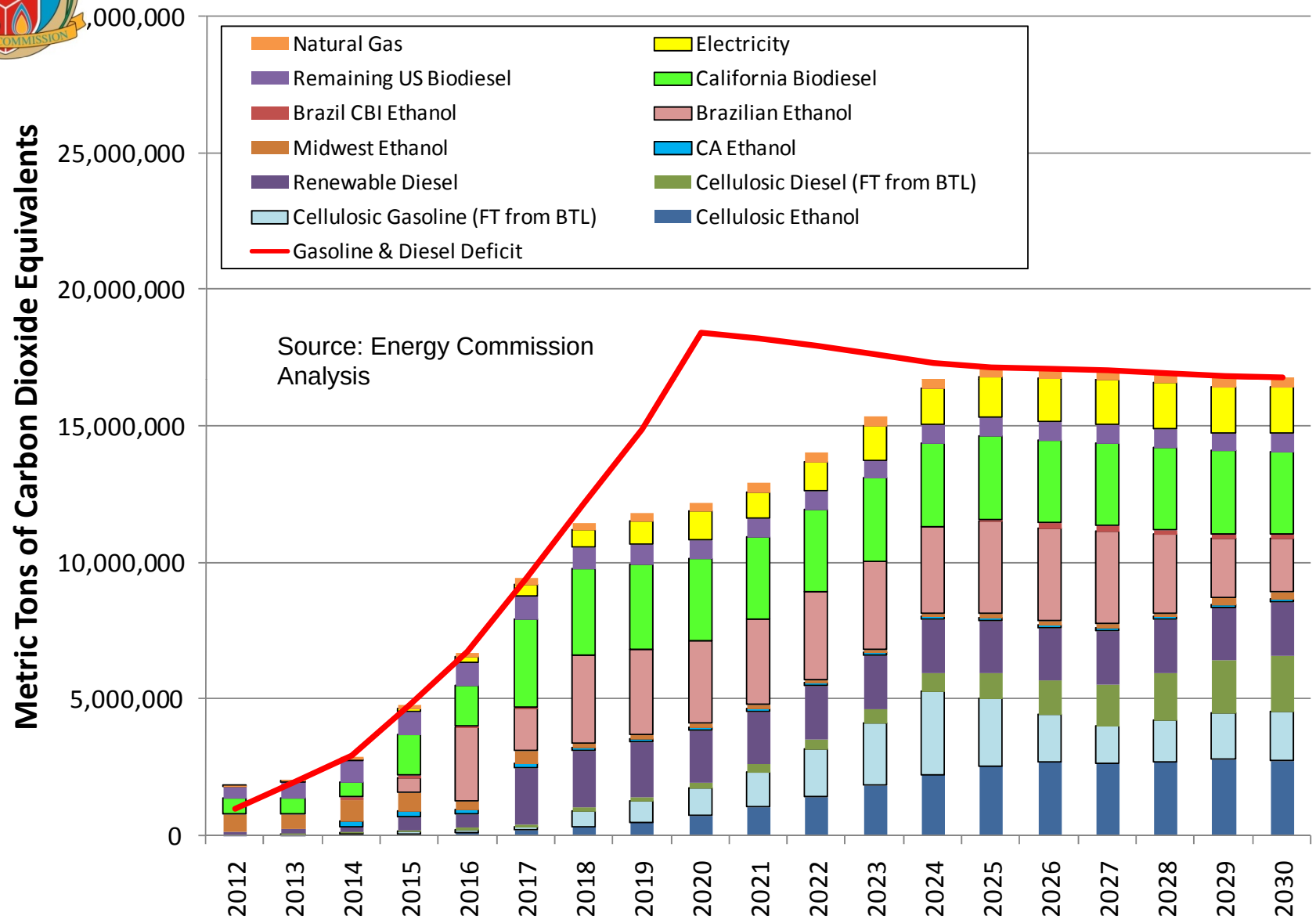
Case 3 Low Demand – Gasoline Blend Fuels



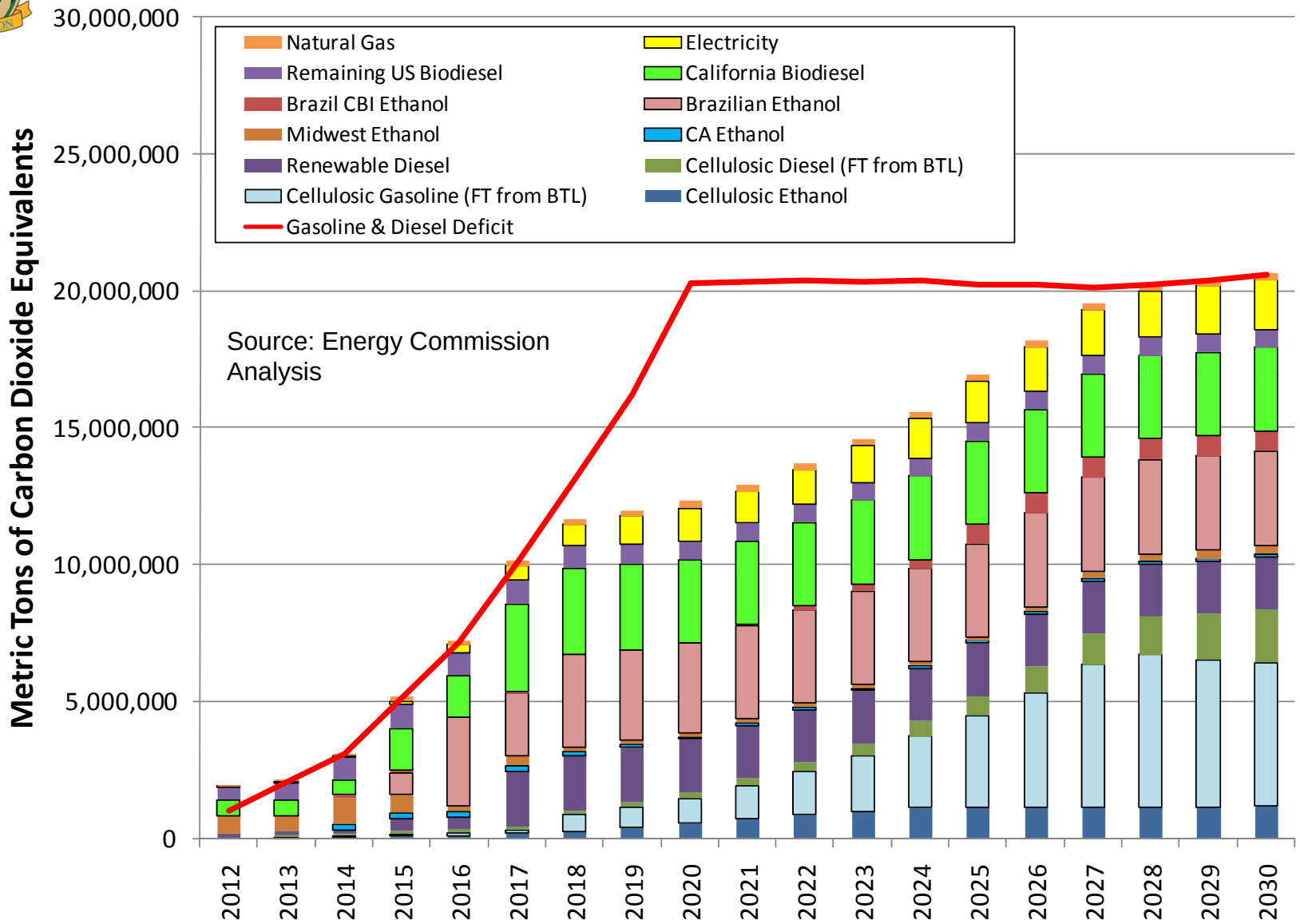
Case 3 Low Demand – Diesel Blend Fuels



Case 3 Results – Low Demand Scenario



Case 3 Results – High Demand Scenario



Case 3 – Demand Observations

- Compliance until 2017 through increased use of cellulosic fuels
- Excess credits can extend compliance an additional years (2018)
  - Due to increased supply of renewable diesel and corn oil biodiesel
- Compliance through deficit portion of the Low Demand forecast period (2019-2024) would require generation of additional credits from:
  - Use of additional quantities of drop-in biofuels greater than 50 percent of total U.S. supply
    - Biomass-to-liquids (BTL) gasoline and diesel
- Deficit portion of the forecast period (2019-2027) under the High Demand scenario would require even greater generation of additional credits

Case 3 – Additional Concerns

- Heavy dependence on Brazilian ethanol lessens somewhat
  - Similar to previous cases
- Biodiesel use would need to rapidly increase to B5
  - Similar to previous cases
  - Feasibility of corn oil biodiesel supply increase in 2017 uncertain
- Use of renewable diesel significantly increased
  - Feasibility of supply increase to 219 million gallons in 2017 uncertain
- Use of cellulosic fuels significantly increased beginning in 2018
  - Feasibility of using half of the U.S. cellulosic fuel supply questionable, even if the volumes forecast by EIA actually become available

More Expensive Biofuels

- Previous LCFS analysis by Energy Commission staff did not incorporate costs of biofuels but recognized that several different types of biofuels selected for use in the cases are currently more expensive than corn-based ethanol
- Staff developed biofuel prices for LCFS analysis
- Used recent historical values as starting point
  - Near-term pricing information
    - Brazilian ethanol as one example
  - Federal RFS2 RIN values during 2010 & 2011
    - Biodiesel
    - Cellulosic ethanol
    - Advanced biofuels

Initial Biofuel Values - Ethanol

- Brazilian sugarcane ethanol
  - $1.04 per gallon greater compared to ethanol delivered to California from the Midwest during 2010
  - $1.56 per gallon greater compared to ethanol delivered to California from the Midwest during the first eight months of 2011
- Caribbean Basin Initiative (CBI) ethanol
  - Ethanol from CBI countries less expensive compared to Brazilian anhydrous ethanol by approximately the value of the tariff
    - 44 cents per gallon (cpg) greater compared to ethanol delivered to California from the Midwest during 2010
    - 53 cpg greater compared to ethanol delivered to California from the Midwest during the first eight months of 2011
- Staff used incremental costs from 2010 for the low prices (high demand) cases and the incremental costs from 2011 for the high prices (low demand) cases

Initial Biofuel Values - Biodiesel

- Biodiesel from soybean oil
  - Calculated as a premium to wholesale diesel fuel
    - Used RIN values multiplied by 1.5
- Renewable Identification Number (RIN) credit values
  - 42 cents per gallon (cpg) for biomass-based diesel during 2010
  - 124 cpg for biomass-based diesel during the first eight months of 2011
- Applied 1.5 multiplier to wholesale diesel
  - $2.88 per gallon calculated biodiesel price for 2010 based on average $2.25 per gallon CARB diesel wholesale value
  - $4.94per gallon calculated biodiesel price during the first eight months of 2011 based on an average $3.08 per gallon CARB diesel wholesale value
- Staff used values from 2010 for the low prices (high demand) cases and the values from 2011 for the high prices (low demand) cases

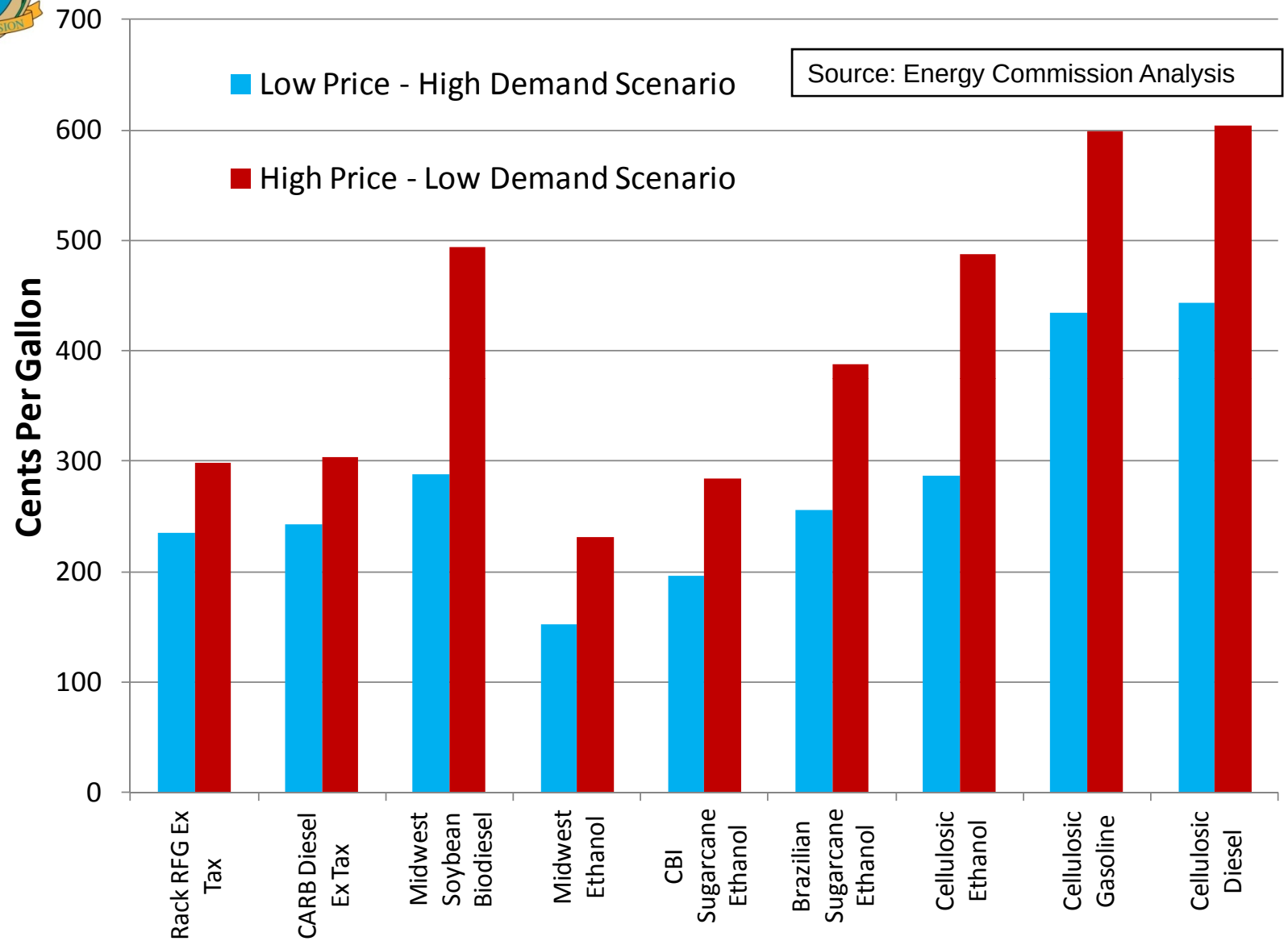
Initial Biofuel Values – Cellulosic Ethanol

- Cellulosic ethanol prices were derived due to lack of historical data
  - Calculated as a RIN premium to Brazilian ethanol
- Renewable Identification Number (RIN) credit values
  - 30 cents per gallon (cpg) for cellulosic biofuels during 2010
  - 100 cpg for cellulosic biofuels during the first eight months of 2011
- Applied these RIN values as premium to Brazilian ethanol
  - $2.86 per gallon calculated cellulosic ethanol price for 2010 based on average $2.56 per gallon Brazilian ethanol value
  - $4.87per gallon calculated cellulosic ethanol price during the first eight months of 2011 based on an average $3.87 per gallon Brazilian ethanol value
- Staff used values from 2010 for the low prices (high demand) cases and the values from 2011 for the high prices (low demand) cases

Initial Biofuel Values – BTL Fuels

- Biomass-to-liquids (BTL) prices were derived due to lack of historical data
  - Calculated as a premium to forecasted wholesale petroleum fuels
    - $2.00 per gallon used for Low Price scenario
    - $3.00 per gallon used for High Price scenario
- Applied these premiums to forecasted wholesale prices
  - 2012 Low Price values for cellulosic fuels
    - $4.43 per gallon BTL diesel price based on forecast $2.43 per gallon CARB diesel wholesale value
    - $4.35 per gallon BTL gasoline price based on forecast $2.35 per gallon CARBOB wholesale value
  - 2012 High Price values for cellulosic fuels
    - $6.04 per gallon BTL diesel price based on forecast $3.04 per gallon CARB diesel wholesale value
    - $5.98 per gallon BTL gasoline price based on forecast $2.98 per gallon CARBOB wholesale value

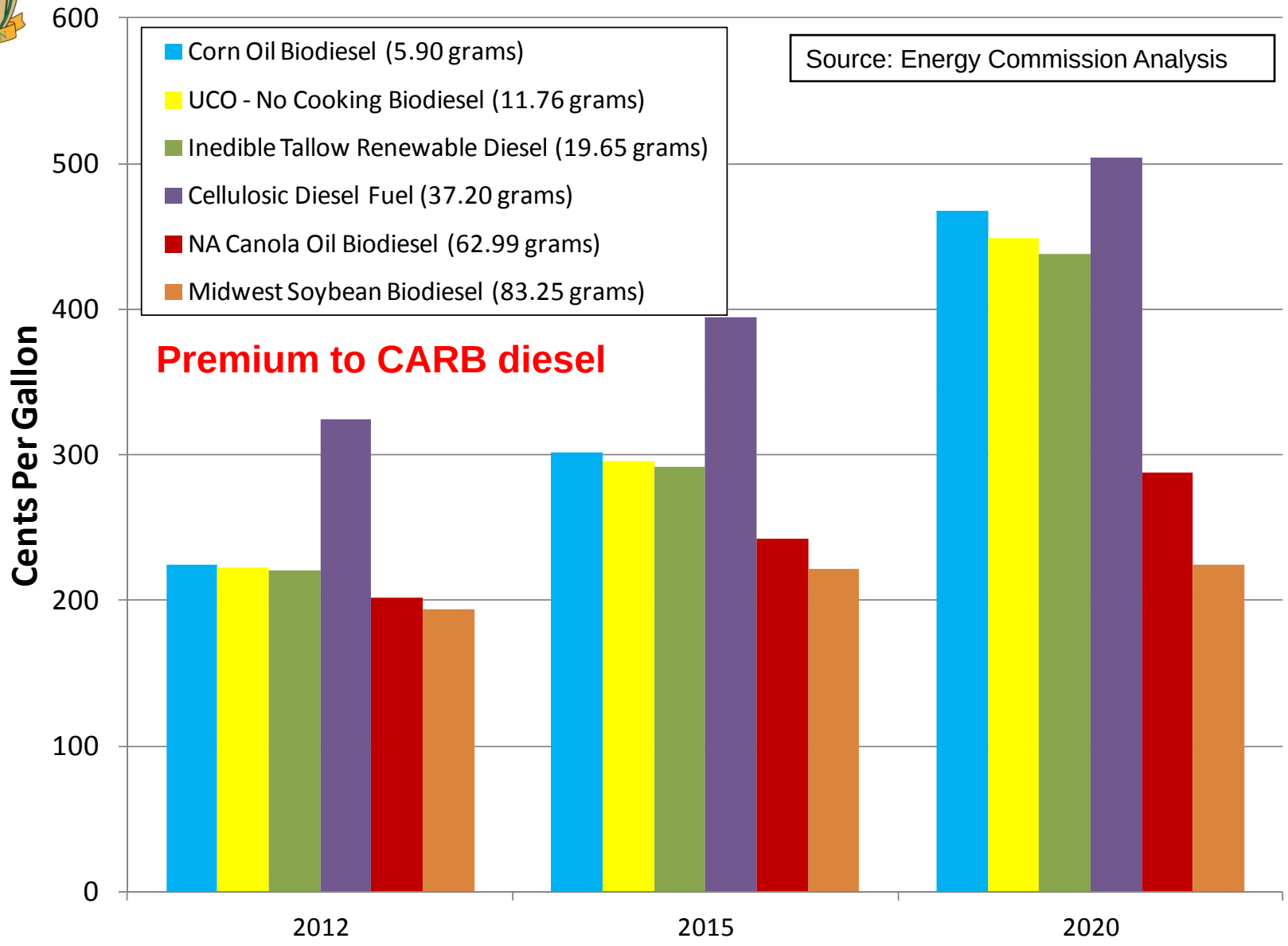
2012 Fuel Prices – No CI Adjustment



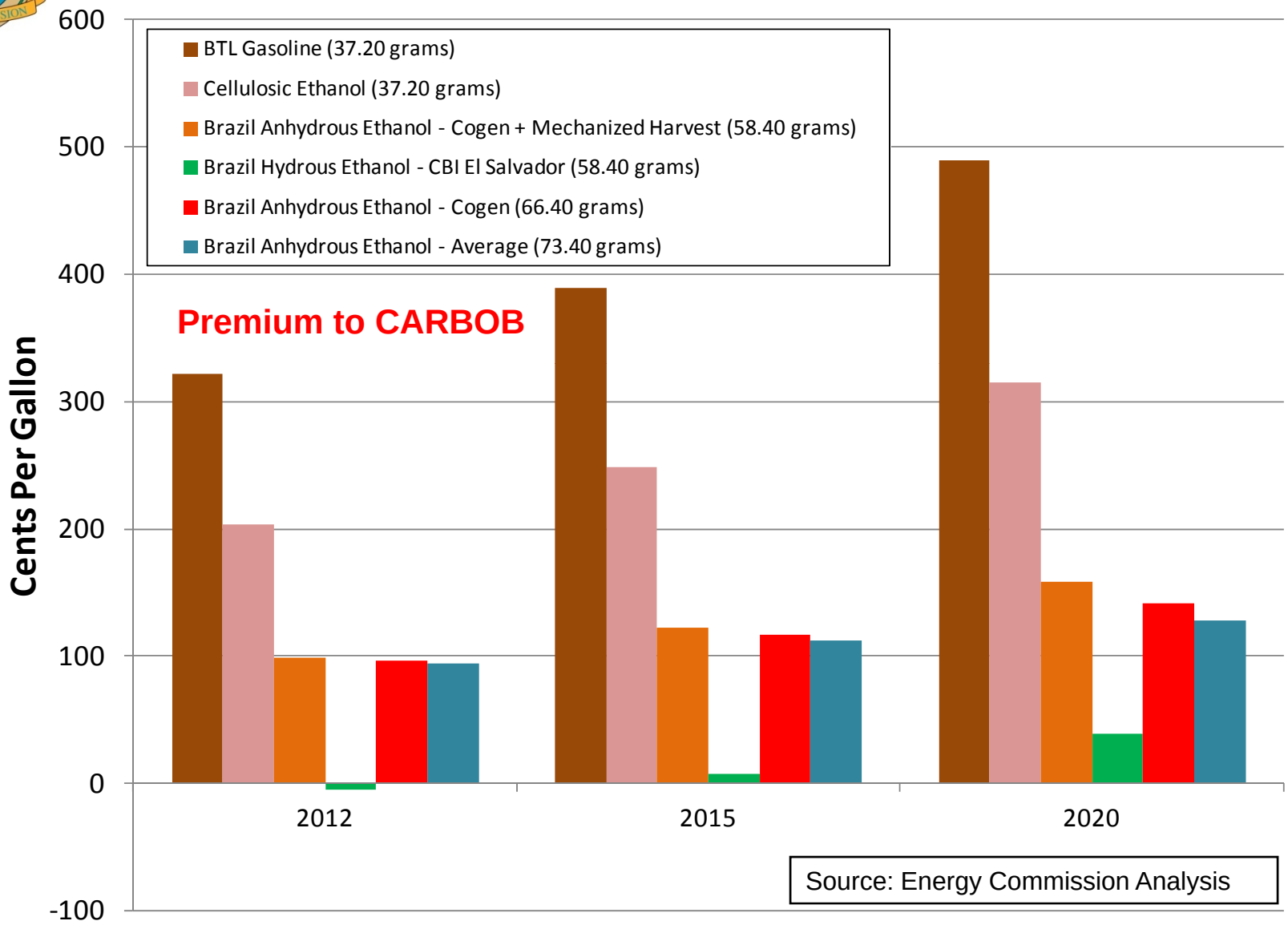
Biofuels – Additional Price Adjustments

- Increased these initial values at same rate as petroleum-based fuels
  - Low and High price forecast for gasoline and diesel fuel
- Further adjusted these values by applying a premium for each gram of carbon intensity differential from the compliance target for each year
  - Based on a range of carbon values
    - $25 per tonne during 2012, rising to ether $100 or $200 per tonne by 2020 for ethanol
  - The lower the carbon intensity of the fuel, the higher the premium
- Carbon costs also adjusted to account for higher energy content
  - Ethanol 80.53 MJ/Gal
  - CARBOB 119.53 MJ/Gal
  - Biodiesel 126.13 MJ/Gal
  - CARBOB 134.47 MJ/Gal

CI Premium Adjustment – Diesel Substitutes



CI Premium Adjustment – Gasoline Substitutes

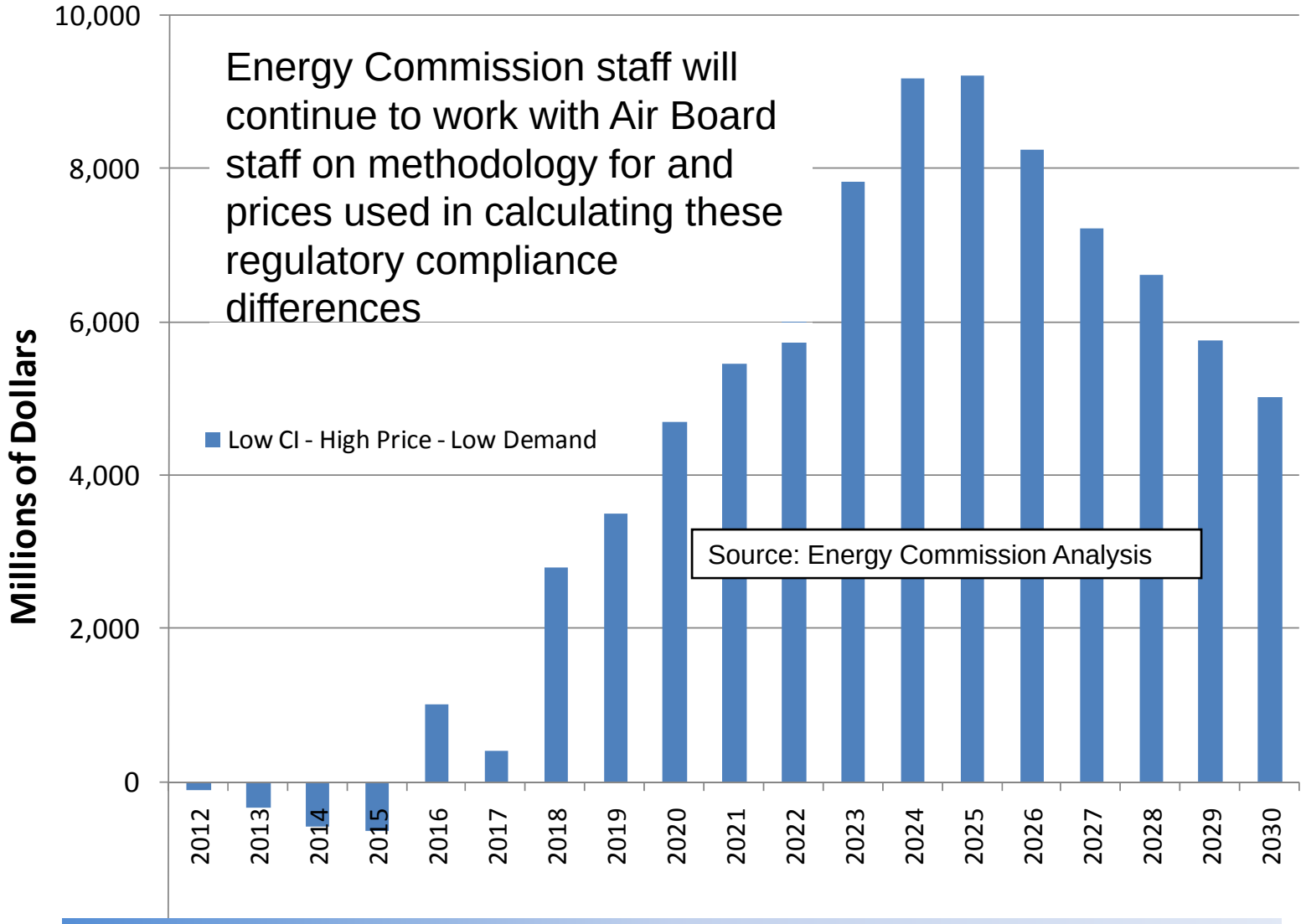


LCFS & RFS2 Estimated Cost Comparison

- Energy Commission staff calculated the cost of RFS2 & LCFS
  - Used estimated biofuel values and forecasted petroleum prices
- California consumers and businesses are expected to pay higher prices for gasoline and diesel fuel due to:
  - Rising crude oil prices & linkage to higher petroleum fuel prices
  - Increased use of more expensive biofuels
- Absent an LCFS regulation for California, transportation fuel prices are expected to rise due, in part, to proportional share compliance with the federal RFS2 provisions
- Therefore, only that portion that is in excess of the biofuels needed for RFS2 compliance should be attributed to the LCFS
- Case 3 results used to calculate the difference in costs between the two regulations

Case 3 Low Demand – LCFS less RFS2

Preliminary Initial Results



Continuing Efforts

- Energy Commission staff will continue to analyze LCFS compliance cases, including:
  - New compliance targets proposed by the Air Resources Board in response to revised high carbon intensity crude oil provisions
  - Additional sensitivities suggested during today's workshop or detailed in subsequent comments
  - More detailed assessment of the differences between Energy Commission and Air Resources Board respective LCFS compliance analysis
- This additional LCFS analysis will be published in the Final Staff Report

LCFS Outside of California

- 22 other states are developing or considering adoption of LCFS programs similar to California
- The incremental demand for the same type of biofuels used to comply with California's LCFS program that would result if any other region of the United States carried out implementation of an LCFS-like program would, at a minimum, increase competition and raise the market-clearing prices of these biofuels
- States considering implementation of LCFS-like regulations equate to 3.7 times the quantity of gasoline consumed in California and 7.2 times the quantity of diesel fuel consumed in California during 2009