



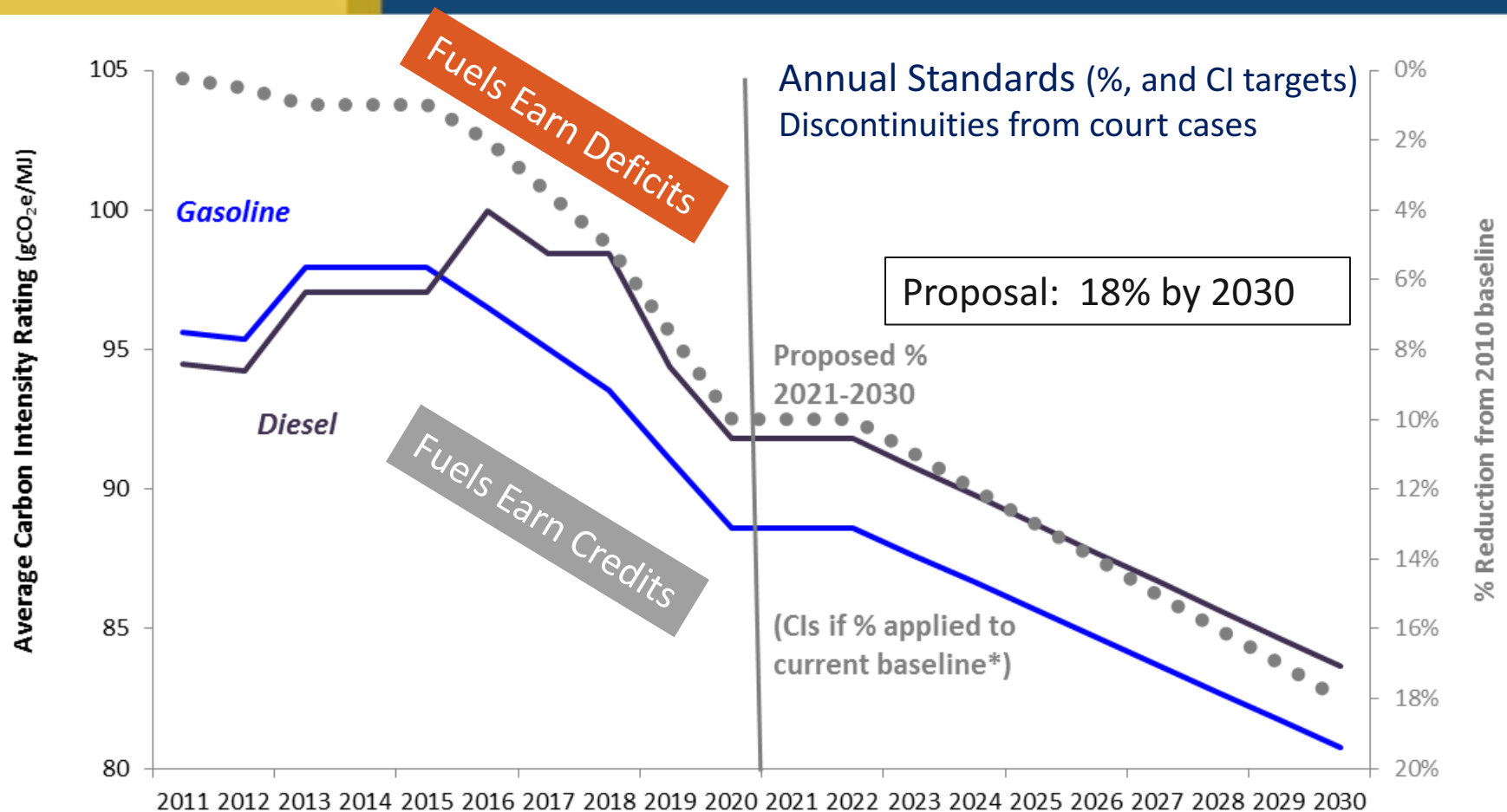
UC DAVIS SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

Low Carbon Fuel Standard (LCFS) Update

December 8, 2017
STEPS Fall Symposium

Julie Witcover
Ass't Project Scientist

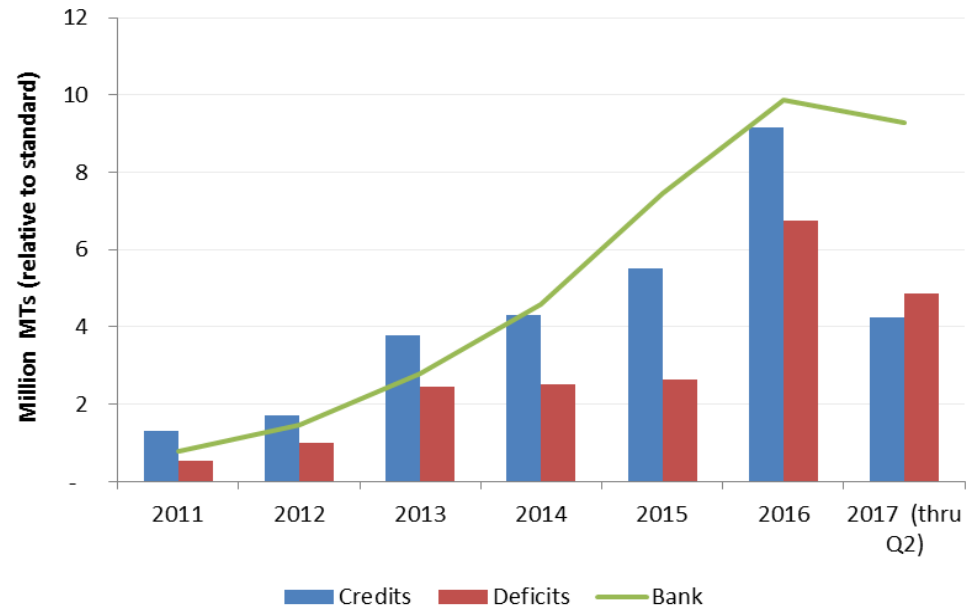
CA LCFS: 10% Reduction in Carbon Intensity (CI) by 2020



- “Lifecycle” CI rated on continuous scale – “direct” + “indirect” effects
- Market mechanism (banking, trading); technology forcing (via stringency); technology neutral (for alternative fuels)

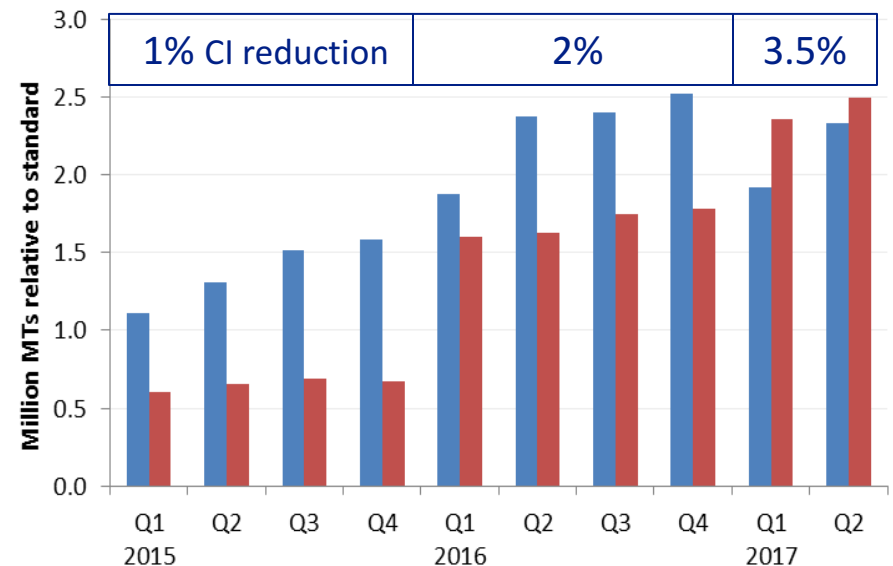
CA Credit/deficit balance pattern shifts in 2017

- Credits exceed deficits until 2017 Q1&Q2 (residential electricity not reported yet)

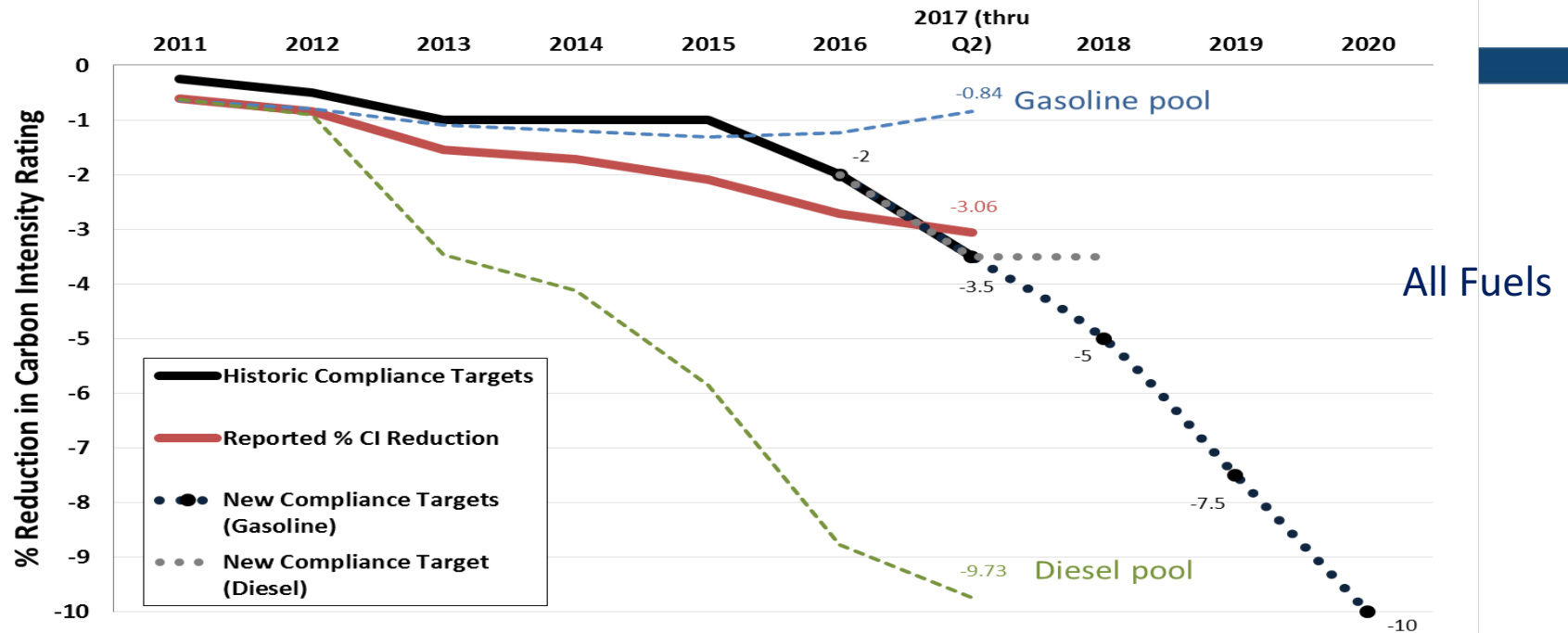


- More excess deficits in Q1 than Q2 2017 (quarterly data)

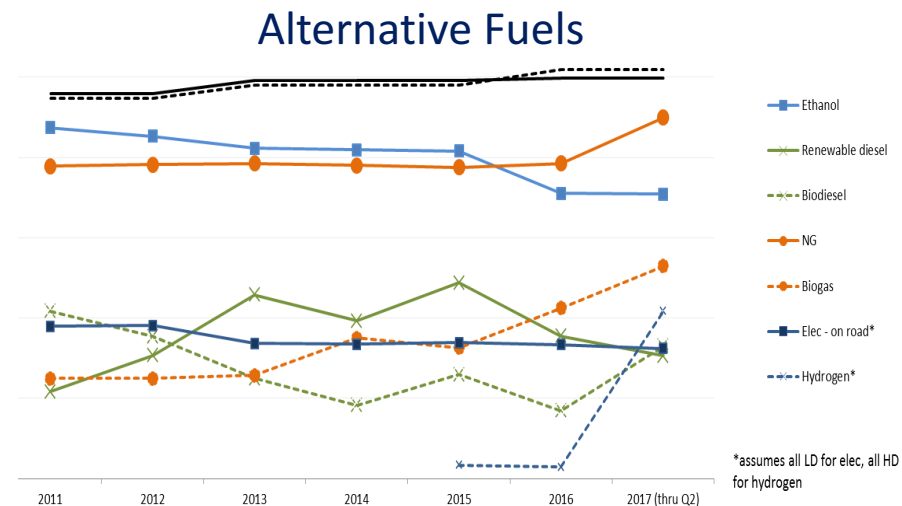
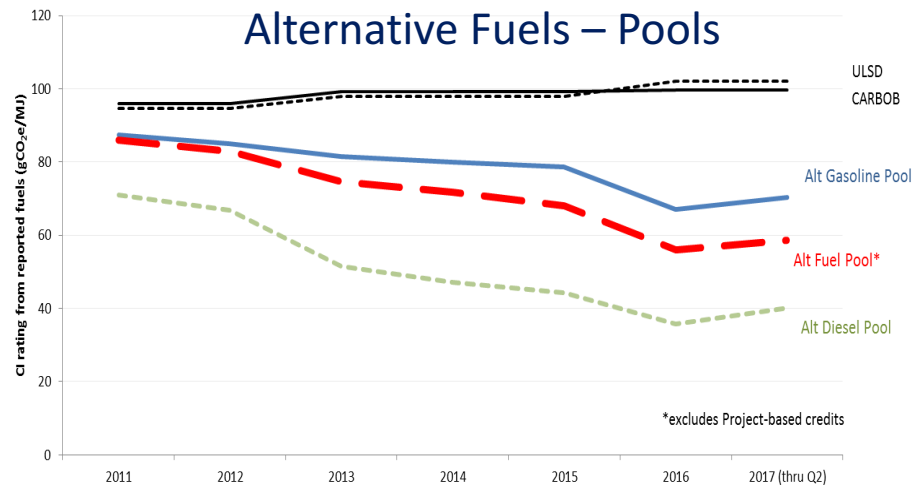
LCFS Credit Price	Week of 11/27/17
Avg. Price (\$/MT CO2e)	\$92
Range	~\$73-\$111
Volume	~552,500



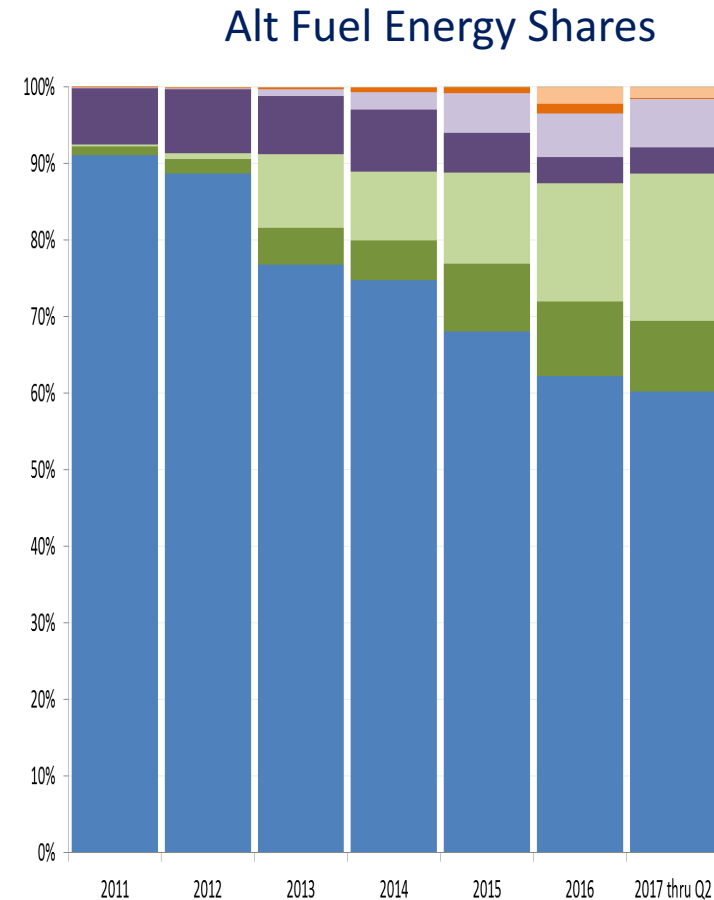
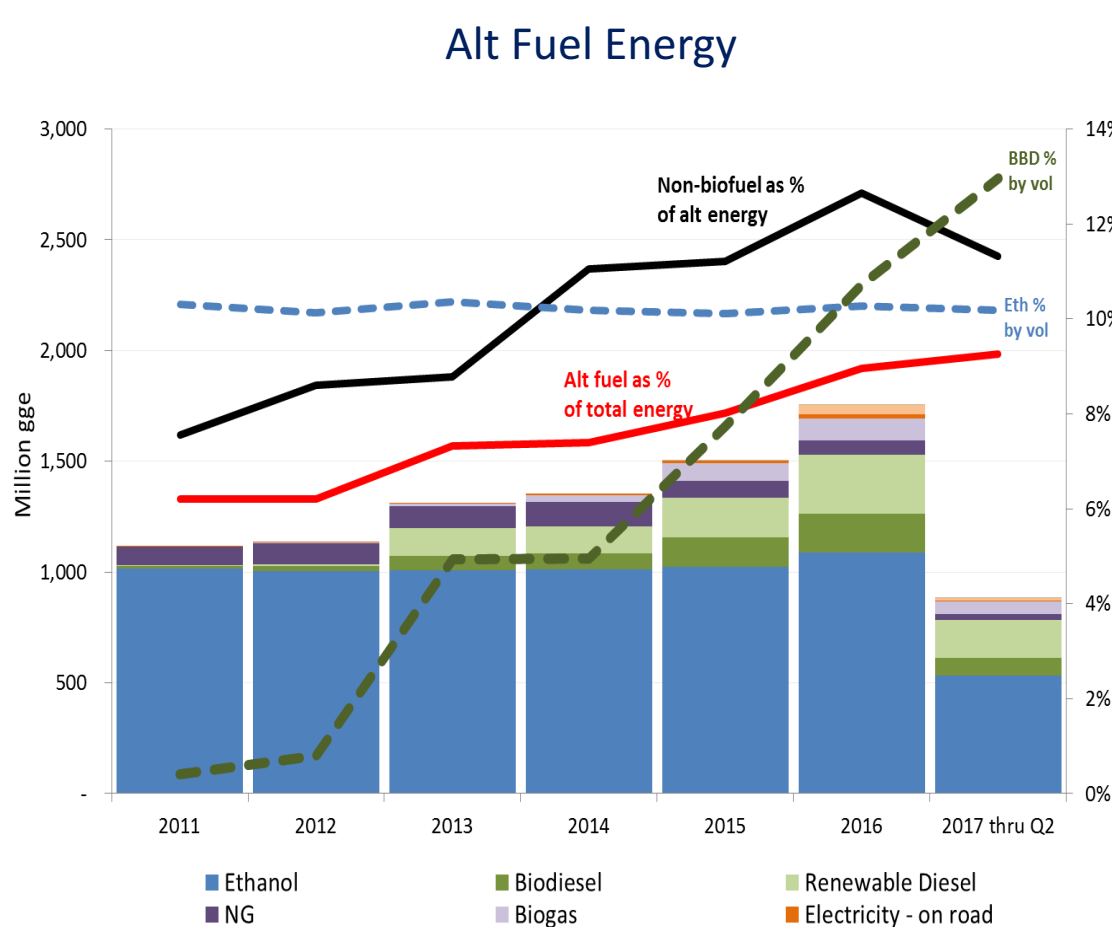
Reported CI Ratings Trends: Diesel Pool Drives Compliance



Reported % CI reduction is for composite of gasoline & diesel fuels; 2017 does not include non-metered electricity credits.



Alternative Fuel: Over 9% Total Transport Energy in 2017* (thru Q2)



*no residential electricity

Source: ARB data

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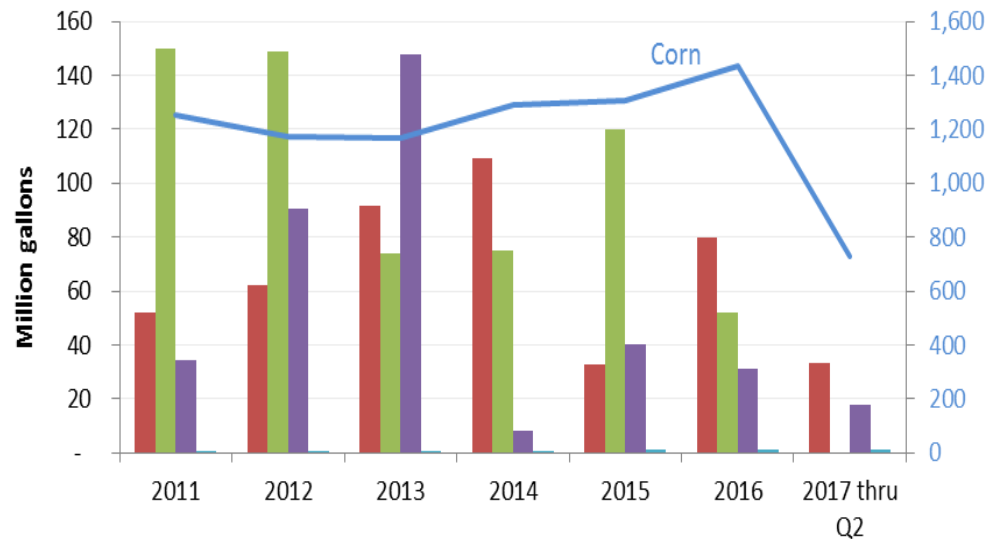
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- Ethanol blend steady
- Biomass-based diesel @ ~13% by volume
- Biogas outpaces fossil NG growth

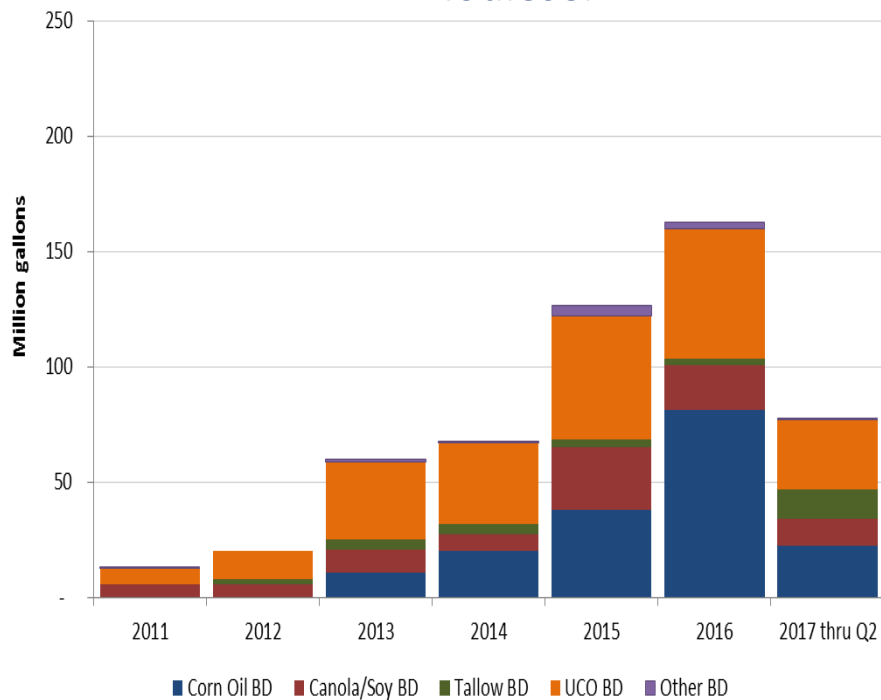
Feedstocks

Ethanol

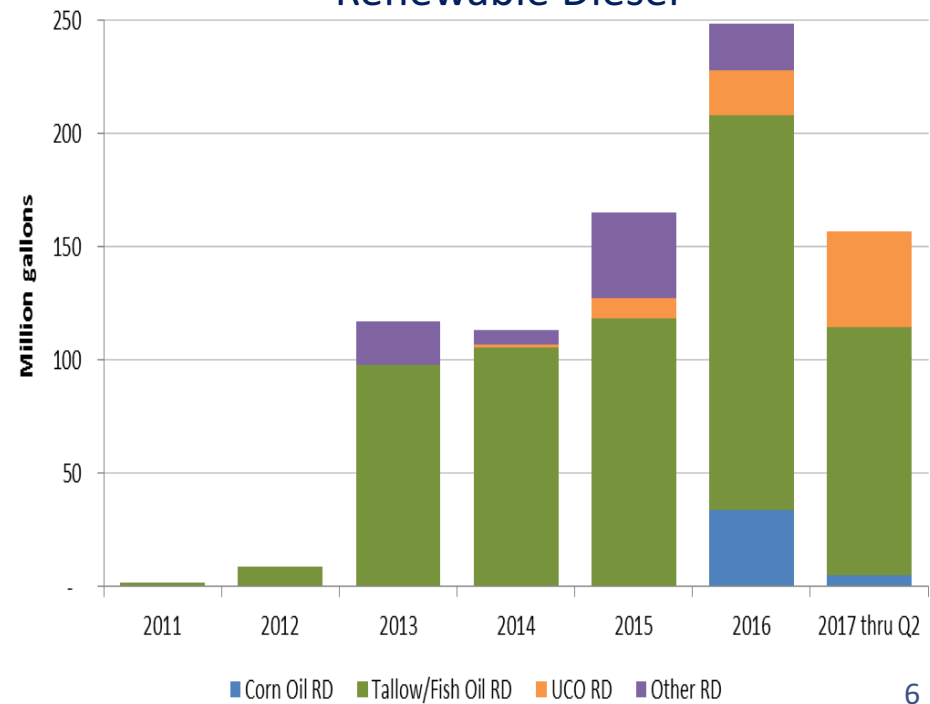


Source: ARB data

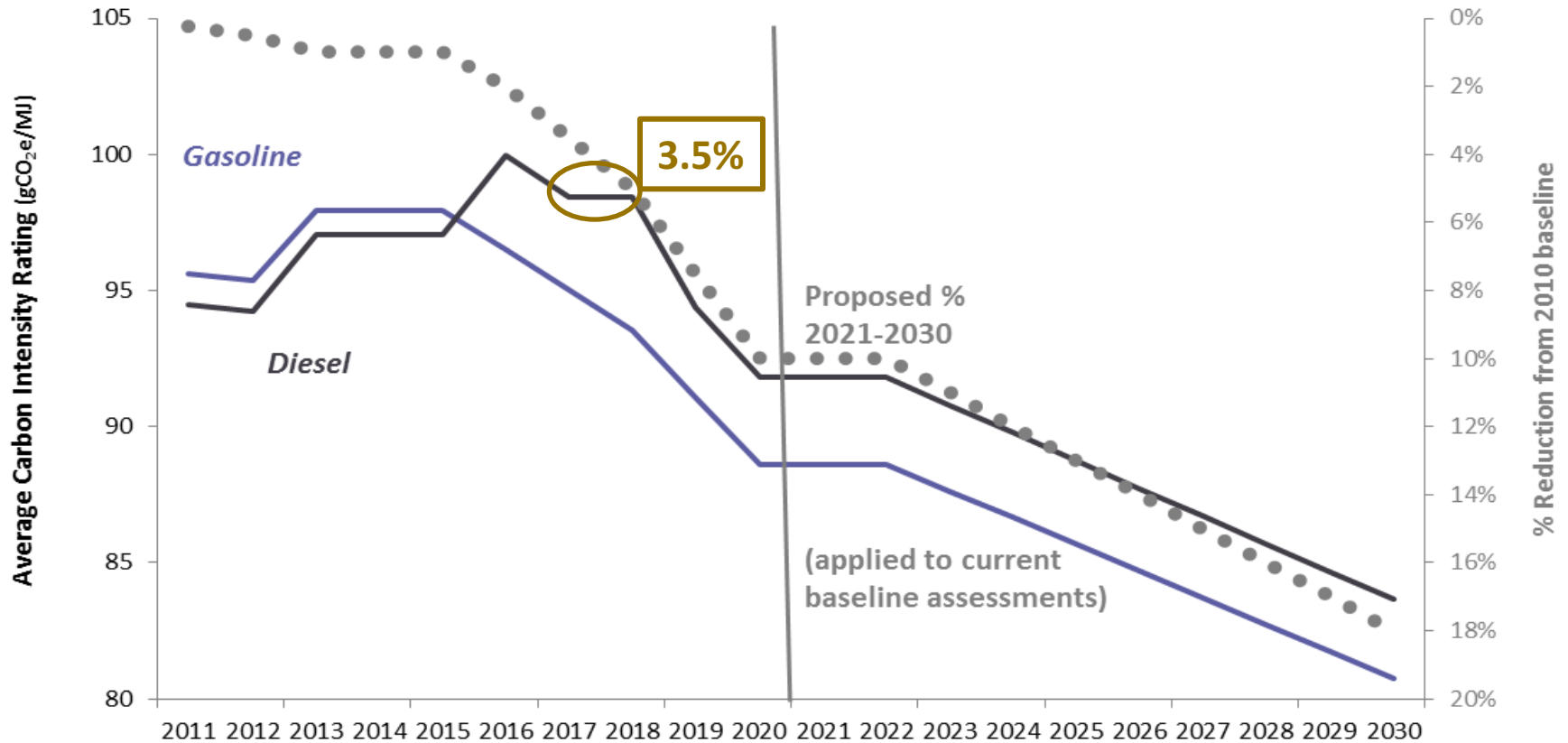
Biodiesel



Renewable Diesel

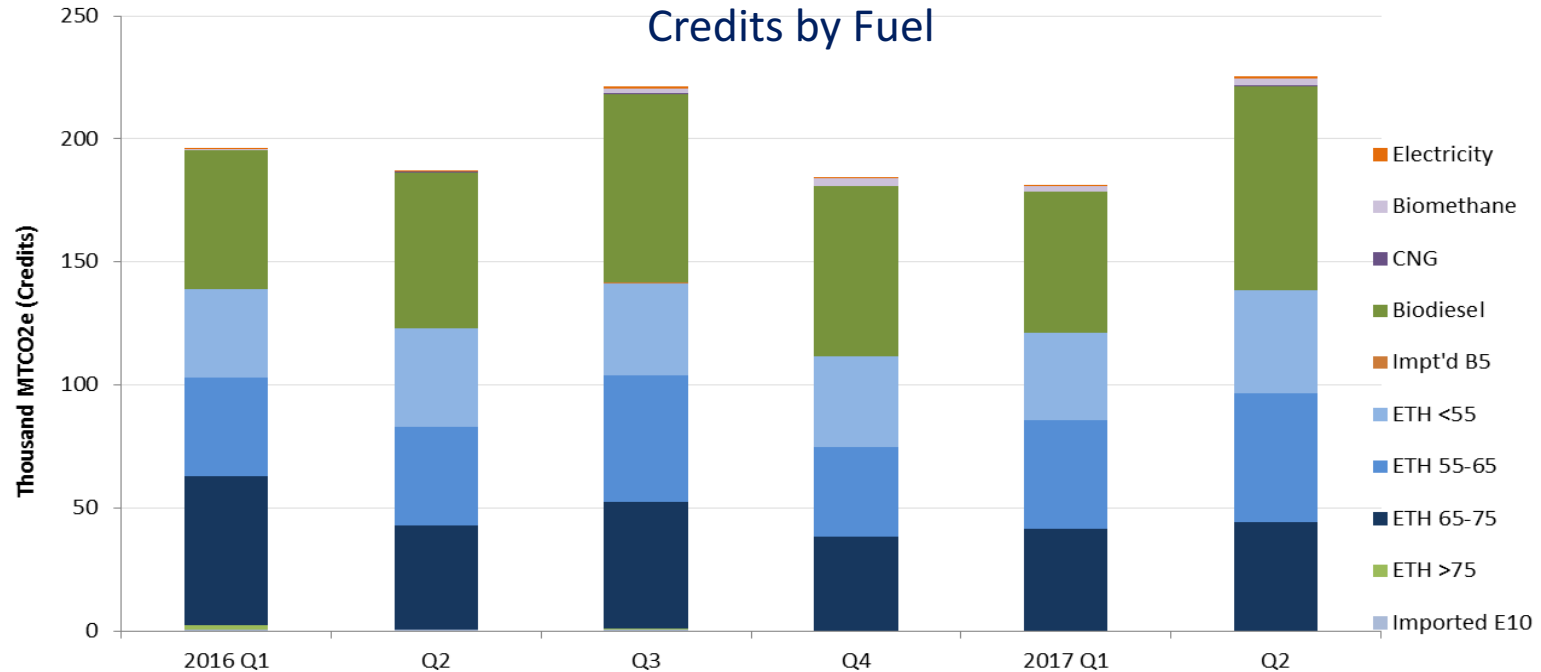


In 2018: California Diesel Standard Frozen, for Q1 (at least)

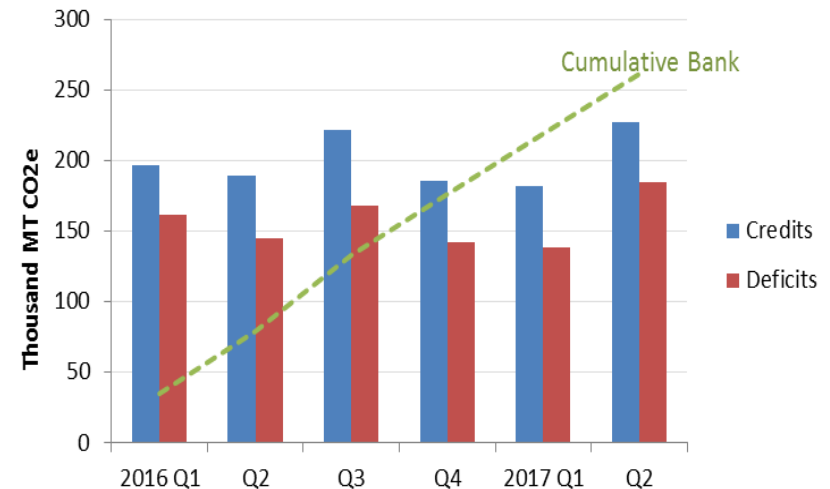


- State court ruling
- ARB must remedy biodiesel environmental analysis

Oregon Clean Fuels Program (CFP), Year 2 (0.5% standard)



- Since August
 - 23 trades
 - 45,000 credits
 - Avg. Reported Mthly Price
 - \$44-\$51.50



Canadian Proposals

- National Clean Fuel Standard

- 30 Million Metric Ton GHG reductions per year in 2030 (target) toward Paris goals (30% below 2005 levels by 2030)
- Intensity standard for transportation, industry, buildings (liquid, solid, gaseous fuels; based on lifecycle analysis)



- Ontario. Renewable Blend Mandates (Eth in Gasoline, Greener Diesel)
 - **Ethanol.** 5% to 10% in 2020. GHG lifecycle CI threshold (“e.g., 35%...” < petroleum). Cellulosic 2.5x multiplier (expand to renewable gasoline, biocrude)
 - **“Greener Diesel”.** Incentivize emerging technologies (e.g., biocrude). 4% biomass-based blend. 70% GHG lifecycle CI reduction threshold

Other program updates

- California
 - Verification/monitoring (proposed)
 - Alternative jet opt-in (proposed)
 - 18% CI reduction target for 2030 (proposed)
 - First project credits (Q3 2016, innovative crude)
 - Enforcement, credit adjustment reporting (+ and -)
- Oregon (2018)
 - Cost containment mechanism (similar to CA, with additional administrative deferrals and study triggers)
 - Renewable diesel in
 - Electricity “backstops”



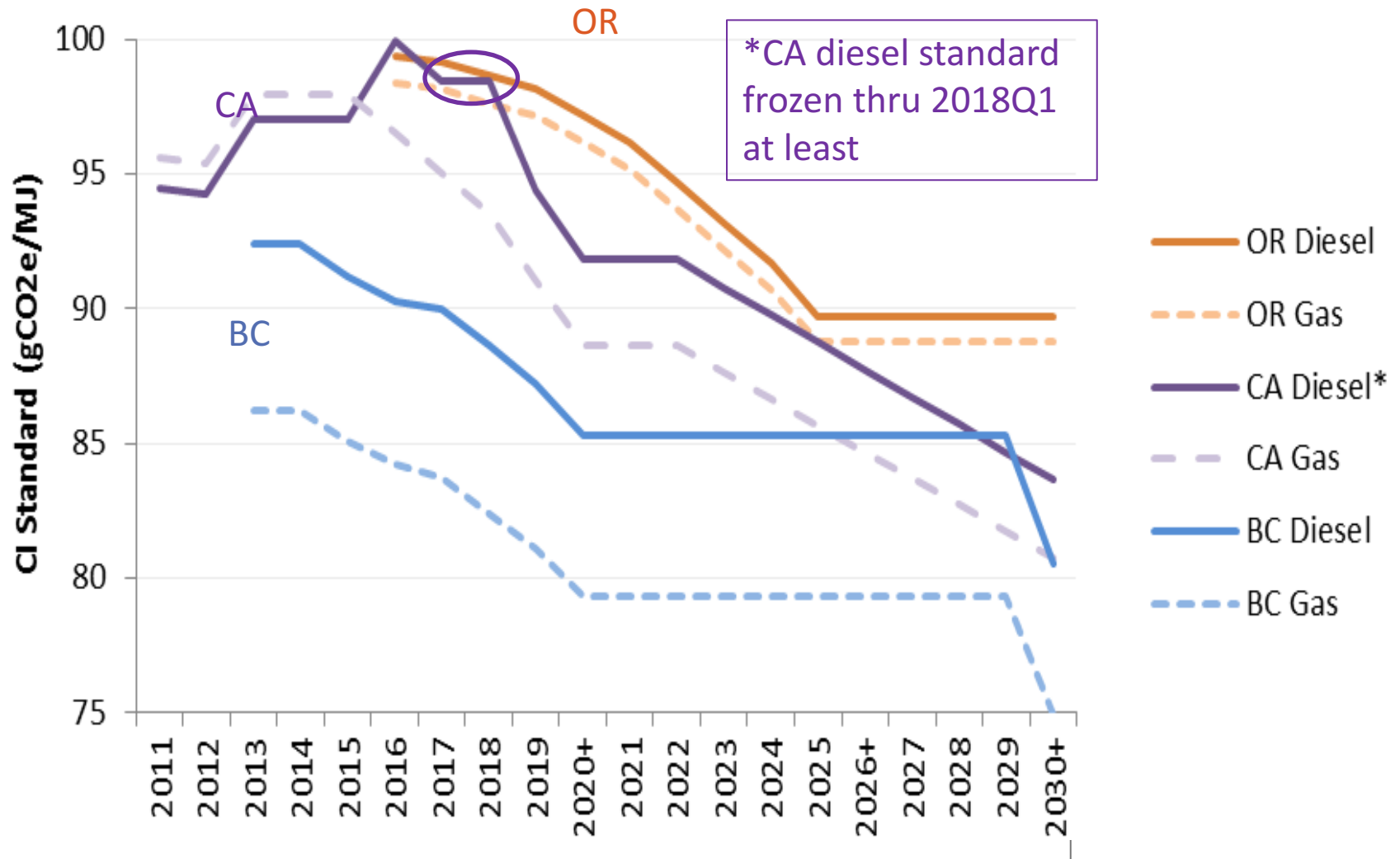
Thank you!

jwitcover@ucdavis.edu

Extra

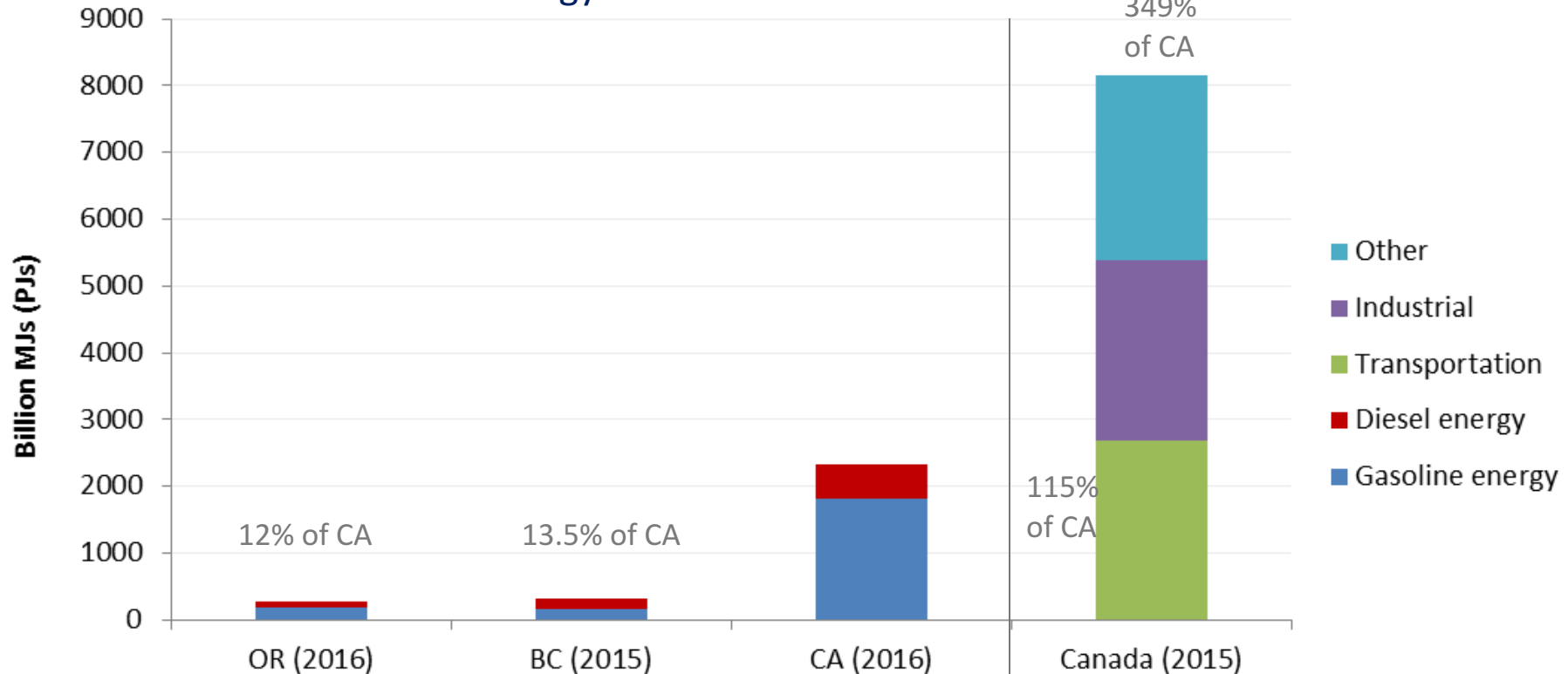


West Coast Jurisdiction CI Standards



Beyond California... “LCFS” Energy (at a glance)

Energy under CI Standards



Clean Fuels Program

- 10%, 2015-2025
- Broader \$C?

RLCF

- 10%, 2010-2020
- Broader \$C tax

LCFS

- 10%, 2010-2020
- Broader \$C (cap-&-trade)

Clean Fuel Standard in 2019

- 30 MT reductions, 2030
- Regulation in development
- Moving beyond transport(?)
- Broader \$C (\$10-\$50/tonne, 2018-2022)

Sources: OR DEQ, BC Energy/Mines, CA ARB, Statcan

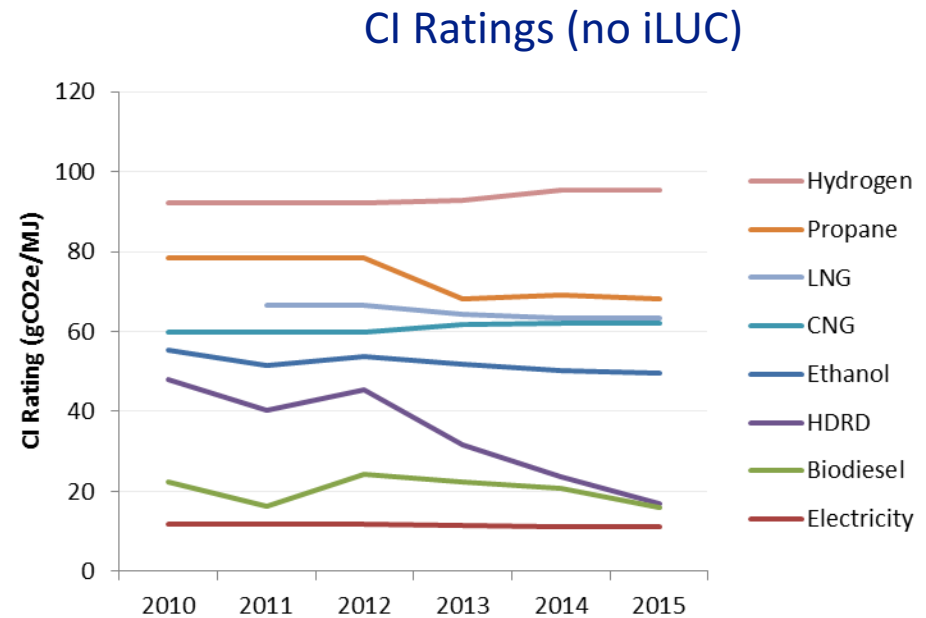
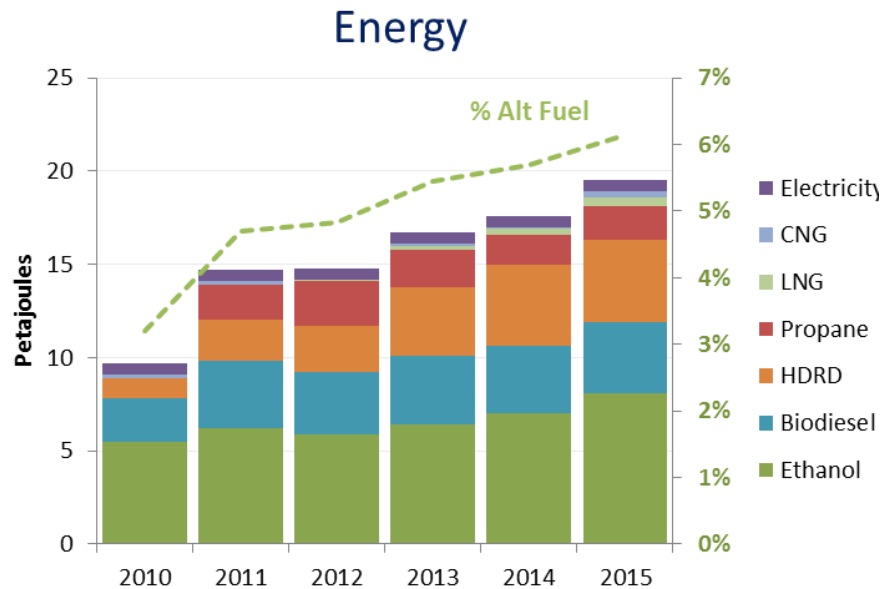
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...+Ontario, Alberta

BC Renewable and Low Carbon Fuel Requirement (at a glance)



Feedstock Biofuel Volumes →

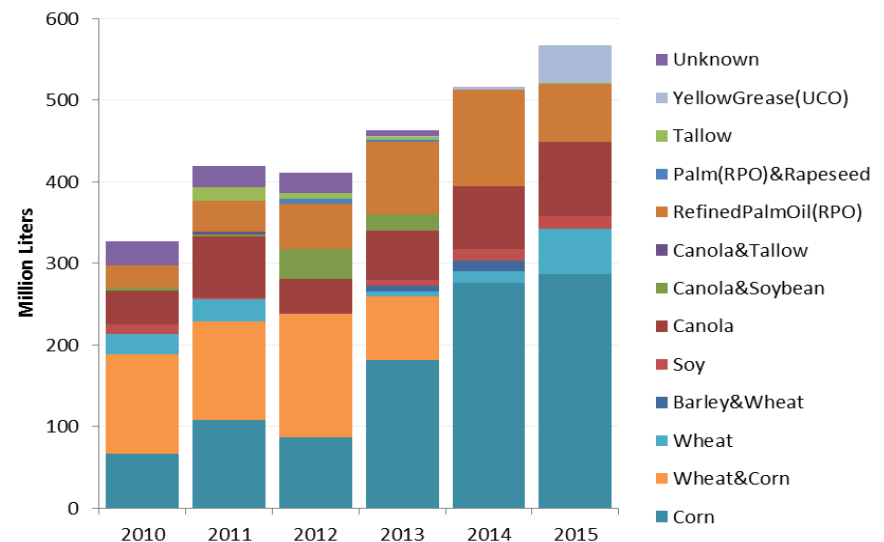
- \$171/MT (17 trades, 2016)
- 3.5% CI reduction, 2016

Source: BC Energy/Mines

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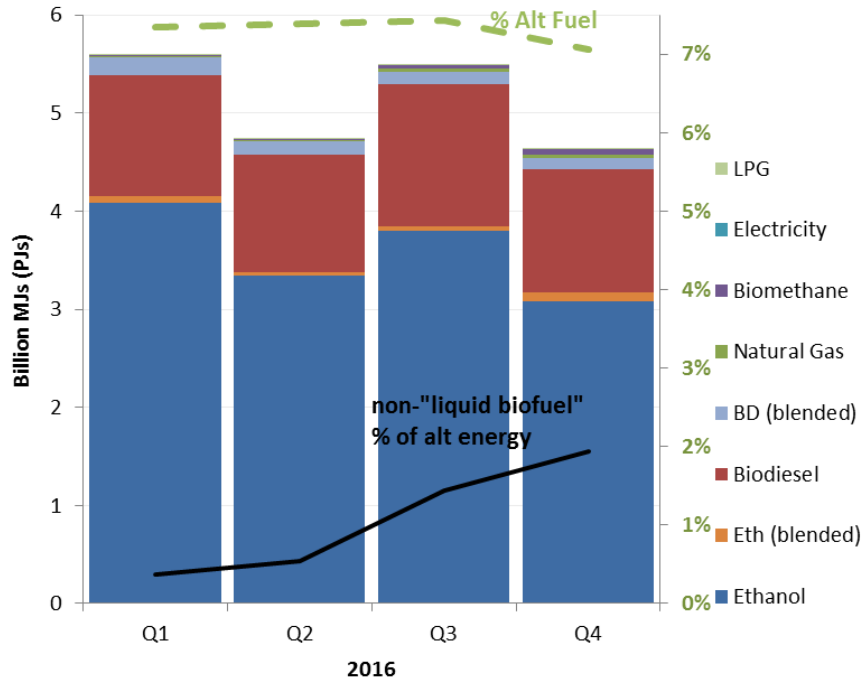
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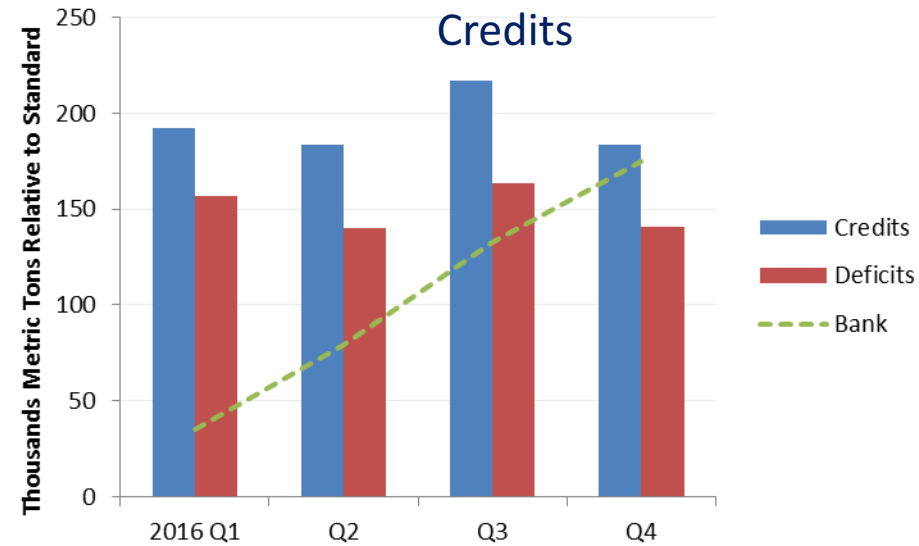


Oregon Clean Fuels Program (CFP) at a Glance

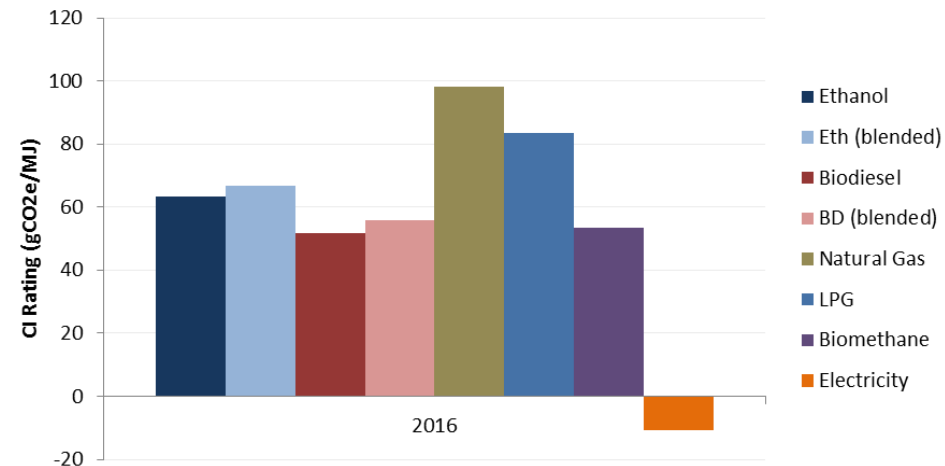
Energy



Credits



CI Ratings of Fuel Used



- \$45/MT*, 6 trades
- 0.25% CI reductions , 2016
- Cost containment under discussion

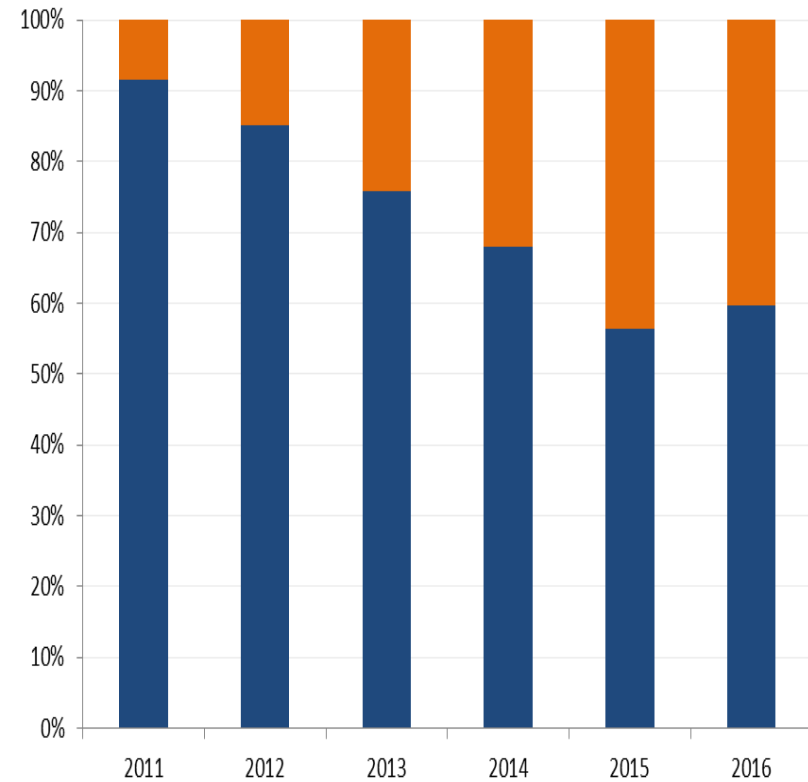
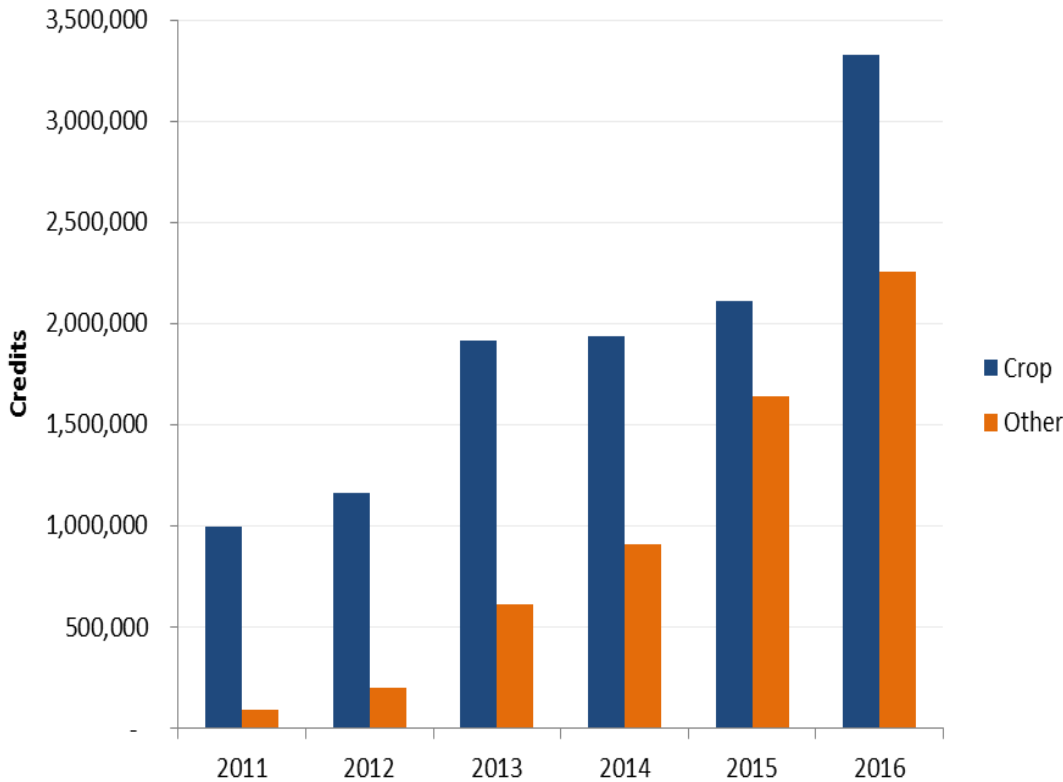
Sources: OR DEQ, *PFL market report

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Biofuel Credits – Trend Away from Crops ‘Resets’ in 2016

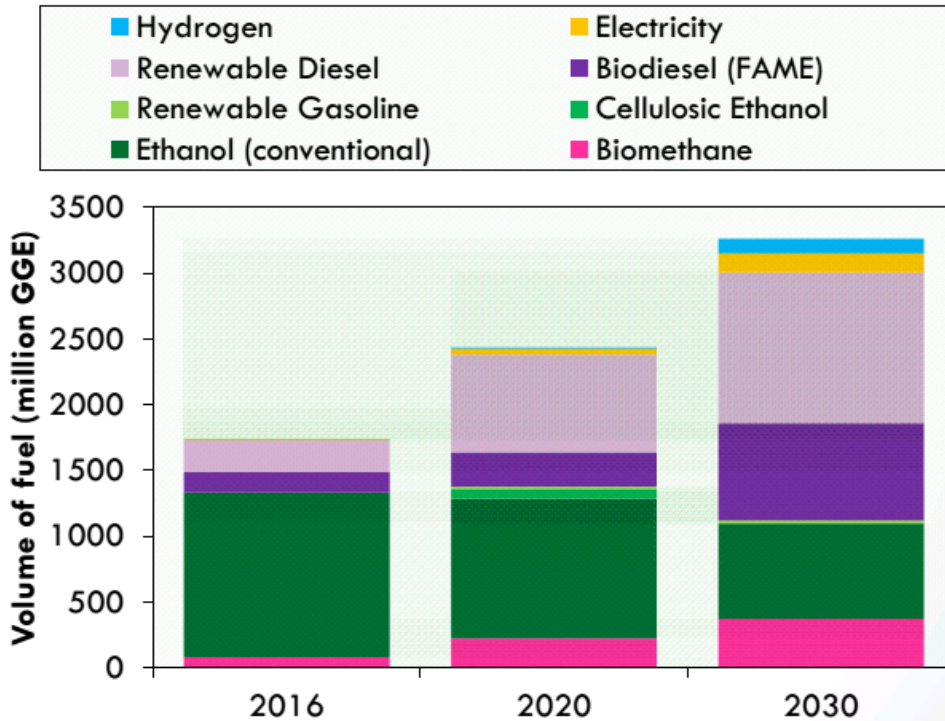


Source: ARB data

- Modeling update (lower iLUC estimates)
- Non-crop fuel – indirect impacts?

ARB Modeling for Scoping Plan Proposal : 18% by 2030

Volumes



- Least-cost-optimization
- ..within scenario modeling constraints (E3)

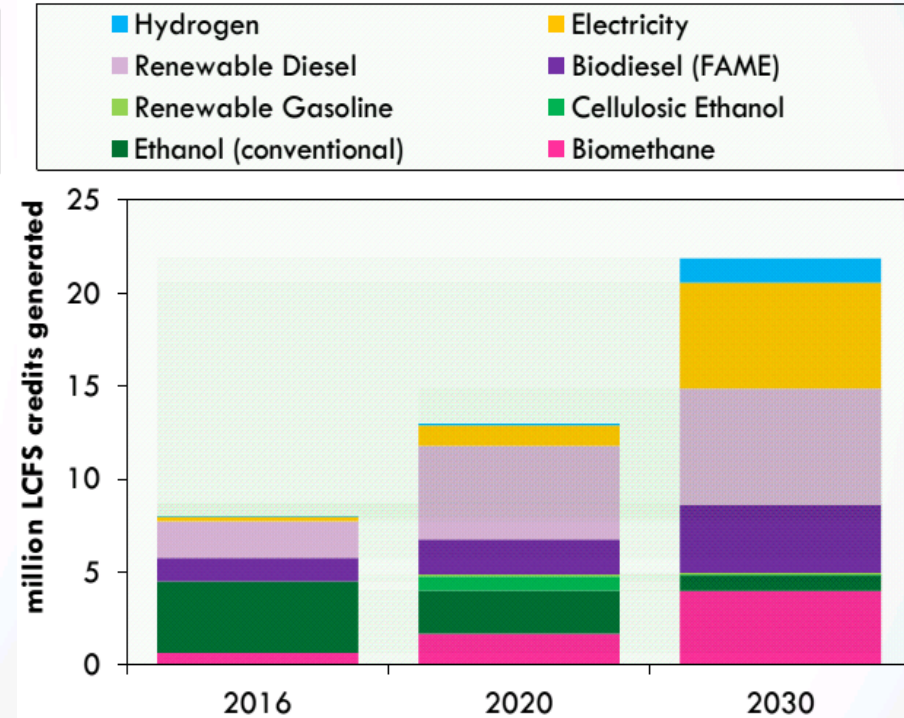
Source: ARB presentation, 3/17/17 workshop

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Credits



- Credits rely on technologies in use
 - Electricity, RD biggest contributors
 - Biogas, BD next
 - Little ethanol
- Competing demand not modeled (yet)

Looking ahead

- Where will fuels flow?
 - market signal for more low-C rated fuel volumes, ambitious targets
 - potentially increased competition for low-C rated fuels
 - program (and credit price) differences might mitigate (‘glidepath’ for some mid-range CI fuels?)
- Cost Containment
 - all jurisdictions have in some form or are considering
- Ex post assessment
 - GHG, environmental impact
 - CI ratings (different across programs, change over time within programs)
 - Compare to baseline-year CI, current CI of reference fuels, or “BAU”?
baseline CI updates?
 - Emissions impacts outside CI ratings system (e.g., rebound effects or fuel pool switching)
 - Accounting for uncertainty (CIs, drivetrain efficiency ratings (EERs))?
 - costs