



# UC DAVIS SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

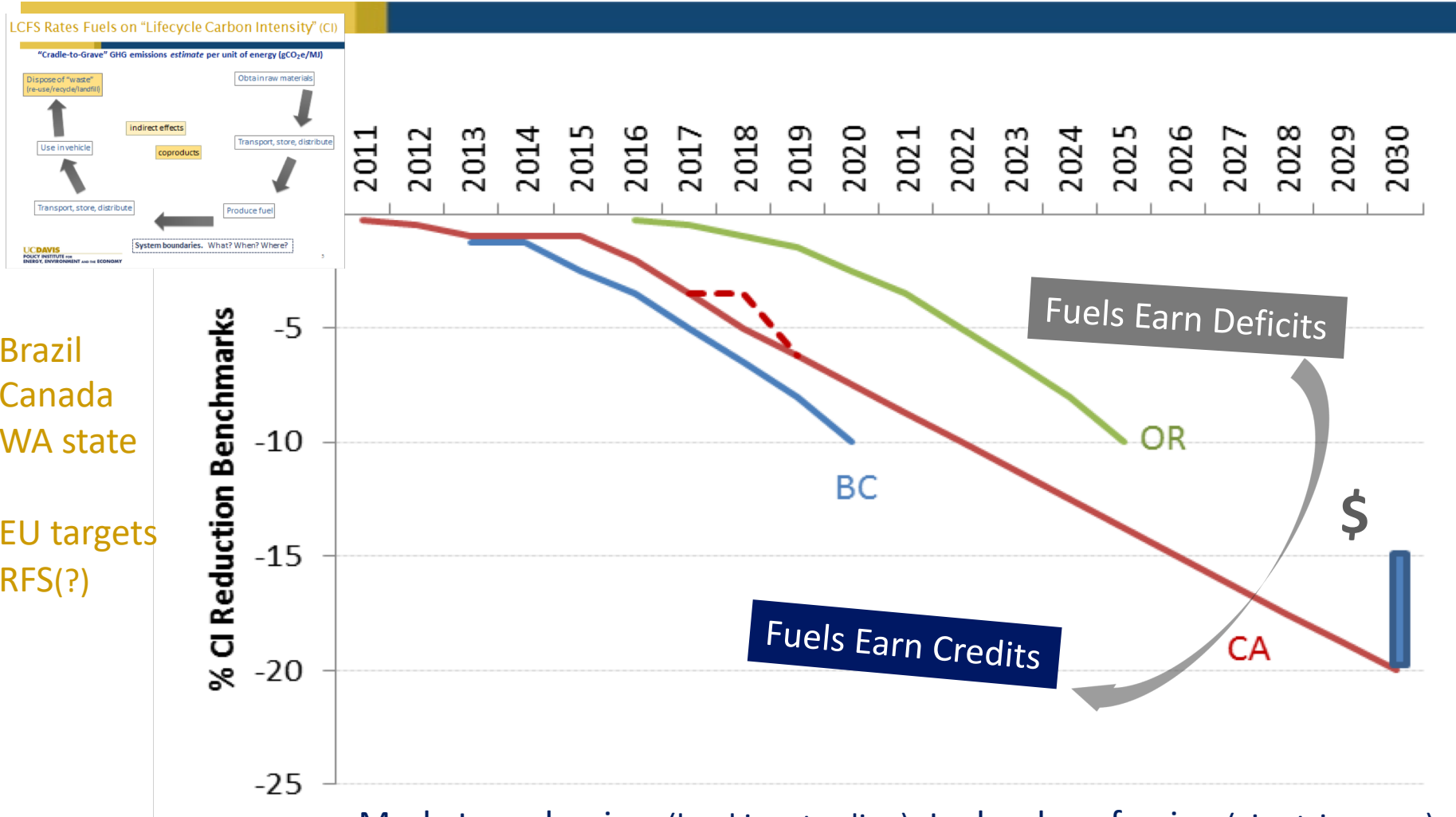
**Biofuels, Electricity, LCA, Vehicles,...  
...LCFS – a (Missing) Link?**

December 12, 2018  
STEPS Fall Symposium

Julie Witcover  
Ass't Project Scientist

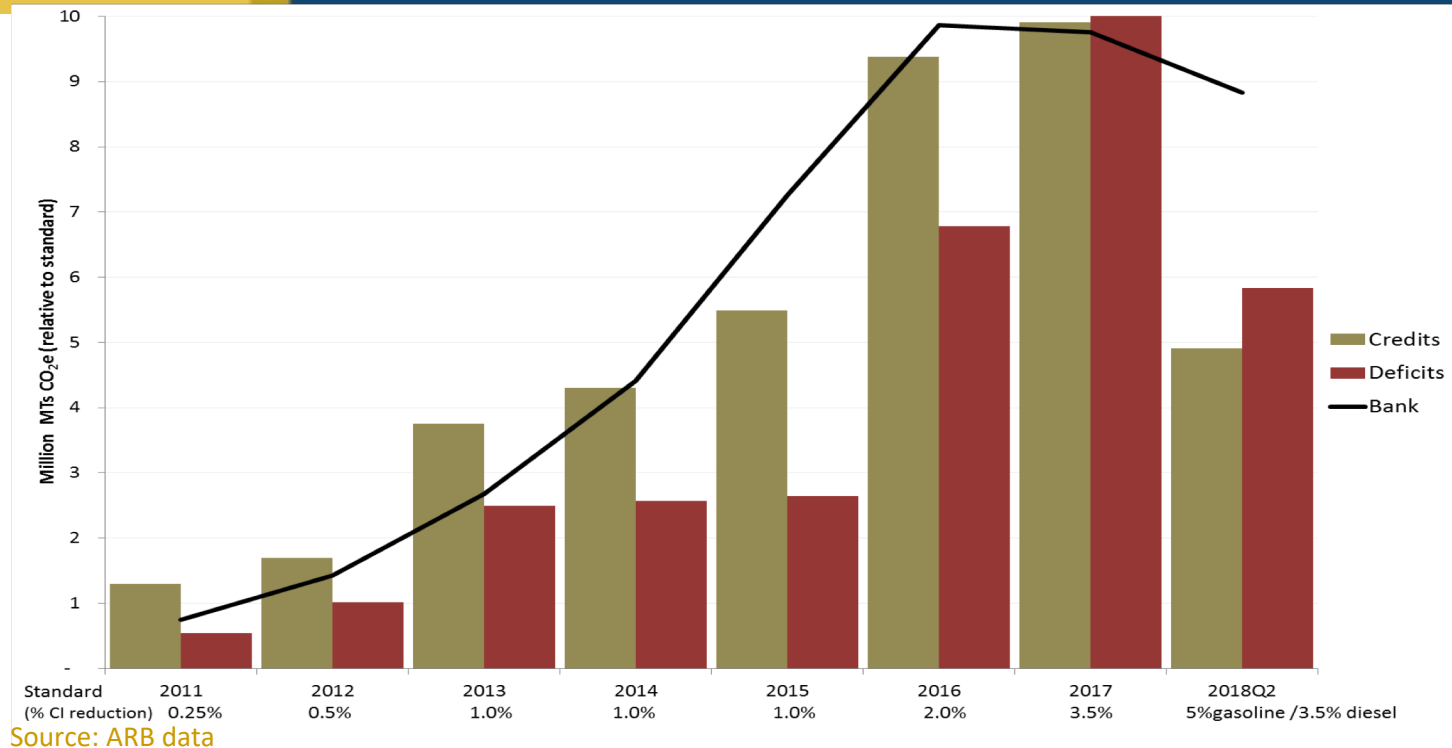
- ...where **biofuels**, **electricity** and other alternative fuels, some requiring new **vehicles** and delivery infrastructure, compete on the basis of lifecycle **LCA** and other market conditions.
- Today
  - a status update
  - and look ahead

# LCFS Targets Reductions in Fuel Carbon Intensity (CI) Ratings



- Market mechanism (banking, trading); technology forcing (via stringency)
- Alternative fuels compete on CI value (& other market factors)
- Revenue neutral; encourages lowest-cost compliance

# CA LCFS Credit Market Tightens



November avg. \$177

LCFS Weekly Snapshot		26 <sup>th</sup> November 2018 – 2 <sup>nd</sup> December 2018
Average Price [3] (\$/MT)	\$169.202	
Price Range (\$/MT)	\$110.00 - \$191.50	
Total Volume (MT)	550,292	
Total Value (\$)	93,012,016	

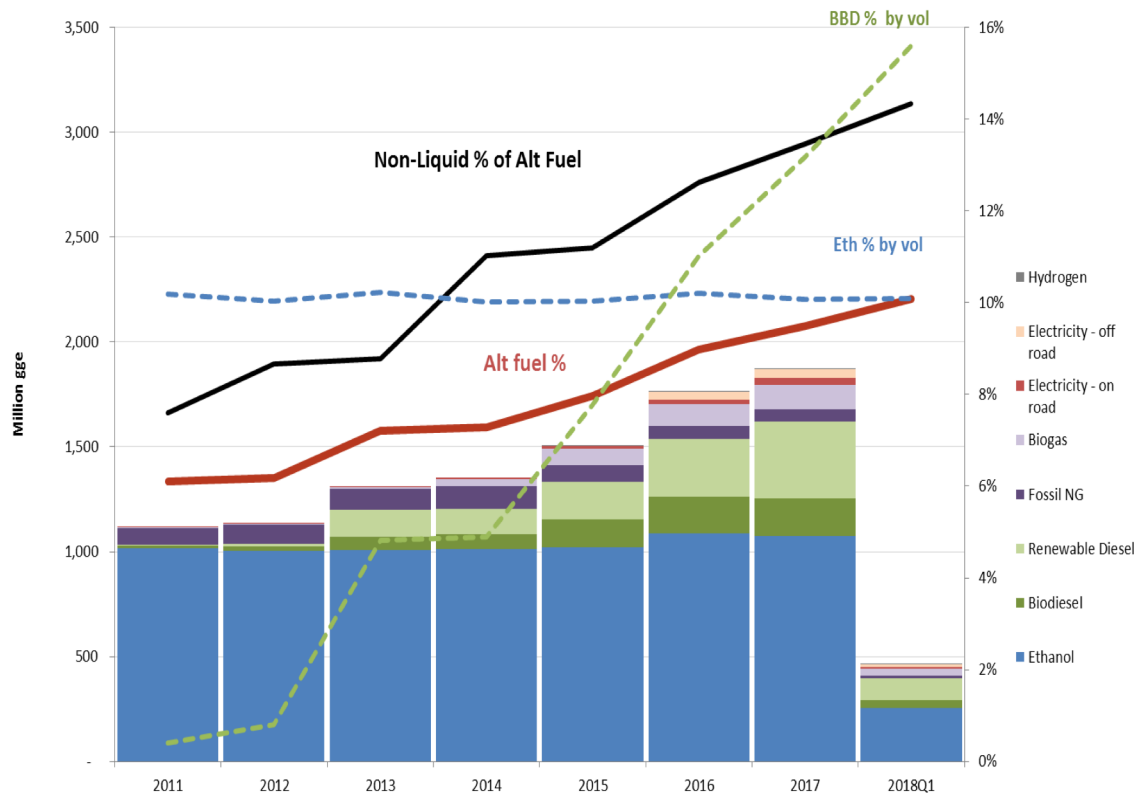
Source: ARB



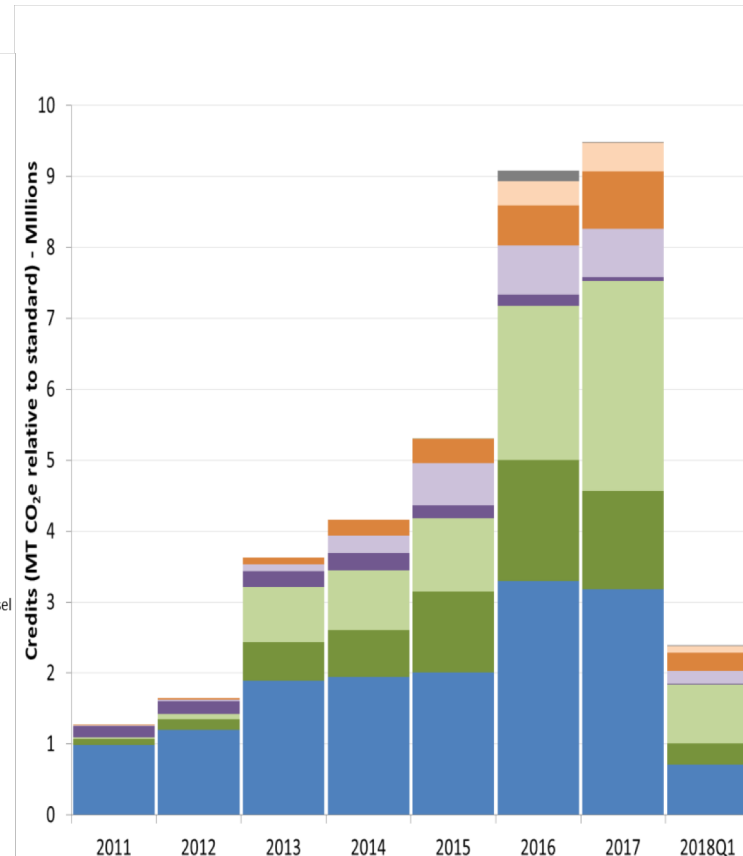


# Alternative Fuel Energy & Credit Trends Continue

## Alternative Fuel Energy



## Alternative Fuel Credits



Source: ARB data

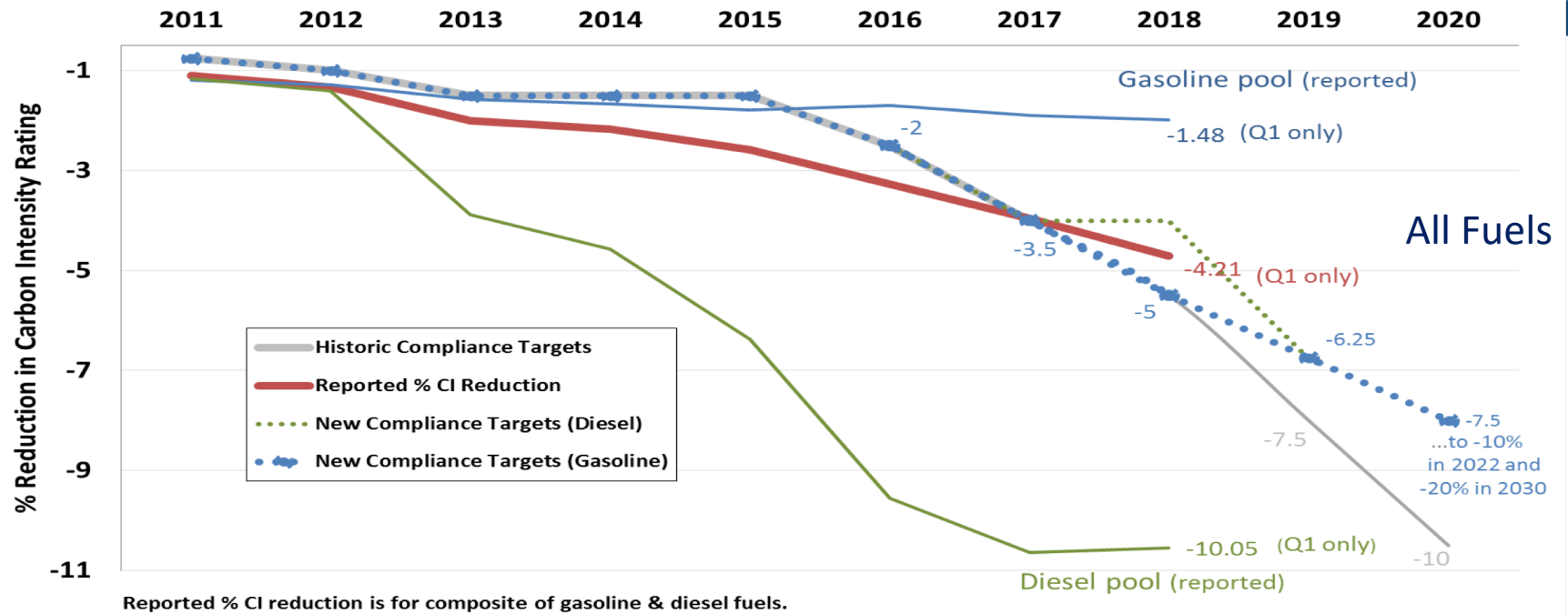
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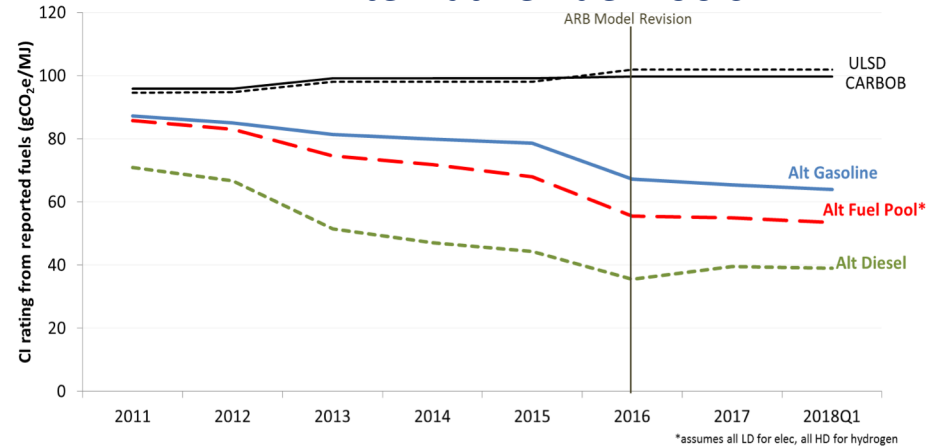
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**Retrospective analysis. ~10% lower CO<sub>2</sub>e emissions from transport fossil fuel combustion, 2011-2014, statistical study (Huseynov & Palma, 2018)**

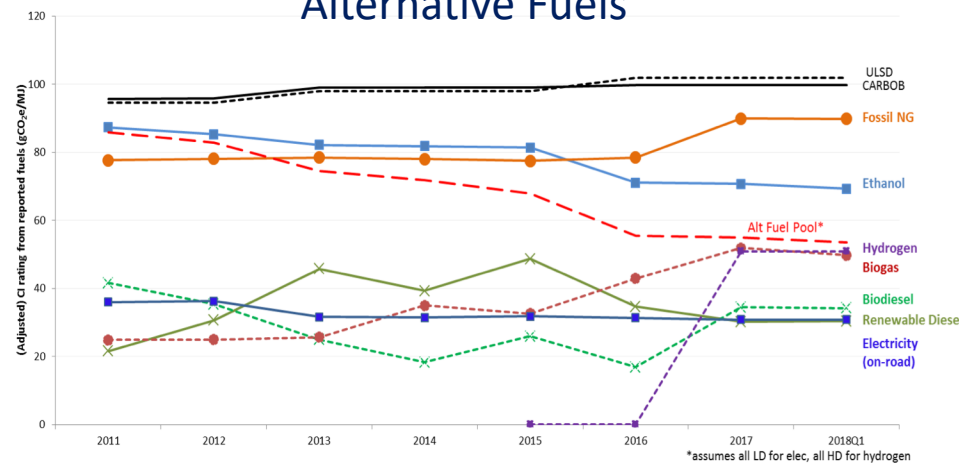
# Diesel Pool CI Rating Declines More; Drives Compliance



## Alternative Fuel Pools

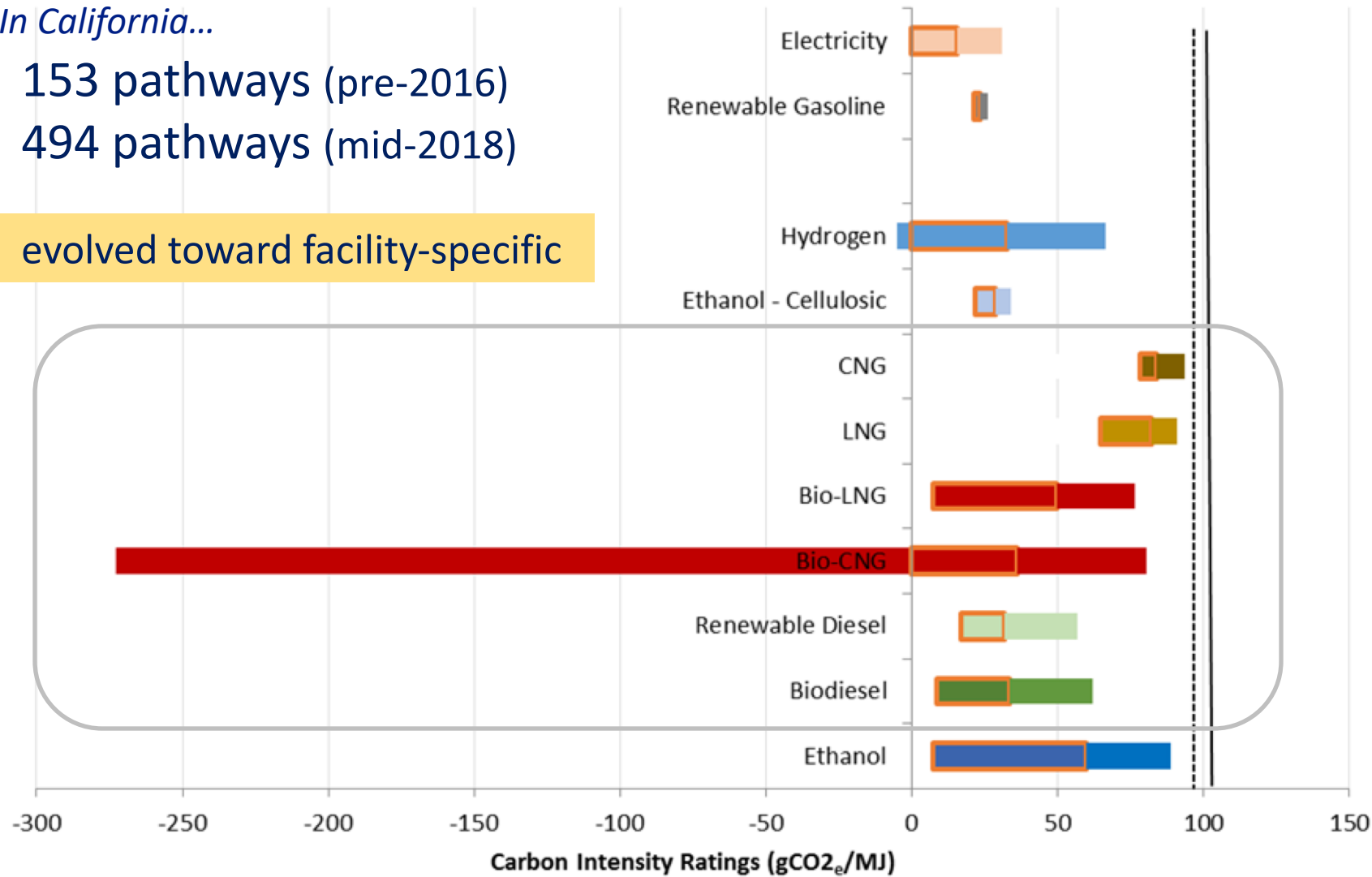


## Alternative Fuels



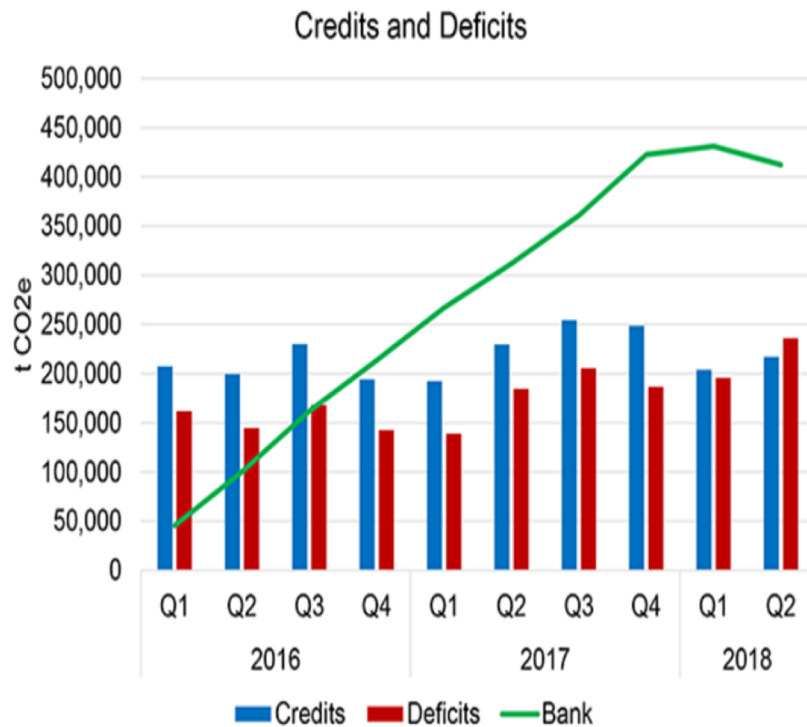
# More LCFS Fuel Pathways, Wider CI Ranges

- In California...*
- 153 pathways (pre-2016)
  - 494 pathways (mid-2018)
  - evolved toward facility-specific



# Oregon and British Columbia Credit Prices Up

## Oregon CFP at 1% Standard

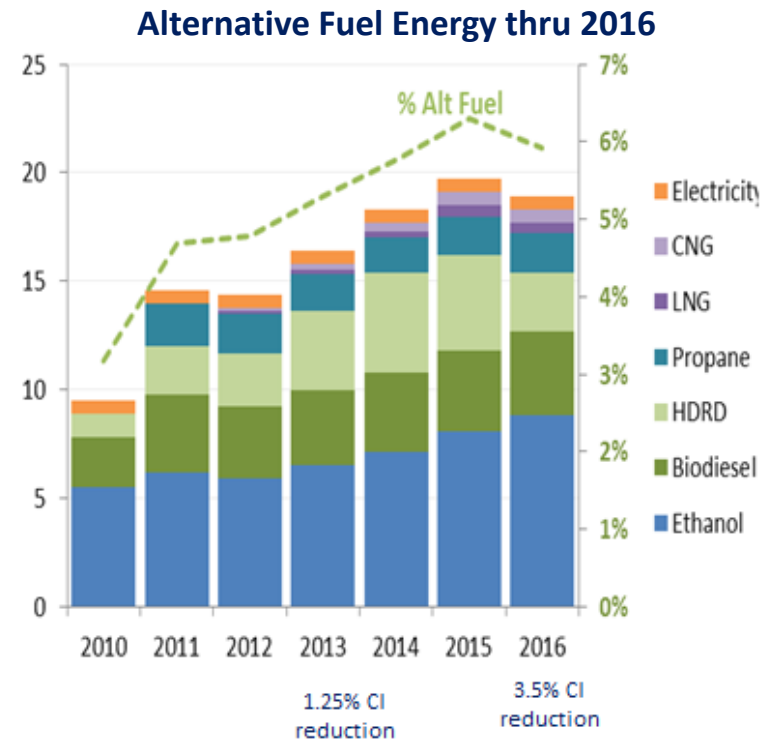


**Nov. 2018**

**\$101/MTCO<sub>2</sub>e**

(Soft Price Cap ~\$200)

## BC “LCFS” at 6% Standard



**Q3 2018**

**C\$199/MTCO<sub>2</sub>e**

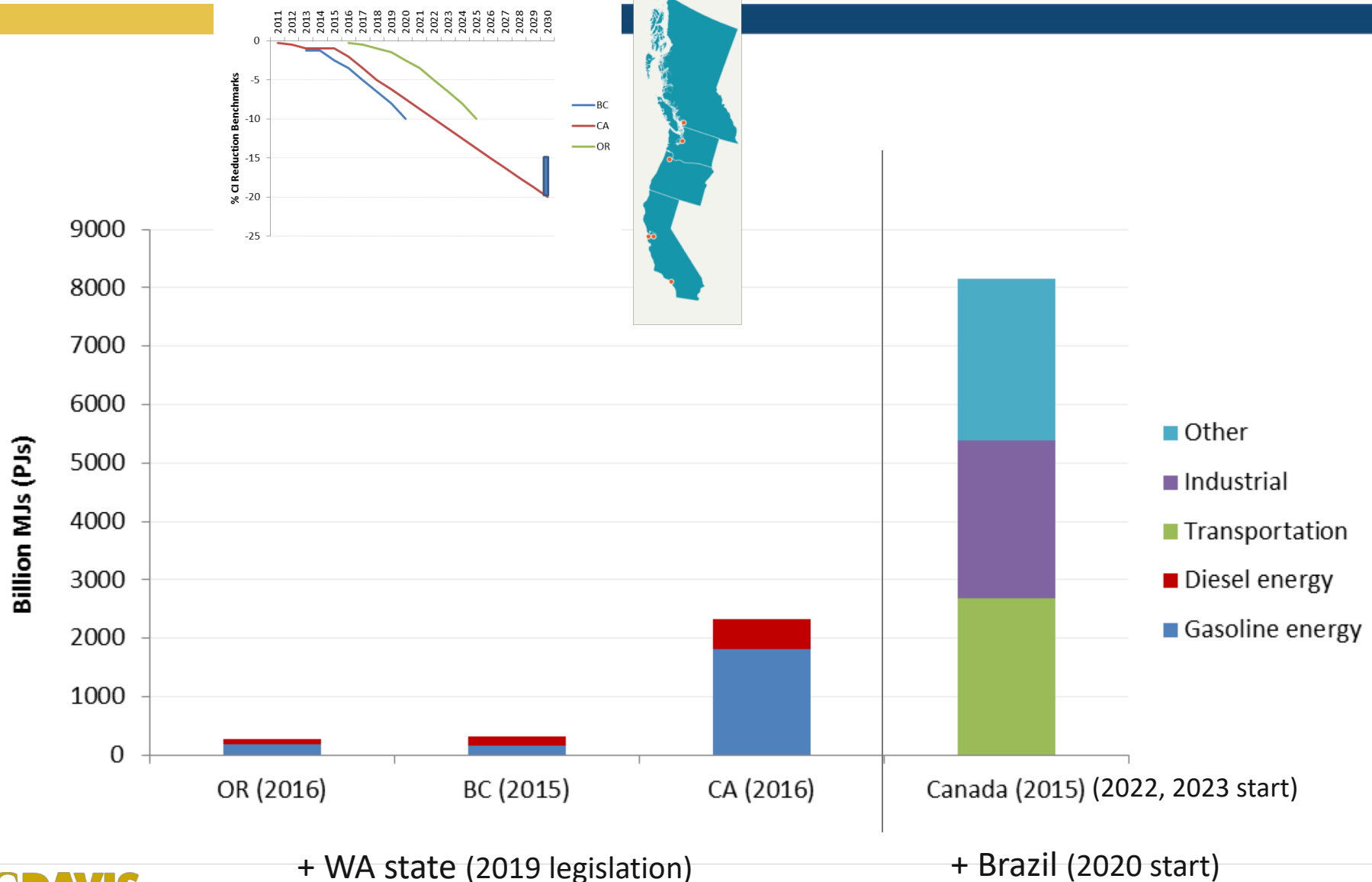
# California LCFS in 2019

- 2030 target of 20% CI rating reduction
- 3<sup>rd</sup> party verification/monitoring
- Credit generation – new sources
  - alternative jet (opt-in)
  - carbon capture & sequestration (protocol now in place)
  - lower/zero carbon electricity (below-grid CI rating book-&-claim)
  - infrastructure credits for ZEV (zero-tailpipe-emission vehicle) fueling capacity\*
- Groundwork for statewide Point-of-Purchase EV rebate program from LCFS credit value of (most) residential charging (CPUC process pending)... **2018 on-road EV credit value to date – ~\$181.5 million**

Source: ARB data

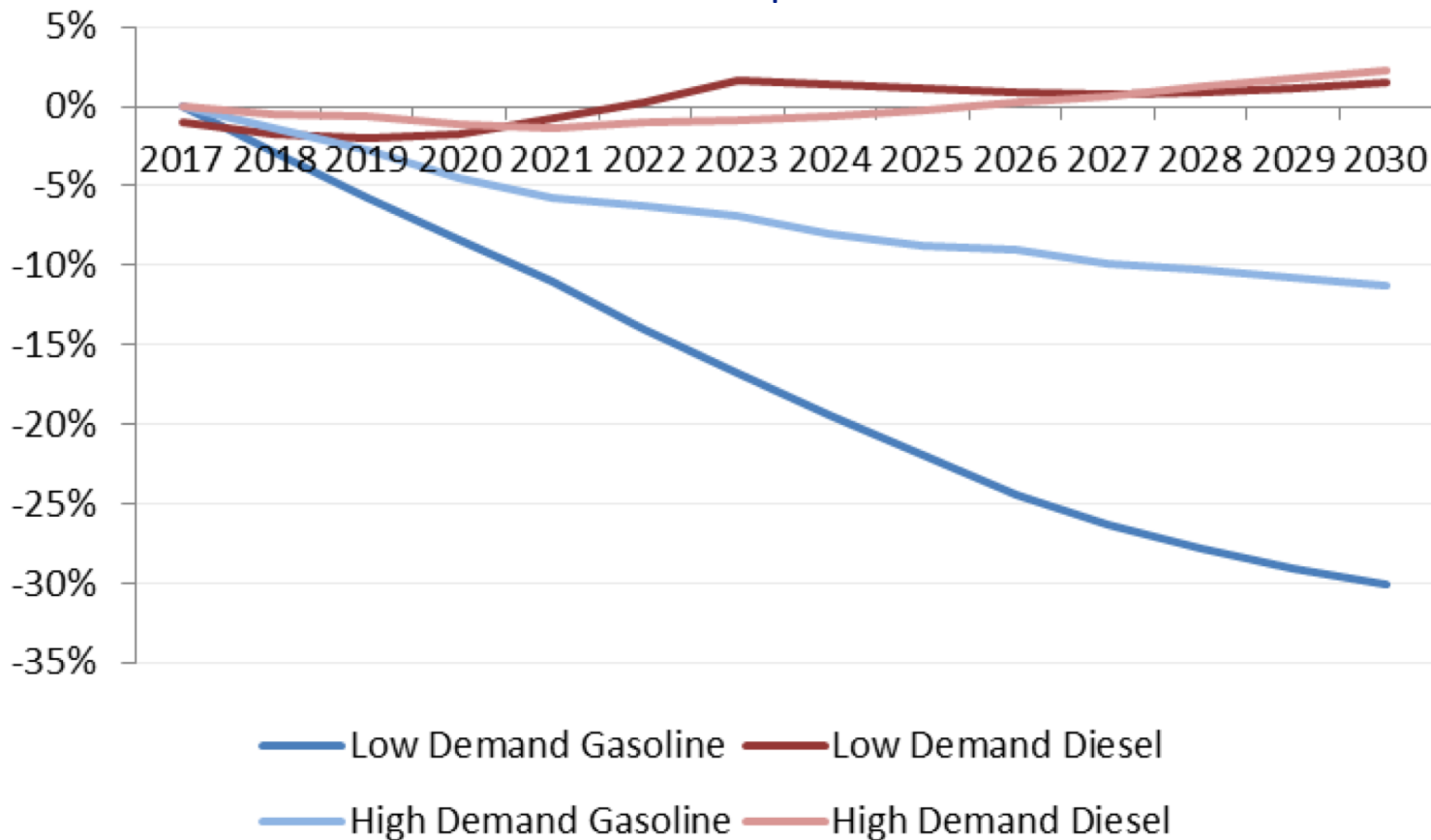
Vehicles

# How to comply? Energy market size & *composition* matter



# Looking ahead: “BAU” in Scenario Analyses

ARB “Built-in” Options for Demand Scenarios,  
Illustrative Compliance Scenario



Source: ARB Illustrative Compliance Scenario Calculator

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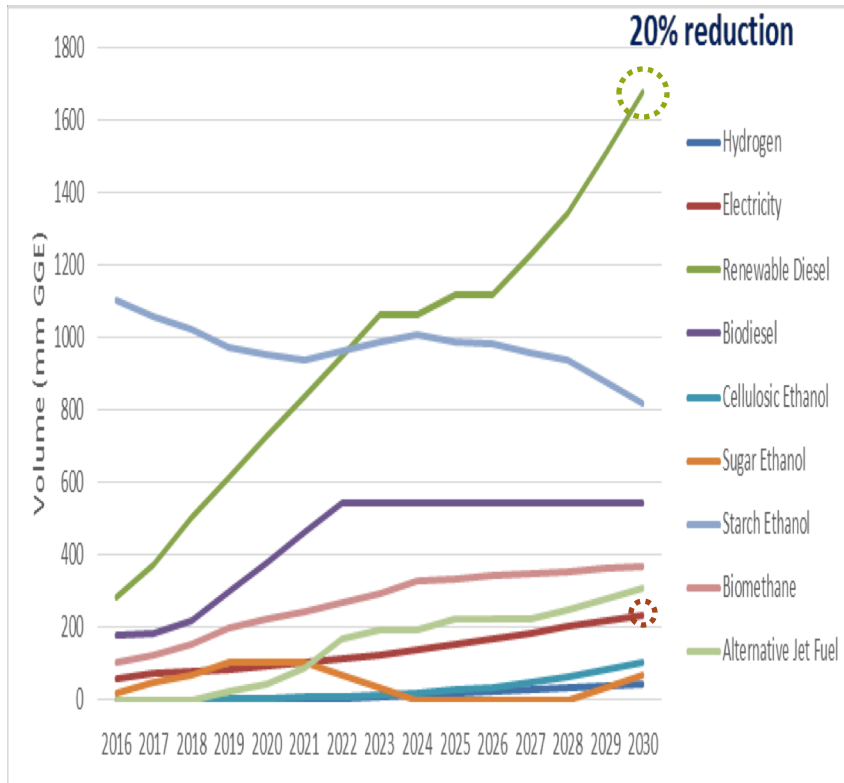
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...retrospective analysis could inform  
additional sensitivity scenarios...

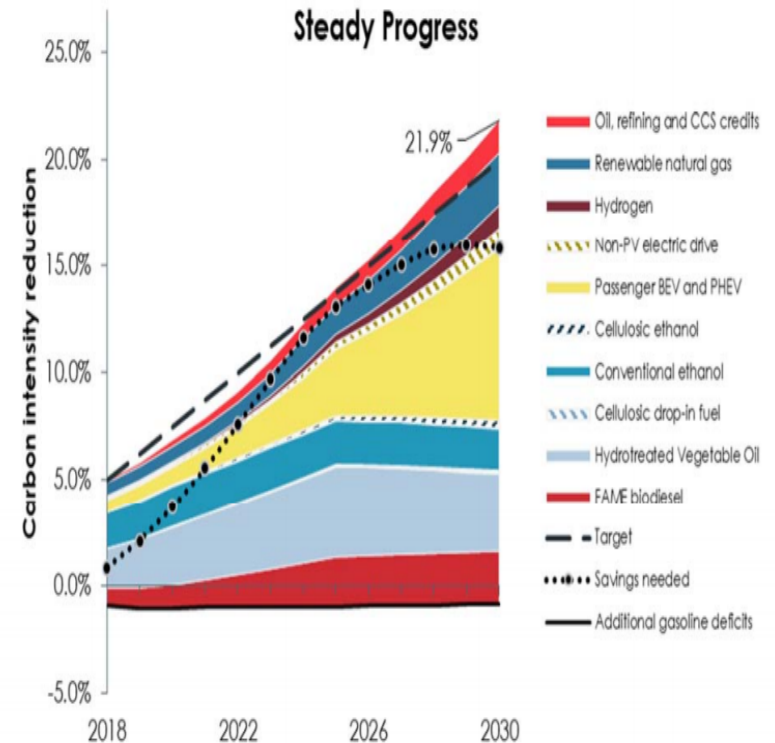
# California to 2030...Drop-in Diesel, Electricity “Set the Stage”

## ARB – High Demand, Low ZEV



Source: ARB Illustrative Compliance Scenario Calculator

## Cerulogy (NextGen/UCS)



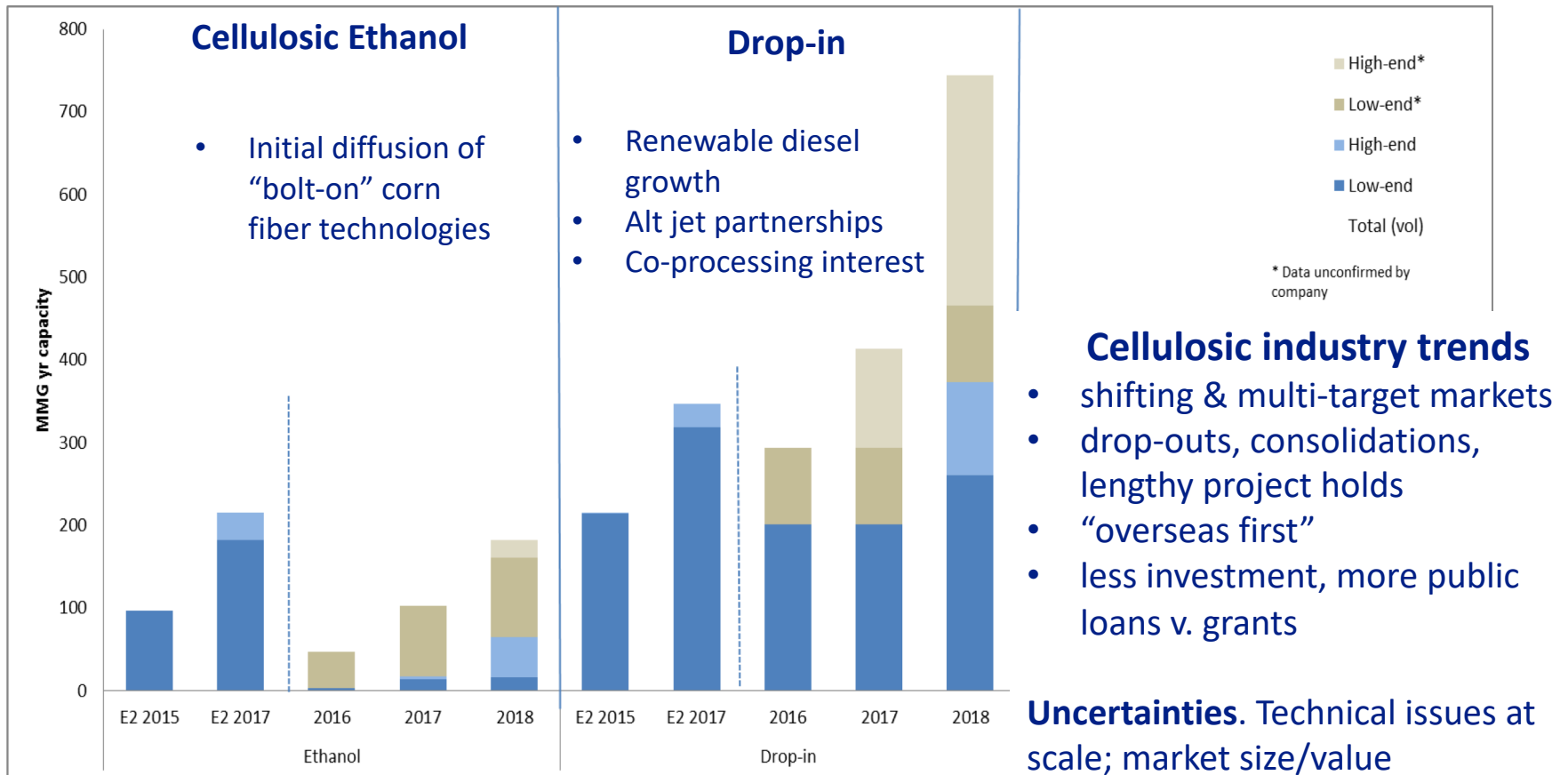
Source: Malins (2018)

...as seen in scenario modeling



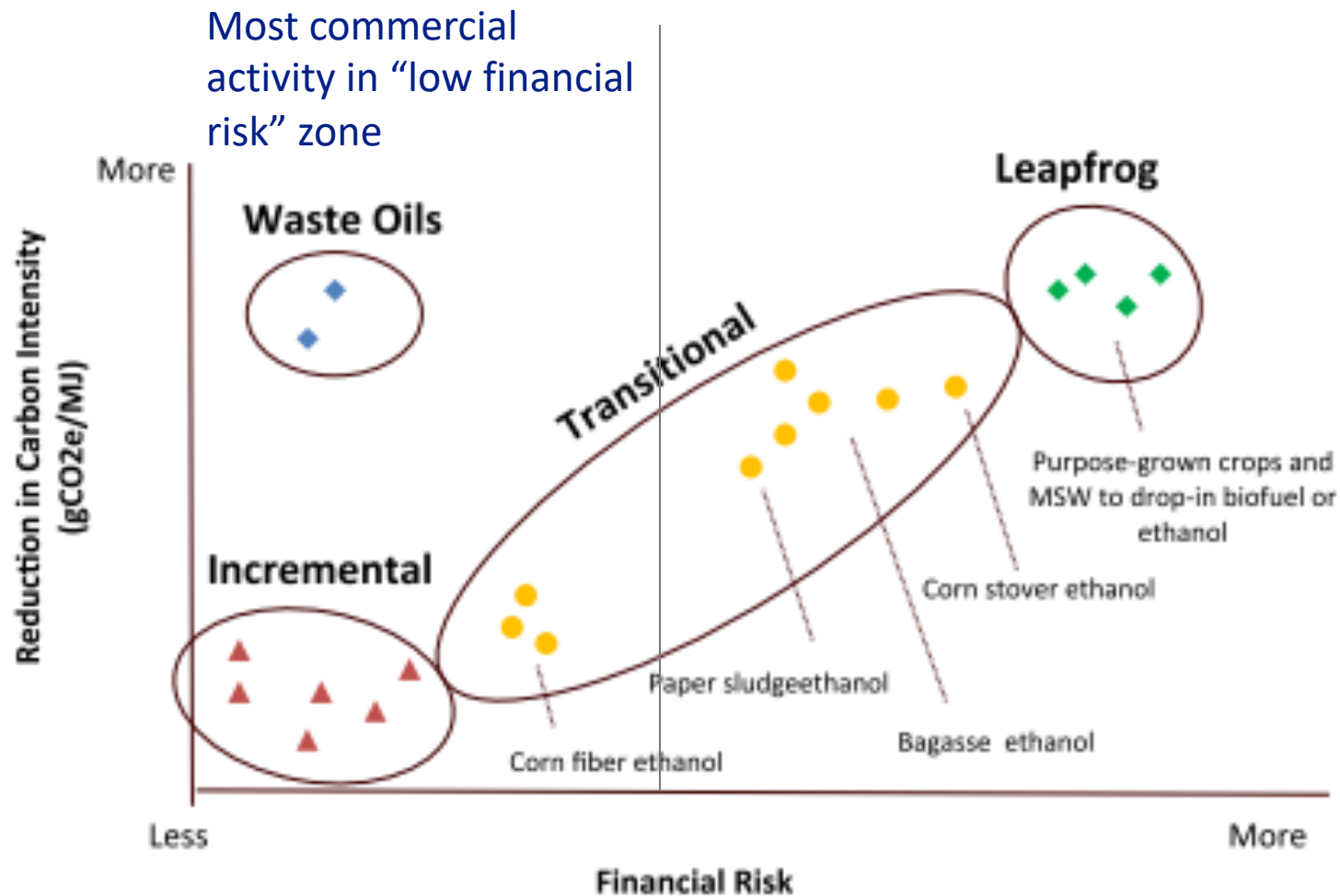
# “Biofuel Tracker” capacity qualitative findings hold

## Fuel Gallons



Source: Witcover & Williams (2018); Biofuel Tracker

# “3 Routes Forward for Biofuels” Revisit



Adequate (low carbon) feedstock supply still a concern  
(e.g., renewable diesel growth, “incremental” co-processing at refineries)

# Takeaways

- More LCFS jurisdictions
- Low carbon fuel supply tighter
  - higher credit prices (cost for fossil fuels; incentive for low carbon fuels)
  - California near “soft” price ceiling
- More CI reductions needed to meet targets to 2030 (and beyond)
  - new credit generation sources...will pattern continue?
- Renewable diesel – potential marginal compliance fuel
  - EV rollout impact/importance (esp. in “gasoline-heavy” fuel pools)
  - ...biomethane growth?
  - ...“transitional,” “breakthrough” biofuels?
  - ...“incrementalism” continues? (e.g., corn, co-processing)
- Feedstock supply – carbon profile of higher volumes a concern
  - residual fats/oils v. new crops; indirect effects of both



Thank you!

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