


UC DAVIS SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS

Cellulosic Fuels – The Path to Commercialization

Policy Considerations

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Three Key Uncertainties in Cellulosic Biofuel Route Forward

1) Policy Uncertainty (size, duration, form/target of incentives)
2) Technological Uncertainty (throughout supply chain)
3) Demand Uncertainty (if we price it, will they come?)

Broad questions on policy role

- Can policy address these uncertainties?
- To what extent should it?
- How?

Broad potential guidelines for policy

- bake learning/flexibility into policy design
- aim to bridge gap separating “policy push” and “demand pull”
- don’t stray too far from market realities

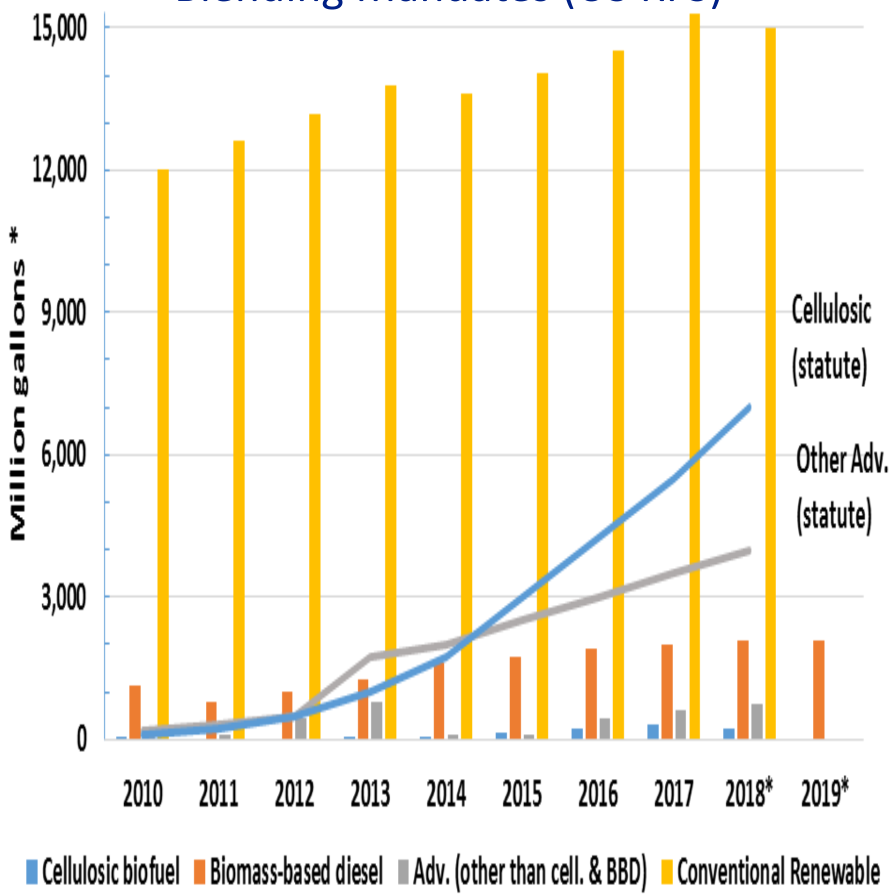
Presentation

- Policy landscape and market response (so far)

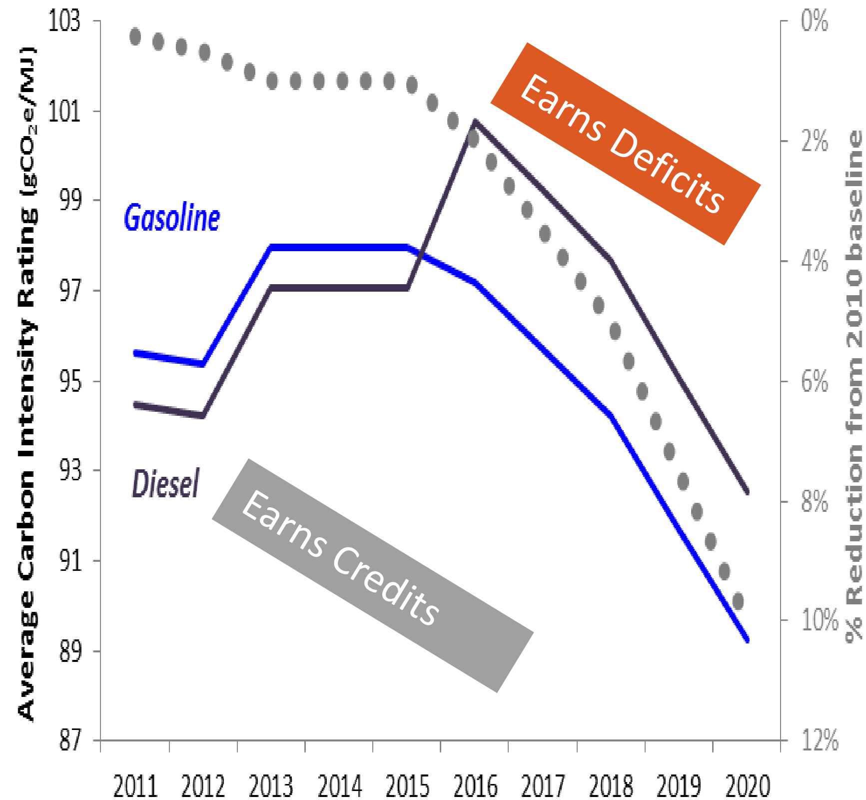
Current Policy Snapshot

- Alternative Fuel Policies Using Carbon Accounting (market-based, "technology-forcing")

Blending Mandates (US RFS)



Low Carbon Fuel Standards (CA, OR, BC)



- ...+ targeted incentives (biofuels to "biobased", fueling infrastructure)
- carbon pricing (CA, BC)

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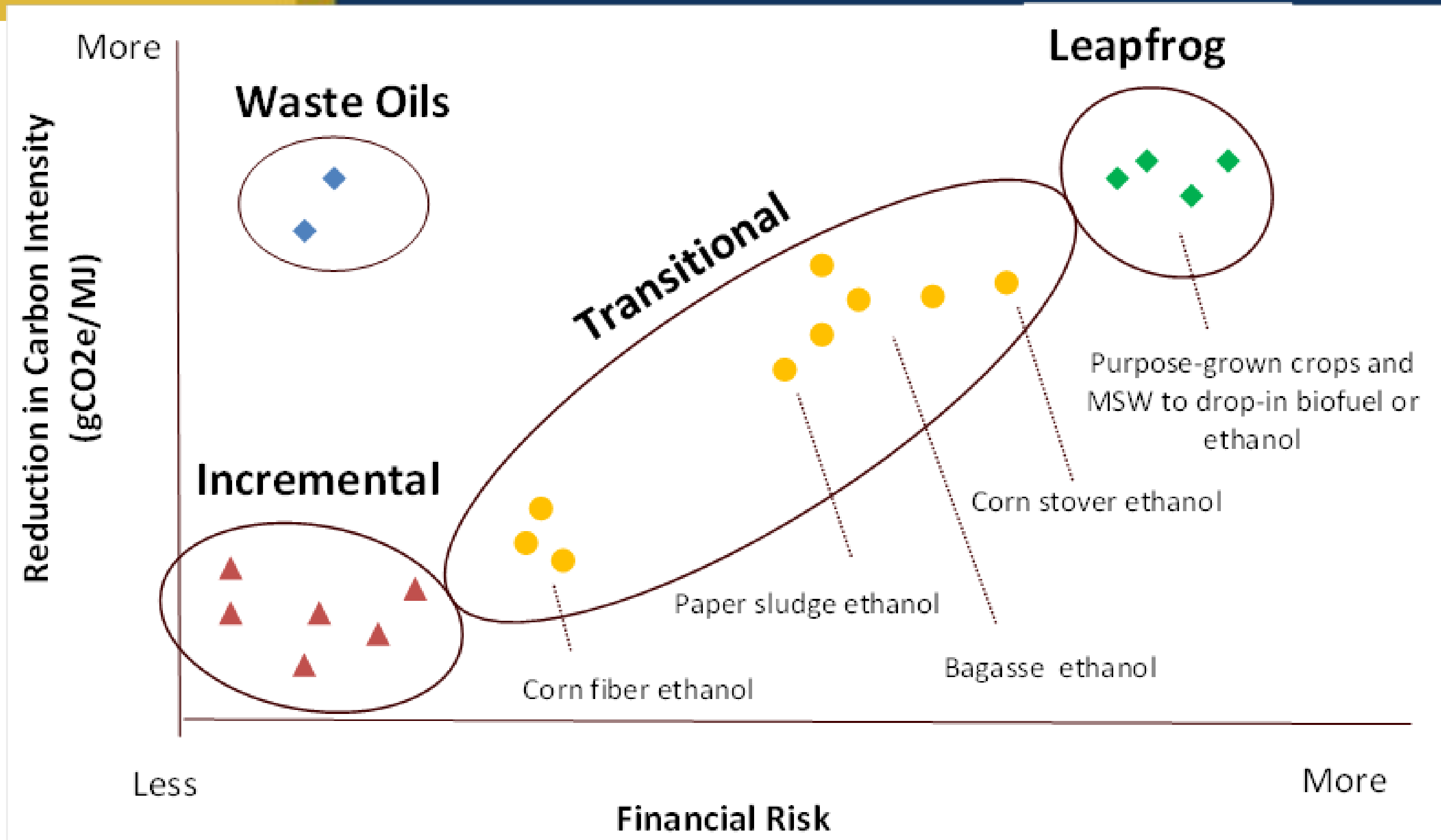
Which 'Biofuel Route(s)' Favored by Current Policy?



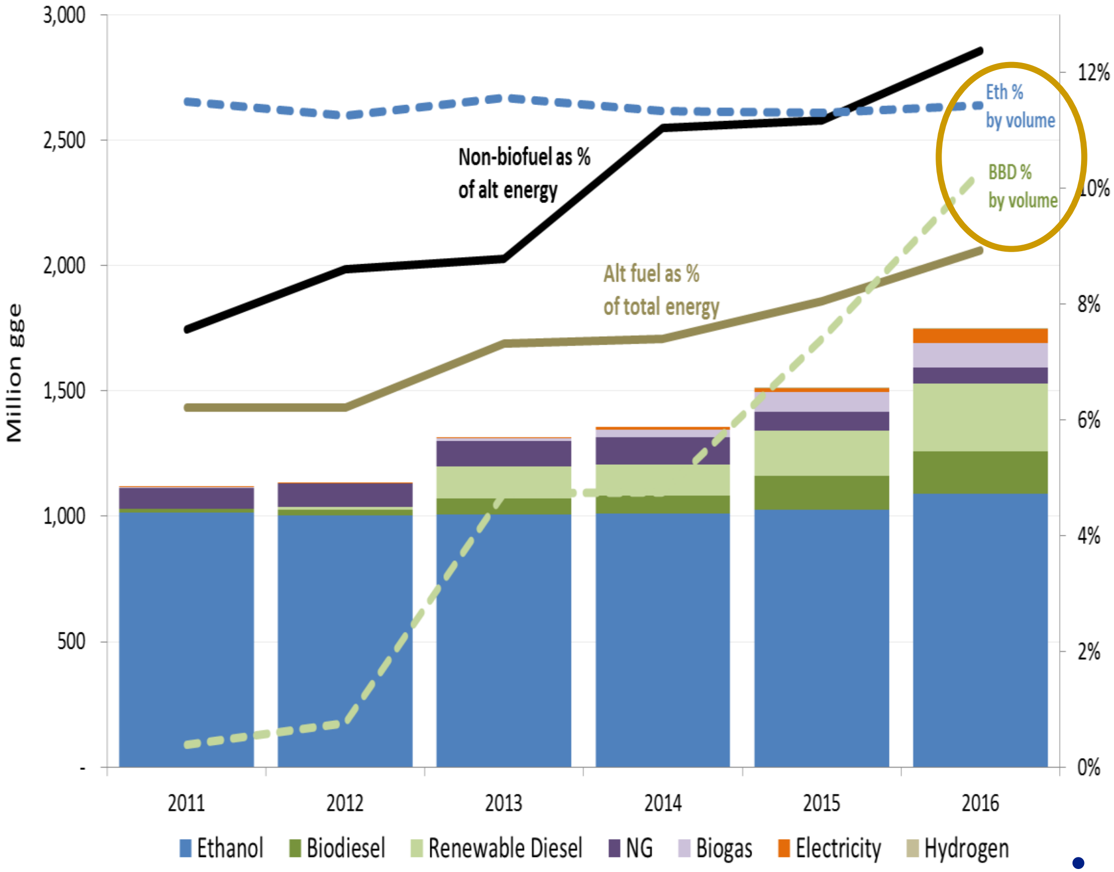
- Policy incentive
  - modest, limited
  - market-based competition to meet targets at lowest cost
- Three Uncertainties?
  - policy incentive size, longevity, form (courts, politics)
  - technological (not fully identified/understood)
  - demand (less emphasized)

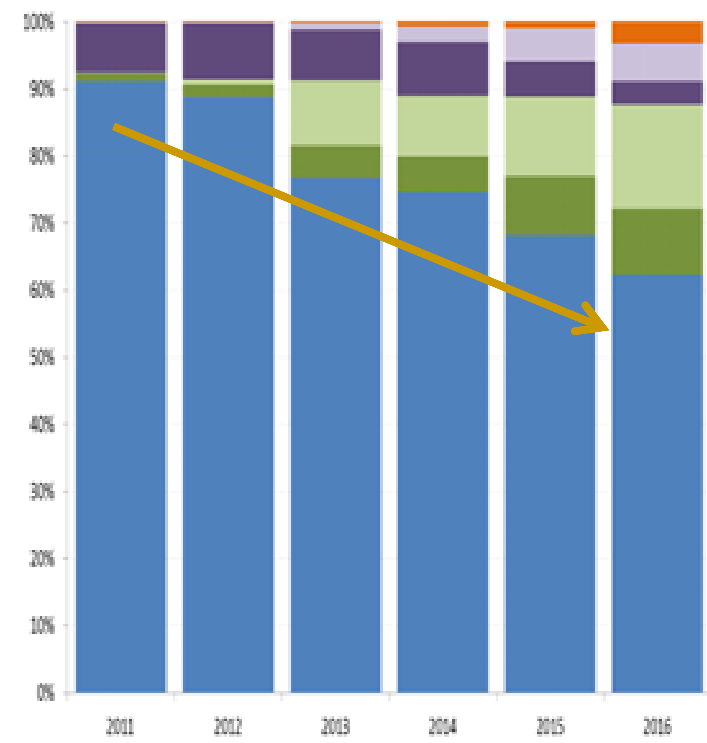
→ Not so technology-forcing (so far)

Source: Morrison et al. 2016

"Incrementalism" On Display in California under LCFS

- More alternative fuels (ethanol dominates, biomass-based diesel use surges)
- Big new fuel is technologically most understood & 'drop-in' (renewable diesel)
- For cellulosics, biogas dominates liquid fuel





- RFS trends are qualitatively similar

Source: ARB data

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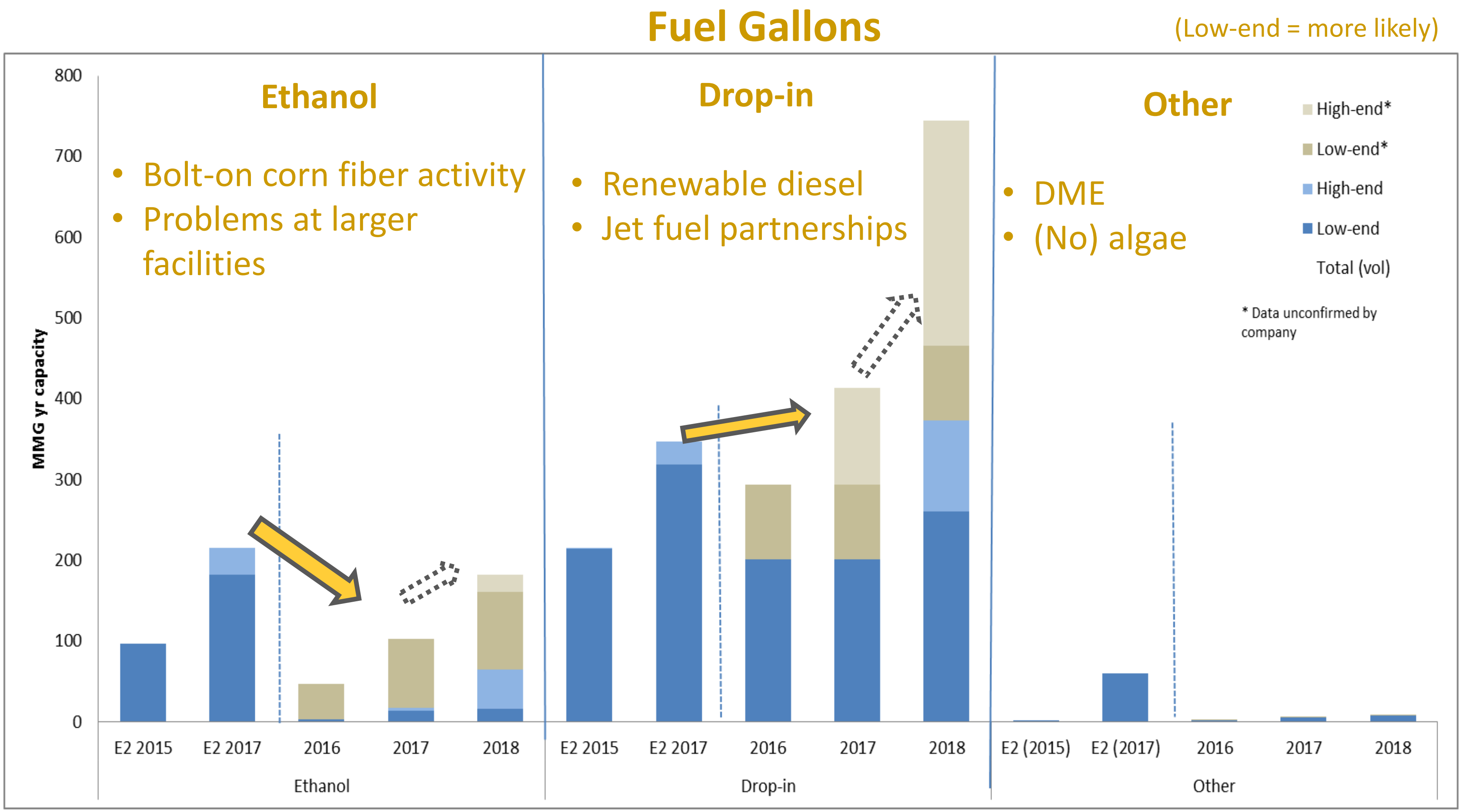
Newer Fuels? Near-term trends highlight "business case strategies"
(Emerging Fuel Capacity, North America)



<u>Total gallons</u>

E2	2017	689
UCD	2017	522
UCD	2018	936

- co-location & retrofits
- multiple (or nonfuel) target markets
- delayed projects & commissioning

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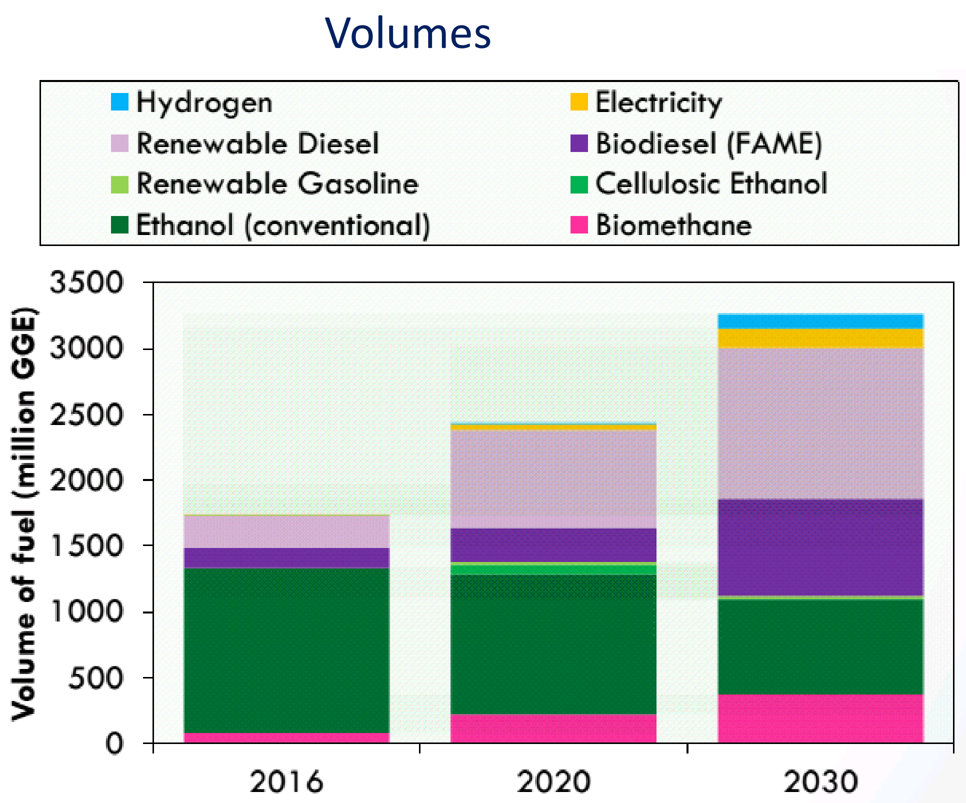
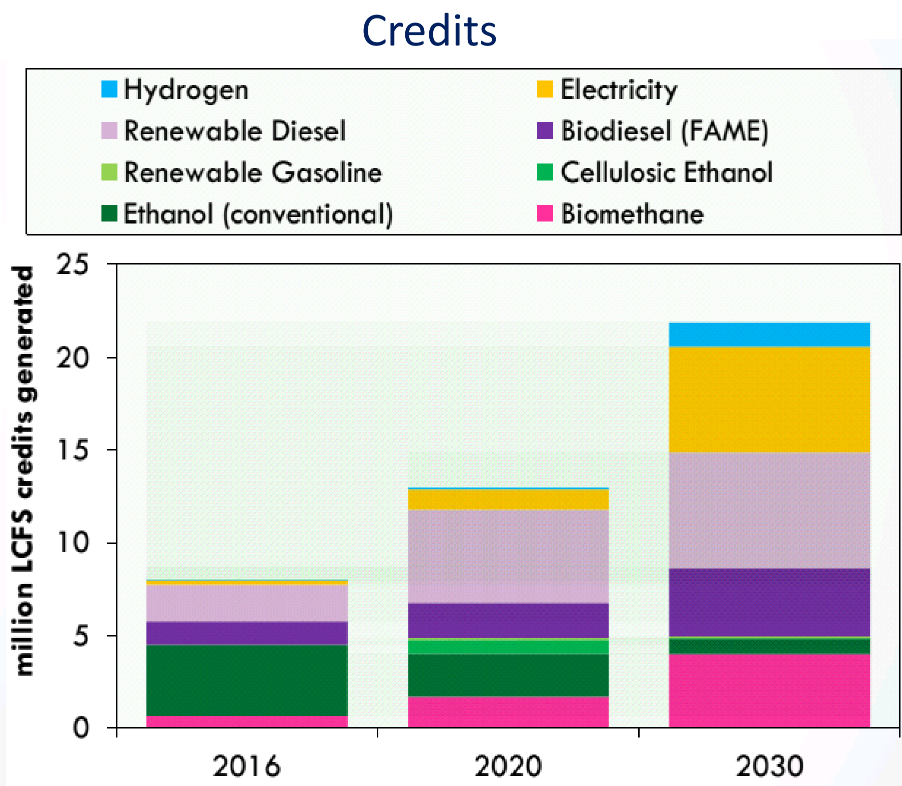
Source: UCD Biofuel Tracker (Witcover and Williams 2017)

Limits to Incrementalism for Lower Carbon Intensity?

ARB Scoping Plan modeling: Proposed 18% carbon intensity reduction by 2030





Source: ARB presentation, 3/17/17 workshop

- Not a projection !!
  - least-cost optimization..within scenario modeling constraints (E3), current CI ratings & costs

- Current technologies dominate
  - Little ethanol of *any* kind
- CA only; competing demand not modeled (yet)

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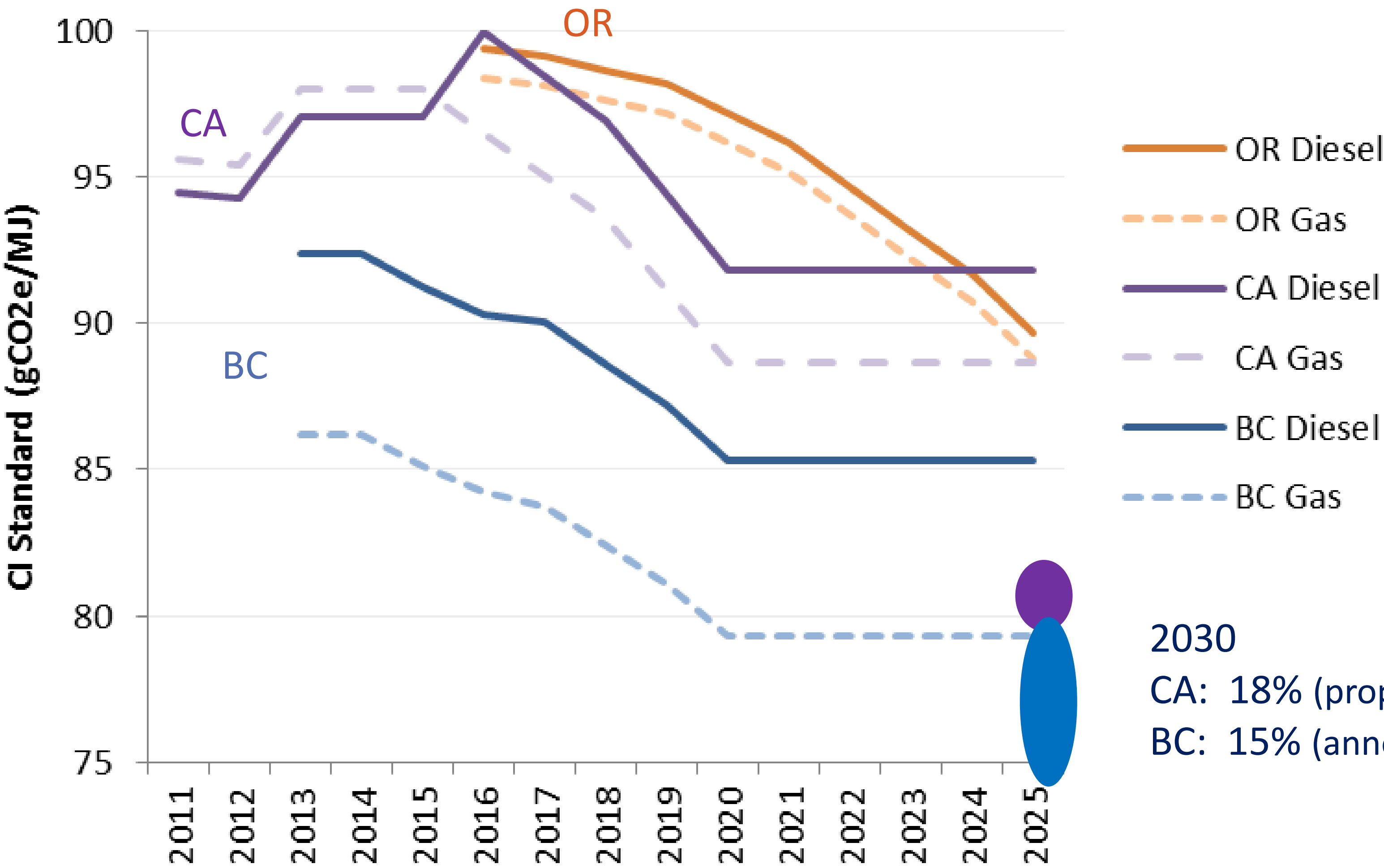
Impact of "More Of The Same"? Multiple "LCFS" Jurisdictions



2030
CA: 18% (proposed)
BC: 15% (announced)

- Expand demand (& competition) for low CI- rated fuels
- Hard to navigate for producer (different timing, CI ratings)
- Sustainability safeguards critical

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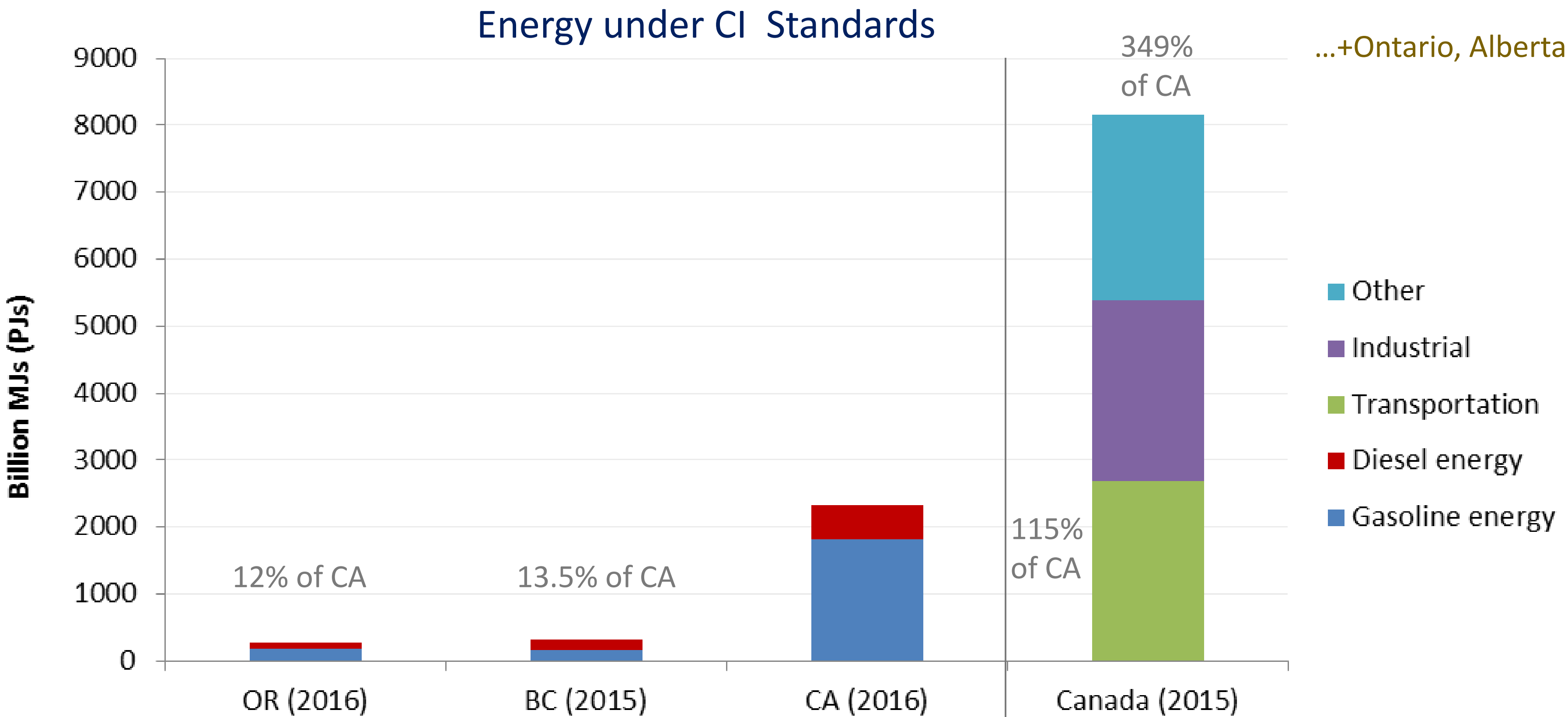
More "LCFS" ahead...beyond transport in Canada, 2019



...+Ontario, Alberta

Clean Fuels Program
- 10%, 2015-2025

RLCF
- 10%, 2010-2020

LCFS
- 10%, 2010-2020

Clean Fuel Standard
- 30 MT reductions, 2030
- Regulation in development
- Key design issues pending, impact on transport fuels uncertain

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

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Current Policy Issues

- Policy uncertainty (RFS annual volume-setting, LCFS court cases and scoping plan)
- Price "collars"
  - cost containment ("soft" credit price ceilings)
  - price floor (for financing)
    - mechanisms under discussion for dairy biogas-to-LCFS in California
    - limited support for specific projects identified through reverse auction process ('contract for difference'* or 'put options')
- Supplemental incentives?
  - if so, how big, for how long?
  - where along distribution chain? ("point of obligation")
  - fosters competition?
- Environmental outcomes (assessing, safeguarding, encouraging)

Still needed

- Clear idea of size, duration of required policy role (or gameplan for this)
- Implications of policy patchwork

*adapted from Pavlenko et al. 2016

Thank you!

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