BCG
ENERGY

Impact of AB 32

Summary of key findings

June 18, 2012

THE BOSTON CONSULTING GROUP

Impact on refining industry

- Energy efficiency projects will have a minimal impact on stationary refinery emissions.

- Demand reduction in the second compliance period (2015-17) shifts gasoline trade balances from Singapore imports to Mexico exports. This will likely result in closure of 4-6 refineries representing 20-30% of California's refining capacity.

- LCFS is unlikely to be fully implemented post 2015
  - Small number of Advanced Technology Vehicles, no commercially available cellulosic ethanol, and limited available quantities of low carbon intensity (CI) sugarcane ethanol
  - California refiners may opt to export fuels versus supplying the local market, potentially creating product shortages
  - A likely scenario is for cost recovery to exceed 250 cpg coupled with gasoline supply shortages as early as 2015.

- If LCFS is completely implemented beyond the second compliance period, this will result in the closure of an additional 1-2 refineries, representing 5-10% of California's refining capacity

- If LCFS regulation is changed abruptly after 2015, it will likely result in additional costs for refiners, consumers, and suppliers of alternative fuels.

Impact on California's economy

- Due to forecasted refinery closures California could lose 28,000-51,000 jobs, including many high-paying skilled manufacturing jobs, as well as indirect job losses due to multiplier effects.
- California could lose up to $4.4 Billion of tax revenue per year by 2020 resulting in further reduction in employment in certain areas (e.g., road maintenance, local businesses).
- There will be a wealth transfer of at least $3.7 Billion per year by 2020 from refineries and fuel suppliers to the California Air Resources Board as a result of purchasing allowances.
- As a result of AB 32 CA refiners will likely begin exporting very large quantities of gasoline, increasing stationary emissions above the level needed to supply the local market.
- Other negative impacts include loss of manufacturing expertise and increased cost of living resulting from higher fuels cost, disproportionately impact low income households.
- California's climate change regulations will discourage energy intensive industries from locating in the state, and existing industry will have an incentive to relocate outside of the state.
- AB32-related measures can achieve the goal of reducing GHG emissions in California to 1990 levels at a high cost, but will be at least partially offset by increased emissions outside of California from crude and bio-fuel shuffling.

Cost of compliance

- Based on carbon cost of $14/ton to $70/ton, we estimate the level of cost recovery required by the industry would likely be in the range of 49-183 cents per gallon (cpg) by 2020.
  - 14-69 cpg would be due to tailpipe emissions from transportation fuels being included under Cap and Trade
  - 2-8 cpg would result from stationary refinery emissions
  - 33-106 cpg (average 70 cpg) would be due to LCFS

- The cost of compliance could be much higher if the cost of carbon rises and becomes volatile, as electricity prices did in 2000
  - Additional 87 cpg (to a total of 270 cpg) in 2020 if Carbon price raises to $150/ton.

- The cost of LCFS compliance could be much higher as there is an inadequate supply of low CI bio-fuels to meet California's estimated demand or if more states adopt policies similar to California.

Key exhibit 1

Scenario if LCFS compliance is achieved solely through blending low CI blendstocks (e.g., sugarcane ethanol)

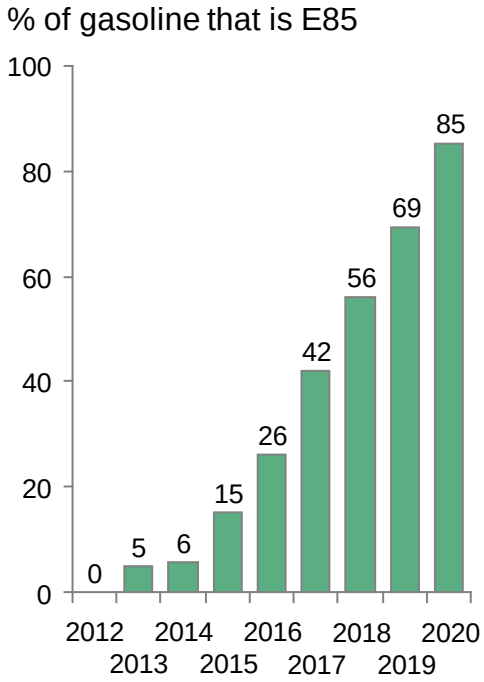
Model assumptions

No widespread adoption of low CI vehicles[1] by 2020, which would require:

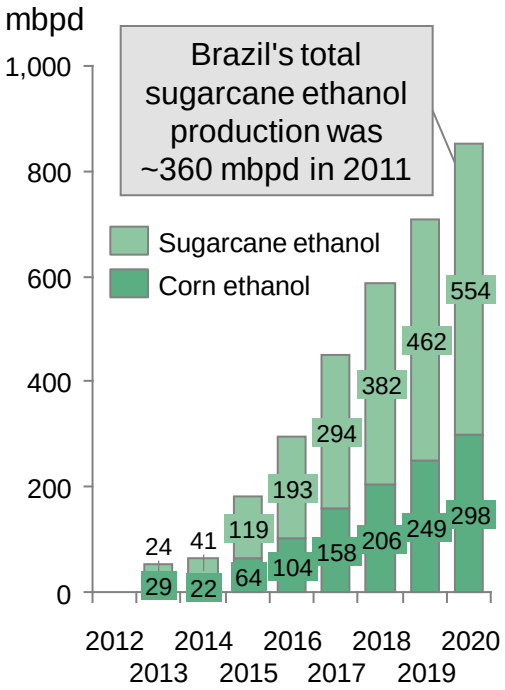
- Faster consumer uptake than historical hybrid uptake
- Significant technological advances
- Brand-new infrastructure network

Volume of sugarcane ethanol reaches 65% of total ethanol volume by 2014

LCFS targets will require majority E85 adoption



LCFS targets would require 554 mbpd of cane ethanol



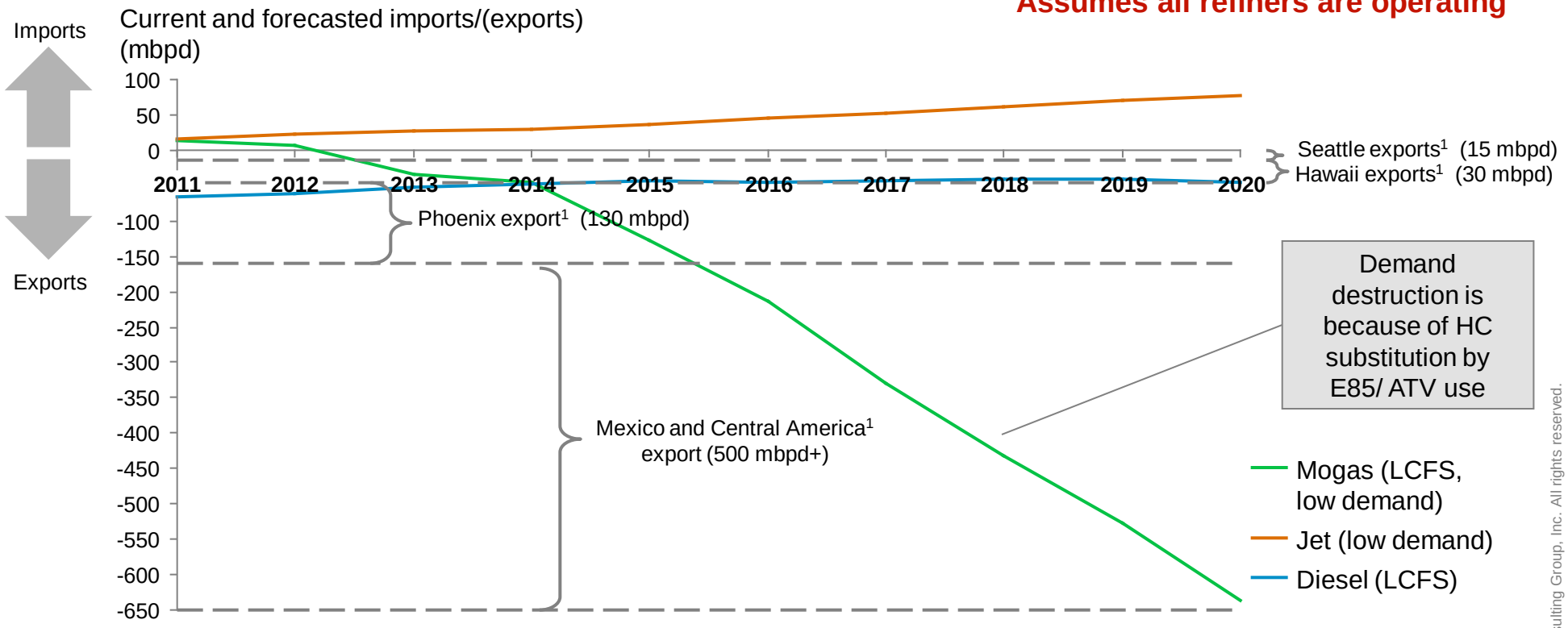
Projected ethanol adoption would also require rapid development of shipping and transport infrastructure

1. Powered by renewable electricity, low CI hydrogen, or CNG

Source: CARB, Bloomberg, BCG analysis, Renewable Fuels Association

Key exhibit 2

Assumes all refiners are operating

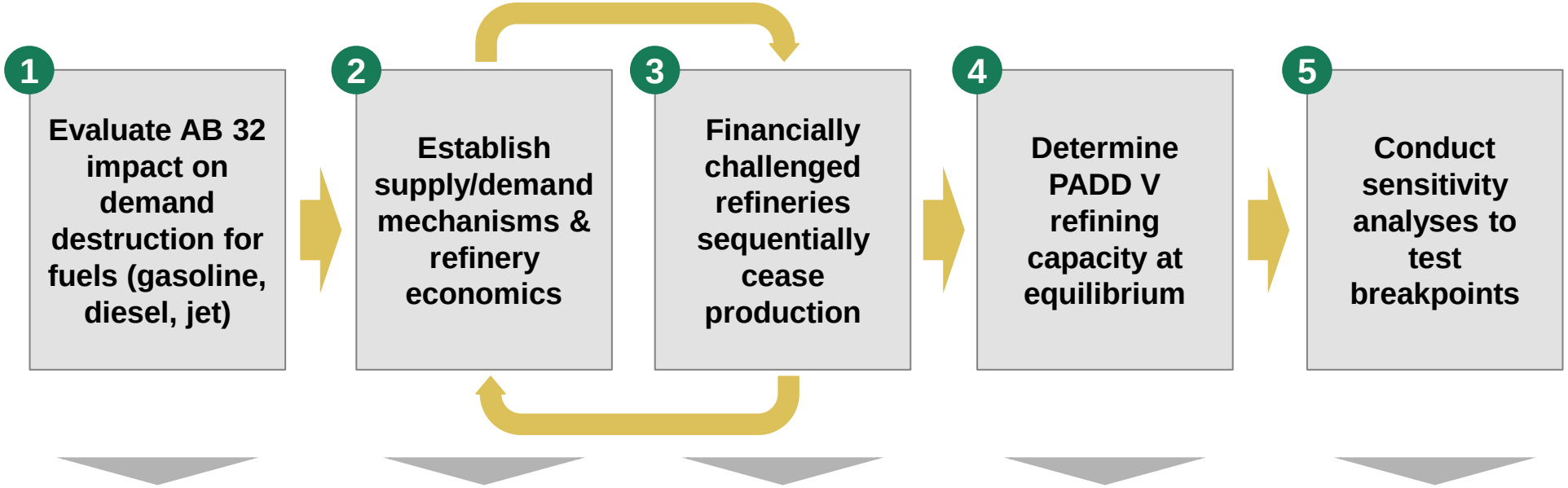


Net trade (mbpd)	1st compliance period		2nd compliance period				3rd compliance period				Δ ('20-'11)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Mogas	13	7	(34)	(45)	(128)	(215)	(330)	(434)	(529)	(639)	(652)
Jet	15	22	28	30	36	45	52	61	70	78	63
Diesel	(67)	(62)	(53)	(48)	(43)	(46)	(45)	(42)	(42)	(46)	21

Import
Export

1. Based on current market conditions, which could change, but have not changed significantly historically; High demand scenario also results in export by 2017 with LCFS
Source: CEC demand forecasts; BCG analysis

Key exhibit 3



- Determine impact of alternative vehicles
- Utilize ethanol blending to reach LCFS compliance
- Revise product demand forecasts

- Model operating and financial parameters of all PADD V refineries
- Create regional supply/demand matrix for potential mogas and diesel outlets
- Include impact of AB 32 compliance

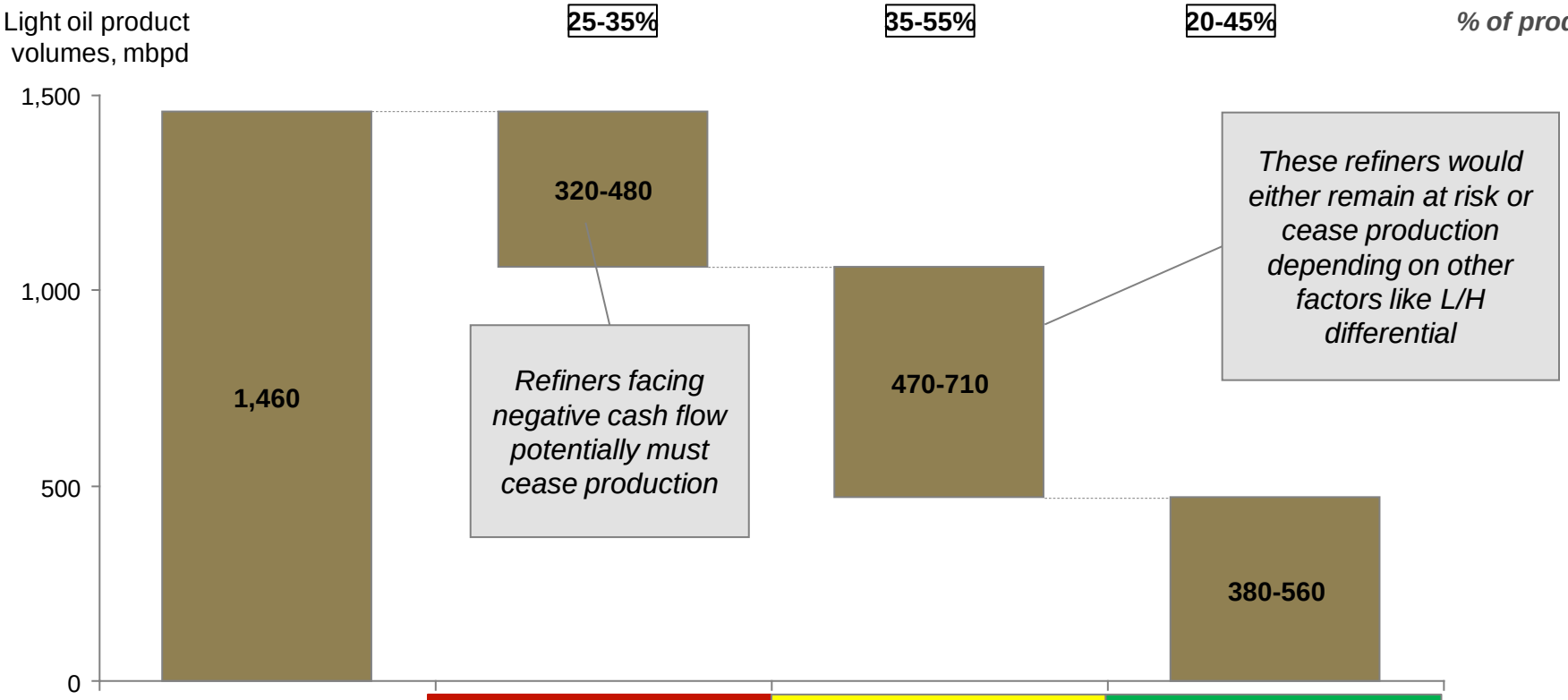
- Assume refineries with sufficiently negative cash flow would cease production
- Re-evaluate supply/ demand balance
- Determine new regional supply/demand balance

- Validate that refineries that have ceased production remain non-producing at new market equilibrium
- Construct new "industry health" matrix

- Use 2017 equilibrium posture as baseline
- Model impact of change in cost of carbon and narrow L/H differentials

Key exhibit 4

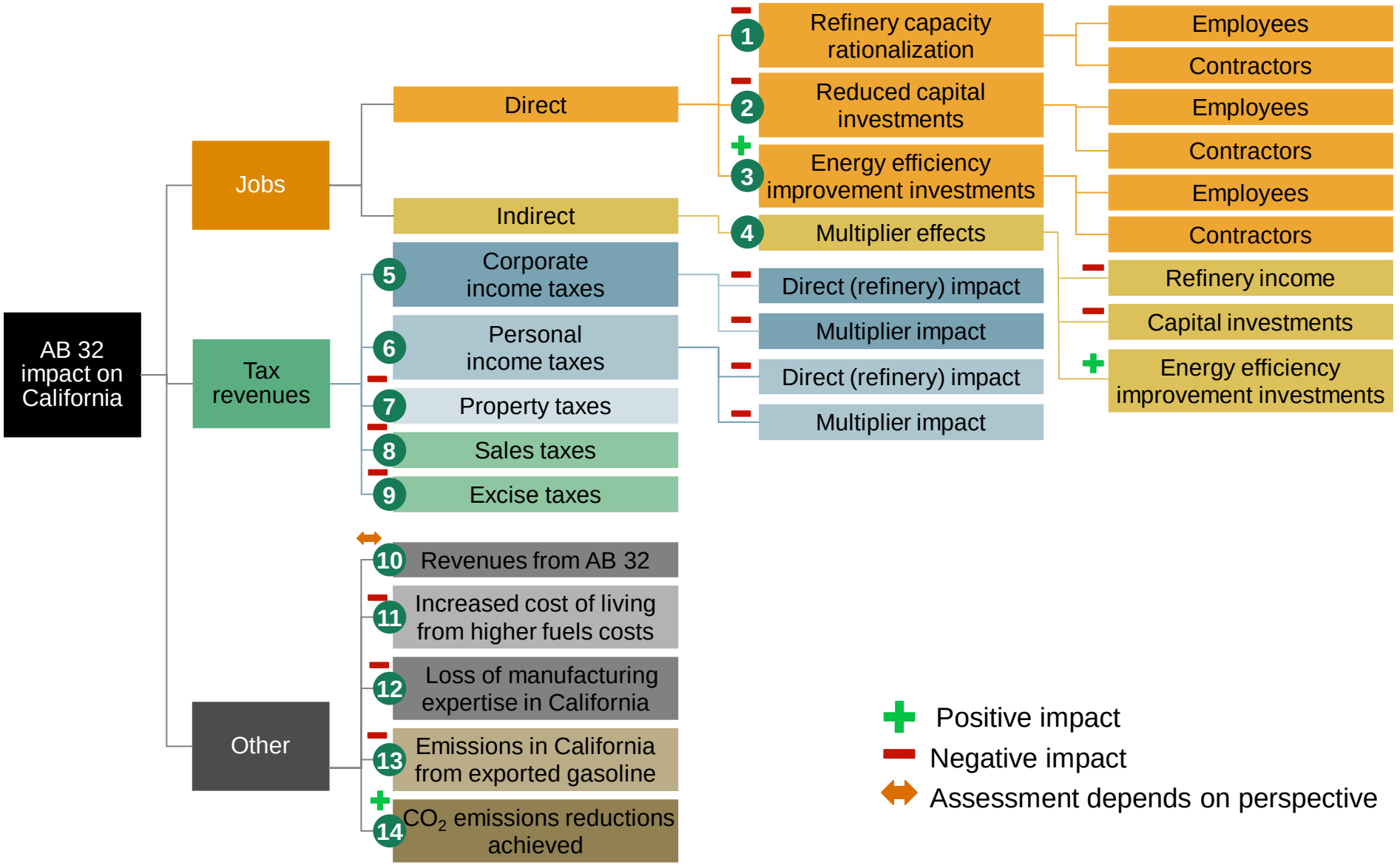
Rounded estimates



	Total	Distressed	May survive	Will survive
Crude capacity (MMBD)	2.0	0.5 – 0.7 (25 - 35%)	0.7 – 0.9 (35 - 45%)	0.5 – 0.7 (25 - 35%)
Number of CA refineries	14	5 - 7	4 - 6	2 - 4

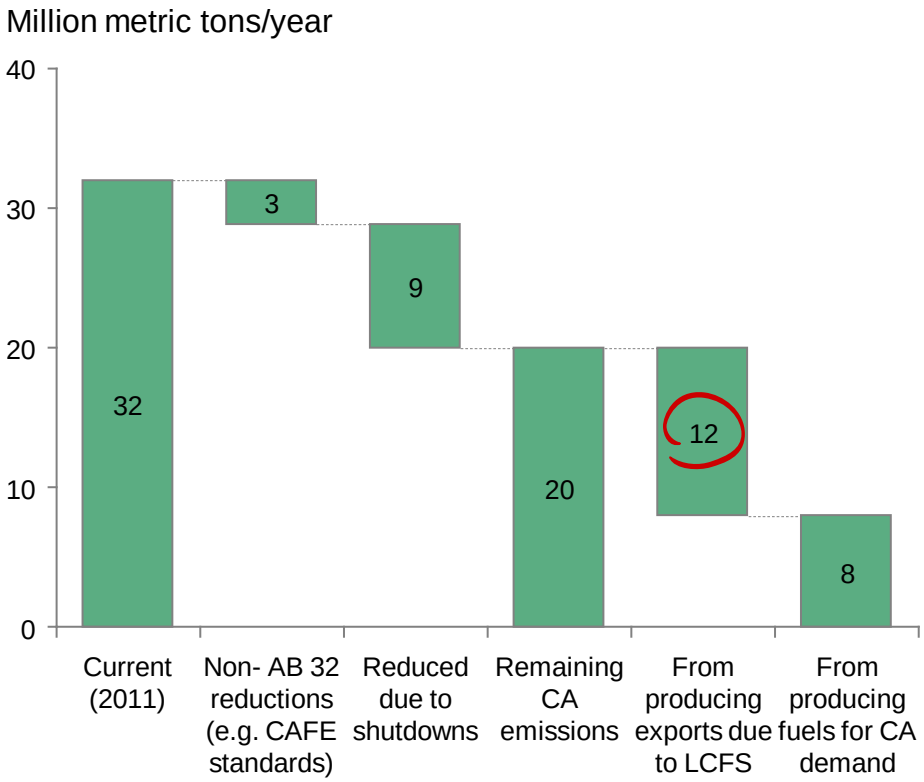
1. Assuming 82% utilization for all refineries
Note: Assumes $110 crude cost and $25/bbl L/H differential
Source: Oil & Gas Journal, Bloomberg, BCG economics model, BCG analysis

Key exhibit 5

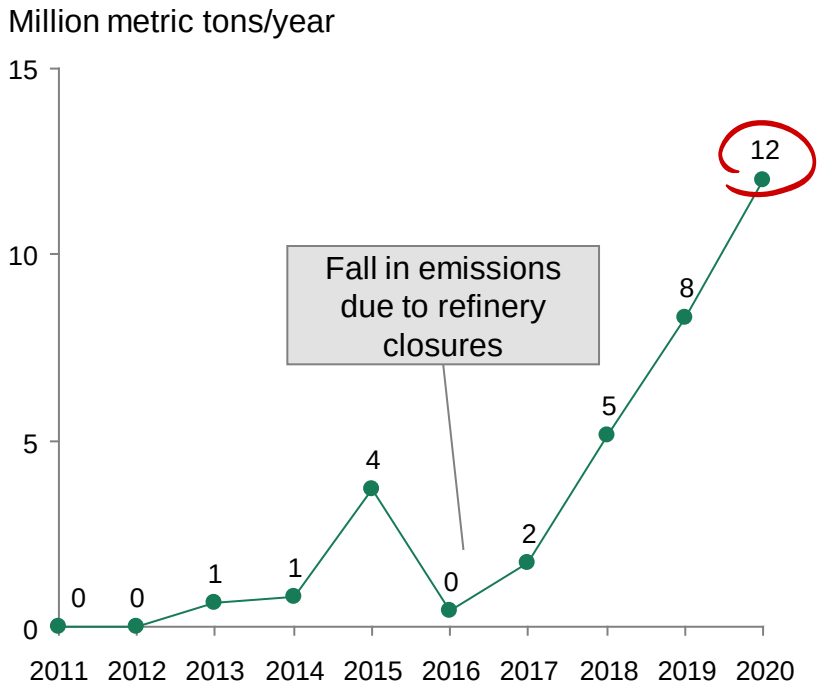


Key exhibit 6

Breakdown of projected California stationary emissions in 2020



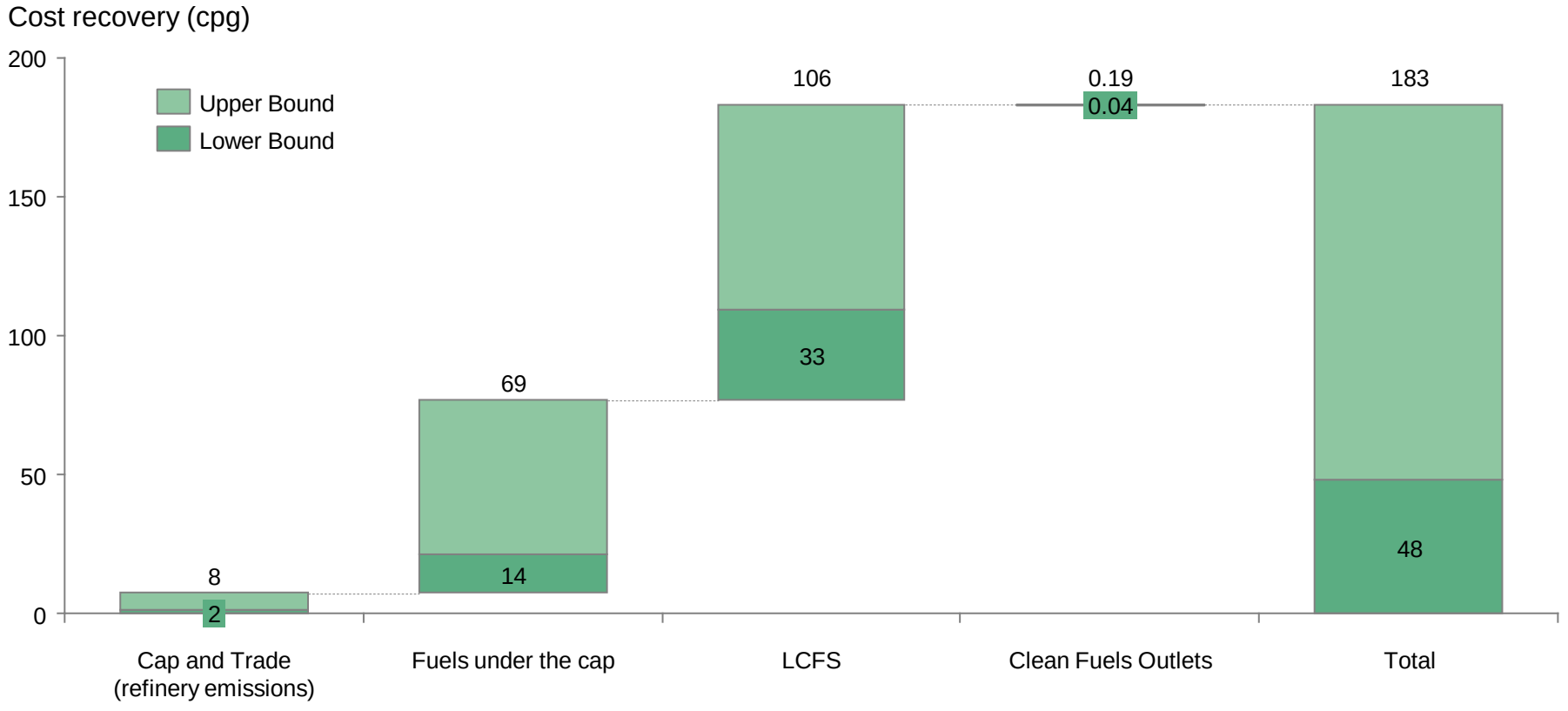
Emissions in California from gasoline exports due to LCFS (out of total 32 million MT of 2011 refinery emissions)



Although tail pipe emissions are reduced, gasoline is still produced and exported; stationary emissions remain in CA

Source: CARB, CEC demand forecast, BCG analysis

Key exhibit 7



	Cap and Trade (refinery emissions)	Fuels under the cap	LCFS	Clean Fuels Outlets	Total
Key assumptions	Refinery emissions constant through 2020 (include 5% efficiency improvement) Compliance achieved through CCA purchases CCA cost is $14-$70	Refinery output constant through 2020 Compliance achieved through CCA purchases CCA cost is $14-$70	Refinery output and CI constant through 2020 Additional cost due to substituting sugarcane E85 for gasoline Sugarcane price is USDA 2020 forecast +-20%	Only cost of capital recovery considered[3], WACC= 10% Investments made evenly starting in 2016, 20 year depreciation 100-450 outlets constructed at $2MM each	**CCA costs set by general and reserve auctions, not open market (which could be higher)**

1. Includes diesel and gasoline
2 One LCFS credit is equal to one metric ton of CO_2e difference from prescribed values
3 Assumes minimal operating cost if colocated with gas station
Source: CARB, Thomson Reuters, BCG analysis

Key exhibit 8

Cost of LCFS compliance impact

In order to achieve sufficient levels of sugarcane ethanol, additional ethanol-specific investment would be needed in:

- Farming
- Distilling
- Shipping
- Terminals
- Distribution

The cost impact is most sensitive to the price of sugarcane. With a surge in demand, the price could spike/ be volatile, due to which our estimates are very conservative.

Based on the USDA 2020 forecast for the price of sugarcane with 20% variation above or below, the cost of compliance could be 33 -106 cpg

Key uncertainties

Is there sufficient sugarcane production capacity to meet rising global demand?

Can industry participants overcome local challenges (e.g., construction permits) to logistical and other required investments?

Will legal challenge to LCFS result in uncertainty that stifles new investment?

Can refineries and other covered entities persuade non-covered entities (e.g., gasoline retailers) to support LCFS mandates like CFO?

Is there a risk that distribution infrastructure gets fragmented across multiple fuel types resulting in fuels shortages?

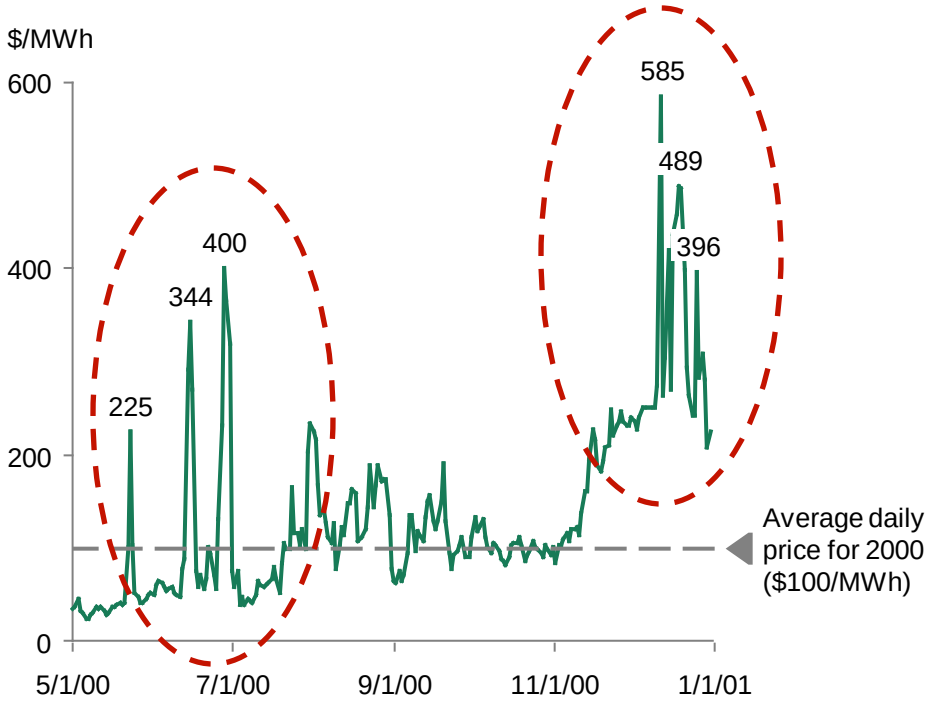
Unclear if the optimal bio-fuel is sugarcane ethanol, cellulosic ethanol or some other technology.

Is there a risk of significant volatility, especially during the nascent stage of evolution of these markets?

Have robust market mechanics been fully thought through to avoid unintended consequences and market manipulation?

Key exhibit 9

California electricity prices (May – Dec 2000)



Cost of carbon could see similar volatility

Spikes in California electricity prices were caused by market uncertainty and speculation

As the carbon market develops, uncertainty will decrease; however, uncertainty will exist at the outset

Thomson Reuters has forecasted carbon prices of $30-35/ton; however, in order to account for a 4-5x spike in carbon prices, similar to electricity prices in the analog, we considered carbon costs of up to $150/ton as an unlikely but plausible scenario

Source: PowerDAT NP15 prices, BCG analysis, Thomson Reuters