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Transportation Energy Supply Chain Infrastructure and Investment Study (TESCII) â€“ Turner, Mason & Company â€“ June 15, 2024

This study analyzes the stability of the existing road liquid transportation fuel supply chain and identifies key risks to its viability under a number of policy combination scenarios.

Additional submitted attachment is included below.

TESCII STUDY REPORT

POTENTIAL IMPACTS OF CALIFORNIA REGULATIONS & POLICY ON THE TRANSPORTATION FUELS SUPPLY CHAIN

JUNE 15, 2024

Turner, Mason & Company
energy consulting & advisory

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- Turner Mason & Company (TM&C) conducted a study of the California transportation fuel system (upstream, refining, logistics, regulatory) with a focus on identifying potential "pinch-points" that could significantly impact the ability of the system to meet future transportation fuel demand in the State.
- Founded in 1971, TM&C provides technical, commercial and strategic consulting services to worldwide clients in the crude oil, midstream, refining, refined products, biofuels and renewable fuels industries.
- Core competencies – Market Analysis, Refinery Strategic Studies, Feasibility Studies / Project Independent Assessments & Due Diligence, M&A / Transaction Support & Due Diligence, Crude / Feedstock Valuation, Asset / Fair Market Value Assessments, Industry Studies, Regulatory Support, Fuels Compliance, Litigation Support.
- TM&C engagement team collectively has over 120 years of experience in the industry across integrated oil companies, independent refiners, and energy consulting firms.

EXECUTIVE SUMMARY

PREFACE

- There are three main tasks assigned to the CEC in SB X1-2
  - Providing a transportation fuels assessment, including an evaluation of oil and gas extraction.
  - Assessing if a refining gross margin cap "likely benefits to consumers outweigh the potential costs to consumers."
  - Develop a process for refiners to report planned maintenance and turnaround schedules.
- This study is a holistic view of potential impacts on the petroleum supply chain
  - CEC's gasoline demand is taken as given (e.g., policies are implemented that achieve the "Slow", "Fast", or "Rapid" cases).
  - Our focus is on risks for the liquid transportation fuels supply chain across those cases.
  - We also look at risks to the system from other factors, such as California crude oil production profiles, crude oil pipeline operating limitations, and marine logistics constraints.
- Several prospective policies are not included in the analysis because we lack sufficient definition at this time to model them:
  - Gross Margin Cap
  - A tighter LCFS carbon intensity
  - A tighter Cap and Trade carbon intensity
- Our results are based entirely on public information and TM&C analysis
  - We leverage public information to calculate state-level supply/demand balances.
  - Where public data are not available, we make assumptions based on our collective experience, industry interviews, and sensitivity analysis.

Note: CEC is California Energy Commission
SB X1-2 refers to California Senate Bill 2 which was signed in to law by Governor Gavin Newsom on March 28, 2023
LCFS is Low Carbon Fuel Standard

KEY FINDINGS

- California crude oil production is in terminal decline
  - Recent production declines are approaching an annualized rate of ~15%, which is about 50% *faster* than gasoline demand declines in the CEC's most aggressive Transportation Fuels Assessment ("Rapid") case.
  - Risk of decline rates accelerating given recent slowing in pace of drilling permit approvals.
  - Setback rule (SB 1137) could shut-in ~20% of current production.

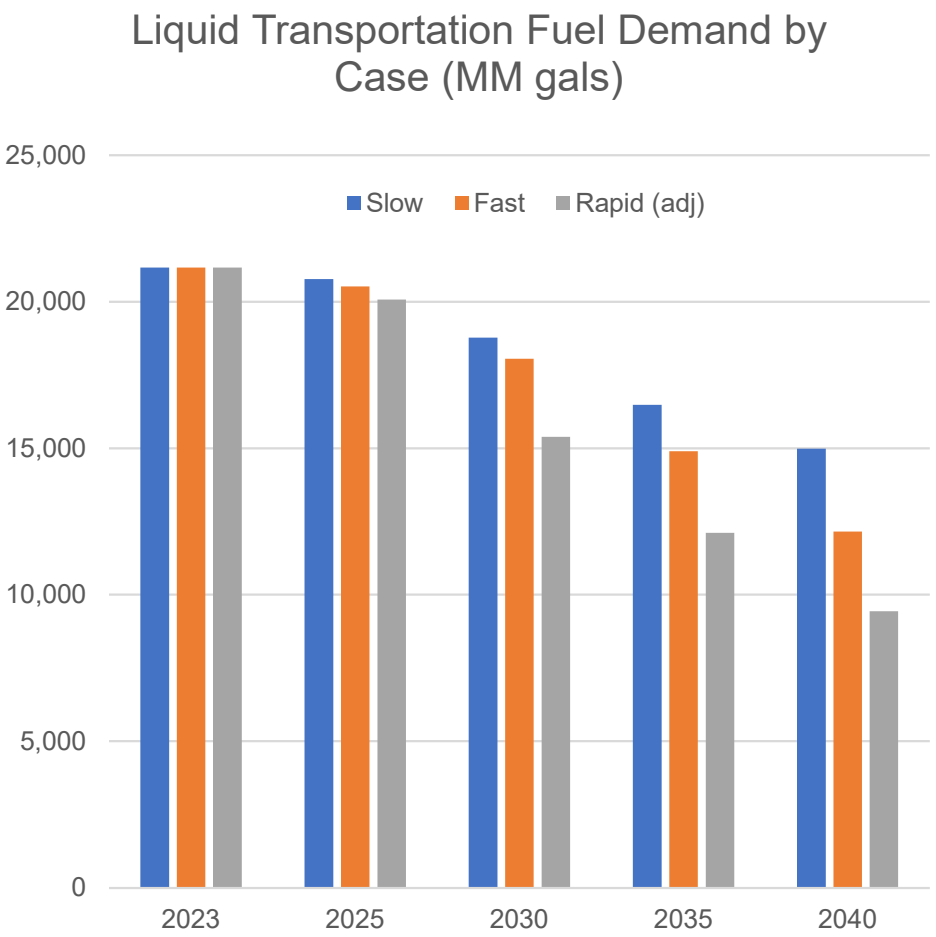
- California refineries could be approaching critical infrastructure constraints
  - Crude oil pipelines are at increasing risk of falling to minimum throughput levels.
  - Central District pipelines serving the San Francisco Bay area appear to have the greater risk.
  - If pipelines close, refineries become more dependent on waterborne crude oil imports.
  - Marine facilities could face a limit on vessel movements before limits on flows or emissions.
  - Marine logistics limits could come from combinations of constraints rather than imposing a single constraint.

- There are several refineries, in the North and South estimated to be on the verge of reaching these logistical constraints of challenged pipeline flows and lack of marine options.

- CARB's "At-Berth" regulation could critically impair marine logistics in the liquid transportation supply chain.

- It is not a question of "if", but "when" refiners could be forced into difficult decisions. The ability of a refinery to adapt to major shifts in crude supply or product demand could be limited without major investments.

LIQUID TRANSPORTATION FUEL DECLINE ESTIMATED TO BE 11% TO 27% BY 2030



- CEC's draft Transportation Fuel Assessment only examines gasoline
- TM&C uses CEC's draft Transportation Fuel Assessment scenarios to map non-gasoline transportation fuels:
  - "Slow" = 2023 IEPR Baseline
  - "Fast" = AATE3 in the 2023 IEPR
  - "Rapid" = CARB 2022 Scoping Plan
- TM&C adopts the CARB Scoping Plan assumption on aviation fuel
  - CARB uses the same demand profile (+1.7% p.a.) across all scenarios due to aviation's decarbonization challenges
  - Aviation fuel continues to grow even though total liquid road transportation fuel demand declines

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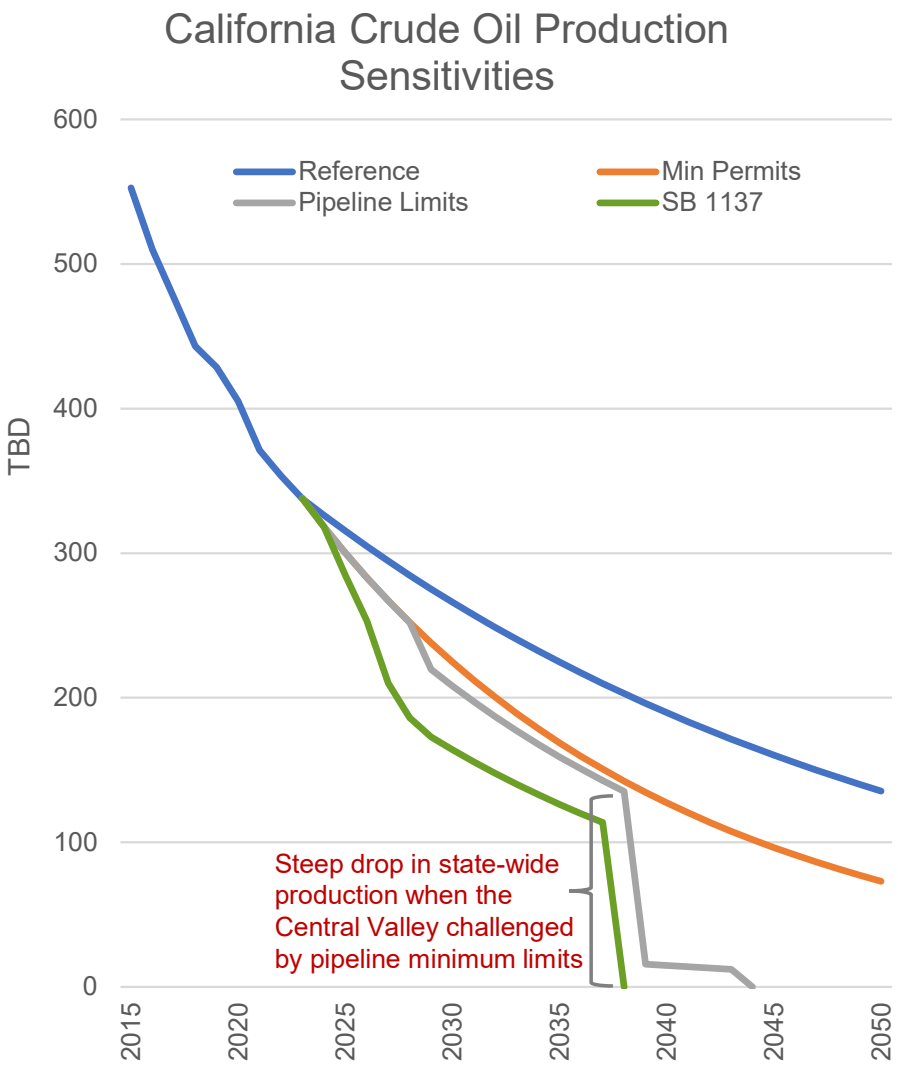
Source: Turner Mason analysis, CEC Draft Fuels Assessment, CARB 2022 Scoping Plan
Note: CARB is California Air Resources Board
TM&C adjusts diesel demand in CARB's 2022 Scoping Plan to 2023 actuals (from CEC data) and preserves the plan's rate of demand decline

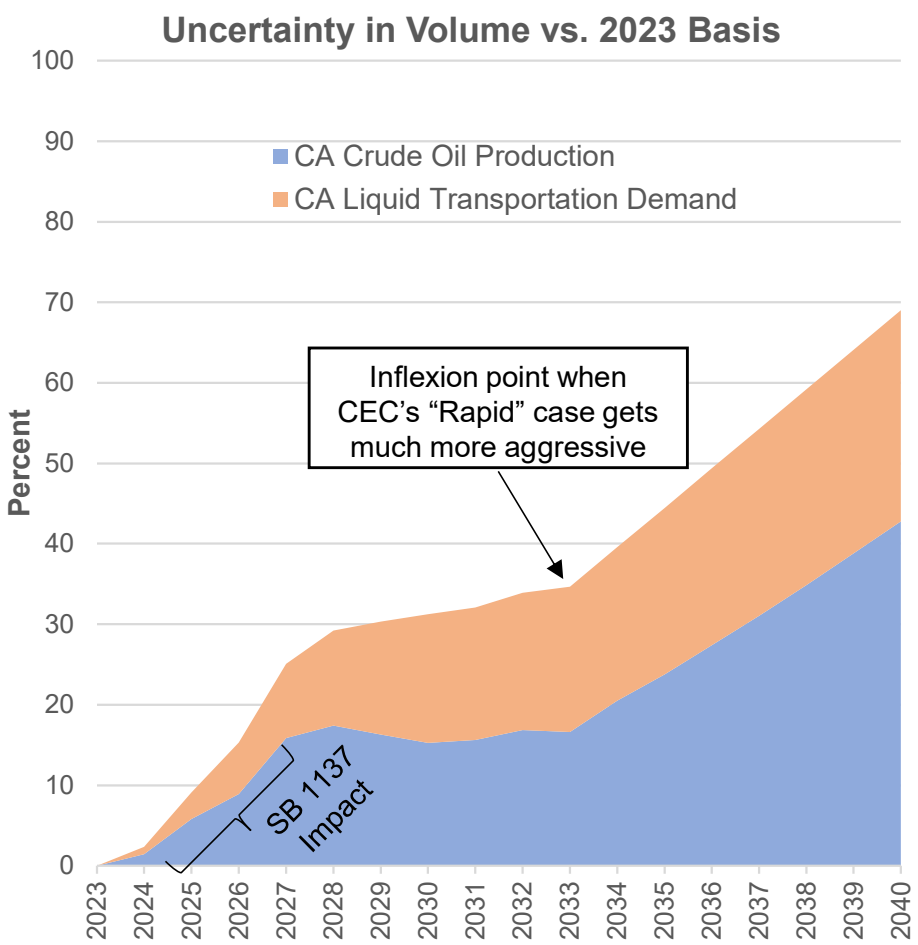
Several factors could impact future California crude oil production



- **Reference**: Production of crude oil in California declines at the 2000-23 rate (3.4% p.a.), which assumes there is a recovery from recent upstream activity, i.e., early-2024 decline rates have accelerated to -15% on an annualized basis.
- **Minimum permits**: Production declines at the 2019-23 rate (5.8% p.a.) driven by the slowing pace of drilling permit approvals.
- **Pipeline limits**: Step changes in production declines caused by shutdowns of pipelines due to minimum throughputs; we assume trucking is not a viable transportation alternative.
- **Setback limit (SB 1137)**: Implementation would accelerate decline across the entire state. The LA Basin could be entirely shut-in by the early-2030s.

Source: CalGEM (California Geologic Energy Management Division), Catalyst Environmental, EIA (US Department of Energy, Energy Information Agency), TM&C analysis

GROWING MARKET UNCERTAINTY MAKES INVESTMENT DECISIONS INCREASING MORE CHALLENGING

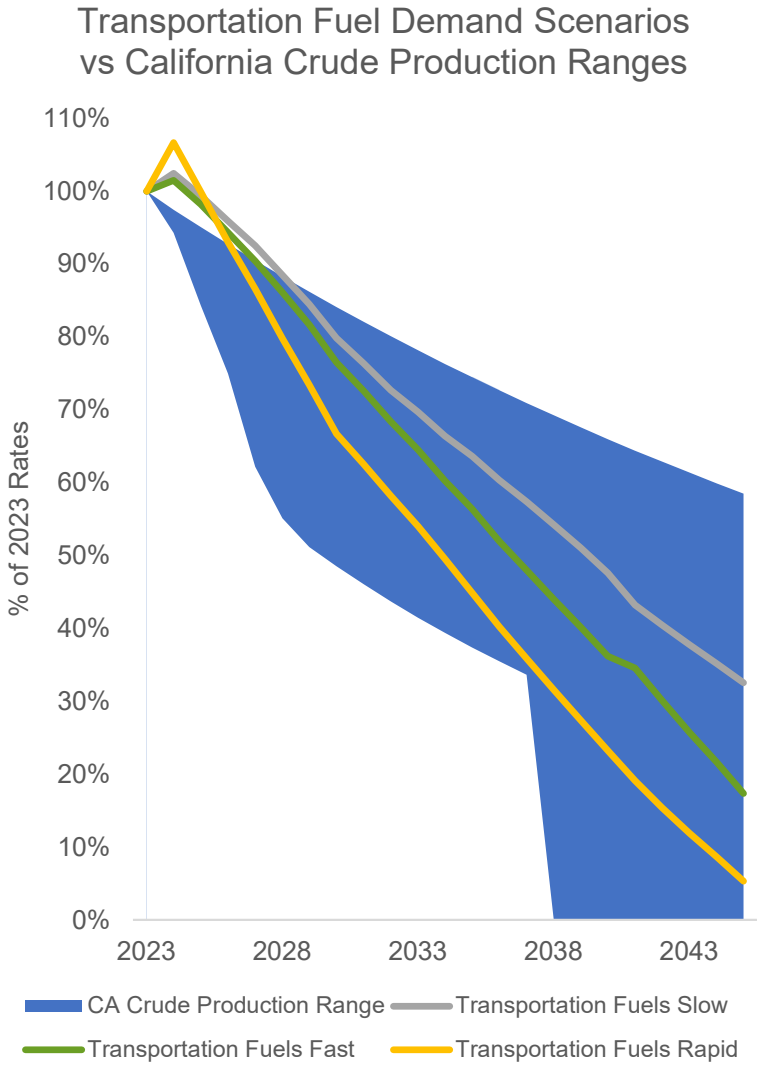


- Crude oil producers and pipeline operators would have to contend with the uncertainty of the blue shaded area when making business decisions.
- Refiners must contend with the uncertainty of both sourcing crude and fulfilling demand:
  - How to source crude oil supply? (blue area)
  - Where product markets might be? (tan area)
  - What projects might improve the ability to adapt?
- Combining these uncertainties could exacerbate the challenges of decision-making ("the whole is greater than the sum of the parts").
- The increase in uncertainty looks to be greatest in next 5 to 7 years, when determining the long-term viability of the supply chain will be most critical.
- How this uncertainty impacts the competitiveness of California assets for corporate capital relative to other assets is likely to vary across companies.

Source: CEC, CARB, TM&C analysis

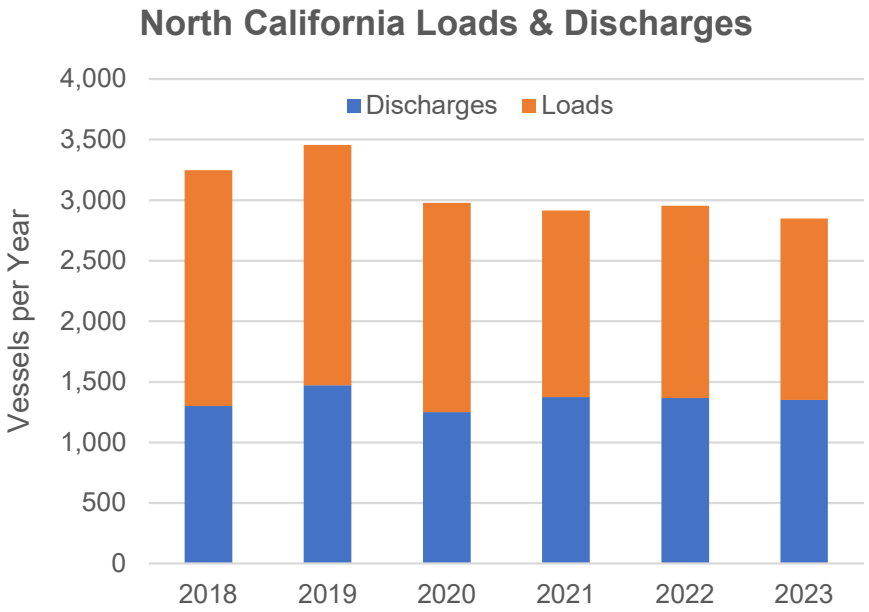
Refinery operations driven by shifts in Supply-Demand dynamics

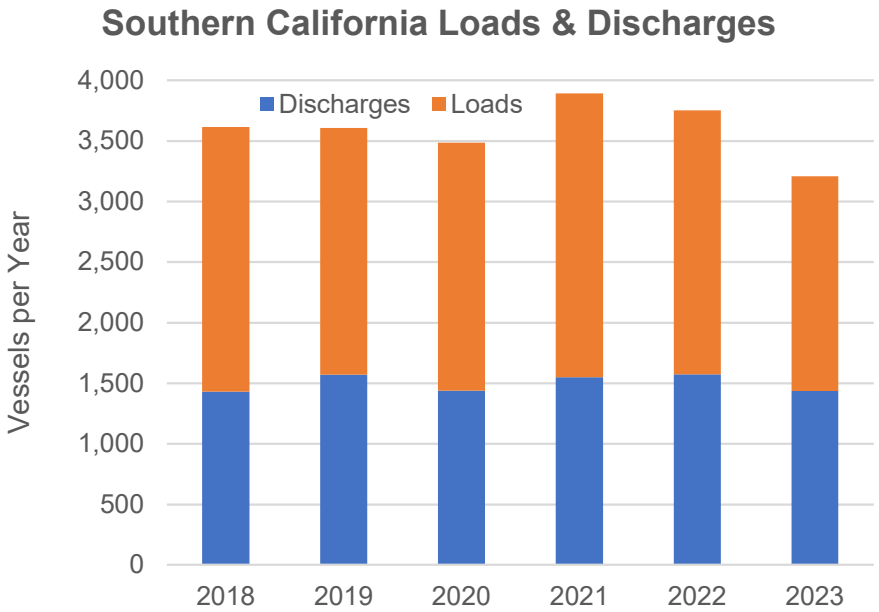
- As product demand declines, refineries would increase product exports, reduce crude oil runs, or eventually shut-down
- Exports must compete in the global market against other refiners with potentially lower costs
- If exports are not economically competitive, or reach logistic / permitting constraints, refineries may then reduce runs or shut-down
- There is a great deal of uncertainty in both future California crude oil production and transportation fuel demand, which may lead to a variety of business decisions as refiners compete within California and across a global market
- The decline of crude oil production relative to transportation fuel demand opens a range of marine logistics decisions (increasing imports/exports) to maintain, slow down, or cease operations. Each refiner may respond differently based on these uncertainties and additional business factors, such as, ability to acquire necessary permits.



Source: TM&C Analysis Refinery Scenarios (Supply-Demand), CalGEM, CEC, CARB

TOTAL MARINE TRAFFIC HAS DECLINED AS CRUDE VESSEL DECLINE IS FASTER THAN PRODUCT VESSEL GROWTH





- Crude oil discharges are down in the North from pre-pandemic levels and expected to drop further with recent refinery shutdowns.
- However, product discharges are growing in the North and South resulting from a mix of growing imports of petroleum products and renewable feedstock cargos.
- It takes 3 to 5 product vessels to replace a crude oil tanker on a product volume equivalent basis.
- Product loads are declining in both the North and South; declines in fuel oil loads in response to new IMO regulations on sulfur content is masking increasing diesel loads (exports) in the South.

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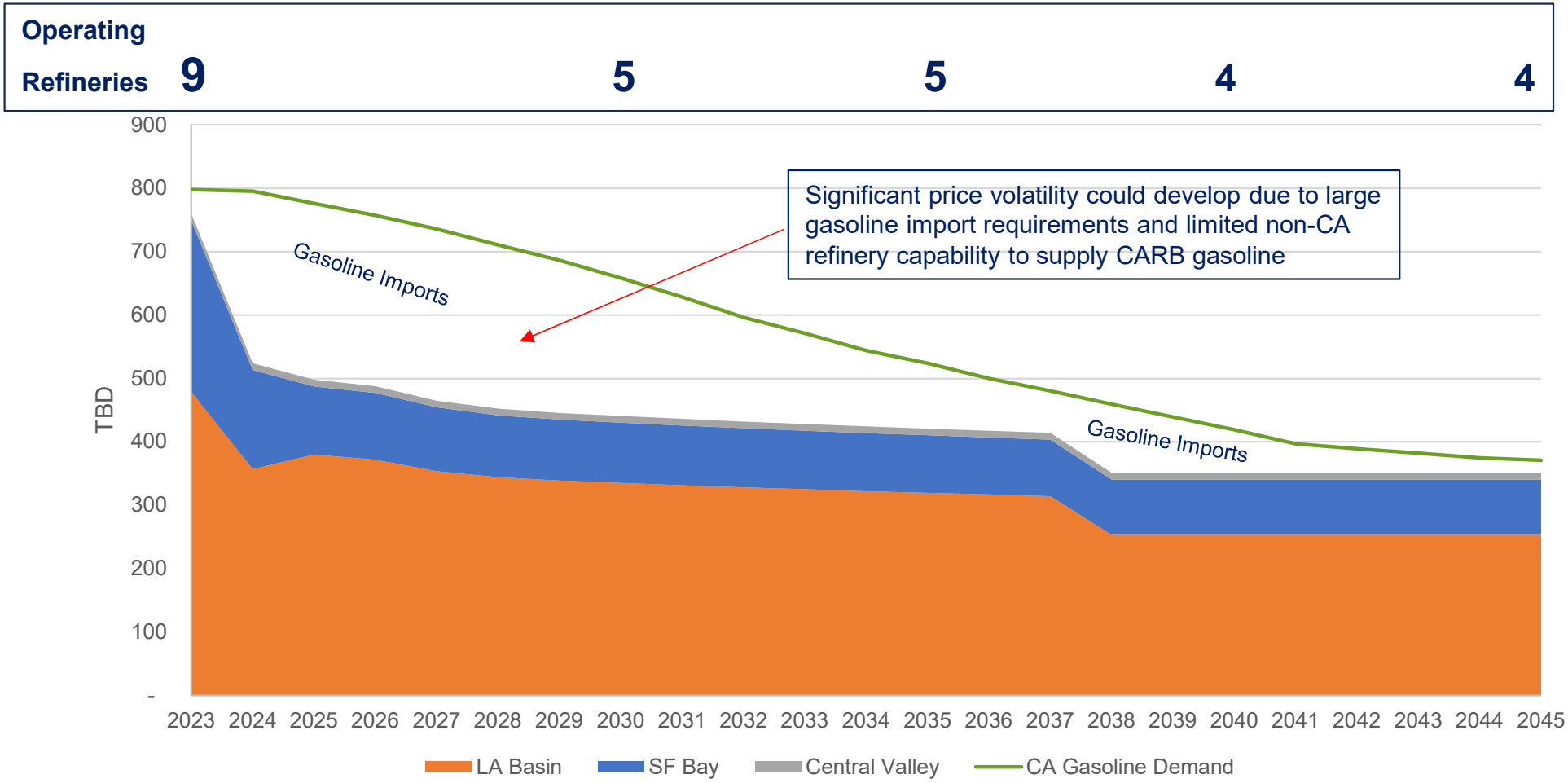
Source: California State Lands Commission, TM&C analysis
Note: Discharges and Loads refer to volumes received from/loaded to a vessel. These volumes could originate from/destined to another location within California so should not be confused with exports/imports

Risk of significant immediate refinery shutdowns if refiners face CARB "at-berth" crude restrictions

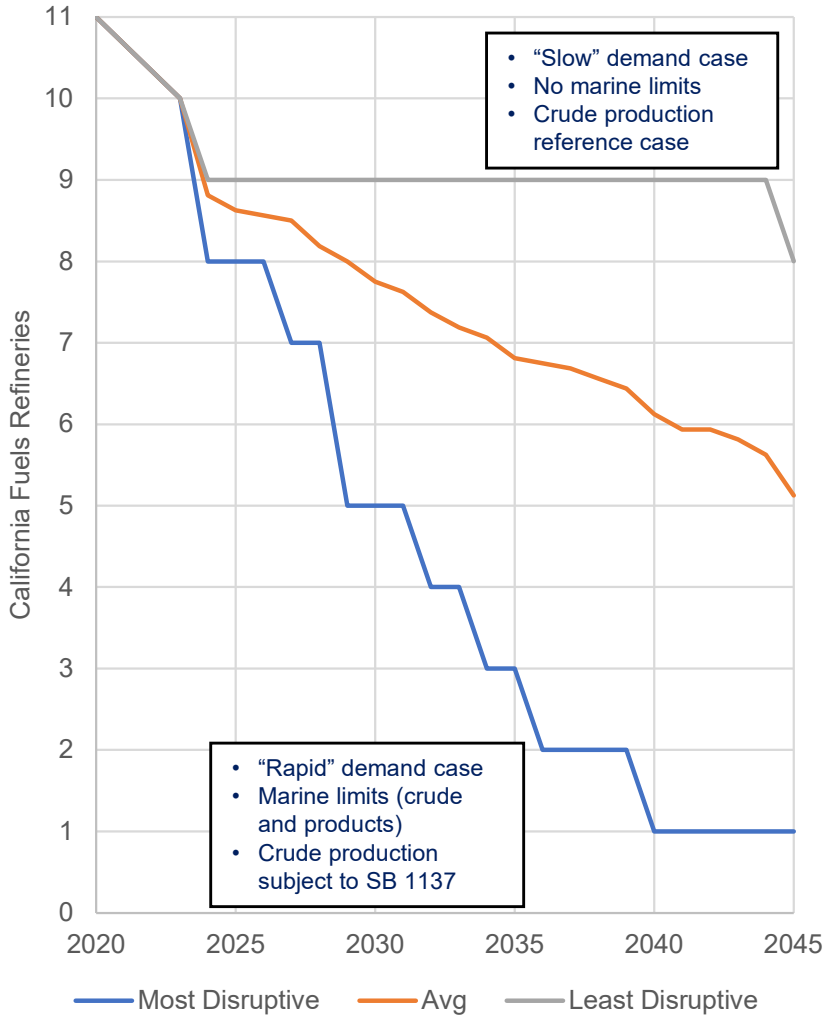
- CEC "Slow" fuels demand case
- CARB "At-Berth" limiting crude imports
- California crude oil production at SB1137 case
- Refinery utilization falls to 65% before shut-down



Source: TM&C analysis

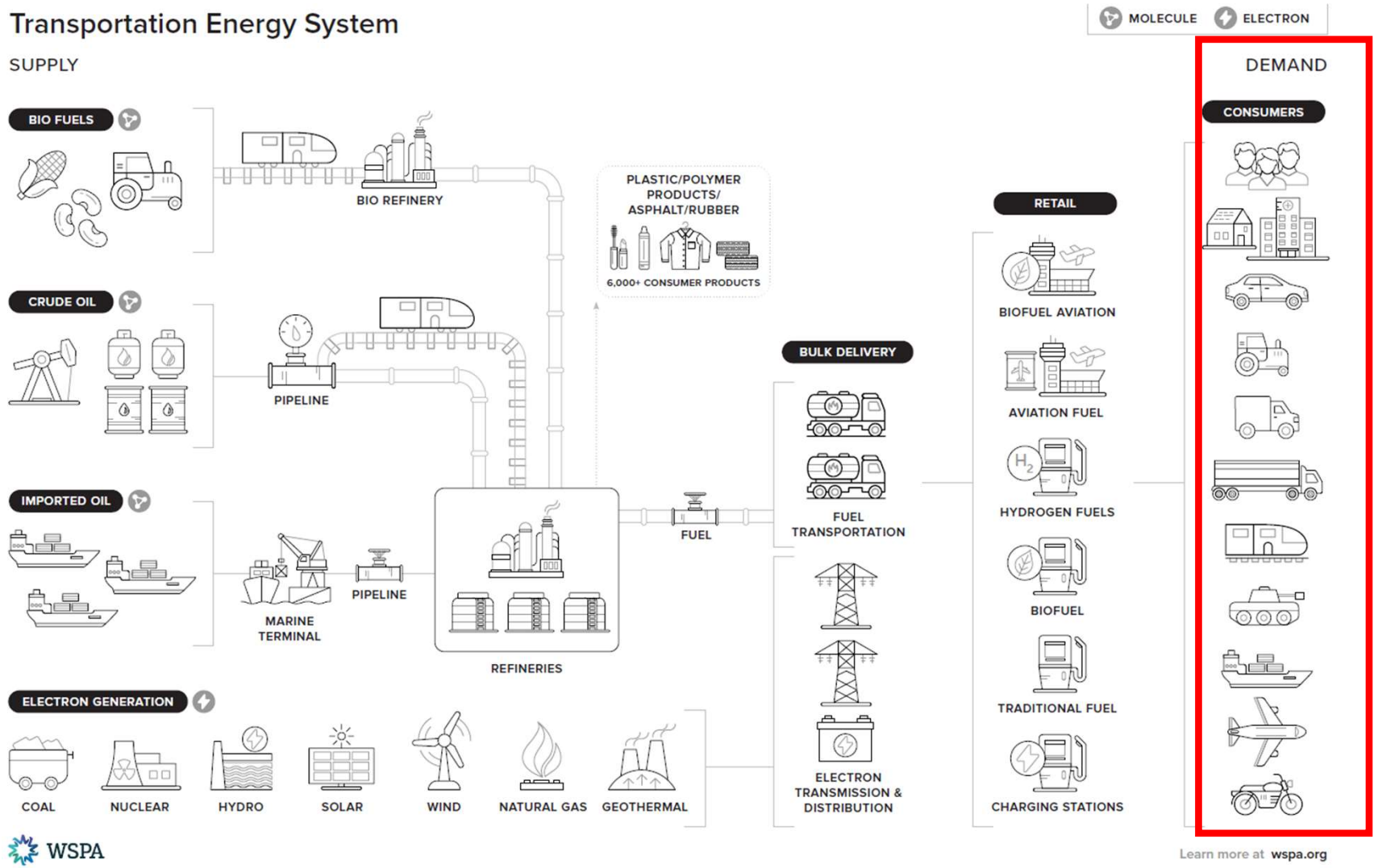
REFINERY CLOSURE RISK IS HIGHLY DEPENDENT ON SCENARIOS

- TM&C evaluated potential refinery closures across 16 scenarios covering combinations of:
  - Transportation fuel demand cases,
  - Crude oil production profiles,
  - Logistics constraints,
  - Refining operating environments.
- Across all scenarios, on average, about half of California's fuels refineries could close by 2045.
- In the most disruptive scenario, only one fuels refinery remains by 2040.
- Even in least disruptive scenario refineries could close
  - Major shifts in business (increases in exports) and operations required.
  - Assumes no new limitations to importing crude and exporting products.
  - Requires exports to be globally competitive.
- If onshore power is unavailable or on-ship capture is infeasible, full enforcement of "At-Berth" restrictions could close 3-4 refineries almost immediately.
- **Refineries may close faster than demand declines, which could put pressure on marine logistics and vessel traffic limits.**



Source: TM&C Analysis
Note: Refinery utilization falls to 65% before shut-down

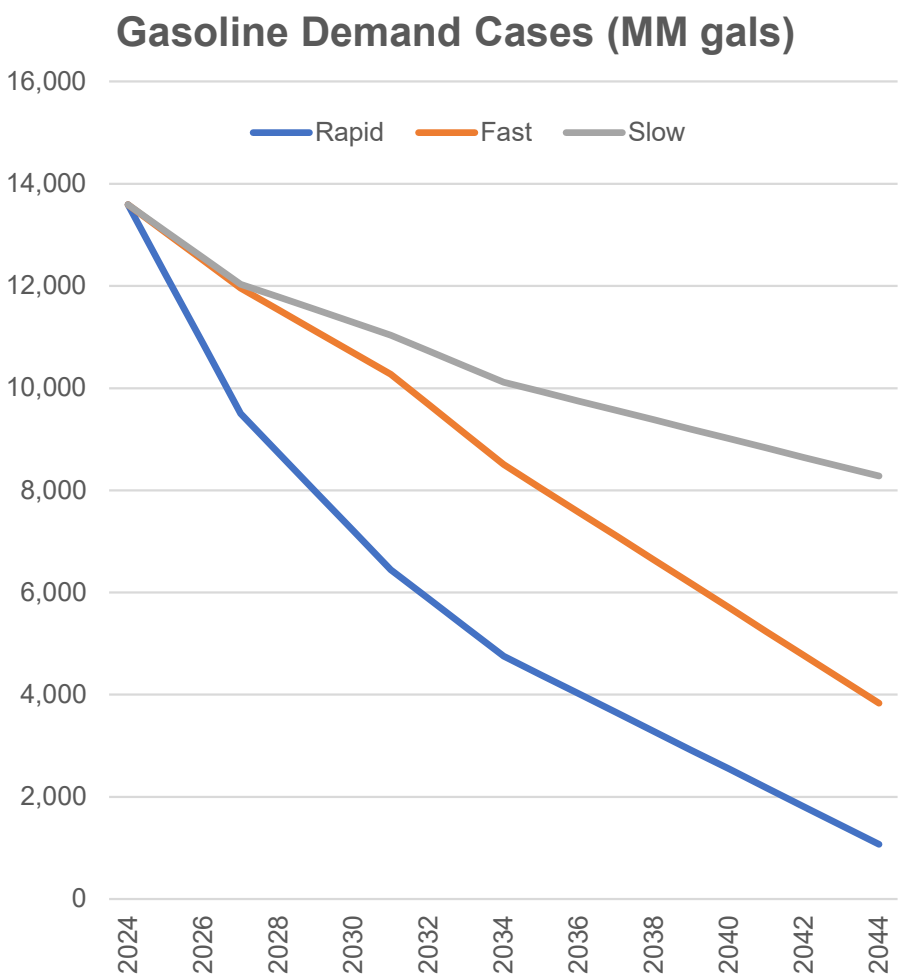
TRANSPORTATION ENERGY SYSTEM: FUEL DEMAND



DEMAND SUMMARY

- California liquid transportation fuel demand has declined ~9% since 2005
- No liquid fuel, except renewable diesel, has recovered from COVID-19 demand destruction
- Across all future demand cases aviation fuel continues to grow even though total liquid transportation fuel demand declines
- In 2023 biomass-based diesel (BBD) was 63% of California's diesel supply, which is greater than at any point in in the future under CARB's Scoping Plan. TM&C's view is that BBD could completely displace petroleum-based diesel as early as 2026.

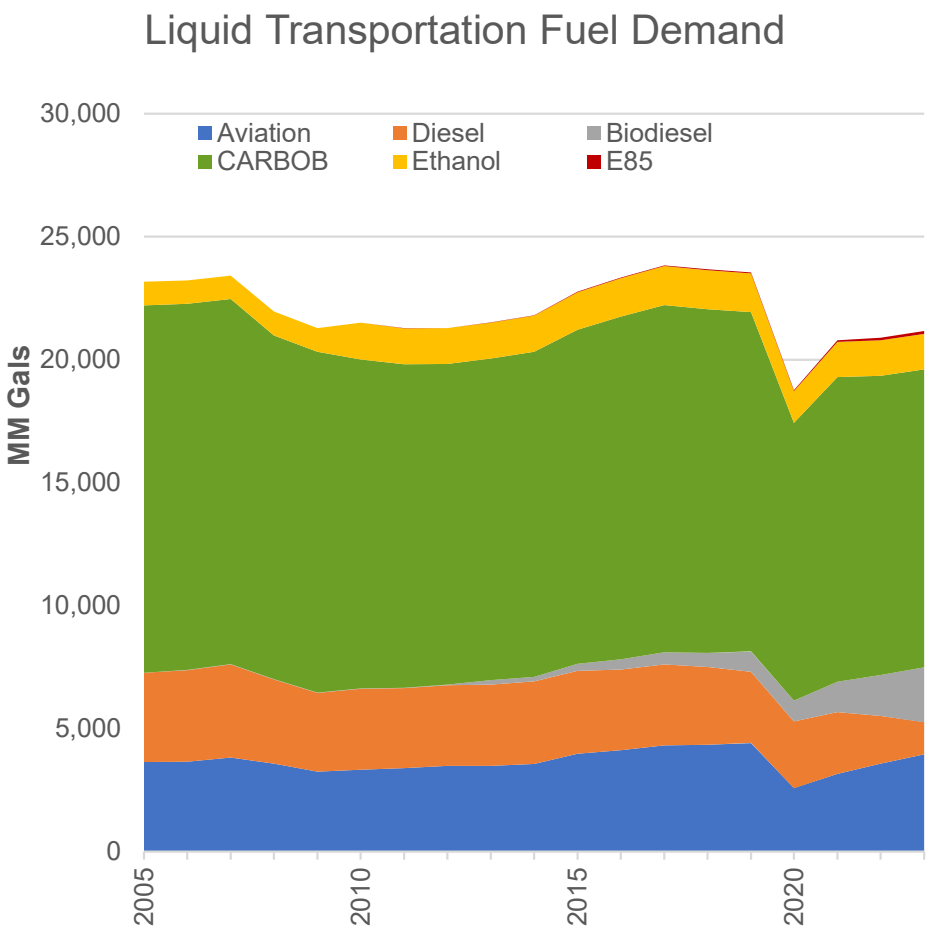
CEC's draft Fuels Transportation Assessment shows a variety of gasoline demand scenarios



- "Slow" scenario
  - 2023 IEPR Baseline
  - Demand declines at 2.4% p.a.
- "Fast"
  - AATE3 case in the 2023 IEPR
  - Demand declines at 6.1% p.a.
- "Rapid"
  - CARB 2022 Scoping Plan
  - Demand declines at 11.9% p.a.
- For historical reference: demand decline (2005 – 2023) = 0.8% p.a.

Source: CEC – Draft Transportation Fuels Assessment

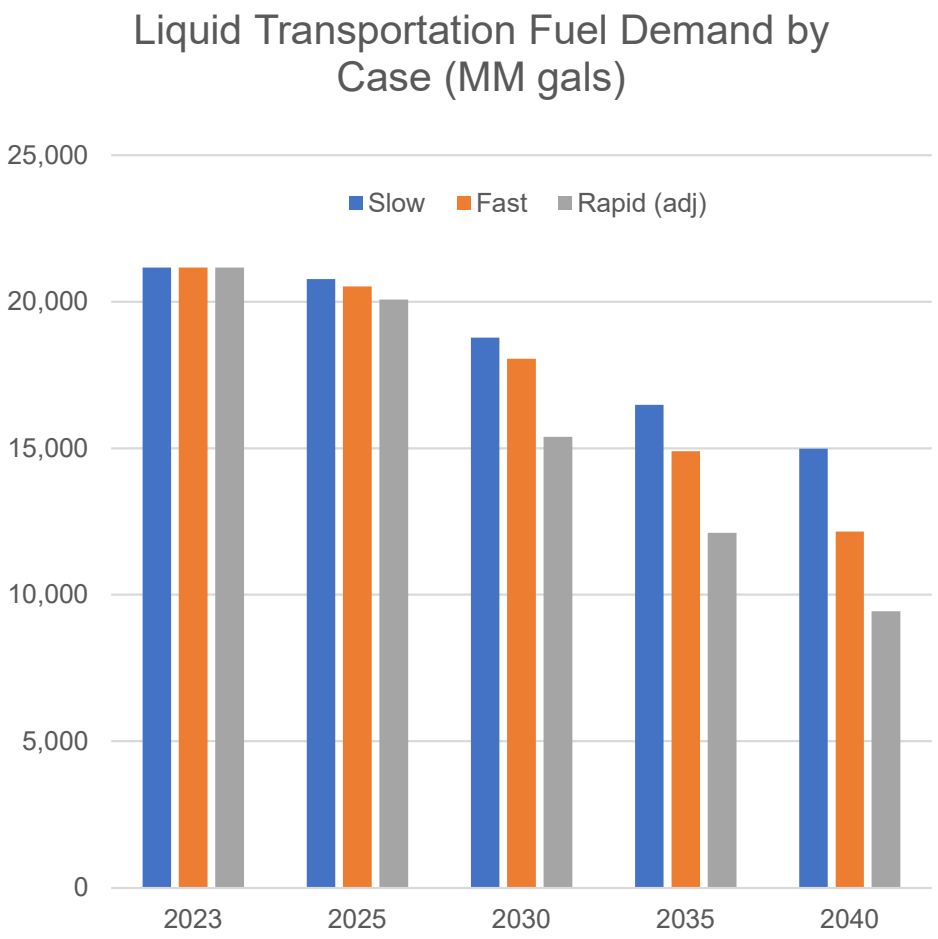
CALIFORNIA LIQUID TRANSPORTATION FUEL DEMAND HAS DECLINED 8.6% SINCE 2005



- No liquid fuel, except renewable diesel, has recovered from COVID-19 demand destruction
- Total diesel demand has declined 2.3% since 2005
  - Petroleum diesel has declined over 60% (-5.5% p.a.)
  - Renewable diesel grew over *45% p.a.*
- Gasoline demand declined 14% from 2005
  - Decline from EV penetration and improving fuel efficiency has been gradual (-0.8% p.a.)
  - Recovery from COVID-19 destruction has been about 50%
- Aviation fuel demand has grown 8.5% since 2005 and has recovered about 75% of its COVID-19 destruction

Source: California Energy Commission

LIQUID TRANSPORTATION FUEL COULD DECLINE 11-27% BY 2030



- TM&C maps non-gasoline fuels demands to CEC's draft Transportation Fuel Assessment scenarios in the following way:
  - "Slow" = 2023 IEPR Baseline
  - "Fast" = AATE3 in the 2023 IEPR
  - "Rapid" = CARB 2022 Scoping Plan
- Aviation fuel continues to grow even though total liquid transportation fuel demand declines
- TM&C adopts the CARB Scoping Plan assumption that aviation fuel has the same demand profile (+1.7% p.a.) across all scenarios due to its decarbonization challenges

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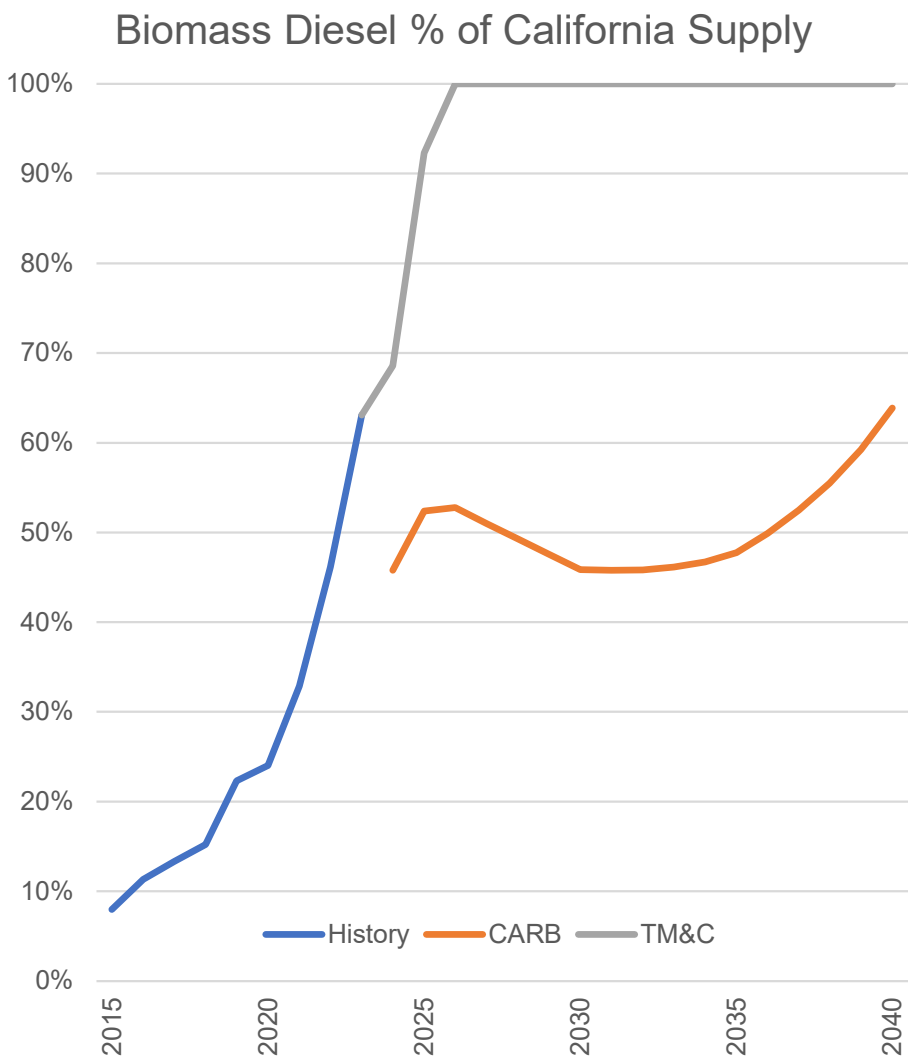
Source: Turner Mason analysis, CEC Draft Fuels Assessment, CARB 2022 Scoping Plan
Note: Turner Mason adjusts diesel demand in CARB's 2022 Scoping Plan to 2023 actuals (from CEC data) and preserves the plan's rate of demand decline

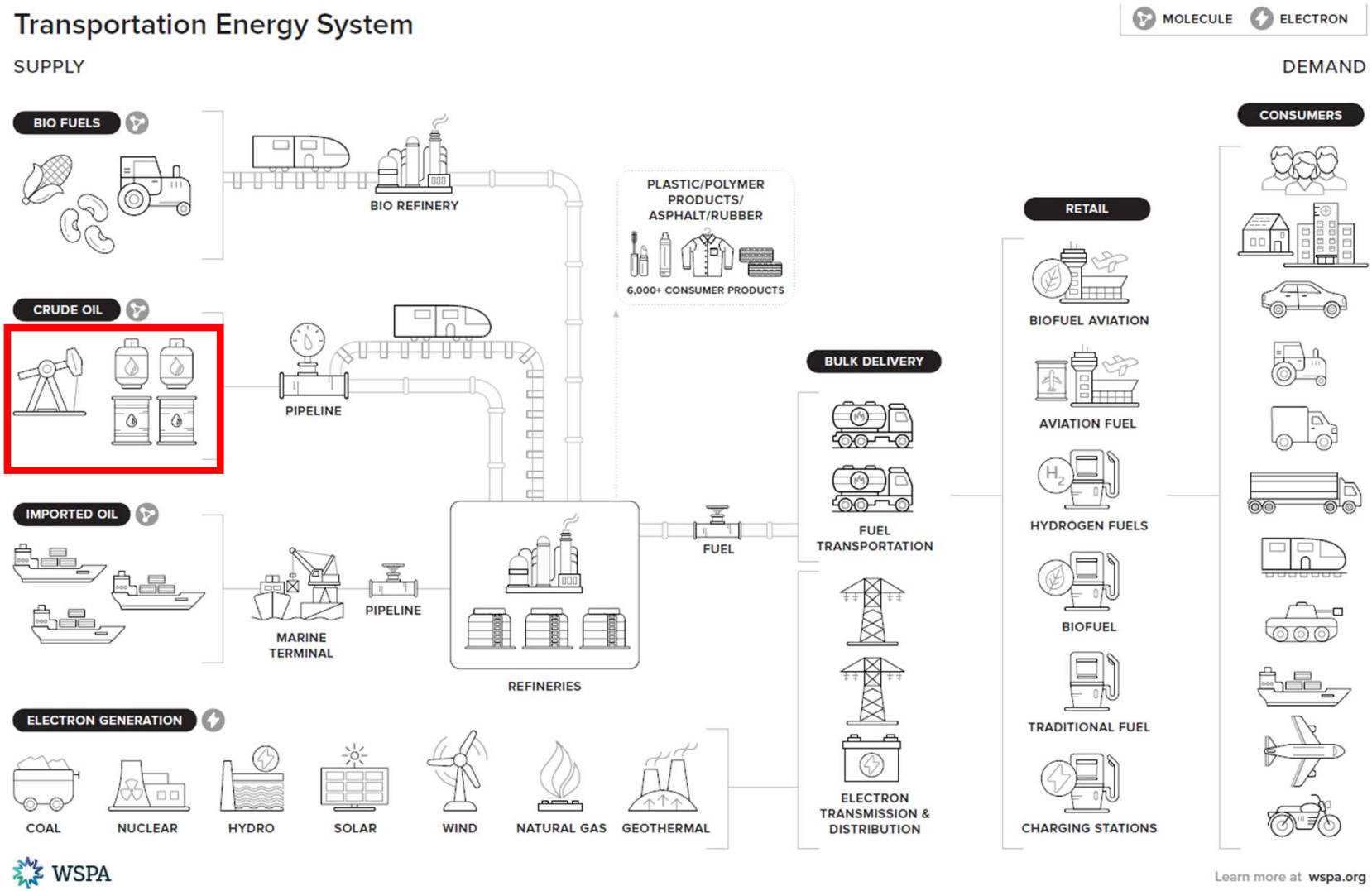
RAPID PENETRATION OF BIOMASS-BASED DIESEL CAN PUT SIGNIFICANT PRESSURE ON REFINERY PRODUCT YIELDS



- In 2023 BBD was 63% of California's diesel supply.
- CARB's Scoping Plan from 2022 already understates BBD penetration into California's diesel supply
- Focus is shifting towards RD (renewable diesel) given its cash margin advantage over biodiesel.
- Imports from out of state could fill the gap of credits needed to comply with increased LCFS compliance targets until all petroleum diesel is displaced.
- TM&C's view is that BBD could completely displace petroleum-based diesel as early as 2026.

Source: CEC, CARB, TM&C analysis
Note: LCFS is Low Carbon Fuel Standard

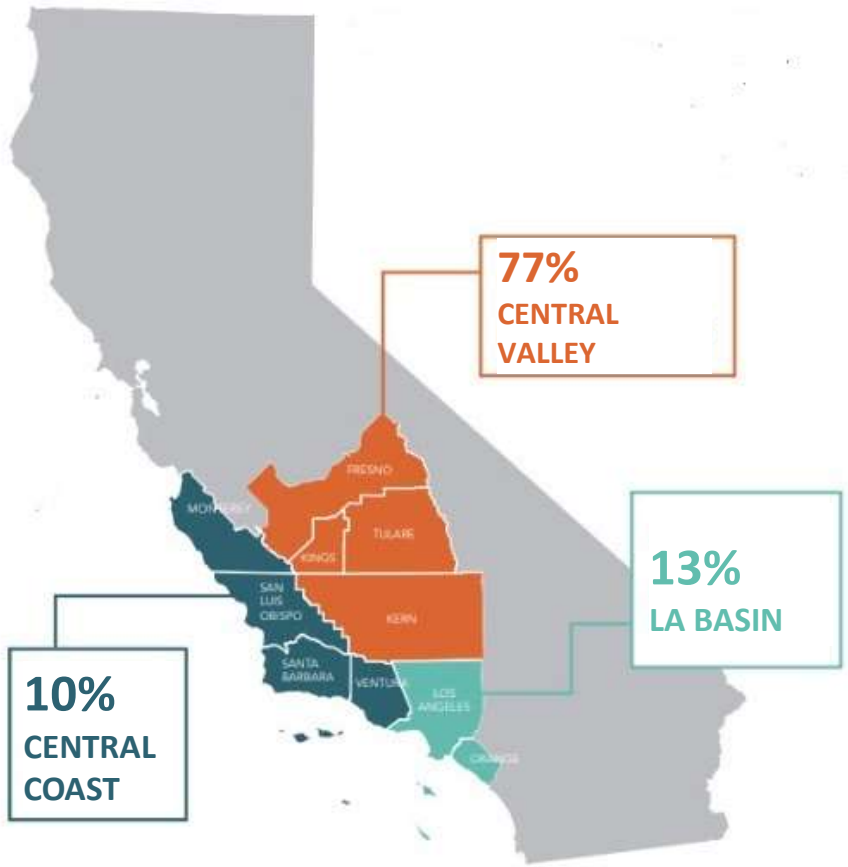
TRANSPORTATION ENERGY SYSTEM: CRUDE OIL PRODUCTION



Upstream Summary

- California crude oil production has fallen over 50% since 2000
- Decline rates have accelerated over time; especially post-COVID
- Wellhead production is at risk of being shut-in, while still economic, because pipelines cannot operate below minimum throughput levels
- Alaska production could see some recovery with new projects, but eventually decline would return; California refineries would continue to compete with Washington refineries, which offer better economics to Alaska producers

California crude oil production is divided into three regions and dominated by the Central Valley

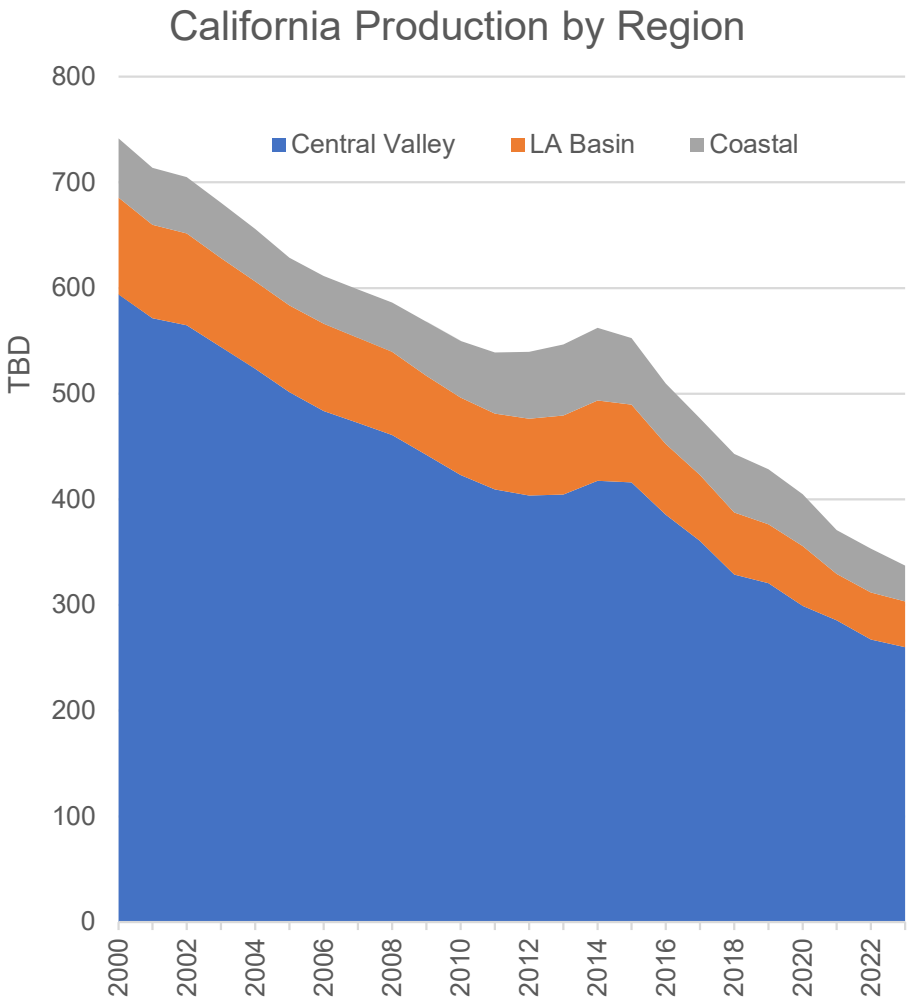


Location	2023 Production (TBD)	2019-23 Decline (% p.a.)
Central Coast	34	-9.9
Central Valley	260	-5.1
LA Basin	43	-6.1
California Total	338	-5.8

- Majority of production in Central Valley.
- Central Valley and LA Basin production face significant regulatory (setback) hurdles in addition to declining production.

Source: CalGEM

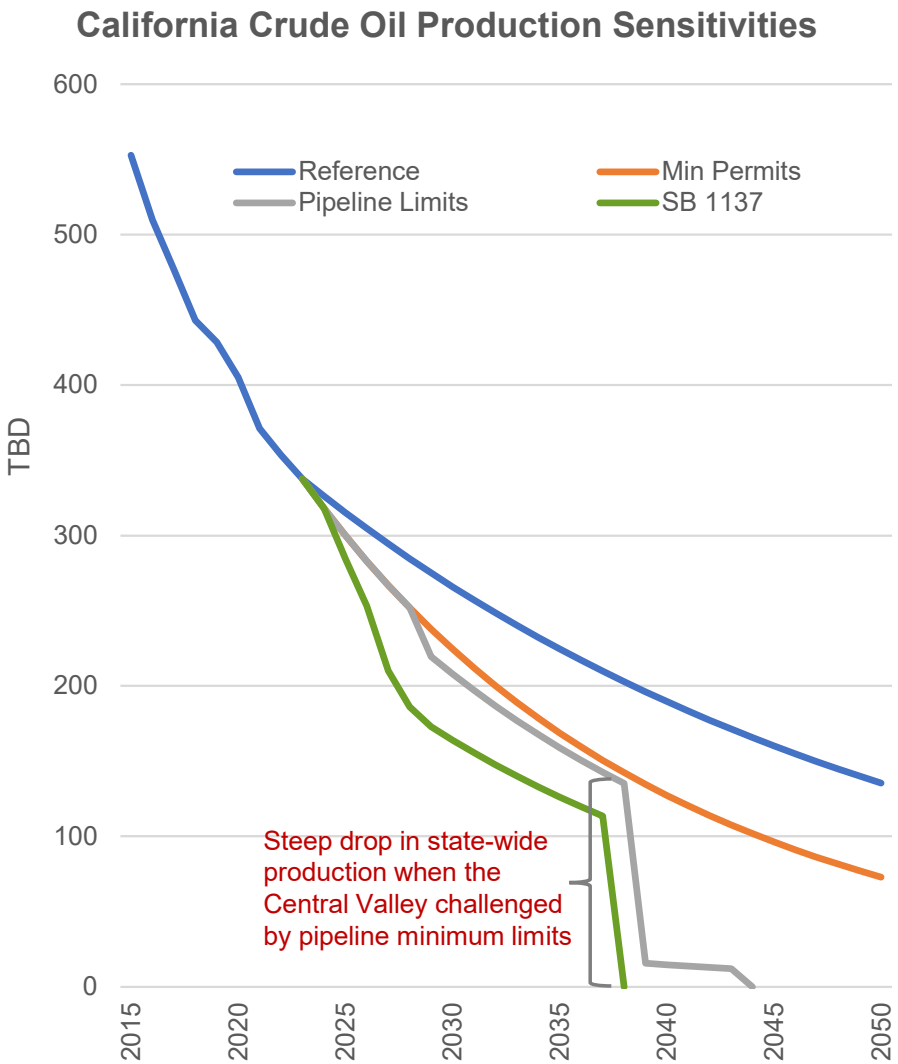
California crude oil production has fallen over 50% since 2000



- Decline rates have accelerated over time; especially post-COVID
- Most of the decline (both by volume and percent) was in the Central Valley (San Joaquin Valley)
- Coastal district production is challenged increasingly by pipeline access

Source: CalGEM

Several factors could impact future California Production



- **Reference**: Production declines at the 2000-23 rate (3.4% p.a.), which assumes there is a recovery in upstream activity, i.e., early-2024 decline rates have accelerated to -15% on an annualized basis
- **Minimum permits**: Production declines at the 2019-23 rate (5.8% p.a.) driven by a slowing pace of drilling permit approvals
- **Pipeline limits**: Step changes in production caused by shutdowns of pipelines due to minimum throughputs
- **Setback limit (SB 1137)**: Implementation would accelerate decline, particularly in the LA Basin, which could see the entire basin shut-in by the early-2030s

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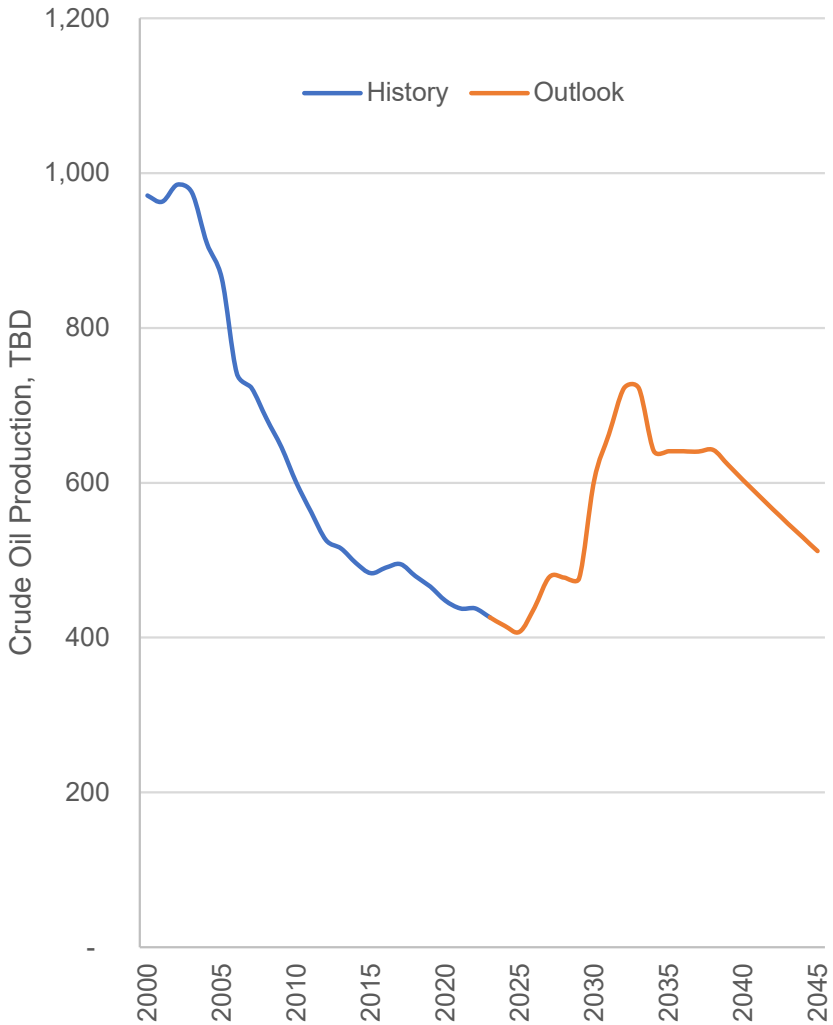
Source: CalGEM, Catalyst Environmental, EIA, TM&C analysis

Alaska Production recovers with Piko and Willow projects, but eventually returns to decline



- Production peaked at 2,017 TBD in 1988 and has since been in decline (-4.3% p.a.)
- Santos expects to start its Pika project (80 TBD) in 2026
- ConocoPhillips intends to start-up its Willow project in 2029, eventually adding 180 TBD of new production
- These projects extend the useful life of the TAPS (Trans-Alaska Pipeline System)
- California competes with Washington area refineries for Alaska crude oil via marine vessels
- California's future consumption of Alaska crude oil is assumed to decline due to Washington refineries maintaining their consumption and offering better economics to Alaskan crude producers

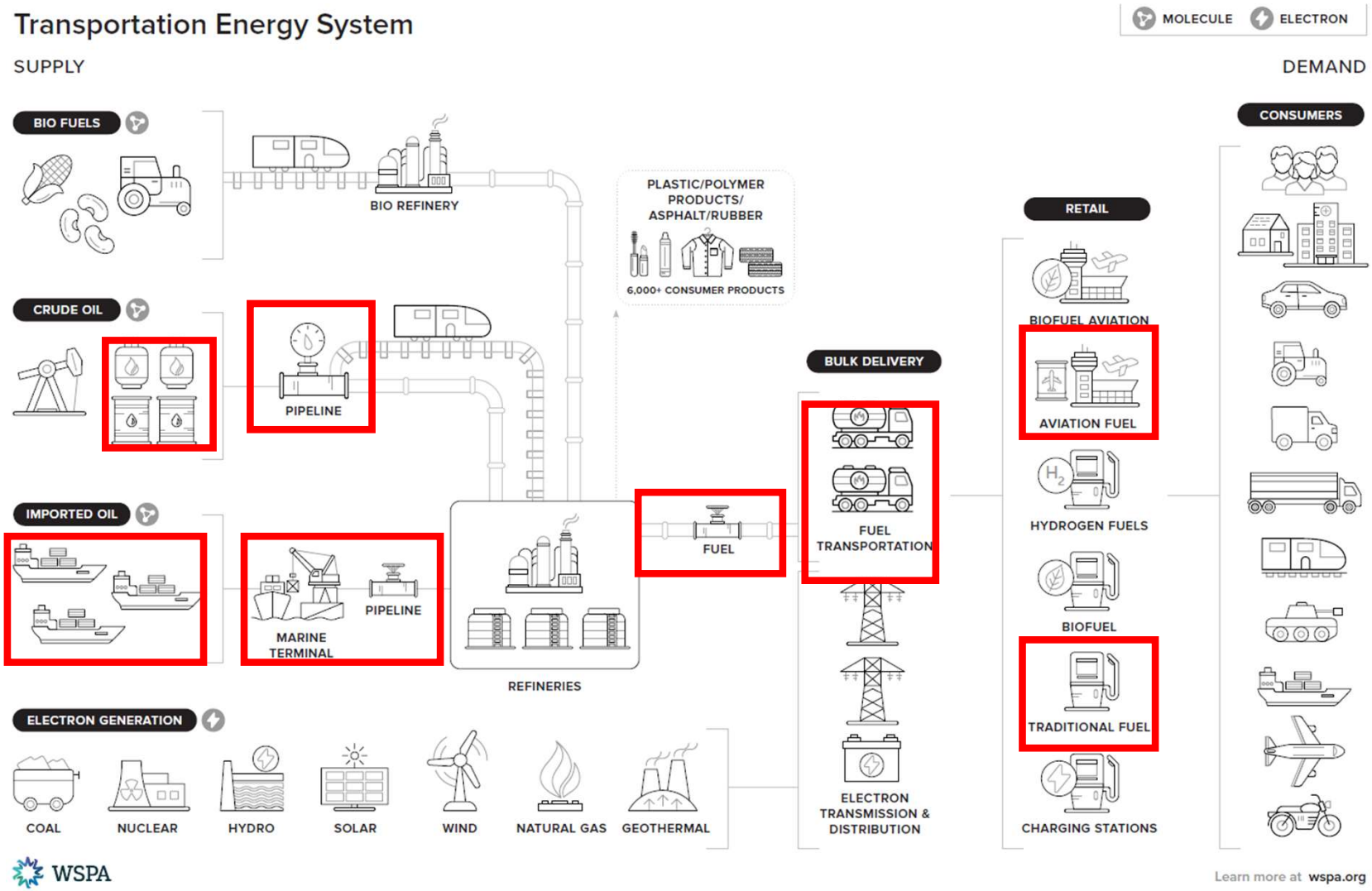
Source EIA, TM&C *Crude and Refining Product Outlook*

IMPACTS OF TMX PIPELINE

- The Trans Mountain Expansion (TMX) pipeline (590 TBD) runs from Edmonton, Alberta to the port in Burnaby, just east of Vancouver, British Columbia. The new pipeline runs parallel to the existing Trans Mountain pipeline (300 TBD).
- TMX is started-up in May 2024 and eventually has the potential for up to 590 TBD of waterborne exports of Canadian crude oil
  - Increases WCS (Western Canadian Select) to global crude markets, particularly US West Coast and Asia
  - Could help replace heavy California grades that are in decline
  - Would reduce need for other foreign imports into California, though WCS would still enter California via marine ports
- Full ramp-up of TMX is a multi-step process and may take 2-3 years
- Some TMX specifications (e.g., vapor pressure, TAN) are so wide some California refiners are concerned they might not be able to buy crude oil shipped on the pipeline.

Source: https://www.transmountain.com/, Argus Media
Note: TAN is Total Acid Number
WCS is Western Canadian Select

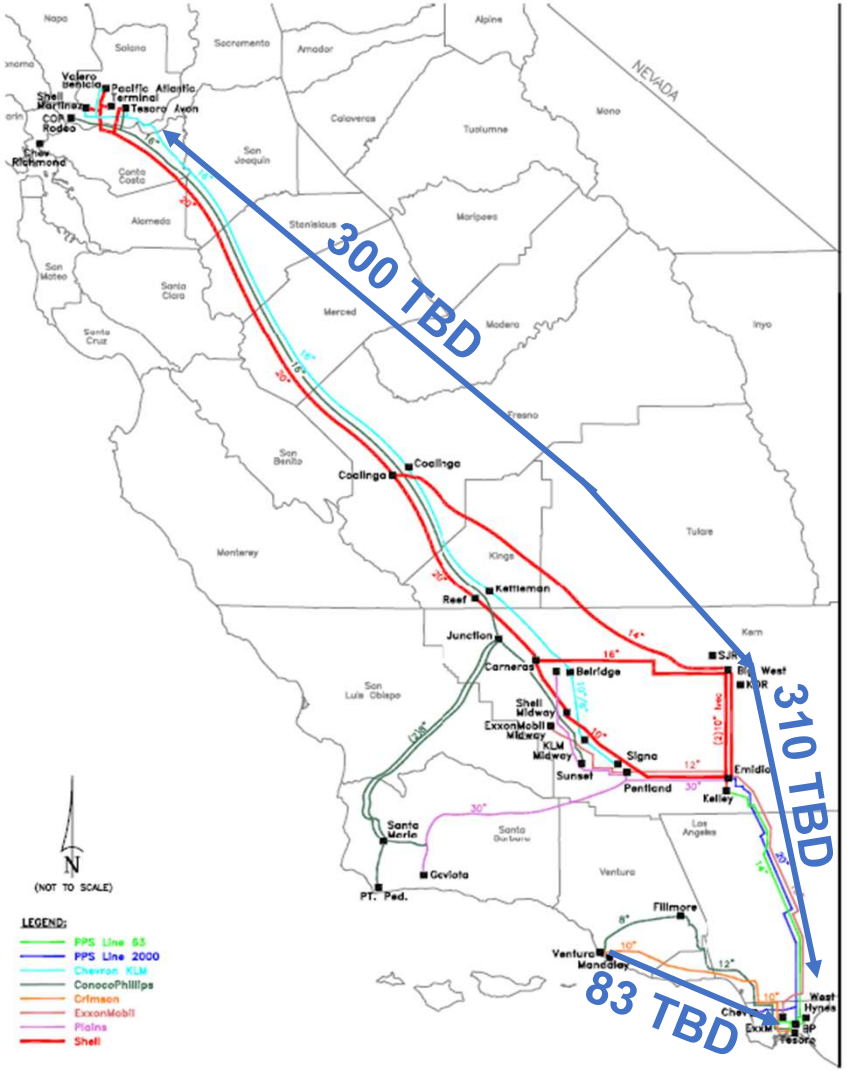
TRANSPORTATION ENERGY SYSTEM: LOGISTICS



LOGISTICS SUMMARY

- CARB's "At-Berth" regulation could critically impair marine logistics in the liquid transportation supply chain
- Multiple pipelines connect crude oil producing areas to refining centers, with throughput appearing to be reaching critical minimum volume for several pipelines
- With the closure of refineries in northern California, the Bay Area appears to be more at risk of pipeline closures
- Crude imports have not increased to fully offset California crude production declines, resulting in refinery capacity slowly declining
- The North is a net exporter of petroleum products, while the South is a net importer
- As refineries shut down, crude oil discharges decrease, but product movements increase to keep demand supplied
- Product cargos tend to be much smaller than crude oil cargos, so as product cargos rise, vessel traffic would greatly increase.
- Very little crude oil is brought in by rail because of high transportation costs. We do not expect rail to play a major role in California's future crude oil supply.

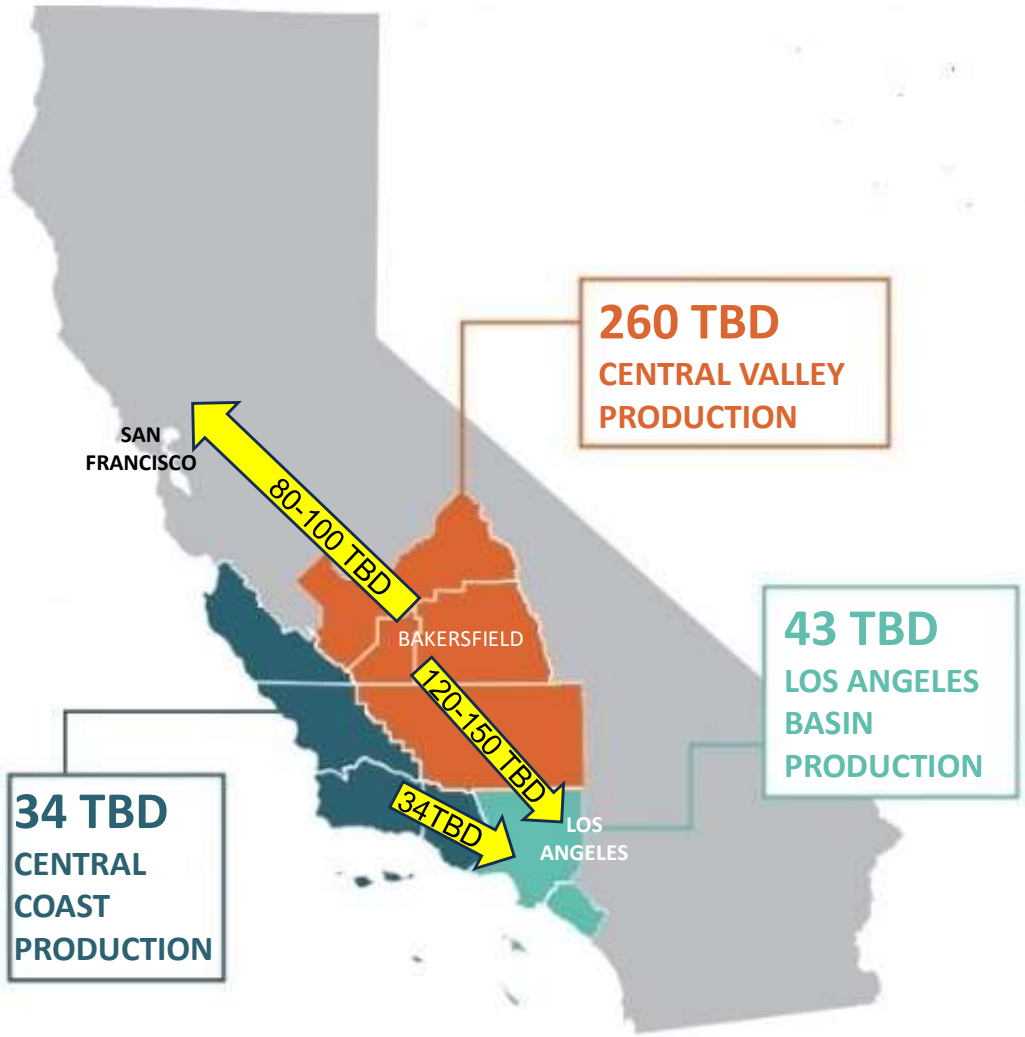
MULTIPLE PIPELINES CONNECT CRUDE OIL PRODUCING AREAS TO REFINING CENTERS



Regional Movement	Pipeline Name	Current Capacity (TBD)	Estimated Minimum Throughput (TBD)
Central Valley to San Francisco	KLM Pipeline	90	30
	San Pablo Bay Pipeline	210	60
Central Valley to Los Angeles	Line 63	60	20
	Line 2000	110	30
	M-70 Pipeline	110	30
	Chevron	30	10
Central Coast to Los Angeles	Texaco	28	10
	Southern California Pipeline System	55	20

Source: California Coastal Commission, CPUC (California Public Utilities Commission), BOEM (Bureau of Ocean Energy Management), *Oil & Gas Journal*, company websites

THROUGHPUT APPEARS TO BE REACHING CRITICAL MINIMUM VOLUME FOR SEVERAL CRUDE OIL PIPELINES



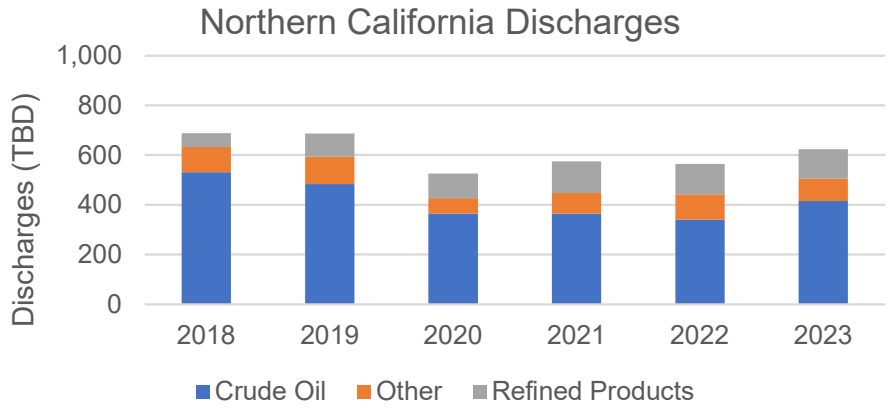
Regional Movement	Pipeline Name	Current Capacity (TBD)	Estimated Minimum Throughput (TBD)	Current Throughput (TBD)
Central Valley to San Francisco	KLM Pipeline	90	30-35	80-100
	San Pablo Bay Pipeline	210	60-65	
Central Valley to Los Angeles	Line 63	60	20-25	120-150
	Line 2000	110	30-35	
	M-70 Pipeline	110	30-35	
	Chevron	30	10-15	
Central Coast to Los Angeles	Texaco	28	10-15	34
	Southern California Pipeline System	55	20-25	

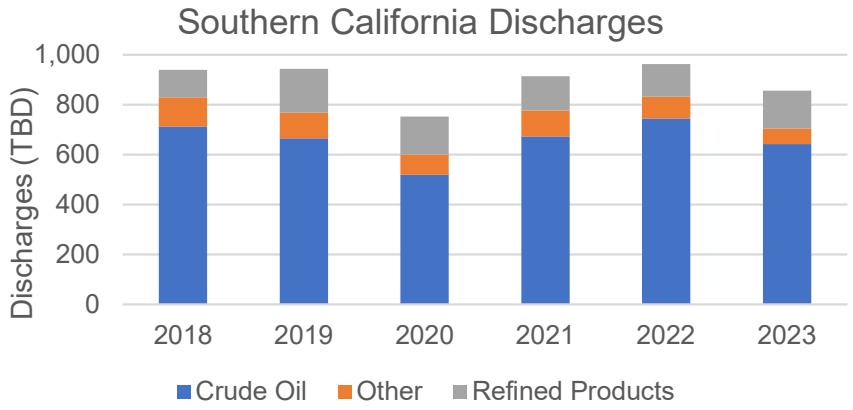
Source: CalGEM, CEC, California State Lands Commission, TM&C analysis

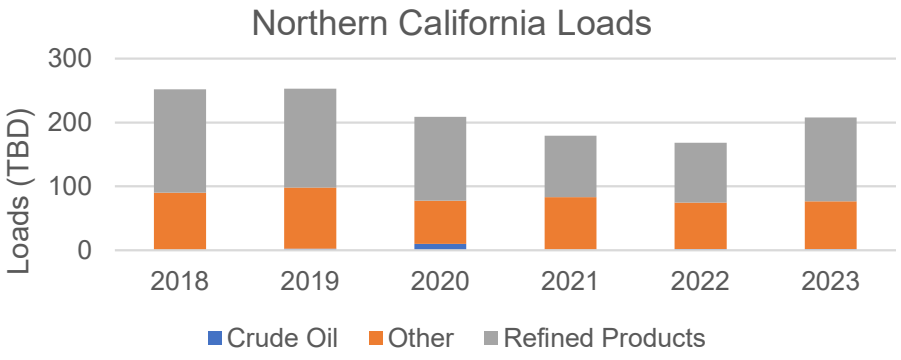
CRUDE LOGISTICS - PIPELINE

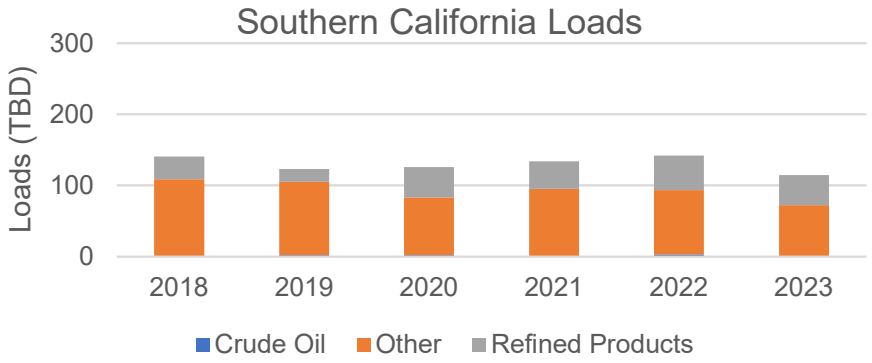
- We estimate pipelines need to operate at ~30% capacity to maintain continuous flow
- This minimum flow constraint can be mitigated with tankage as volume can be built up and shipped in batches
- We assume once a pipeline is shut down it does not return to service, due to the significant hurdle of securing necessary permits and re-start costs
- With closure of refineries in northern California, the two remaining pipelines are more at risk of shutting down if flow reductions continue than the South
- Closure of pipelines and denial of permits to restart them or to allow trucking of crude oil makes it difficult to get central coast crude oil production to market. This could accelerate further production declines.

MARINE LOGISTICS SUMMARY







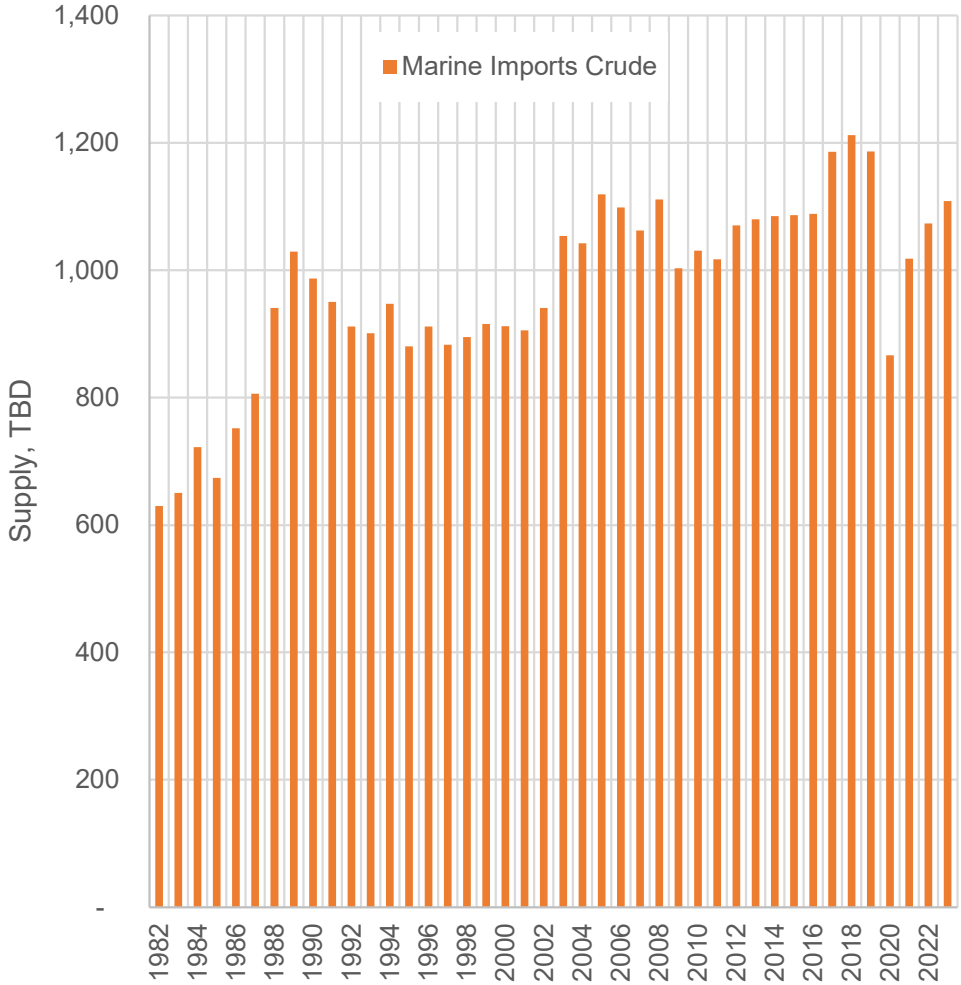


- Discharges and Loads refer to volumes being received from or loaded onto a vessel. These should not be confused with imports and exports as much of the volume originates from or is destined for another location within California.
- Northern crude oil discharges are down from pre-pandemic levels. These volumes are expected to drop even further with recent refinery shutdowns.

Source: California State Lands Commission, TM&C analysis

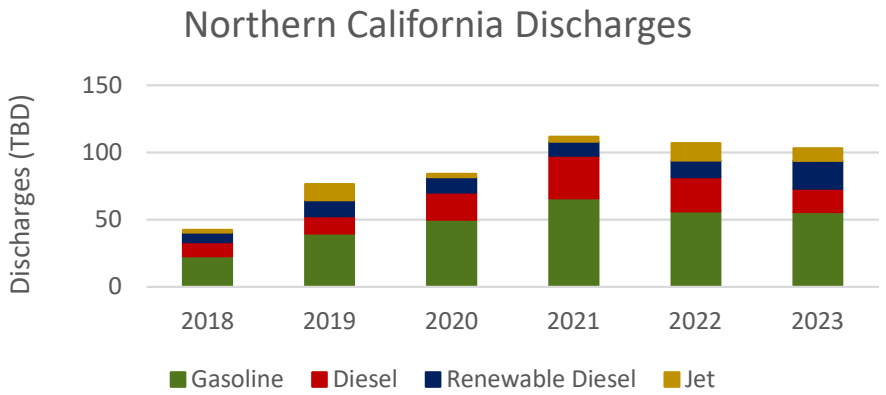
Potential Crude Oil Marine Limits

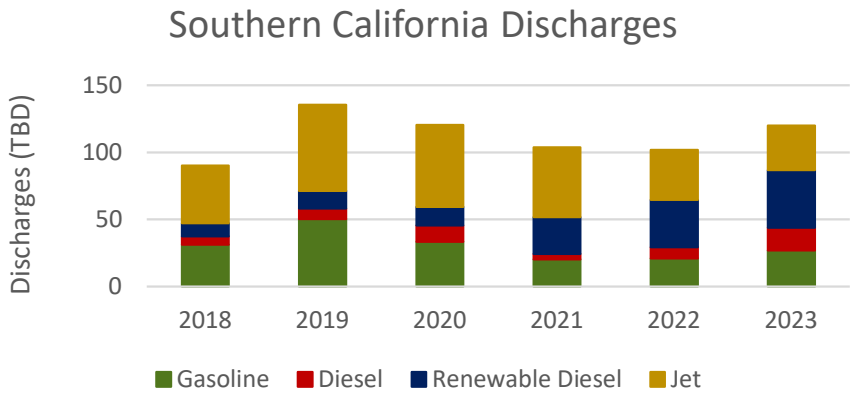
- Crude marine import limit is set at 1,150 TBD based on historical volumes
  - Apart from COVID-19, marine crude imports have exceeded 1,000 TBD since 2003
  - However, only once has marine crude imports exceeded 1,200 TBD (2018)
- Region specific marine import history
  - SF Bay ~ 430 TBD (160 million barrels/yr.)
  - P66 Rodeo and Marathon Martinez already converted to renewable fuels operations; we assume their marine crude oil import capacity is not available to industry
  - LA Basin ~ 715 TBD (260 million barrels/yr.)
  - Marine logistics availability assumptions
    - Marine import capacity dedicated to a refinery shuts when the refinery closes
    - Marine import capacity separate from refinery would remain available to the industry as refineries close
- Crude imports have not increased to fully offset California crude production declines, resulting in refinery capacity slowly declining

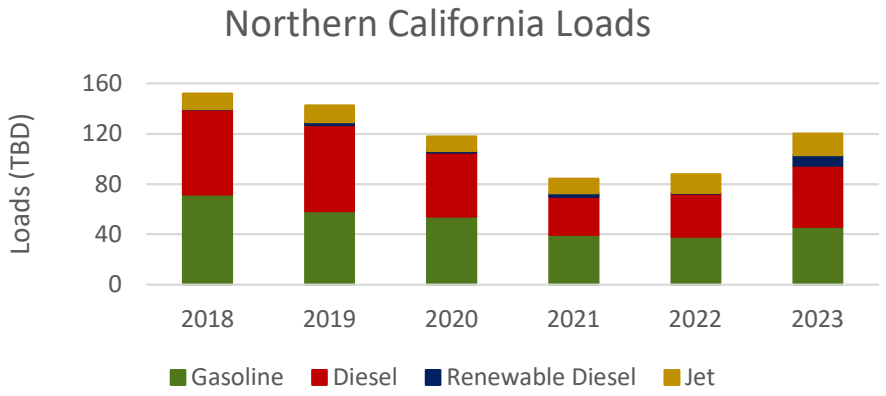


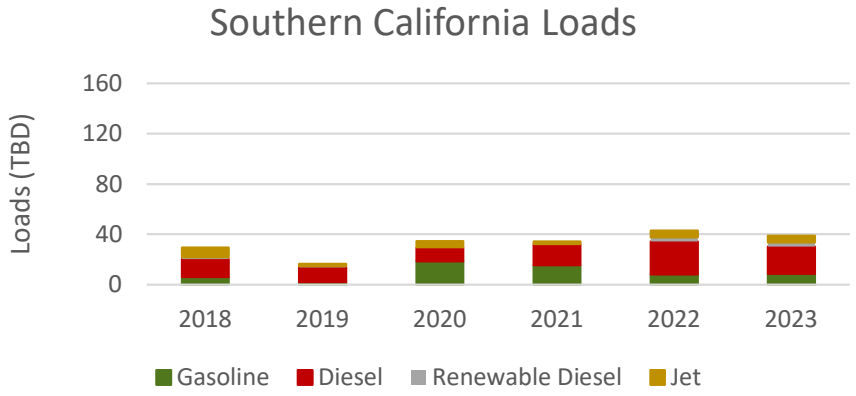
Source: EIA, TM&C Analysis

PRODUCT LOGISTICS - MARINE





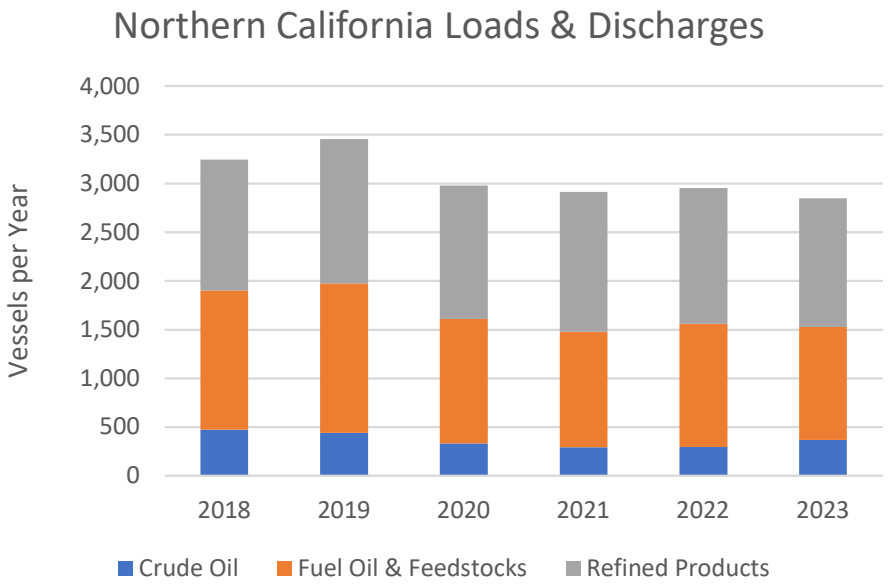


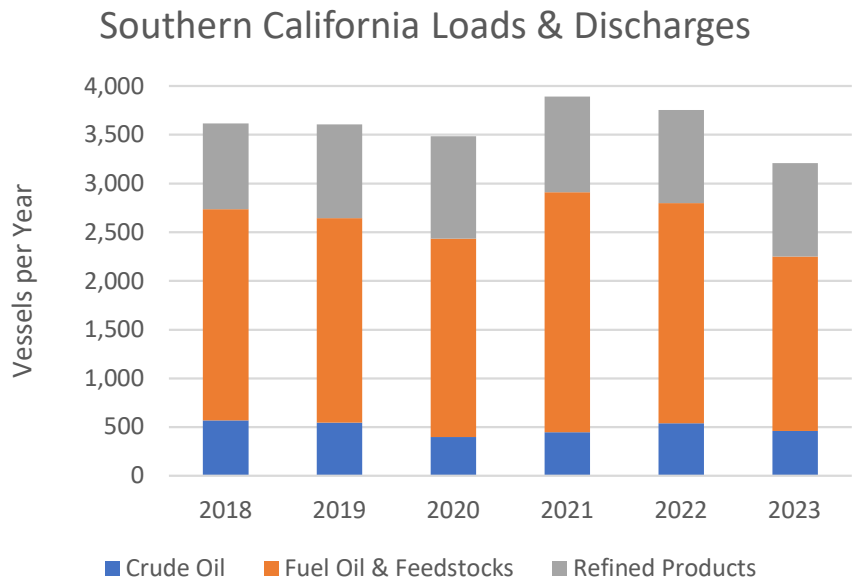


- Discharges and Loads refer to volumes being received from or loaded onto a vessel. These should not be confused with imports and exports as much of the volume originates from or is destined for another location within California.
- **Northern California is a net exporter, while the South is a net Importer of refined products and blend stocks.**

Source: California State Lands Commission, TM&C analysis

MARINE LOGISTICS - VESSELS

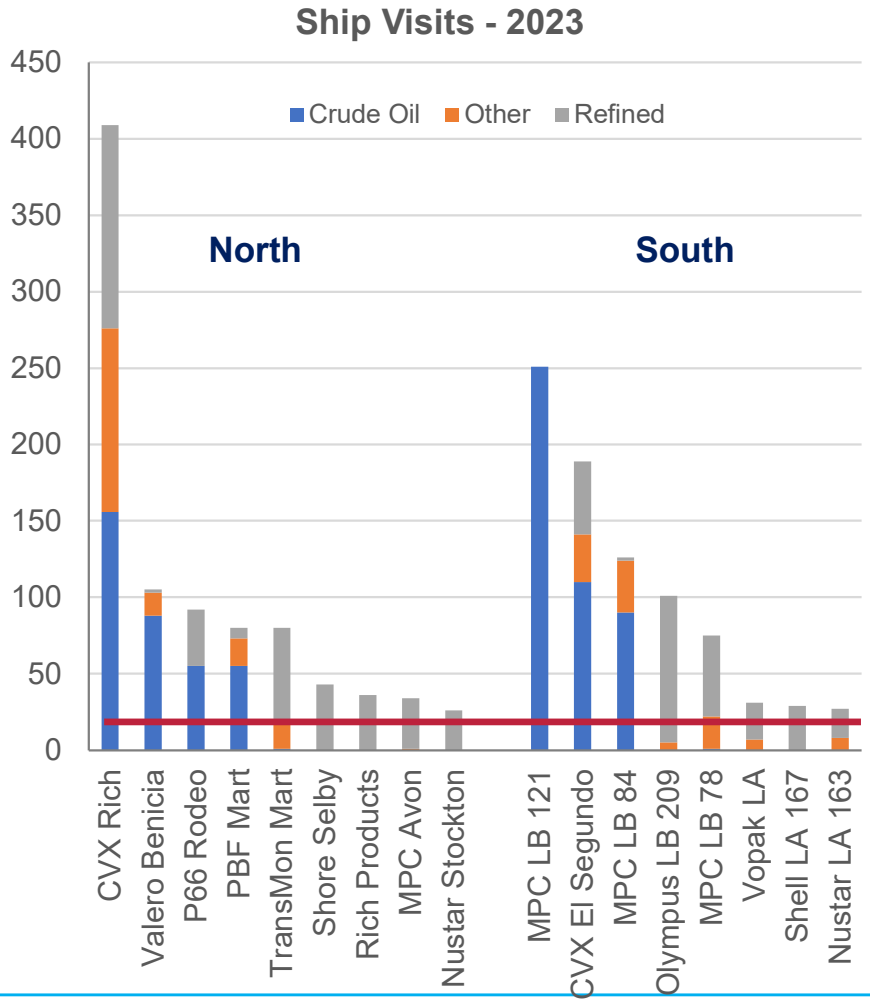




- Discharges and Loads refer to volumes being received from or loaded onto a ship or barge. These should not be confused with imports and exports as much of the volume originates from or is destined for another location within California.
- The total number of ships, both loads and discharges, that are visiting Northern or Southern points is depicted on these graphs.
- Total number of ships in the North has been relatively constant since 2020
- However, in the South there was an increase in ship calls in 2021, which has tapered off

Source: California State Lands Commission, TM&C analysis

CARB's "At-Berth" regulation could critically impair marine logistics in the liquid transportation supply chain



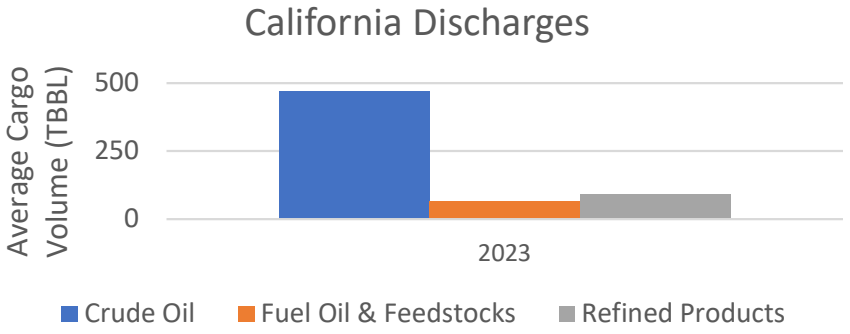
- The purpose of "At-Berth" regulations is reduce hoteling (or at-berth) emissions from idling engines onboard vessels docked at California ports.
- "At-Berth" compliance for tanker vessels begins January 1, 2025
- Because emission control technology is not available for industry tankers, to comply with regulations, companies will be limited to 20 vessels per berth per year.

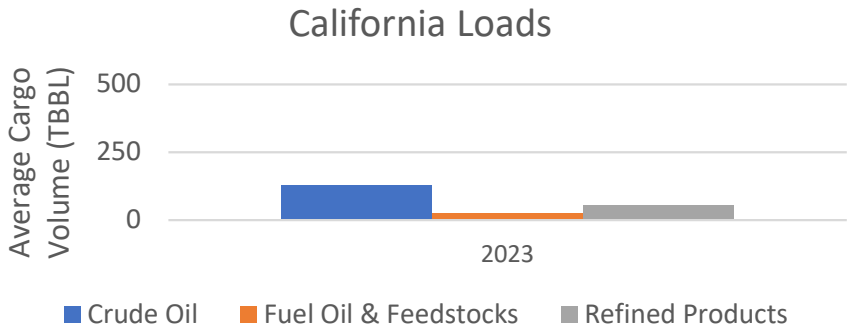
"At-Berth" limit with no technology solution

Source: California State Land Commission, TM&C analysis

PRODUCT LOGISTICS - MARINE

- The volume of products being loaded and discharged were highest in 2023.
- As refineries shut down, product discharges have increased, while loads have decreased
  - Jet is a significant portion of the discharges in the south as airlines are increasingly sourcing their fuel internationally.
  - Product cargos tend to be smaller than crude oil cargos. As product cargos rise, vessel traffic would greatly increase.
- These trends point to higher shipping traffic, especially among products, in the future.
- As renewable diesel grows its share of the California market, refiners increasingly rely on marine capacity to bring in renewable diesel finished fuel, renewable feedstock, and gasoline plus loading ships with fossil diesel to keep the market balanced.
- If refineries reach a marine logistic limit or saturate commercially attractive markets, they could be forced to cut refinery crude oil runs, which could reduce the supply of several products and especially gasoline production.





Source: California State Lands Commission, TM&C analysis

PRODUCT LOGISTICS – PIPELINE (ARIZONA, NEVADA)

Destination	Pipeline Name	Capacity (TBD)	Throughput (TBD)	Minimum Throughput (TBD)
Reno, NV	SFPP Northern Region	40	40	10-15
Las Vegas, NV	CalNev Pipeline	128	60	35-40
Phoenix, AZ	SFPP Southern Region	100	100	25-30

- California's refining centers deliver transportation fuels to the Arizona and Nevada markets via pipelines.
- The northern pipeline system is not connected to the southern system. Any fuel moved between the North and South refining centers must move via ocean going vessel.
- California refineries are major transportation fuels suppliers to markets in Arizona (88%) and Nevada (45%), so disruptions in fuels production in California would impact all three states.

Source: CEC, Kinder Morgan website, https://www.naseo.org/Data/Sites/1/schremp-1.pdf

CRUDE LOGISTICS - RAIL

- Refineries have the capability to bring in small volumes of crude by rail if needed.
- Very little crude oil is brought in by rail. With high transportation costs, crude by rail is not very competitive in California.
  - A decade ago, crude by rail was a growing industry in California, with several facilities expanding their capabilities to offload crude oil from railcars.
  - The crude by rail was driven by discounted crude oil in Canada and North Dakota.
  - Within a few years, many of the incentives that had driven acquiring crude oil from this source had dissipated.
    - Pipeline infrastructure in the Bakken (North Dakota) was built up to take crude oil to market, reducing the financial incentive to deliver crude oil by rail.
    - Reduced fuel demand cause by the pandemic, and the shutdown of refineries in California, reduced the demand for crude oil.
    - By 2021, only 1.7 million barrels of crude oil (5 TBD) entered California by rail (less than 0.5% of all crude oil imports), all of which went to Bakersfield.
    - The completion of the Trans Mountain Pipeline expansion (bringing crude from Alberta, Canada to the Pacific Coast) further reduces the incentive to bring Canadian crude oil to California by rail.
- Crude by rail is not expected to play a major role in California's future crude oil supply.
- Product by rail is also unlikely as it takes 3 to 5 unit trains (100 cars) to equal one typical tanker

Source: CEC, EIA

PRODUCT LOGISTICS – RAIL

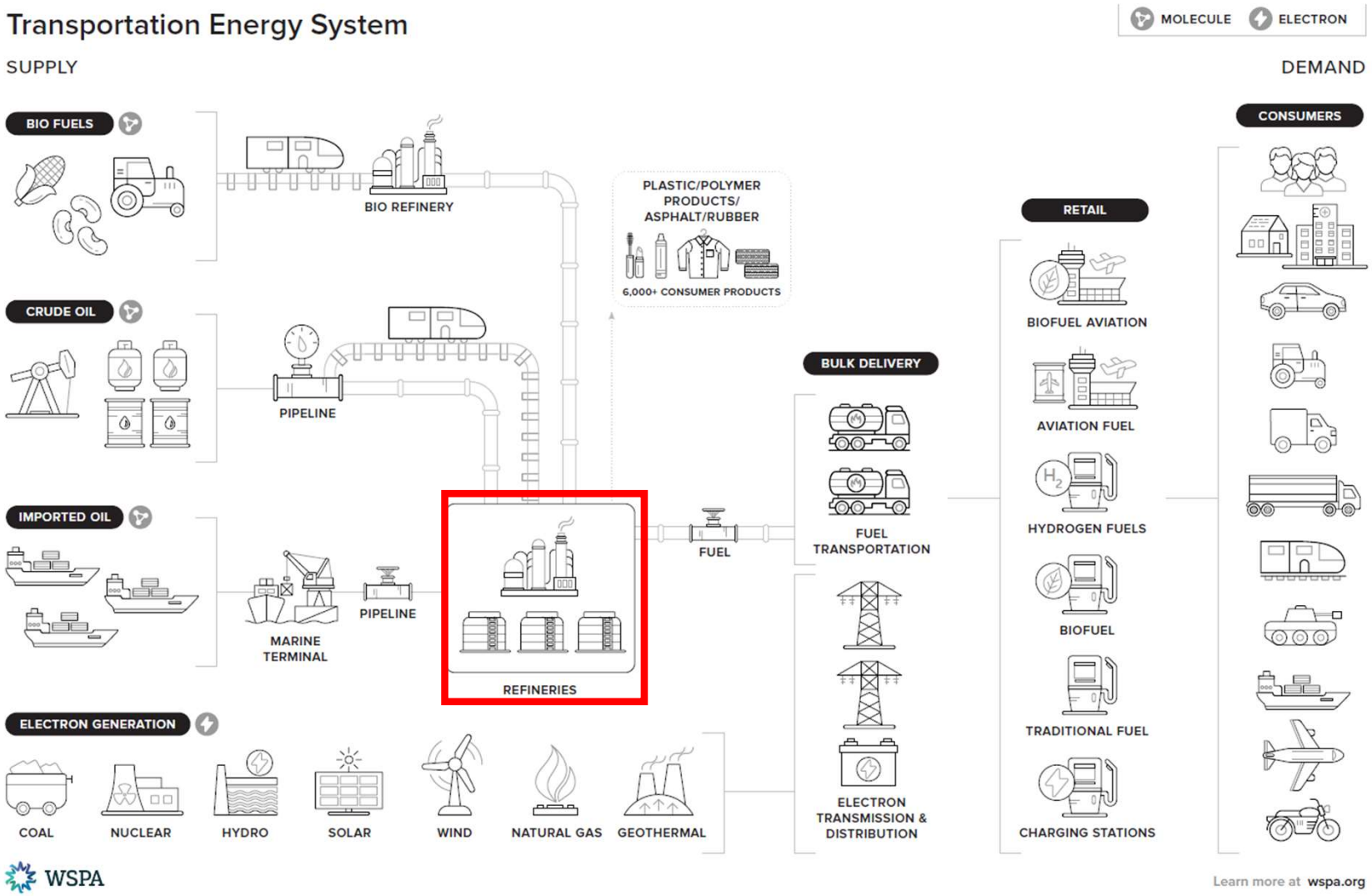
- Largely renewable fuels, like ethanol or biodiesel, or liquid petroleum gases like butane or propane
- Stockton (1) & Colton (2) are main ethanol hubs
- These facilities are unlikely to be an option for any significant quantity of imported gasoline or diesel as renewable fuels continue to be imported

Source: EIA

Potential Product Limits

- As transportation fuel demand in California declines, product pipelines may face the same type of turndown concerns as the crude pipelines. This could lead to difficult business decisions on how to operate pipelines at reduced rates to meet demands of the California consumer.
- Product pipeline exports to AZ and NV may be potentially impacted.
  - From SF Bay – 40 TBD to Reno
  - From LA Basin – 160 TBD to Las Vegas/Phoenix
- Demand decline may lead to increased need of importing or exporting transportation fuel, increasing vessel calls in the north and the south.
- Additional constraints on product pipeline operations or vessel movements may contribute to further price volatility.

TRANSPORTATION ENERGY SYSTEM: REFINING

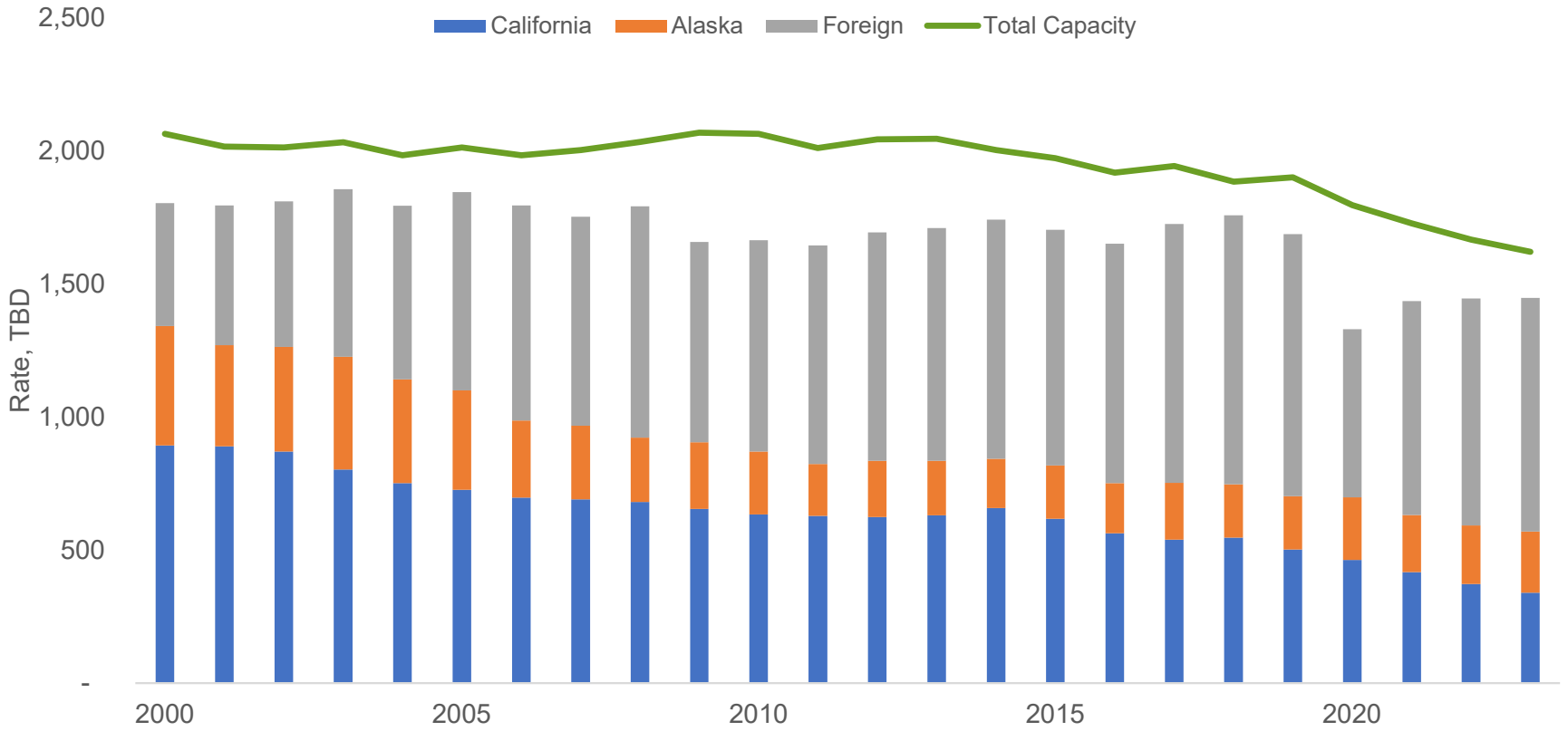


Refining Summary

- As California crude production declines, refineries have become more dependent on marine imports of crude oil to maintain refinery throughput
- Future declines in California crude production coupled with import logistic constraints could limit the ability of refineries to maintain operating rates
- Conversion of crude oil fuels refineries to renewables results in a net loss of total fuels production. These conversions are not a 1:1 change in transportation fuels.
- The amount of each fuel a refiner produces is a function of the installed hardware at a refinery, the crude slate chosen to maximize overall profit, and the operating conditions within the refinery.
- There are a limited number of refineries in California that supply transportation fuels to the state. As demand declines, refiners may face difficult business decisions to export their production, curtail their operations, or shut down.

CALIFORNIA REFINERIES HAVE A HISTORY OF DECLINING CAPACITY AND CRUDE OIL RUNS

- Foreign crude oil imports have grown to meet refinery supply needs as California and Alaska crude production declines
- Overall crude oil runs declined with recent refinery closures or site conversions to renewable fuels



Source: CEC, EIA, TM&C

After the most recent closures there are nine fuels refineries remaining in California

Asphalt vs Fuels Refiners (May 2024)

Area	Asphalt	Fuels
Number of Facilities (#)	4	9
Crude Distillation (TBD)	44	1,664

Regional Distribution of Refiners (May 2024)

Area	LA Basin	Central	SF Bay
Number of Facilities (#)	7	3	3
Crude Distillation (TBD)	1,089	54	564
Fuels Production Capability* (TBD)	845	8	419

* Actual fuels production may exceed fuels production capability due to imports of blend components and finished products

- California has a limited number of refineries supplying transportation fuels to the state.
- As demand declines, refiners may face difficult business decisions, such as exporting production to other markets, curtailing operations, or shutting down facilities (which could be converted to alternative fuels facilities, terminals, or permanently closed).

Source: EIA, TM&C Analysis

CONVERSION TO RENEWABLES CAUSES NET LOSS OF TRANSPORTATION FUEL SUPPLY

Marathon Martinez
- Refinery capacity = 166 TBD crude (2,550 MMGY)
- Renewable diesel capacity = 730 MMGY

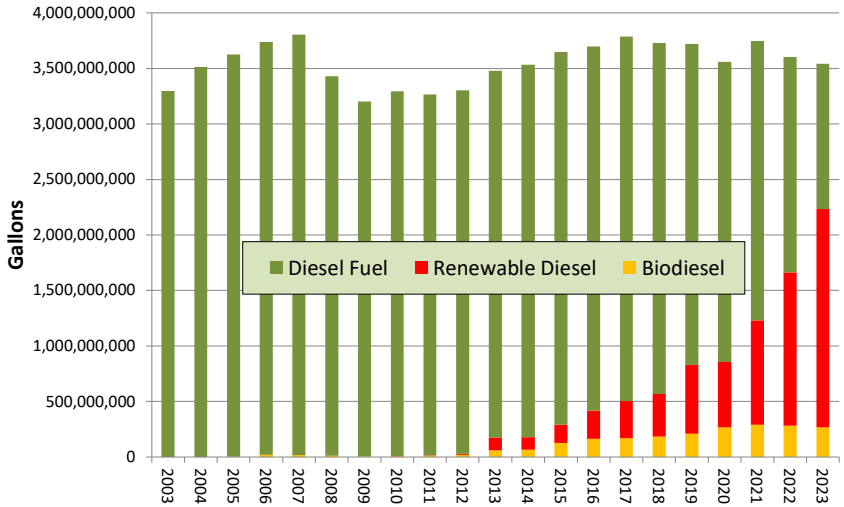
P66 Rodeo
- Refinery capacity = 120 TBD crude (1,840 MMGY)
- Renewable diesel capacity = 800 MMGY

Conversion to renewables results in a net loss of total fuels production – not 1:1 change
- Net increase in diesel production competing for space among other diesel supplies
- Decrease in gasoline production, which cannot be made up by yield shifts in other refineries
- Could require an increase in gasoline and jet imports to satisfy demand

LCFS compliance is displacing fossil ULSD
- ULSD supply is down 103 TBD since 2019 (-54%)
- Pressuring refiners with higher yields of fossil ULSD

	Net Production Change (TBD)	% Change North CA capability
Gasoline	-148	-55%
Jet	-31	-42%
Diesel	27	+25%
Total	**-152**	**-36%**

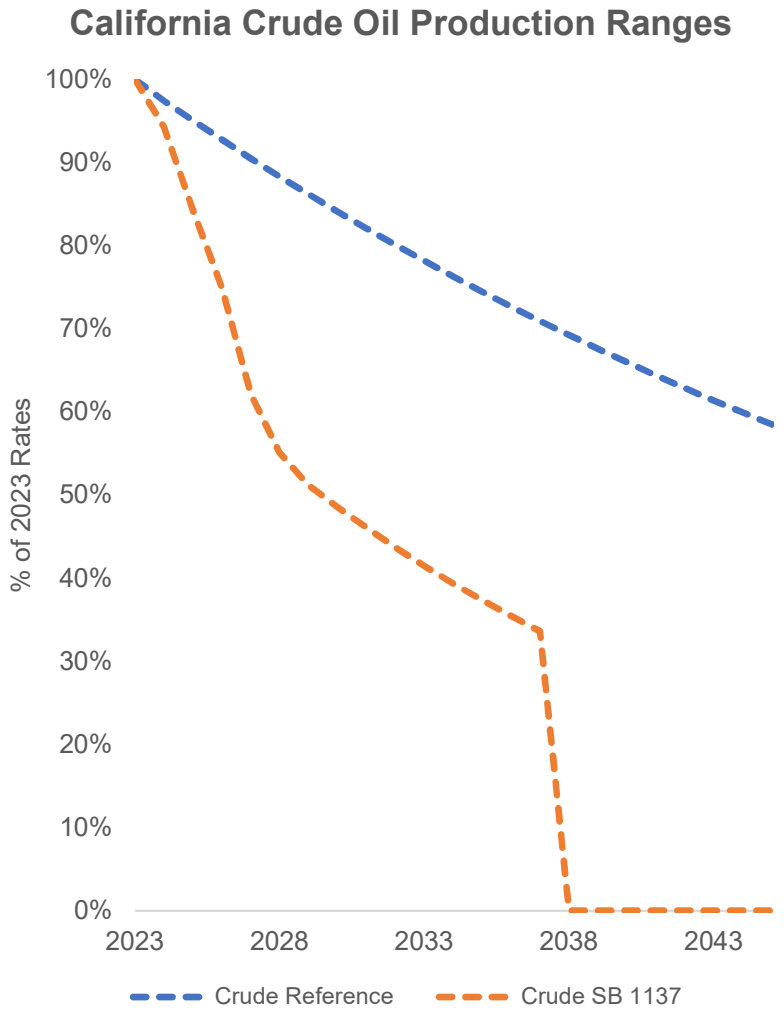
California Diesel, Biodiesel & Renewable Diesel Demand 2003 - 2023



Source: EIA, company websites, CEC, TM&C Analysis

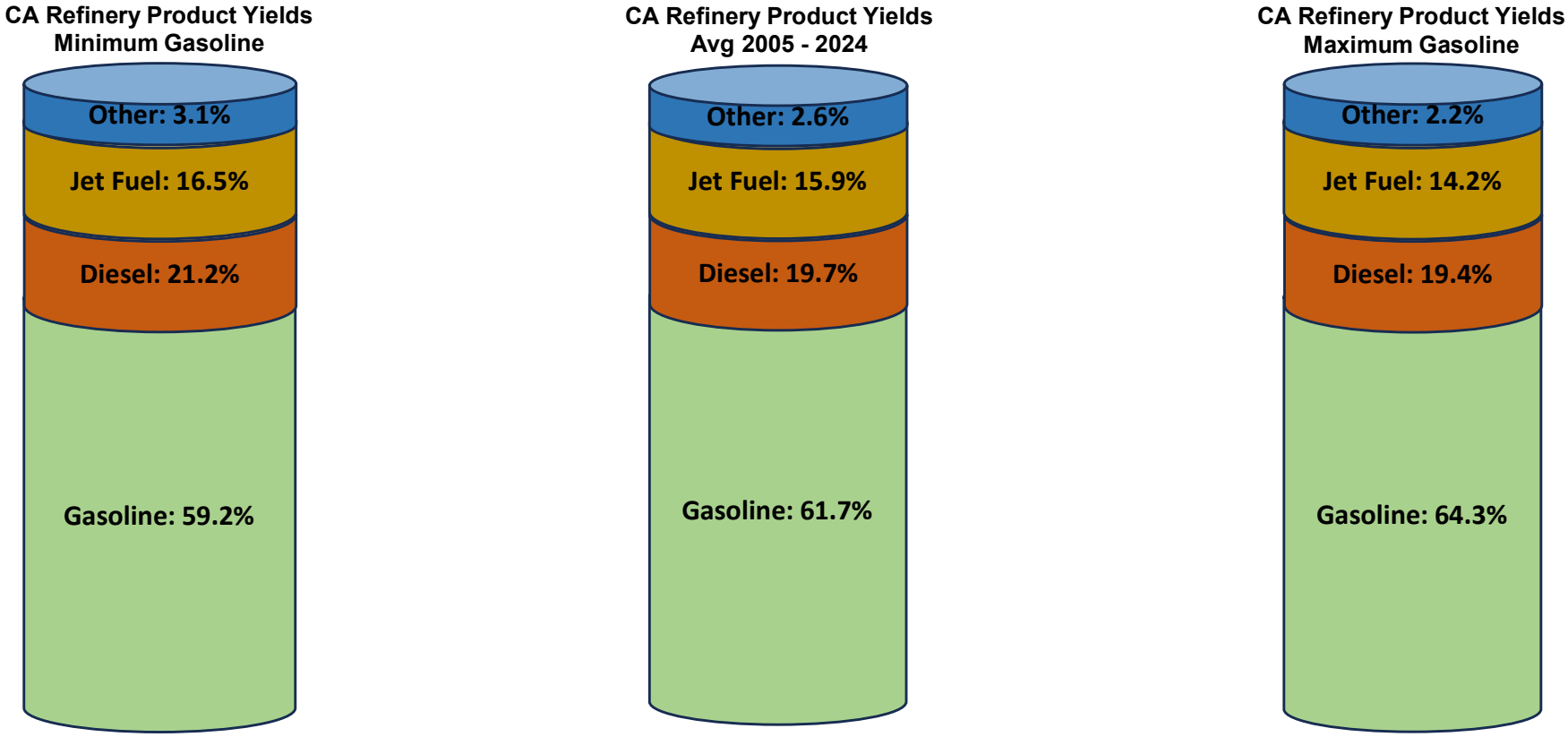
REFINERS ARE BEING FORCED TO ADAPT TO DECLINING CRUDE OIL AVAILABILITY

- Range of decline rates of California crude oil production is highly uncertain and varies across basins.
- The pace of approving permits and regulations, such as SB 1137, can also have material impacts on the production profile of California crude oil basins.
- Regulations, such as “At-Berth”, could impact the ability to import crude oil.
- California policies could impact not only where and how refineries source crude oil, but also the overall operating rate of a refinery.



Source: TM&C Analysis, CalGEM

THE CALIFORNIA REFINING SYSTEM CAN ONLY FLEX ITS GASOLINE YIELD 5%

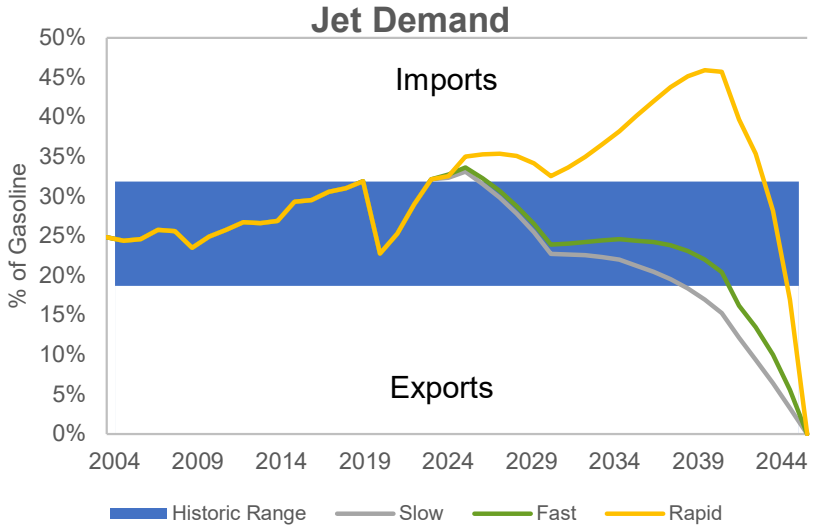


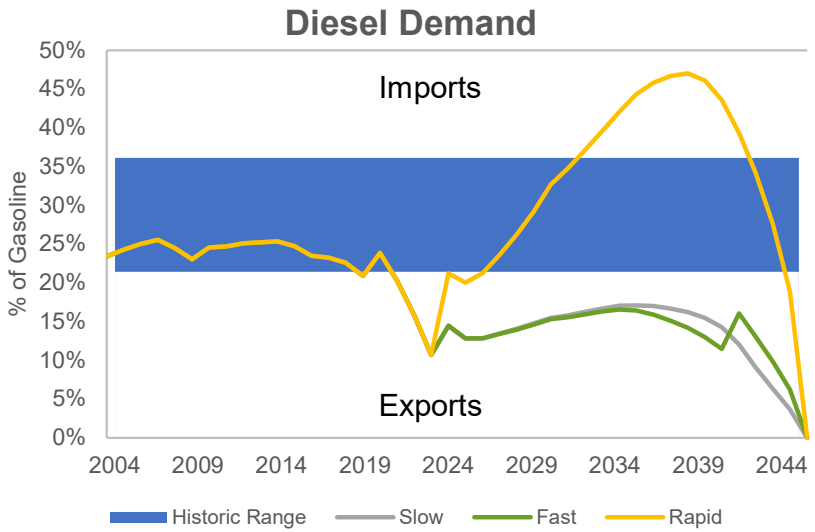
- Recent data shows refiners trying to minimize diesel in favor of jet (jet has increased from 12% in 2020 to 20% in 2024)
- Additional significant increase in jet yield eventually would require a major shift in the crude oils processed and probably capital projects

Source: CEC Weekly Production, CEC, TM&C Analysis

A CHANGE IN DEMAND FOR ONE PRODUCT HAS MULTI-PRODUCT IMPLICATIONS FOR A REFINER

- The amount of each product each refinery can make is a function of the installed hardware and the crude slate chosen to maximize overall profit within the constraints of the facility.
- As demand for jet or petroleum diesel shifts (relative to gasoline) – there is a limited ability to shift refining operations to produce more or less of a particular fuel.
- The petroleum diesel chart on the right shows some refineries are struggling to balance through yield adjustments. However, because the refinery does not know what the future holds (e.g., yellow vs. green lines), it is difficult to plan, permit, invest, and build necessary changes in the configuration.
- A refiner could have to export or import products to maintain balances while meeting demands.
- Uncertainty in future demand shifts limit the ability to make investment decisions, such as committing capital for the installation of new hardware to adapt to *potential* changes in product mix.



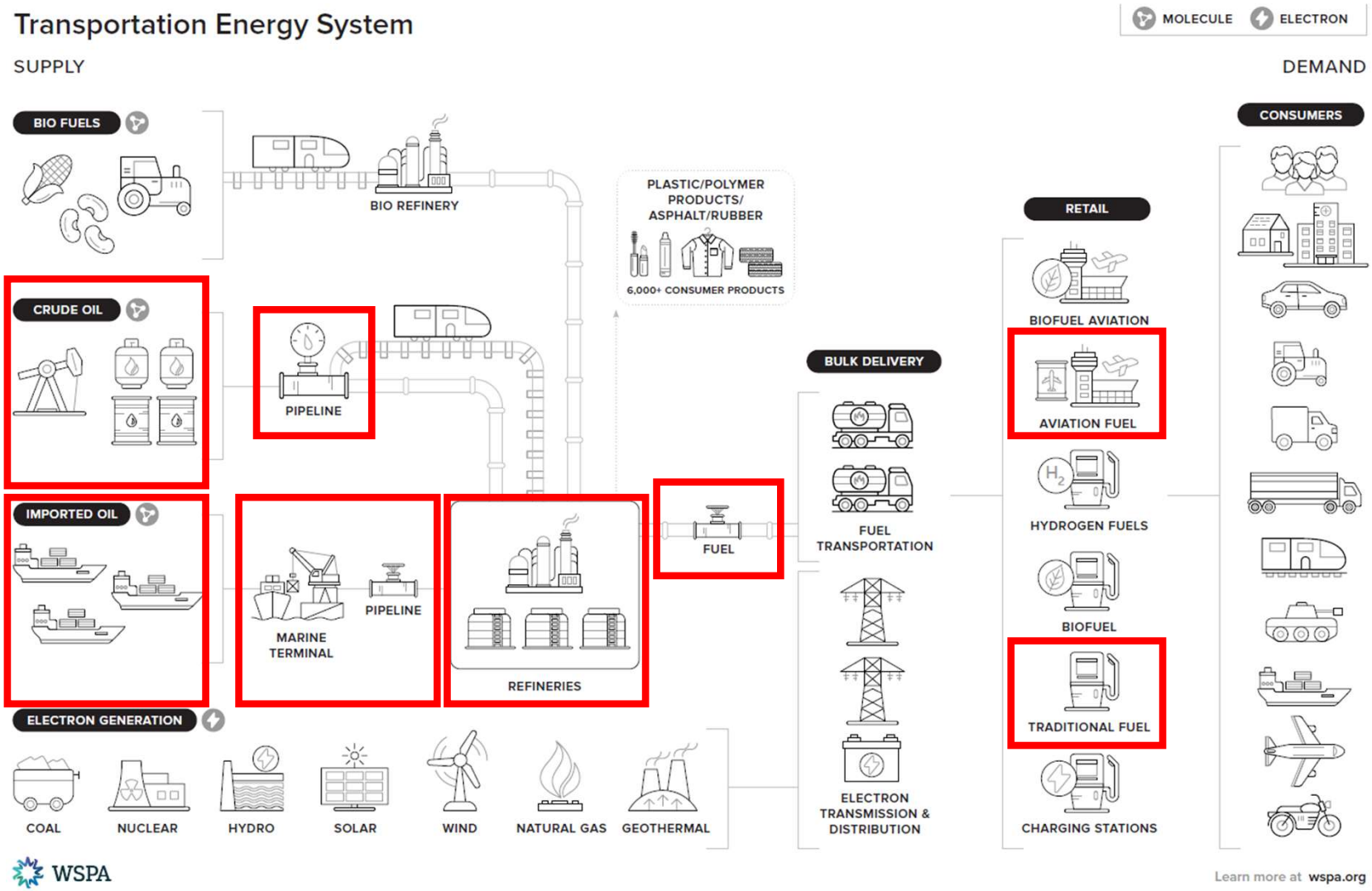


Source: CEC Weekly Production, CEC, CARB, TM&C Analysis

POTENTIAL LOGISTICS IMPACTS OF REFINERY SHUTDOWNS

- Terminal Conversion
  - Logistics still available to industry
  - Site owners would be able to defer site decommissioning and remediation costs as site would still be operating (as a terminal)
- Renewable Fuels Plant (Bio-Refinery) Conversion
  - Logistics fully (or partially) repurposed for renewable operations
    - Renewable plant logistics generally not available to fossil industry as they are used for renewable feedstock imports and product exports
    - Importing of renewable feedstock
  - Potential exporting of products after meeting California demand
  - Limited opportunities for additional sites to convert to renewable fuels production as market nears saturation
    - RD currently is 60% of California diesel supply
    - TM&C market outlook expects RD saturation could be as early as 2026
    - Newer markets in Oregon, Washington and Canada, but may favor locations closer due to logistical constraints
- Complete Site Shutdown
  - Logistics not available to industry
  - Site owners would incur costs associated with site decommissioning and remediation

SCENARIOS


Transportation Energy System
MOLECULE
ELECTRON
SUPPLY
DEMAND
BIO FUELS
BIO REFINERY
PLASTIC/POLYMER PRODUCTS/ ASPHALT/RUBBER
6,000+ CONSUMER PRODUCTS
CRUDE OIL
PIPELINE
IMPORTED OIL
MARINE TERMINAL
PIPELINE
REFINERIES
FUEL
BULK DELIVERY
FUEL TRANSPORTATION
ELECTRON TRANSMISSION & DISTRIBUTION
RETAIL
BIOFUEL AVIATION
AVIATION FUEL
HYDROGEN FUELS
BIOFUEL
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SCENARIO SUMMARY

- The California refining industry faces numerous constraints that could impact their future ability to continue operations and supply transportation fuels to the state
- Major potential physical constraints include minimum refinery utilization, both crude and product pipeline throughputs minimums, crude oil marine imports, product marine exports, upstream crude oil production declines and permitting restrictions
- The industry also faces declining transportation product demand within California, with limited ability to alter operations to significantly shift their product yields
- Economic factors including profitability, capital requirements, and global competition in markets where they potentially would need to increase exports of products could impact whether a specific crude oil production well, refinery, or pipeline continues operations
- TM&C evaluated scenarios primarily focused on the impact of physical constraints (utilizations, marine limits, pipeline limits) faced by the industry under various crude oil supply and product demand cases.
- Refineries in these scenarios close for technical or operational reasons. However, they could close sooner for other reasons, e.g., inability to obtain required permits, structurally negative margins, not competitive in their corporate portfolio.
- Across all scenarios, on average, about half of California's fuels refineries close by 2045. In the most disruptive scenario, only one fuels refinery remains by 2040. Even in the least disruptive scenario refineries could close.

Overview of Potential Constraints

- Physical Utilization Minimum (65%)
  - Difficult to continually run crude units below 65% utilization
  - More exact constraints would require confidential business information from each site
- Economic Utilization Minimum (80%)
  - Estimate of crude unit utilization below which a refinery may financially struggle due to very high unit fixed costs
  - Overall corporate financial health determines how long a specific refinery could operate with negative financials
- Bay Area has a product pipeline to Nevada, while LA Basin has product pipelines supplying Arizona and Nevada
  - 40 TBD limit from Bay Area to NV
  - 160 TBD limit from LA Basin to AZ + NV
- Marine crude oil import limit of 1,200 TBD for entire state, but decreased slightly to 1,150 TBD due to Marathon Martinez and P66 Rodeo conversions to renewable fuels production
- Marine product loading limit of 670 TBD for entire state
- Key marine logistics assumptions
  - Marine import capacity dedicated to a refinery shuts with refinery closure
  - Marine import capacity separate from refinery still available to the industry as refineries close
  - Potential for limit to decline in future due to regulatory / permitting change
- Black swan events (e.g., COVID) do not demonstrate sustainable (physically / economically) operating potential

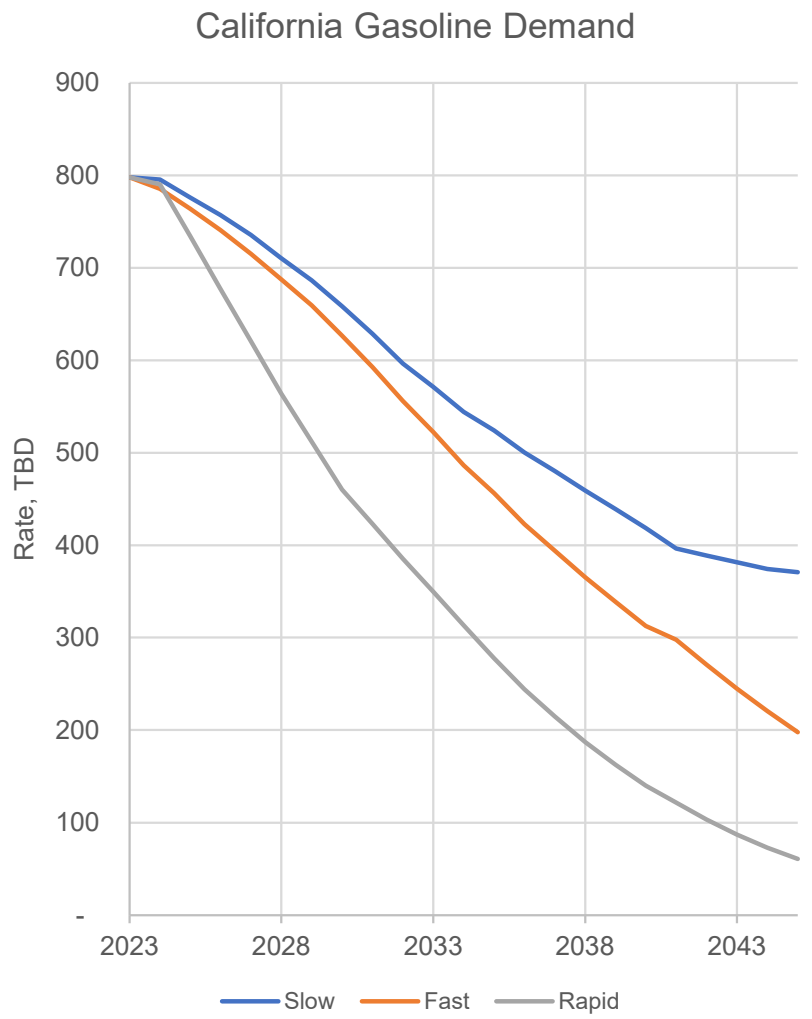
PLAUSIBLE SCENARIOS

We crafted these scenarios to understand how plausible constraints could expose potential dislocations in the entire system. These are not a forecast of decision-making at individual assets (e.g., wellheads, pipelines, berths, refineries). Decisions made by asset owners at specific sites could involve several factors that could vary on a case-by-case basis.

Reference	Scenario Name	Description / Constraints	Potential Impacts
A	Open Constraints	• No discontinuities	• System remains operable with no limits or disruptions
B	Refinery runs to satisfy CA gasoline demand	• Refinery turndown limit • No pipeline gasoline to AZ/NV, fill pipeline with diesel/jet	• Only satisfy local (CA) demand for gasoline, can import CARB components if necessary • Renewable diesel for local demand • Export petroleum diesel • Reach refinery turndown limits sooner, causing some refiners to shut down more quickly
C	Marine constraints	• Crude inbound limit (1,150 TBD) • Product (inbound/outbound) limit (VOC emissions) • Physical Utilization Min (65%)	• Crude marine limit prevents marine volume from full replacement of declining California production • Product outbound limit as declining CA transportation fuel demand forces growing product exports; impacting refinery crude runs • Reaching physical refinery turndown limits results in refinery closures to maintain minimum throughput at remaining refineries.
D	Turn-arounds become Refinery closures	• Decision to close rather than spend capital when a refinery reaches a major turn-around	• System becomes more reliant on product imports
E	Marine constraints with Economic Utilization	• Similar to Marine Constraint Scenario but with more restrictive utilization constraint (80%)	• Economic Utilization constraint results in two additional potential refinery closures under all gasoline demand scenarios
F	Crude production	• Different CA crude production profiles, with marine constraints • Slow CA gasoline demand profile	• As CA production more rapidly decreases in different scenarios, crude marine limit could have a greater impact on operations than in the Marine constraints case
G	Fully Enforced “At-Berth” Emissions Limits	• Limit to 20 vessel/berth (effective Crude import limit 700 TBD) • Physical Utilization Min (65%) • SB1137 Crude production profile • Slow/Rapid product demand profiles	• Rapid initial closure of refineries due to crude production declines and “At-Berth” emissions limit • Increased marine product imports due to refinery closures • Marine product constraint, even if filling AZ/NV pipelines is not limiting

CARB Gasoline Demand Cases

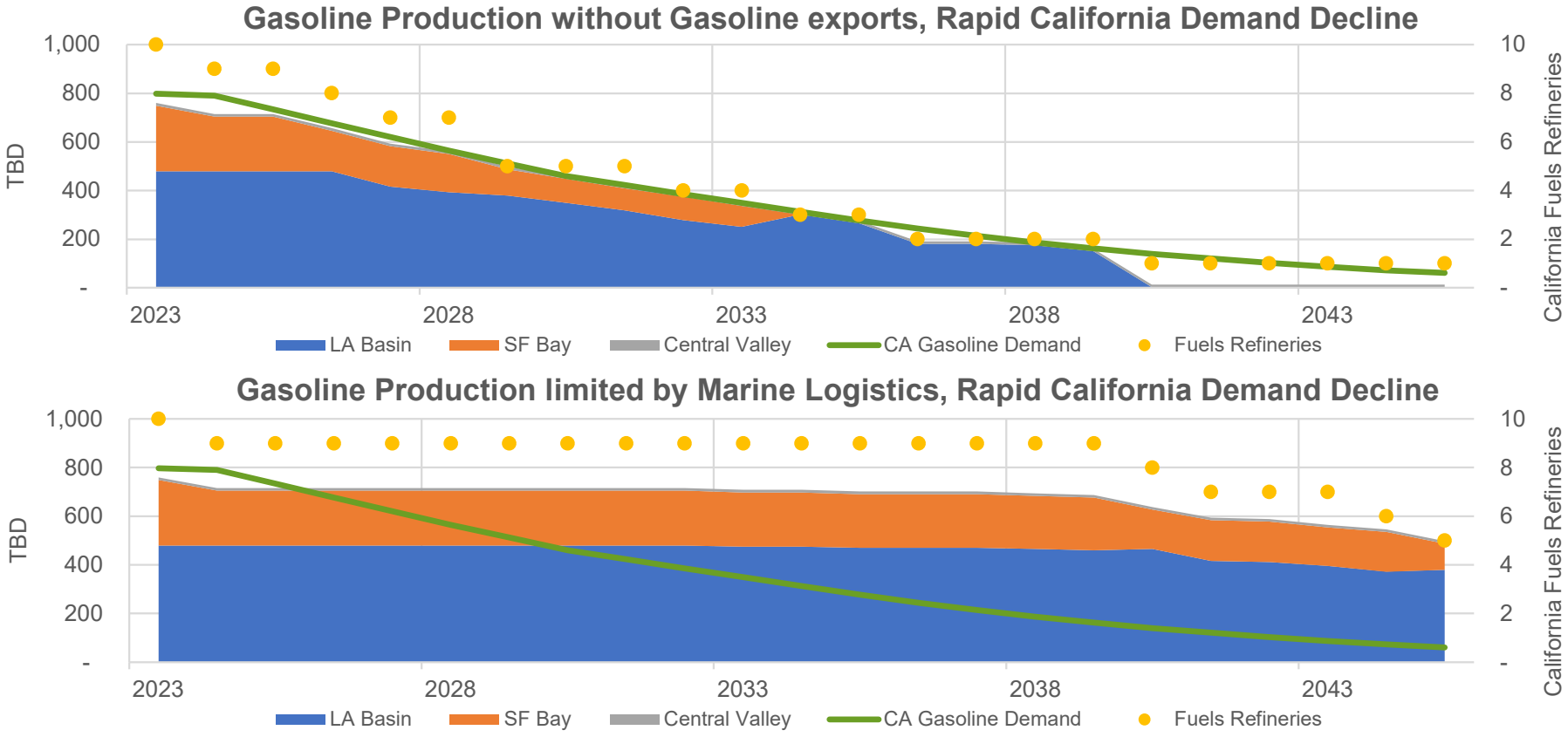
- Studied three CARB gasoline cases from CEC Transportation Fuels Assessment – Slow, Fast, Rapid decline in demand.
- Imposed same three demand curves in each scenario.



Source: CEC Transportation Fuels Assessment, TM&C Modeling

California Gasoline Production Under Different Constraint Scenarios

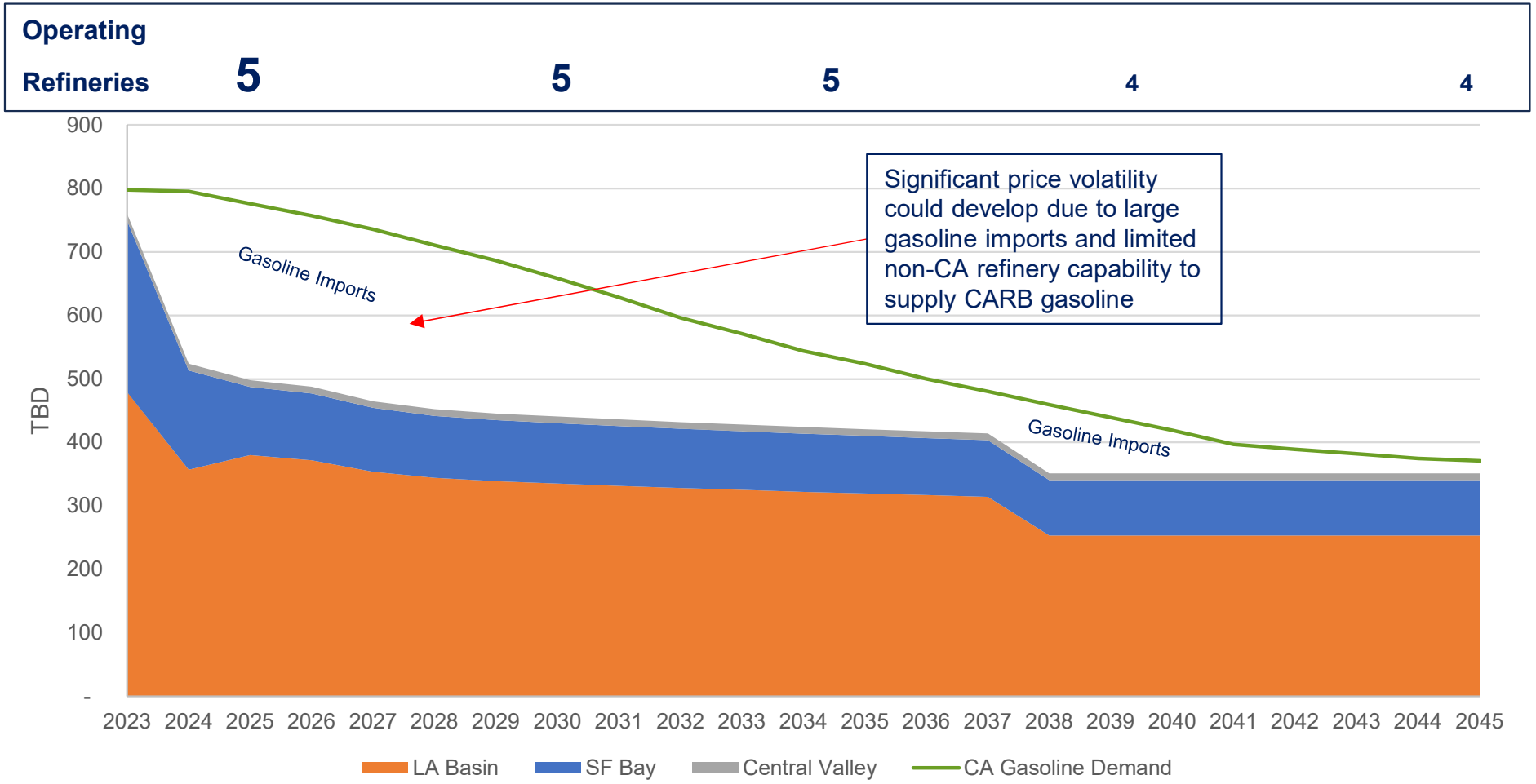
- Limiting exports of gasoline may cause rapid shutdown of refineries as excess production has no disposition, requiring imports to balance demand.
- Potential for price volatility due to transitioning between imports and exports, can impact business decisions.
- Exports must compete in global market; imports must meet strict California product specifications.



Source: TM&C Modeling

Risk of significant immediate refinery shutdowns if refiners face CARB "at-berth" crude restrictions

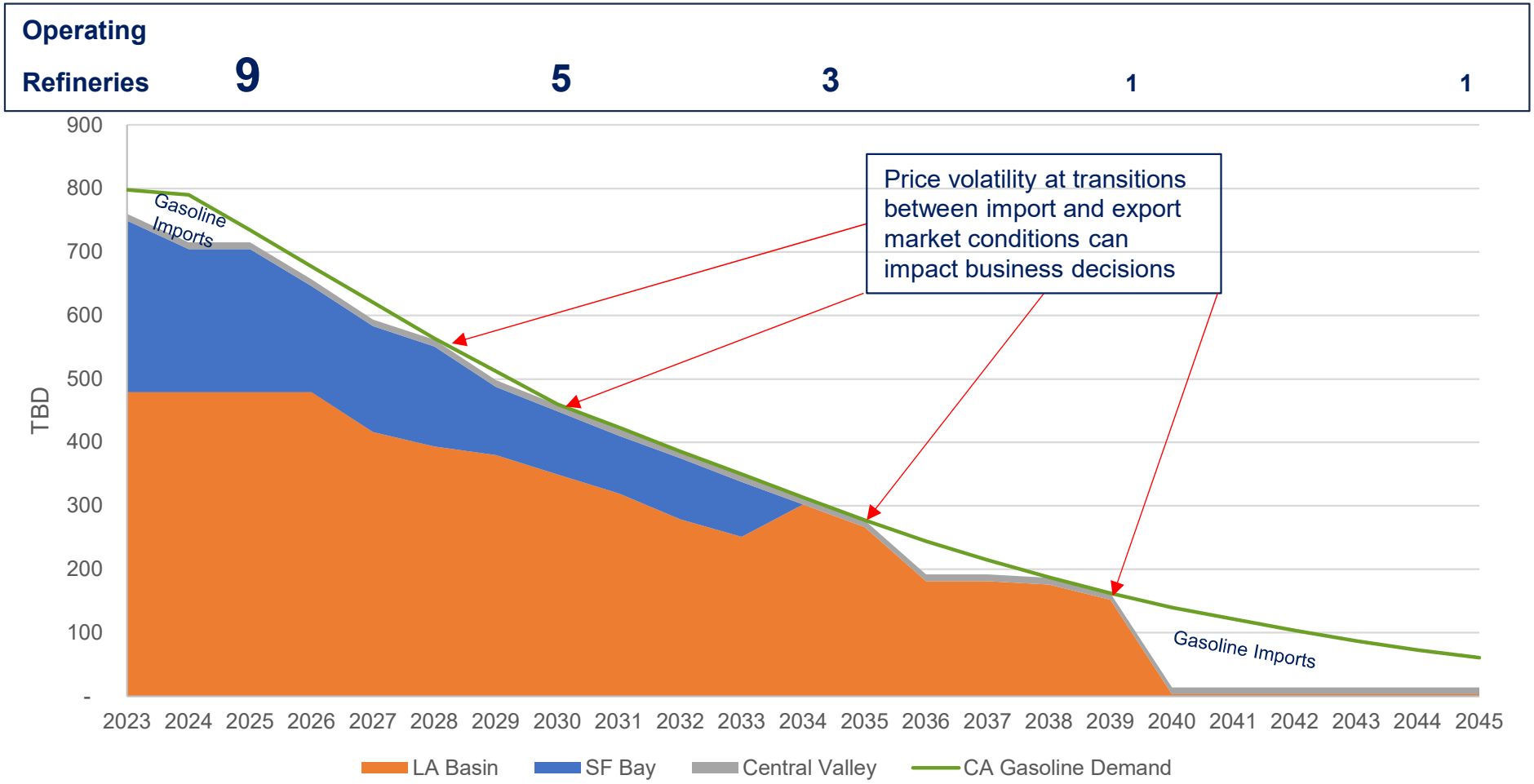
- CEC "Slow" fuels demand case
- CARB "At-Berth" limiting crude imports
- California crude oil production at SB1137 case
- Refinery utilization falls to 65% before shut-down



Source: TM&C analysis

If California refineries could not export products, the risk of refinery shutdowns could accelerate

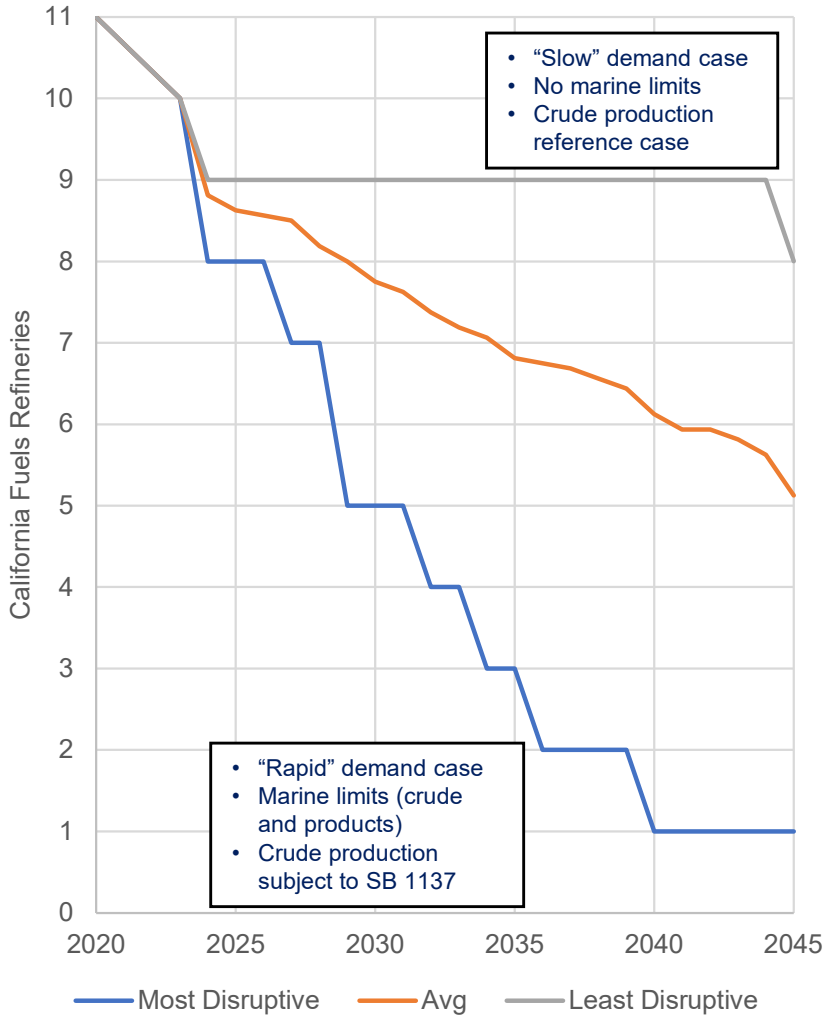
- CEC "Rapid" fuels demand case
- Limited non-CARB product exports (e.g., CARB "At-Berth")
- California crude oil production at reference case
- Refinery utilization falls to 65% before shut-down



Source: TM&C analysis

REFINERY CLOSURE RISK IS HIGHLY DEPENDENT ON SCENARIOS

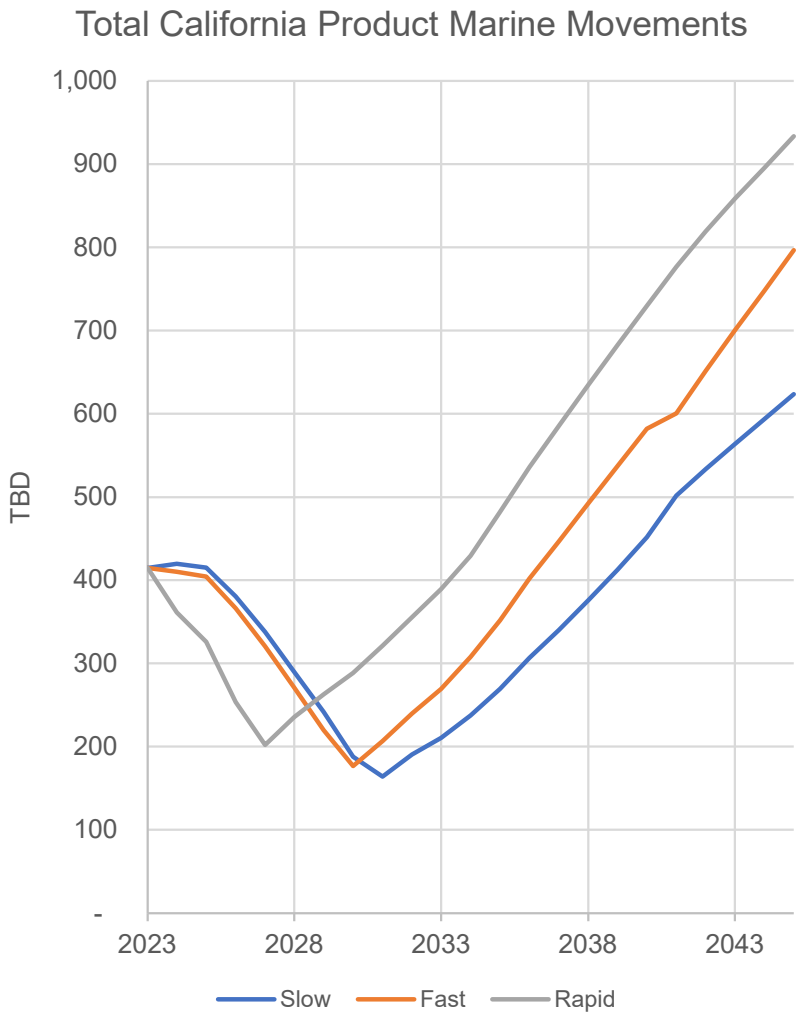
- TM&C evaluated potential refinery closures across 16 scenarios covering combinations of:
  - Transportation fuel demand cases
  - Crude oil production profiles
  - Logistics constraints
  - Refining operating environments
- Across all scenarios, on average, about half of California's fuels refineries could close by 2045
- In the most disruptive scenario, only one fuels refinery remains by 2040
- Even in least disruptive scenario refineries could close
  - Major shifts in business (increases in exports) and operations required
  - Assumes no new limitations to importing crude and exporting products
  - Requires exports to be globally competitive
- If onshore power is unavailable or on-ship capture is infeasible, full enforcement of "At-Berth" restrictions could close 3-4 refineries almost immediately
- Refineries may close faster than demand declines, which could put pressure on marine logistics and vessel traffic limits



Source: TM&C Analysis
Note: Refinery utilization falls to 65% before shut-down

A. Open Constraints

- Current system remains operating in nearly identical state as today (P66 Rodeo refinery fully converted to renewable diesel in 2024)
- Declining California crude oil production requires increase in import crude volumes to maintain refinery throughput
- Declining California transportation fuel demand requires increase in product export volumes to maintain refinery throughput
- No constraints on marine movements (crude or product) imposed
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand



Source: TM&C Modeling

A. Open Constraints

- Current system remains operating in nearly identical state as today (P66 Rodeo refinery fully converted to renewable diesel in 2024)
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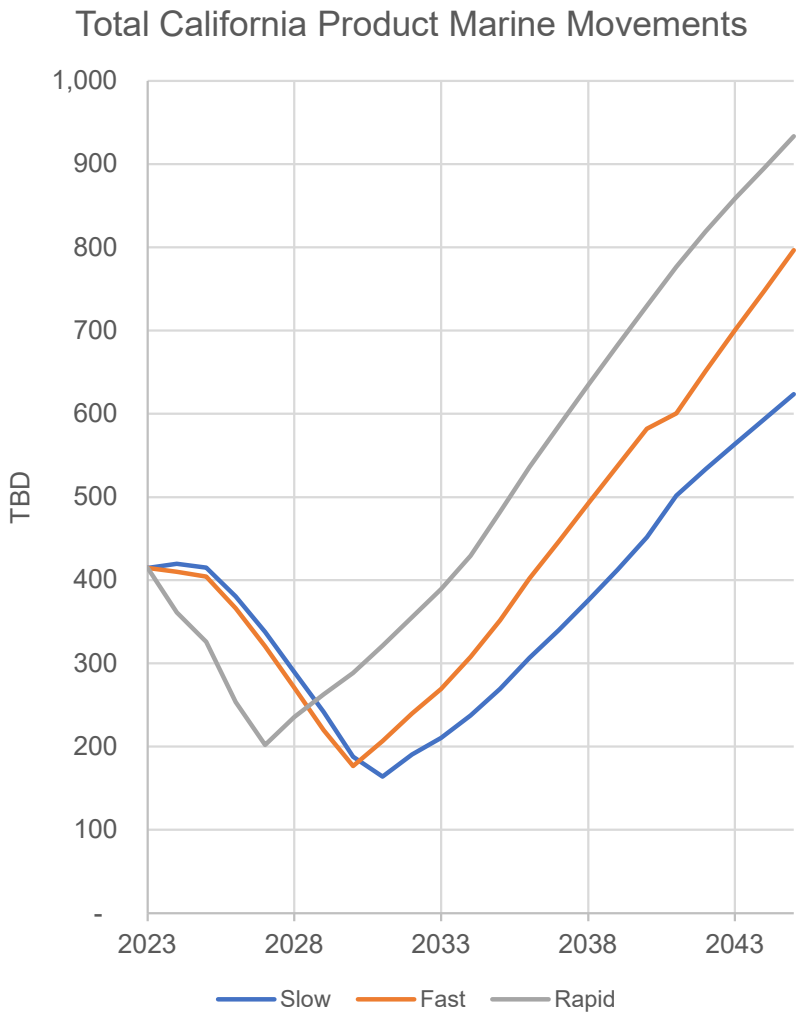


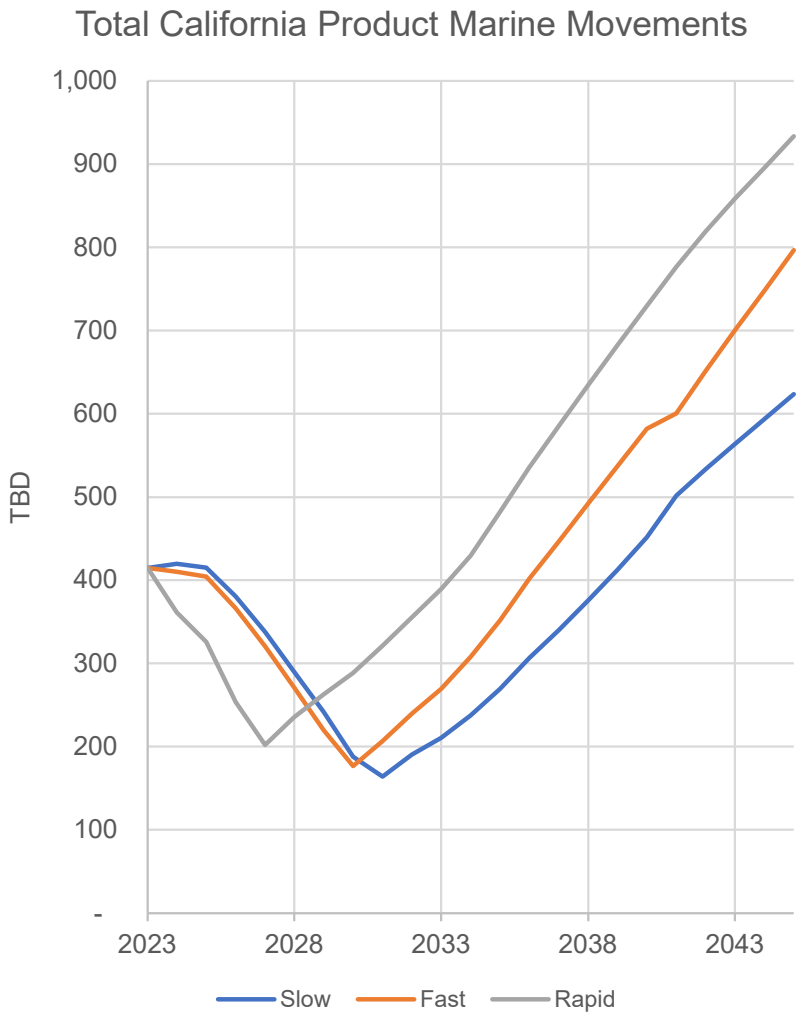
Source: TM&C Modeling

A. Open Constraints (cont.)

- Current system remains operating in nearly identical state as today (P66 Rodeo refinery fully converted to renewable diesel in 2024)
- Shows impact of declining California crude production and necessary increase in import crude volumes to maintain refinery throughput
- Shows impact of declining California transportation fuel demand, and necessary increase in product export volumes to maintain refinery throughput
- No constraints on marine movements (crude or product) imposed
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand

A. Open Constraints Results (cont.)

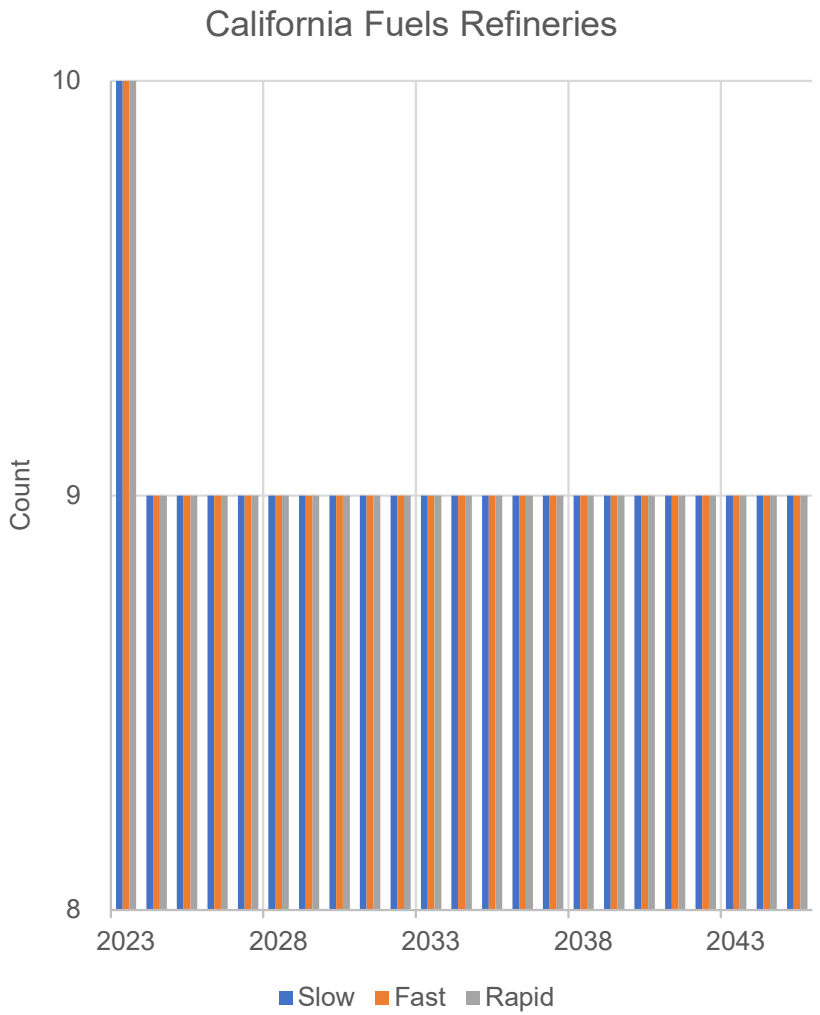
- Total product marine movements (gasoline, jet, diesel).
- Changes due to changes in California CARB gasoline demand curves (Slow, Fast, Rapid).
- No constraints imposed on total product marine movements.
- Switch from importing gasoline and jet in early years to eventual exporting both products
- Total product marine movements would continue to grow due to decline in California demand for transportation products.



Source: TM&C Modeling

A. Open Constraints Results (cont.)

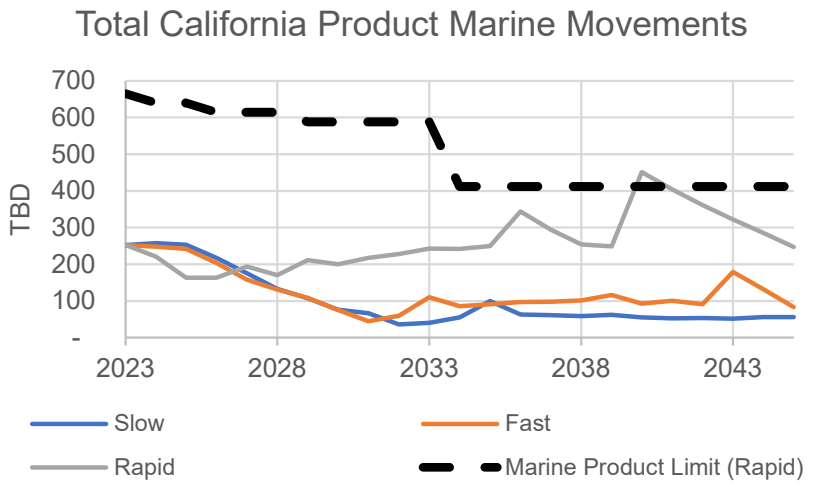
- Total number of fuels refineries remains unchanged since there are no constraints on system, particularly exporting of product.
- P66 Rodeo refinery converted to renewable fuels production in 2024.
- Number of fuels refineries the same regardless of California CARB demand forecast (Slow, Fast, Rapid) because the system is unconstrained.

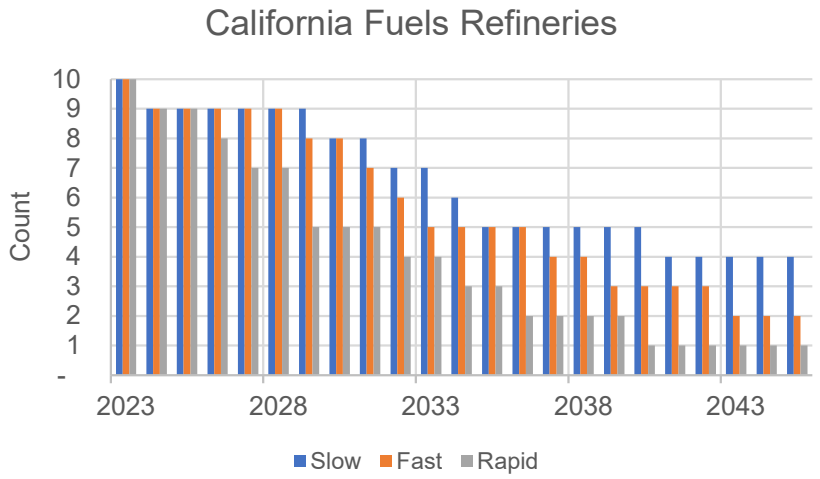


Source: TM&C Modeling

B. Satisfy California Gasoline Demand only

- Imposing CEC product demand curves on system, while not allowing export of gasoline (pipeline or marine)
- Under more aggressive declining California product demand curves, significant refinery closures are needed to maintain minimum refinery utilization
- Crude imports decline rapidly due to refinery closures
- Refinery closures under more restrictive demand scenarios can require significant jet and diesel exports
- Potential for infeasibility in Rapid scenario due to hitting marine product export limit





Source: TM&C Modeling

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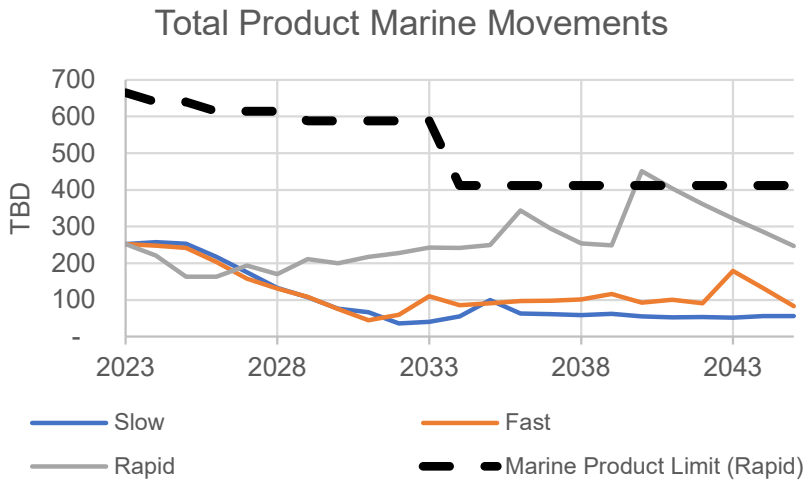
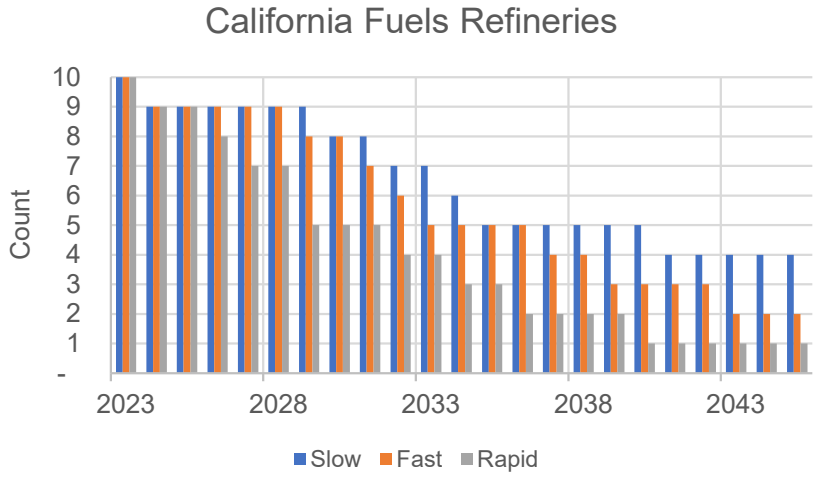
- Crude imports decline rapidly due to refinery closures
- Refinery closures under more restrictive demand scenarios can require significant Jet and Diesel exports
- Slight potential for infeasibility in Rapid scenario due to hitting marine product limit





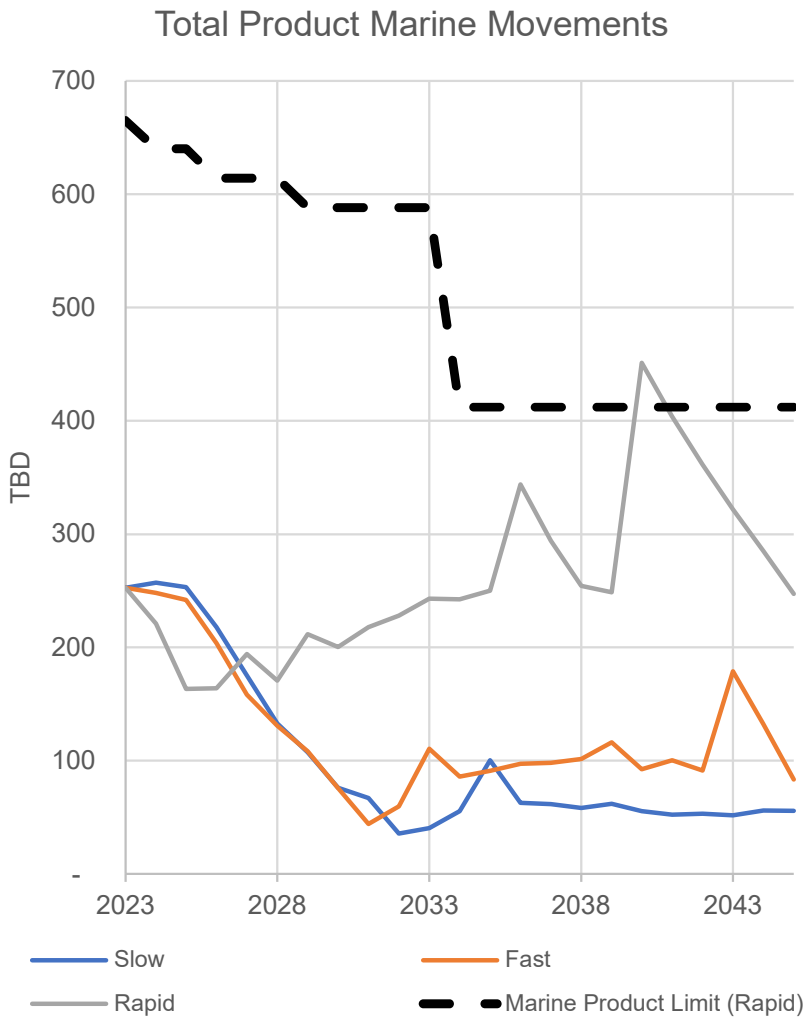
Source: TM&C Modeling

B. Satisfy California Gasoline Demand only

- Imposing CEC product demand curves on system, while not allowing export of gasoline (pipeline or marine)
- Imports of gasoline allowed to meet California demand only
- No pipeline exports of gasoline to AZ / NV allowed
- Allow import / export of diesel and jet fuel as necessary
- Represents bookend case of California system under most stress
- Under more aggressive California product demand curves, refinery closures are significant to maintain minimum refinery utilization

B. Satisfy California Gasoline Demand Only(cont.)

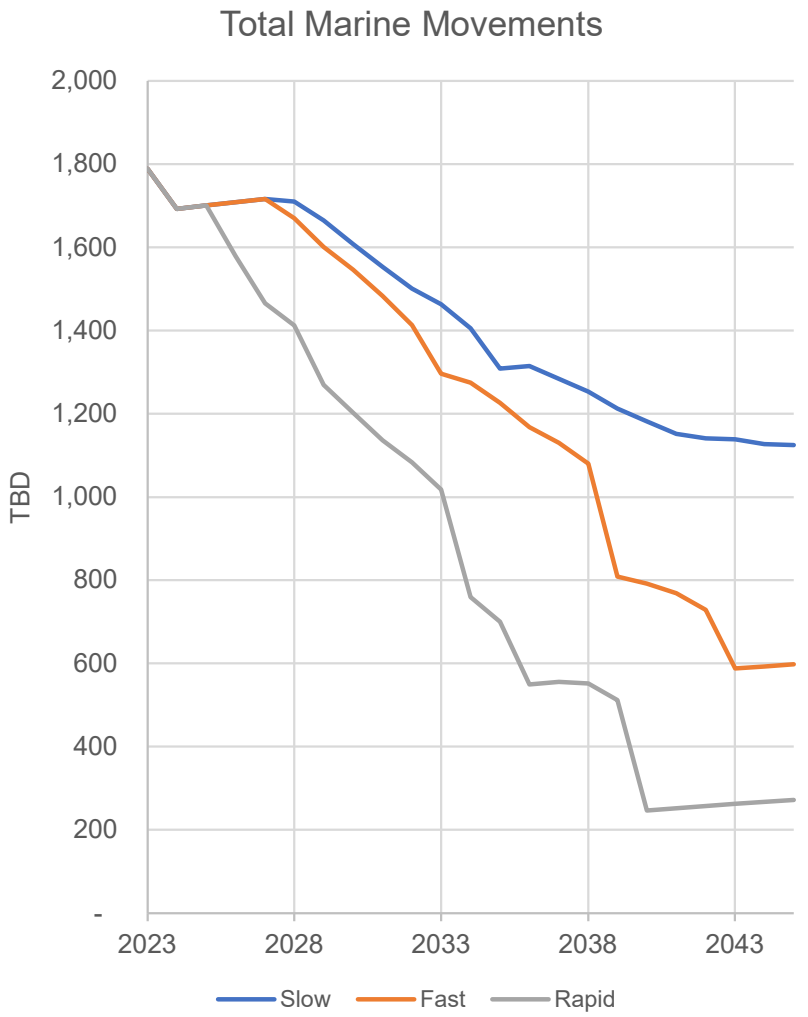
- Total product marine movements (gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- Under Slow scenario, jet goes from import to export, while diesel remains steady export.
- Under Fast scenario, jet goes from import to steady export, while diesel exports steadily decline and become imports due to refinery closures.
- Under Rapid scenario, refinery closures cause diesel to go from export to large import.
- Slight potential for infeasibility in Rapid scenario due to hitting marine product movements limits



Source: TM&C Modeling

B. Satisfy California Gasoline Demand Only(cont.)

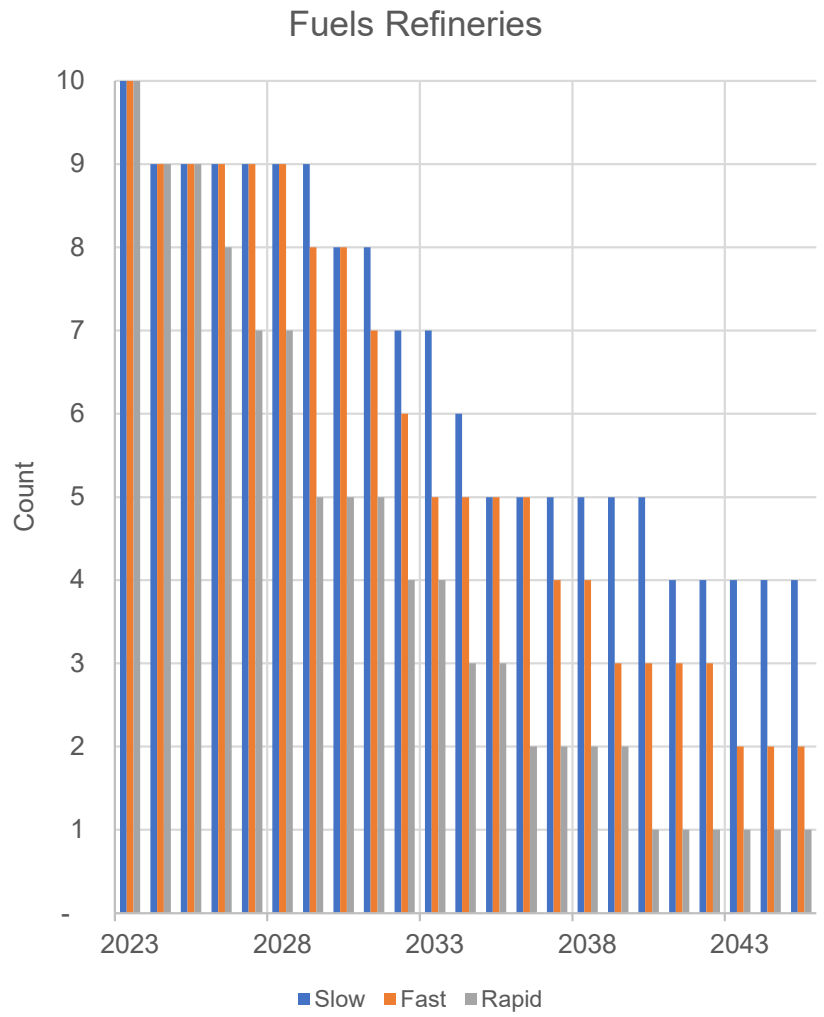
- Total marine movements (crude, gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- Crude imports constrained in Slow scenario, while crude imports rapidly decline due to refinery closures in Fast and Rapid scenarios.



Source: TM&C Modeling

B. Satisfy California Gasoline Demand Only (cont.)

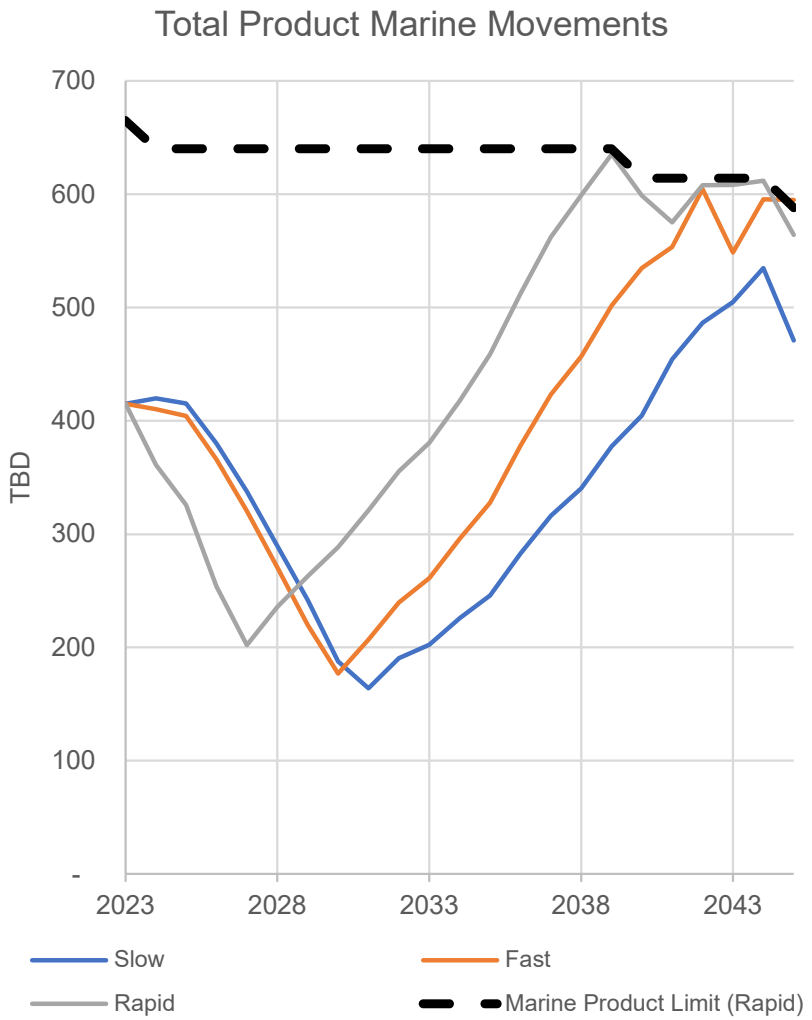
- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- Slow scenario sees refinery closures begin in 2030.
- Fast scenario sees one large fuels refinery operating by 2045, and one structurally advantaged small fuels refinery.
- Rapid scenario sees one fuels refinery operating by 2045.



Source: TM&C Modeling

C. Crude and Product Marine Limited

- Imposing crude marine import limits and product marine movement limits on system, in additional to the minimum refinery utilization limits.
- Marine Logistics
  - Marine import capacity dedicated to a refinery shuts with refinery closure
  - Marine import capacity separate from refinery still available to the industry as refineries close
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand
- Enough room in system, via California product demand and AZ/NV pipeline to keep system running through 2040 in all California gasoline demand scenarios, but one refinery closure could be required in 2045 under the Rapid demand decline scenario
- Under all scenarios, jet goes from import to export, while diesel remains steady export
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios but remains an import in the Slow scenario
- Crude oil imports constrained in all scenarios, except in later years for the Fast and Rapid scenarios where the product marine export limit dominates.



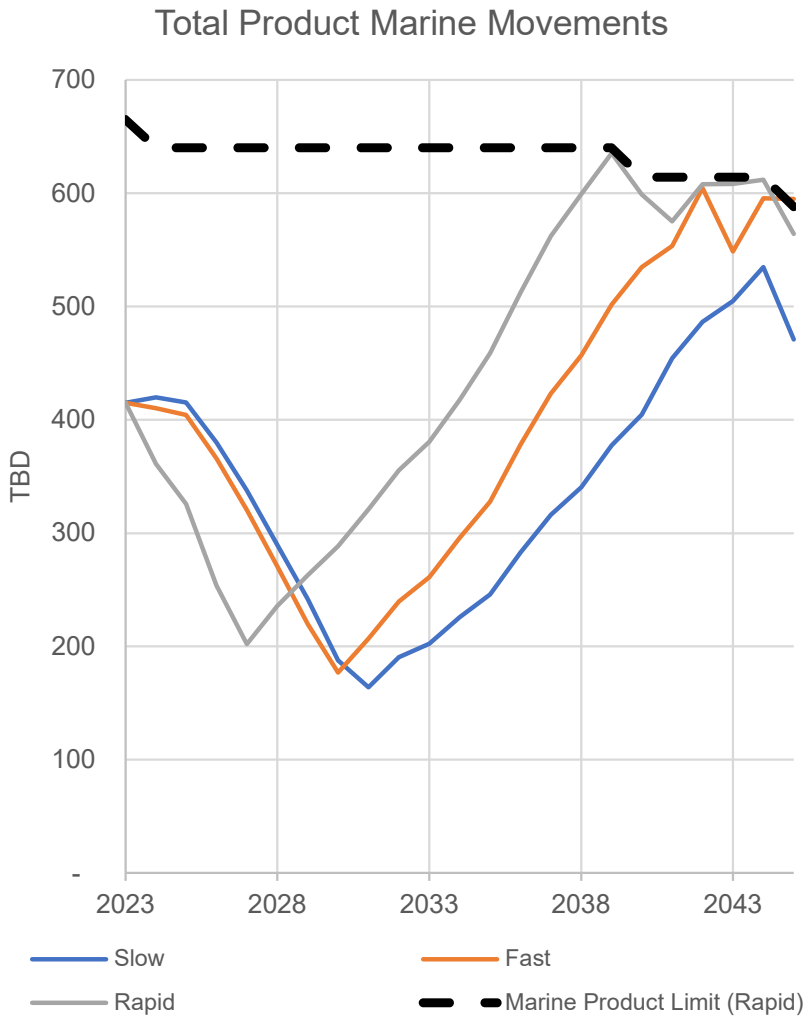
Source: TM&C Modeling

C. Crude and Product Marine Limited (cont.)

- Imposing crude marine import limit (1,150 TBD) and product marine movement limit (670 TBD) on system, in additional to the normal minimum refinery utilization limit
- Marine Logistics
  - Marine import capacity dedicated to a refinery shuts with refinery closure
  - Marine import capacity separate from refinery still available to the industry as refineries close
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand
- Enough room in system, via California product demand and AZ/NV pipeline to keep system running through 2040 in all California gasoline demand scenarios, but one refinery closure could be required in 2045 under the Rapid demand decline scenario

C. Marine Limited (cont.)

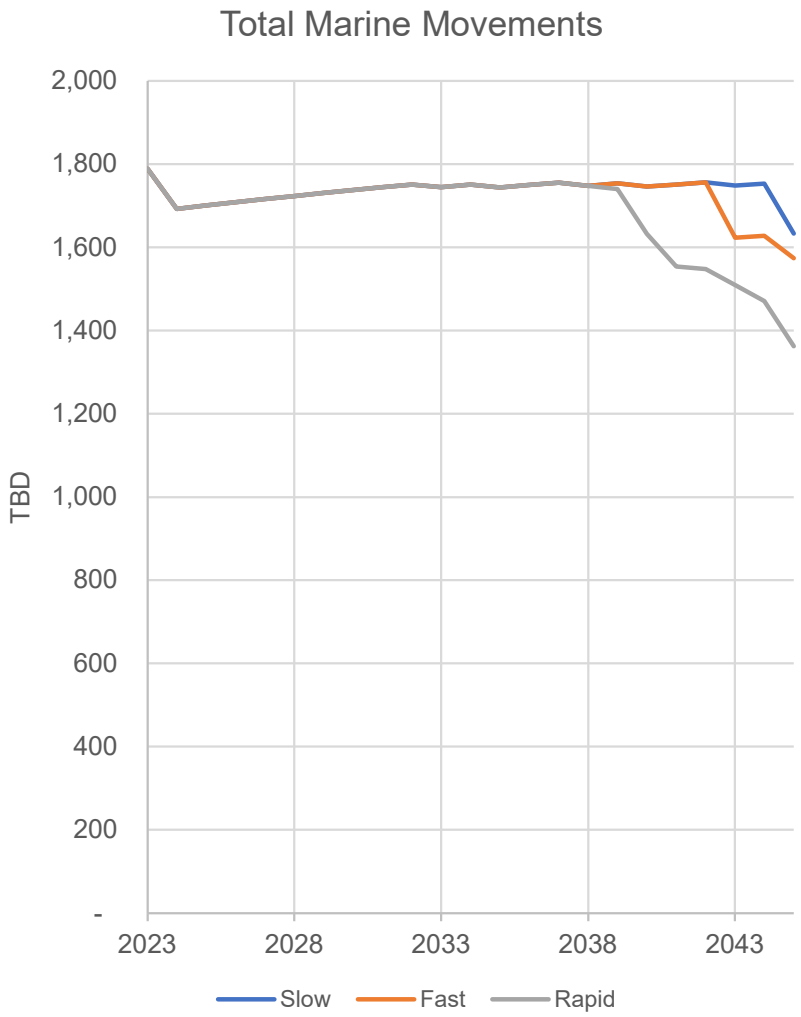
- Total product marine movements (gasoline, jet, diesel).
- Changes in California CCEC gasoline demand curves (Slow, Fast, Rapid).
- 670 TBD limit on total product marine movements imposed and reduced as refineries shutdown.
- Under all scenarios, jet goes from import to export, while diesel remains steady export.
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios but remains an import in the Slow scenario.



Source: TM&C Modeling

C. Marine Limited (cont.)

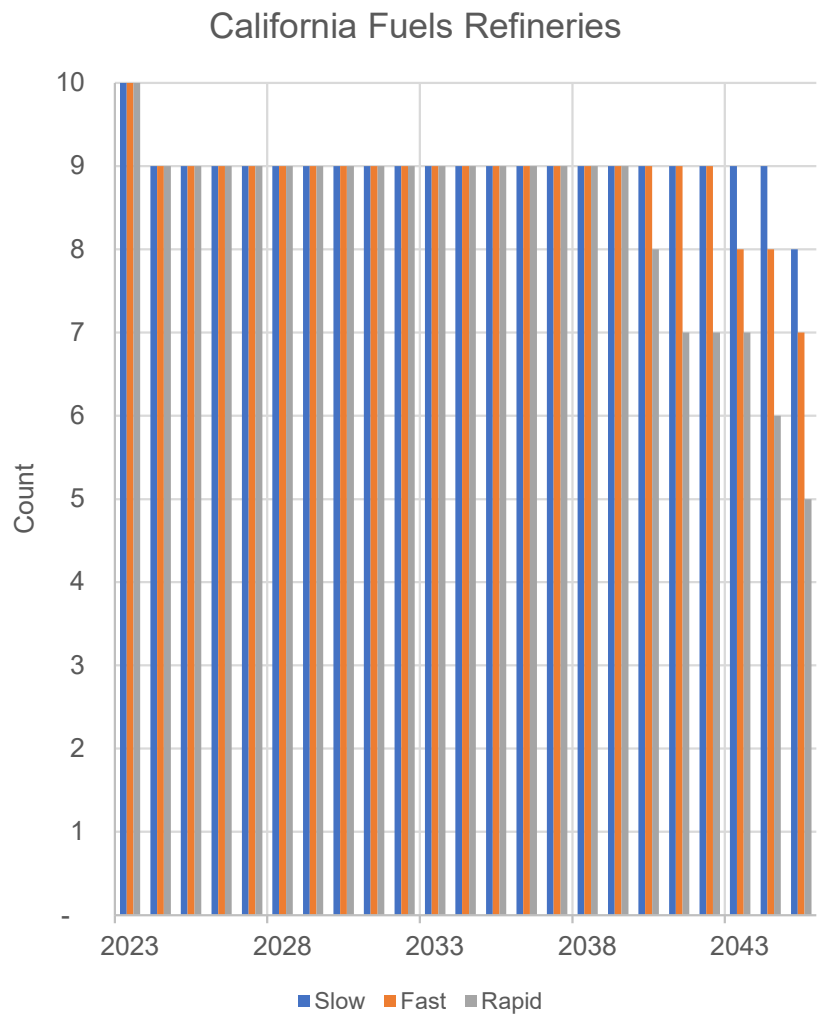
- Total marine movements (crude, gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- Crude imports constrained in all scenarios, except in later years for the Fast and Rapid scenarios where the Product Marine Export Limit dominates.
- One refinery could close in 2045 under Rapid scenario causing total marine movements to decline.



Source: TM&C Modeling

C. Marine Limited (cont.)

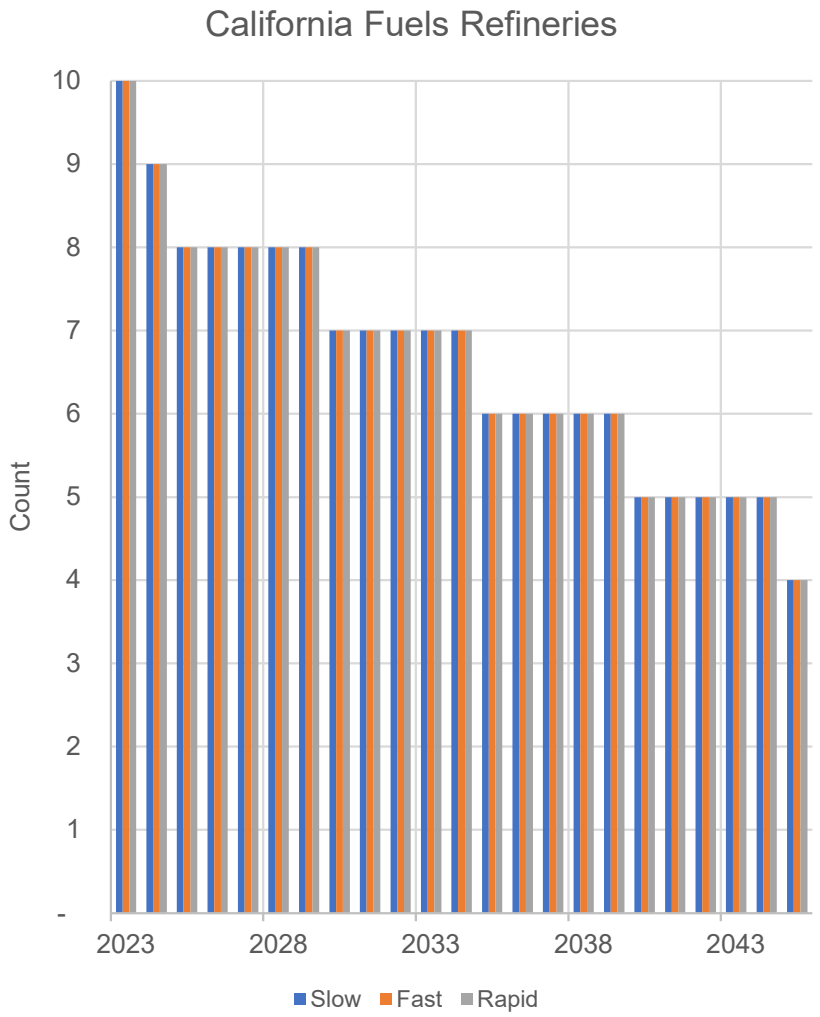
- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- Slow scenario could see first refinery closure after 2040, while Fast scenario could see first refinery closure before 2040.
- Rapid scenario could see five refinery closures by 2045.



Source: TM&C Modeling

D. Refinery turnarounds become shutdowns

- Imposing crude marine import limit (1,150 TBD) and product marine movement limit (670 TBD) on system, in addition to the minimum refinery utilization limit
- At each turnaround (2025, 2030, 2035, 2040, 2045) one refinery is modeled to shutdown rather than incur large turnaround costs. Refinery shutdown according to seriatim
- Due to one refinery shutdown every five years, system is not constrained by crude or product marine export limits
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand
- Under all scenarios, jet goes from import to export, while diesel remains steady export
- Gasoline goes from import to export in more aggressive declining California CARB gasoline demand scenarios, but still requires imports in the Slow scenario



Source: TM&C Modeling

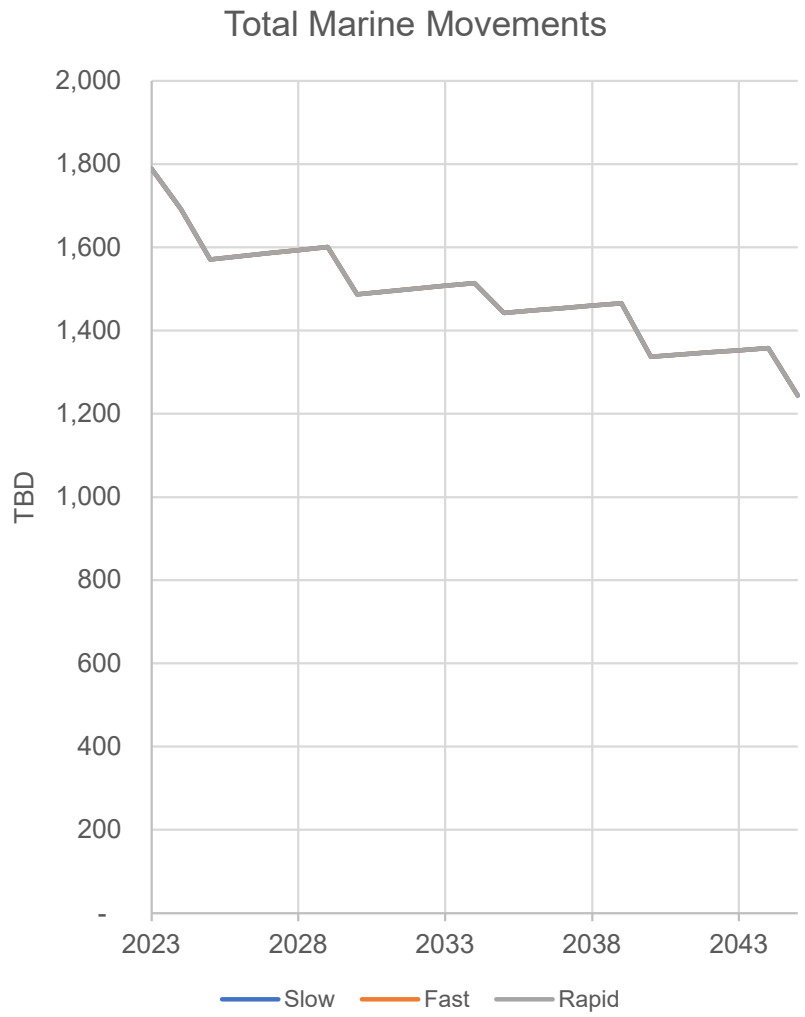
D. Refinery Turnaround becomes a Shutdown (cont.)

- Total product marine movements (gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- 670 TBD limit on total product marine movements imposed and reduced as refineries close.
- Under all scenarios, Jet goes from import to export, while diesel remains steady export.
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios, but remains an import in the Slow scenario.

Source: TM&C Modeling

D. Refinery Turnaround becomes a Shutdown (cont.)

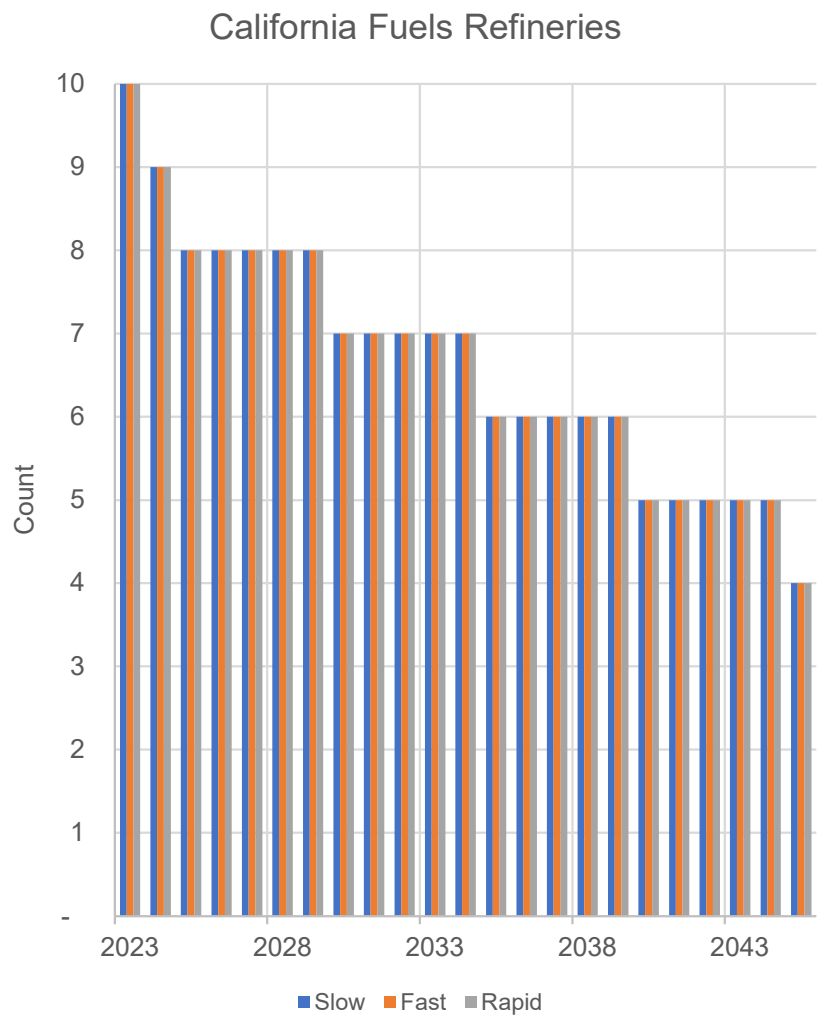
- Total marine movements (crude, gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- Crude unconstrained in all scenarios due to refinery shutdowns.
- Product marine export limit also not a factor.
- Follow same curve due to same operations in all demand curves



Source: TM&C Modeling

D. Refinery Turnaround becomes a Shutdown (cont.)

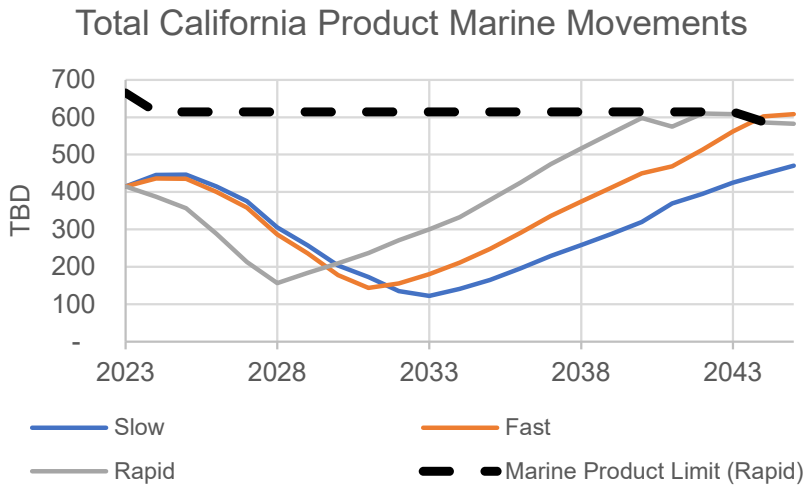
- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- One refinery shutdown every five years. No other refinery shutdowns look to be required to keep system in balance.

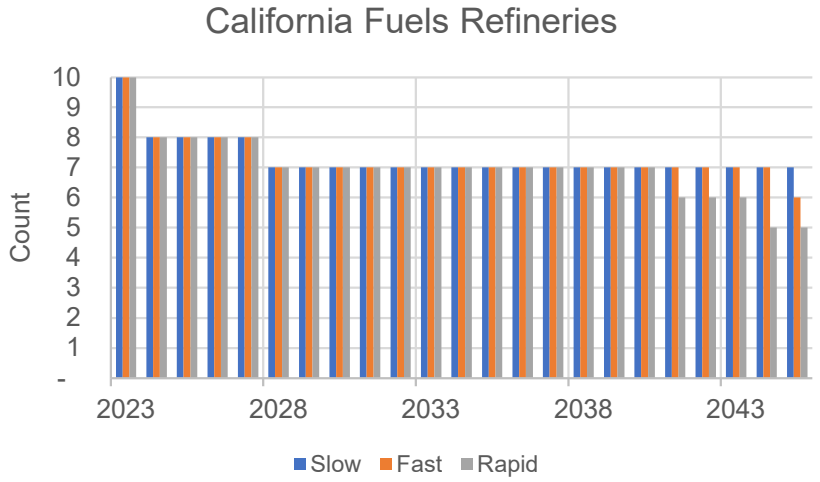


Source: TM&C Modeling

E. Crude and Product Marine Limited (Economic Utilization)

- Imposing crude marine import limit and product marine movement limit on system, but with an economic utilization (80%) instead of the physical refinery utilization limit
- Economic utilization limit increases the number of refinery closures to two under all gasoline demand scenarios. One by 2035, another by 2040. In the prior physical utilization limit (65%) scenario, only one refinery closes by 2045, and only under the rapid gasoline demand scenario
- Early refinery closures (before 2030) due to low utilization in base operations
- Under all scenarios, Jet goes from import to export, while diesel remains steady export
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios but remains an import in the Slow scenario
- Crude imports constrained in all scenarios, except in later years for the Fast and Rapid scenarios where the product marine export limit dominates
- Total marine movements expected to remain steady under California demand destruction until 2040 when refinery closures begin to limit total crude runs

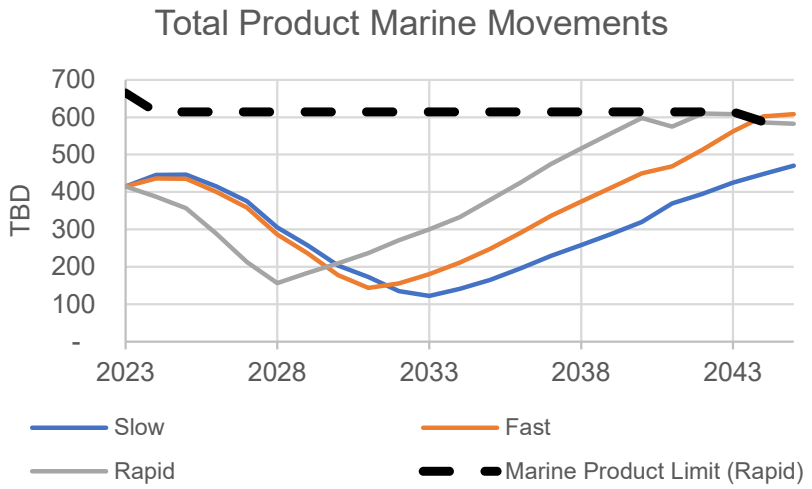


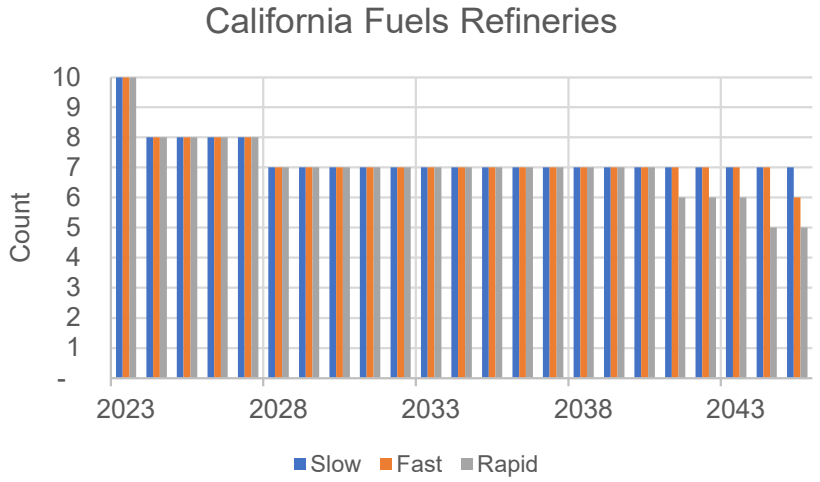


Source: TM&C Modeling

E. Crude and Product Marine Limited (Economic Utilization)

- Imposing crude marine import limit and product marine movement limit on system, but with an economic utilization (80%) instead of the physical refinery utilization limit
- Economic utilization limit increases the number of refinery closures to two under all gasoline demand scenarios. One by 2035, another by 2040. In the prior physical utilization limit (65%) scenario, only one refinery closes by 2045, and only under the rapid gasoline demand scenario
- Early refinery closures (before 2030) due to low utilization in base operations
- Under all scenarios, Jet goes from import to export, while diesel remains steady export
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios but remains an import in the Slow scenario
- Crude imports constrained in all scenarios, except in later years for the Fast and Rapid scenarios where the product marine export limit dominates
- Total marine movements expected to remain steady under California demand declines until 2040 when refinery closures begin to limit total crude runs





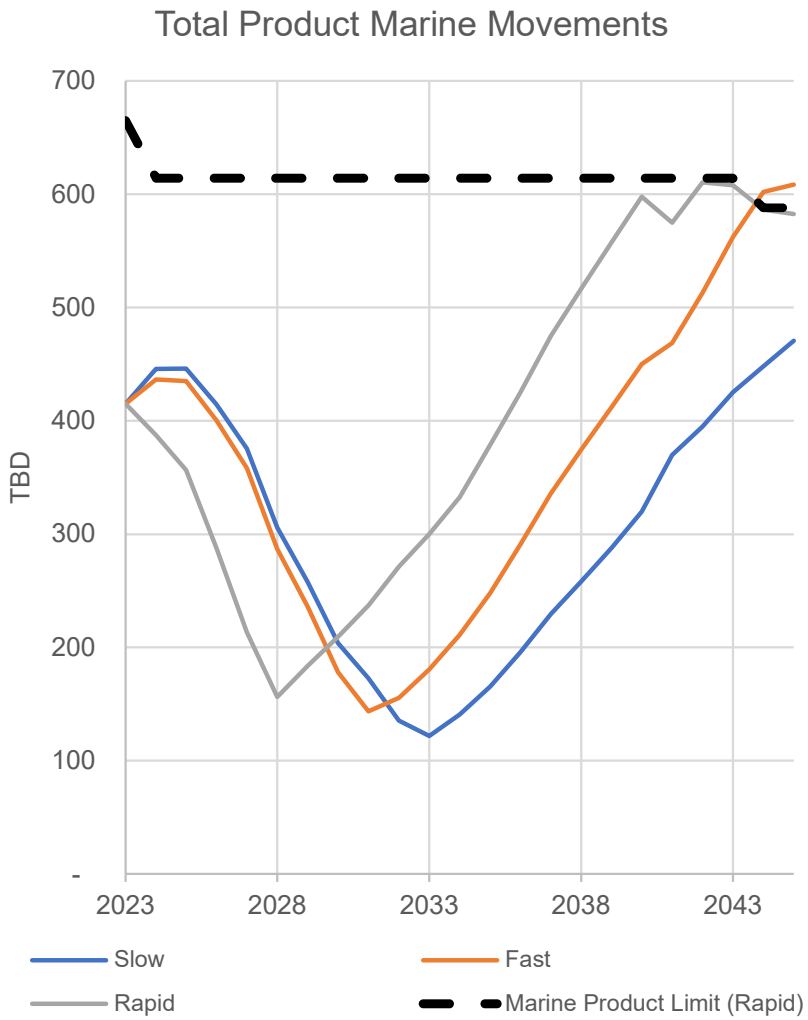
Source: TM&C Modeling

E. Crude and Product Marine Limited (Economic Utilization)

- Similar to early utilization limiting scenario, we impose a crude marine import limit (1,150 TBD) and product marine movement limit (670 TBD) on system. However, in this scenario, the crude distillation unit utilization is assumed to have a minimum economic utilization of 80% instead of the previous technical minimum refinery utilization limit of 65%.
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand
- Economic utilization limit increases to the number of refinery closures under all gasoline demand scenarios to two: one by 2035 and another by 2040. In the prior physical utilization limit (65%) scenario, only one refinery closes by 2045, and only under the rapid gasoline demand scenario.

E. Economic Utilization Limited (cont.)

- Total product marine movements (gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- 670 TBD limit on total product marine movements imposed and reduced as refineries close.
- Under all scenarios, jet goes from import to export, while diesel remains steady export.
- Gasoline goes from import to export in more aggressive California CARB gasoline demand scenarios but remains an import in the Slow scenario.



Source: TM&C Modeling

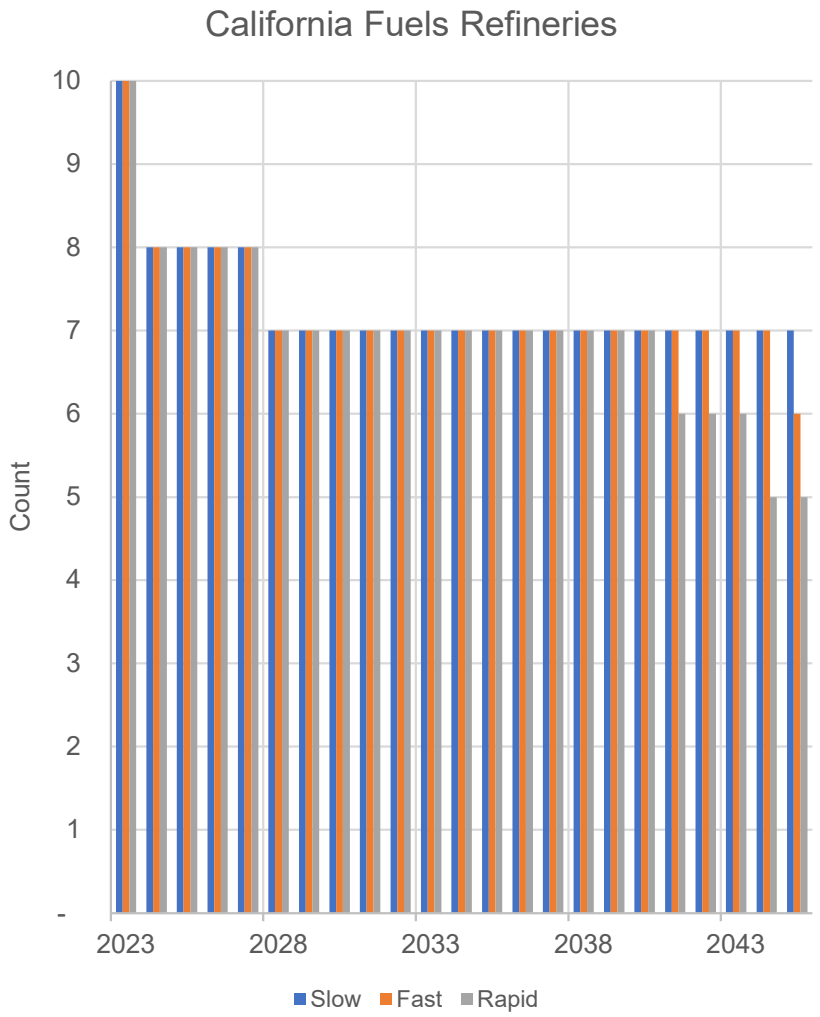
E. Economic Utilization Limited (cont.)

- Total marine movements (crude, gasoline, jet, diesel).
- Changes in California CEC gasoline demand curves (Slow, Fast, Rapid).
- Crude imports constrained in all scenarios, except in later years for the Fast and Rapid scenarios where the product marine export limit dominates.
- Total marine movements expected to remain steady under California demand destruction until 2040 when potential refinery closures could begin to limit total crude runs.

Source: TM&C Modeling

E. Economic Utilization Limited (cont.)

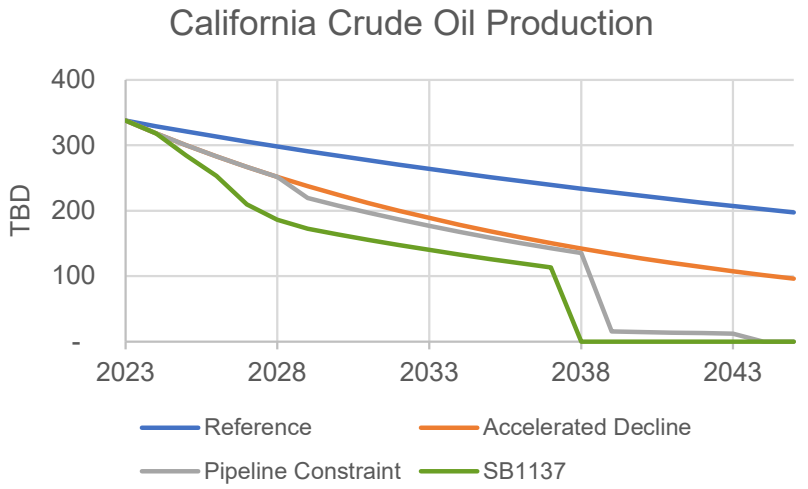
- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- Early refinery closures (before 2030) due to low utilization in base operations.
- More refineries could close than under the Physical Utilization Limited scenario.

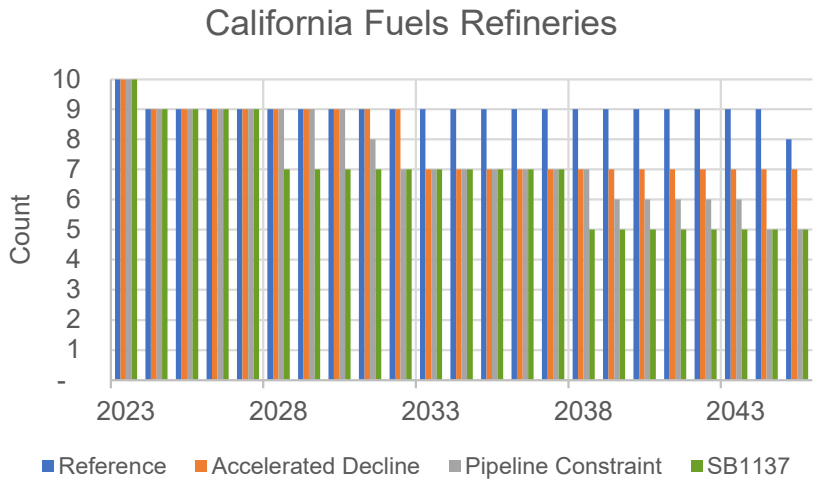


Source: TM&C Modeling

F. Crude Production Alternatives

- Apply different California crude oil production scenarios on system, under the "Slow" product demand scenario. Crude marine import limits become a more prominent driver as California crude oil production declines.
- In all California gasoline demand scenarios (and including AZ/NV pipeline demand), there is enough capacity in system through 2040.
- However, in the "Rapid" scenario demand declines enough to result in the closure of a California refinery by 2045.





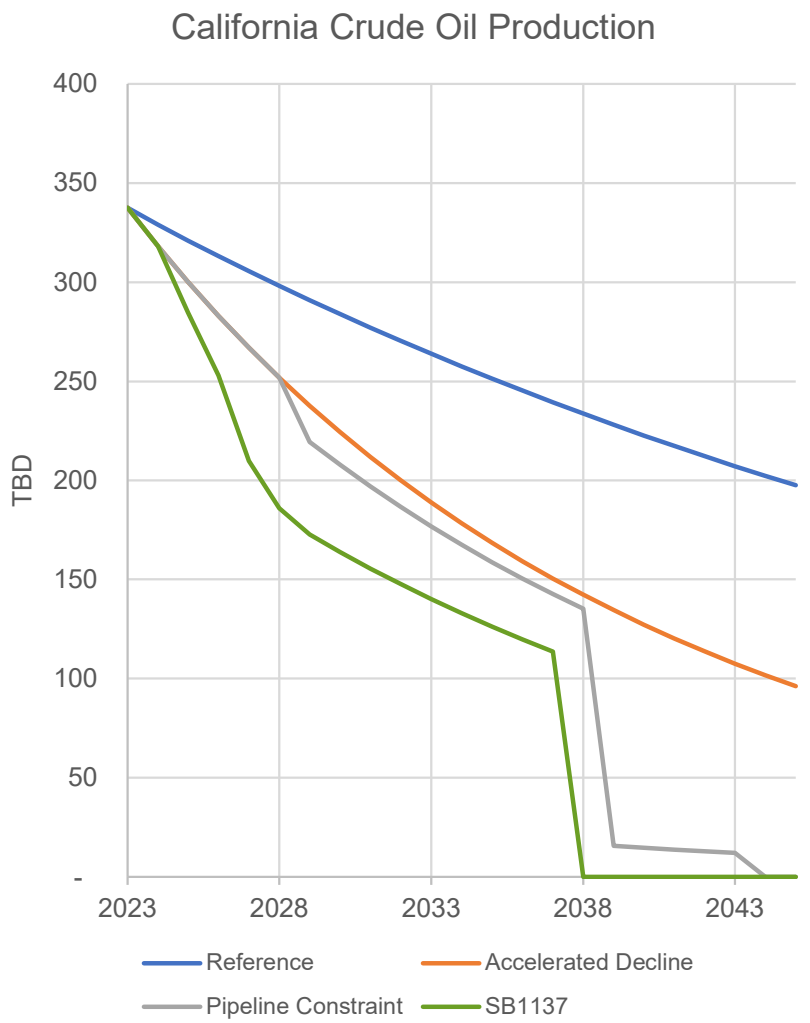
Source: TM&C Modeling

F. Crude Production Alternatives

- Apply different California Crude Production scenarios on system, under Slow Product Demand scenario. Crude marine import limit becomes a more prominent driver as California production declines.
- Imposing crude marine import limit (1,150 TBD) and product marine movement limit (670 TBD) on system, in addition to the normal minimum refinery utilization limit
- Product pipelines supplying AZ and NV are filled, potentially requiring additional imports of products to meet demand
- Enough room in system, via California product demand and AZ/NV pipeline to keep system running through 2040 in all California gasoline demand scenarios, but one refinery could close in 2045 under the Rapid demand decline scenario

F. Crude Production Limited (cont..)

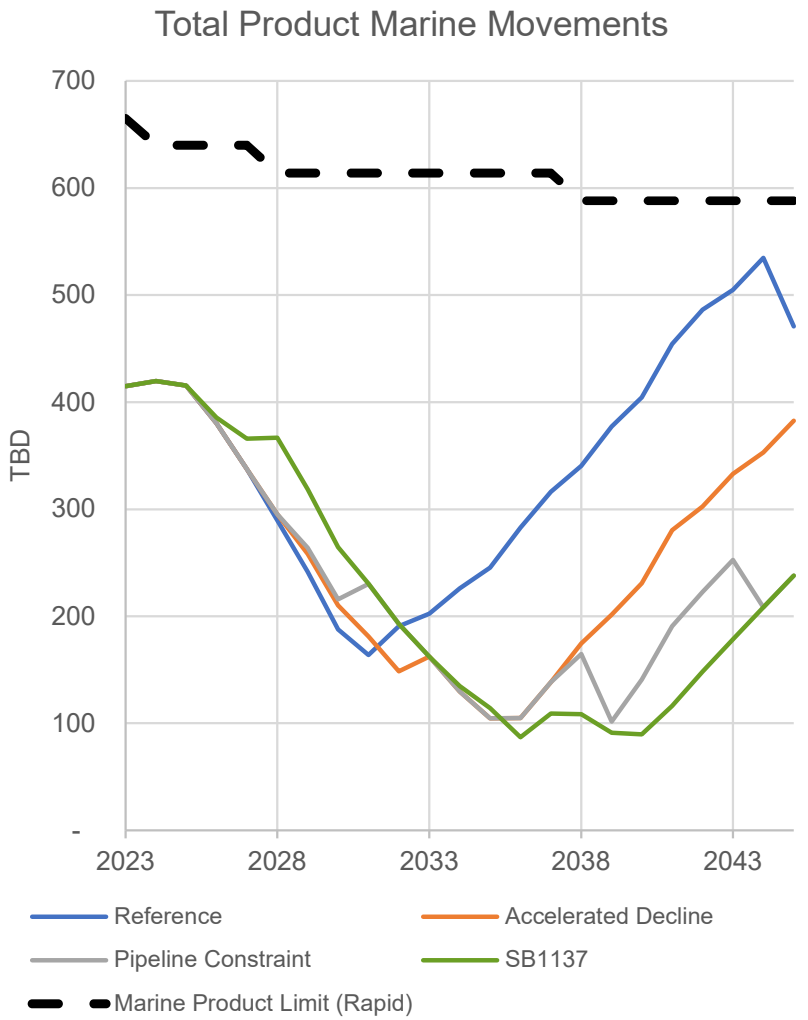
- Reference: Production declines continue based on recent decline rates
- Accelerated Decline: Production declines driven by a slowing pace of drilling permit approvals
- Pipeline Constraint: Once a pipeline reaches minimum throughput, the pipeline and production that filled it are both shutdown; trucking the production out of the field is assumed to not be an option.
- SB1137: Setback limits shut-in production in urban areas first, eventually across state.



Source: CalGEM, Catalyst Environmental, EIA, Turner Mason analysis

F. Crude Production Limited (cont.)

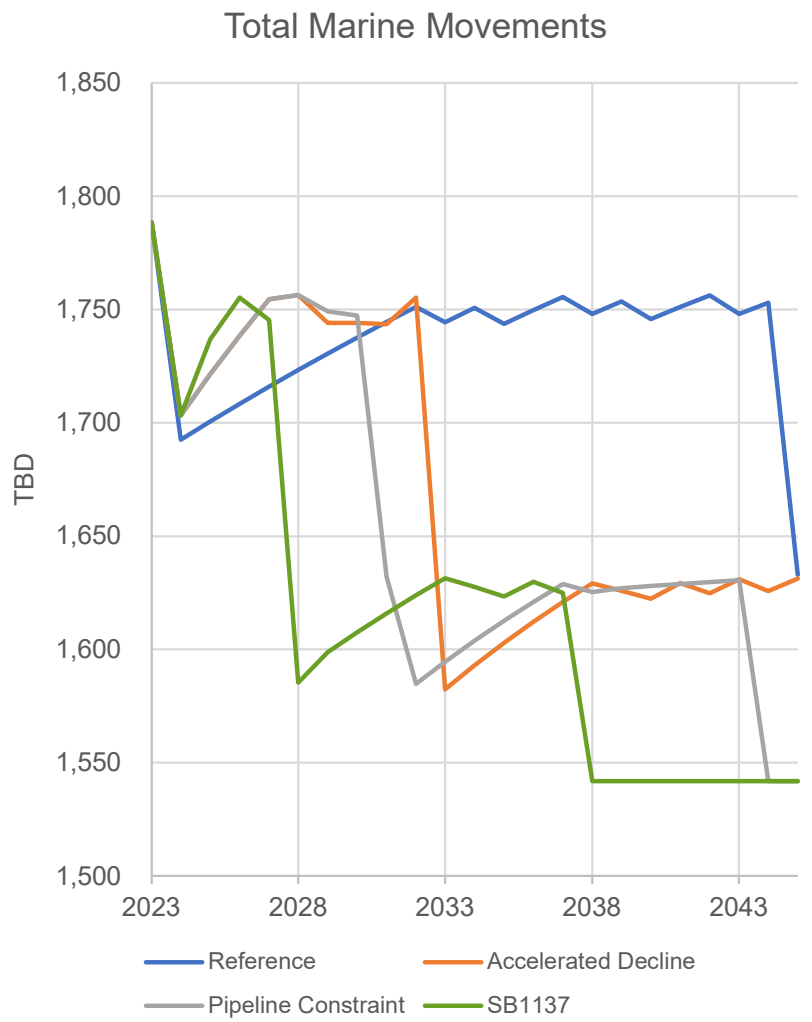
- Total product marine movements (gasoline, jet, diesel).
- Changes in California Crude Production profiles.
- 670 TBD limit on total product marine movements imposed and reduced as refineries shutdown.
- Marine import limit is not constraining.
- Under all scenarios, gasoline and jet goes from import to export, while diesel remains steady export.



Source: TM&C Modeling

F. Crude Production Limited (cont..)

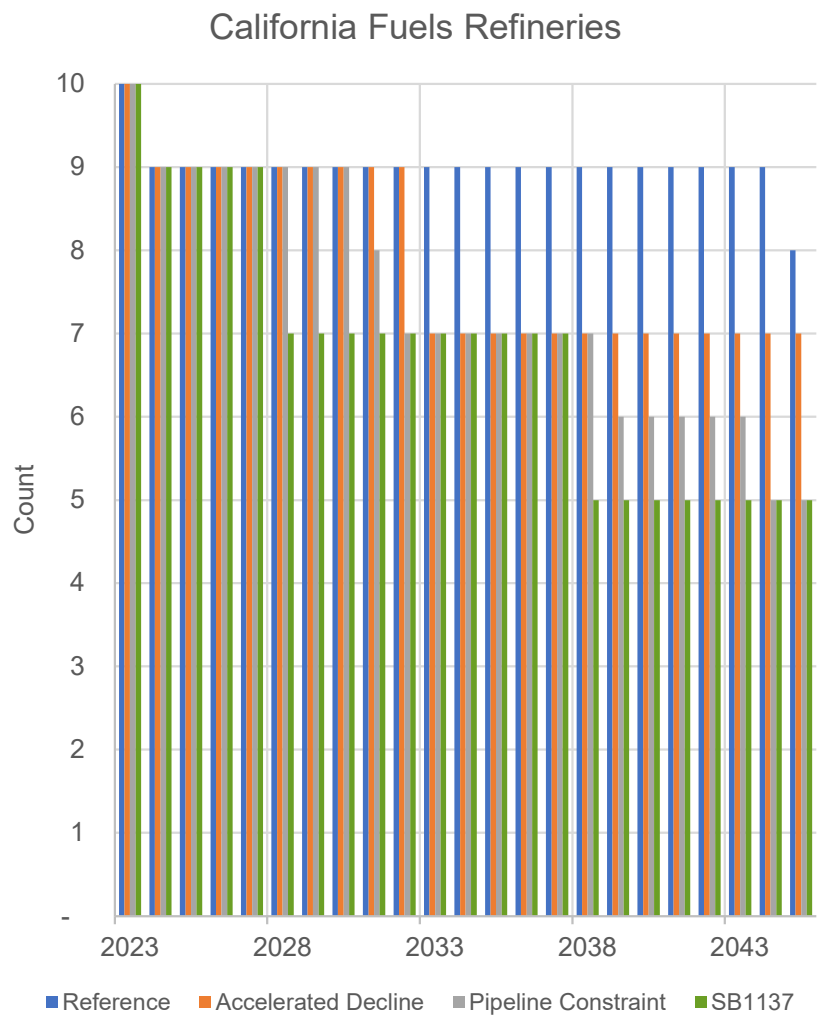
- Total marine movements (crude, gasoline, jet, diesel).
- Changes in California Crude Production profiles.
- Crude imports constrained in all scenarios due to rapid decline in crude production.



Source: TM&C Modeling

F. Crude Production Limited (cont..)

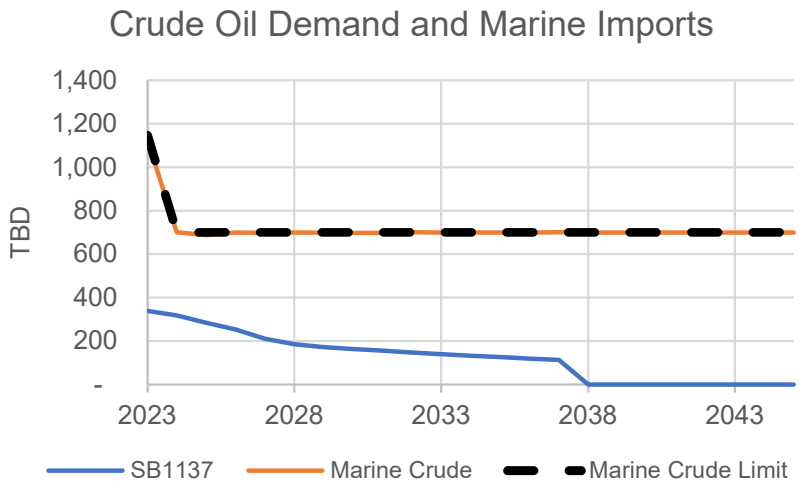
- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- All crude production scenarios expected to see refinery closures.
- Pipeline Constraint and SB1137 may force half of California refineries to close by 2045.

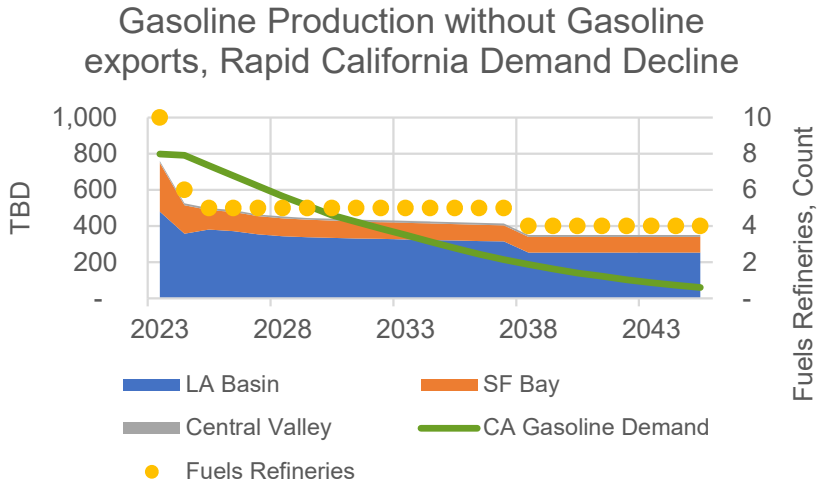


Source: TM&C Modeling

G. Fully Enforced "At-Berth" Emissions Limits

- Marine system is rendered infeasible if 20 vessel/berth per year limit is applied to total ship visits
- To make the system feasible, we assume there is a waiver in some way:
  - If 20 vessel/berth per year limit is applied to crude oil, it creates an effective crude marine import limit of 700 TBD, vs 1,150 TBD in other scenarios
  - Product marine import limit nearly unchanged with 20 vessel/berth per year limit (670 TBD)
- Under SB1137 California crude oil production decline and "At-Berth" constraints, see rapid initial closure of refineries
- Timing of implementation of "At-Berth" constraints uncertain, which would change impacts on system
- Increased marine product imports due to refinery closures
- If importers use largest available product vessels, California **demand must decline rapidly** for marine product berths to not be constrained.
- Imports of gasoline required in early years due to rapid shutdown of refineries that are "At-Berth" constrained on crude oil
- As California demand rapidly declines, eventually move to exports of gasoline required (Rapid demand) but continued imports required (Slow demand)

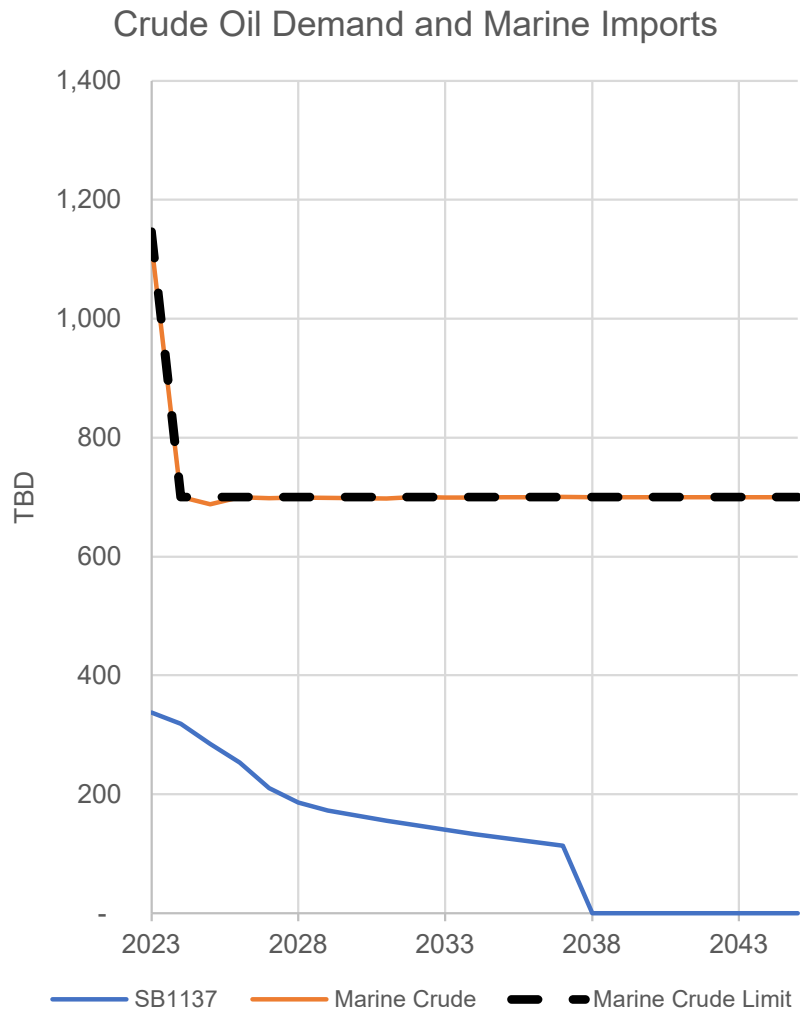




Source: TM&C Modeling

G. Fully Enforced "At-Berth" Emissions Limits (cont..)

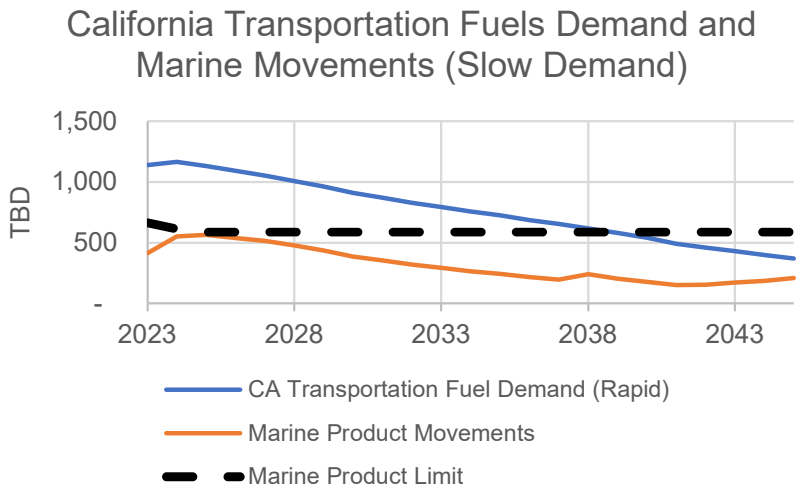
- SB1137 Demand: Setback limits shut-in production in urban areas first, eventually across state.
- 20 vessel/berth per year limit creates effectively 700 TBD crude marine import limit.

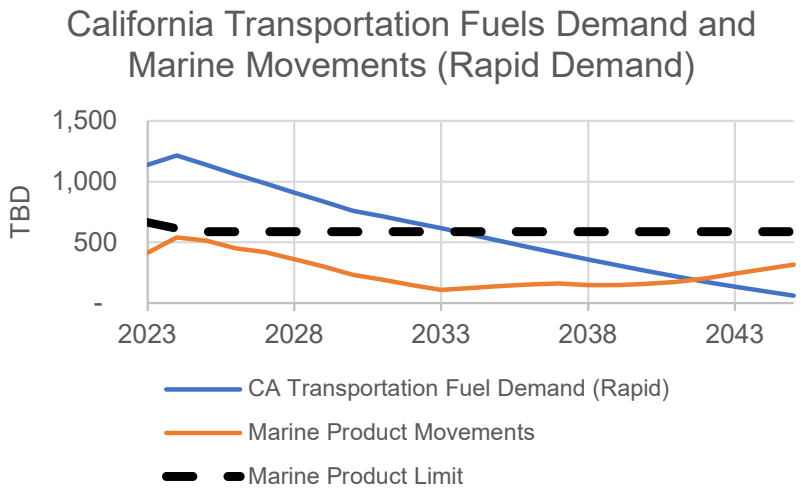


Source: TM&C Modeling

G. Fully Enforced "At-Berth" Emissions Limits (cont)

- Total product marine movements (gasoline, jet, diesel).
- Slow and Rapid California Transportation Fuel Demand Scenario
- 670 TBD limit on total product marine movements imposed and reduced as refineries shutdown.
- Total product marine limit is not limiting in either scenario.

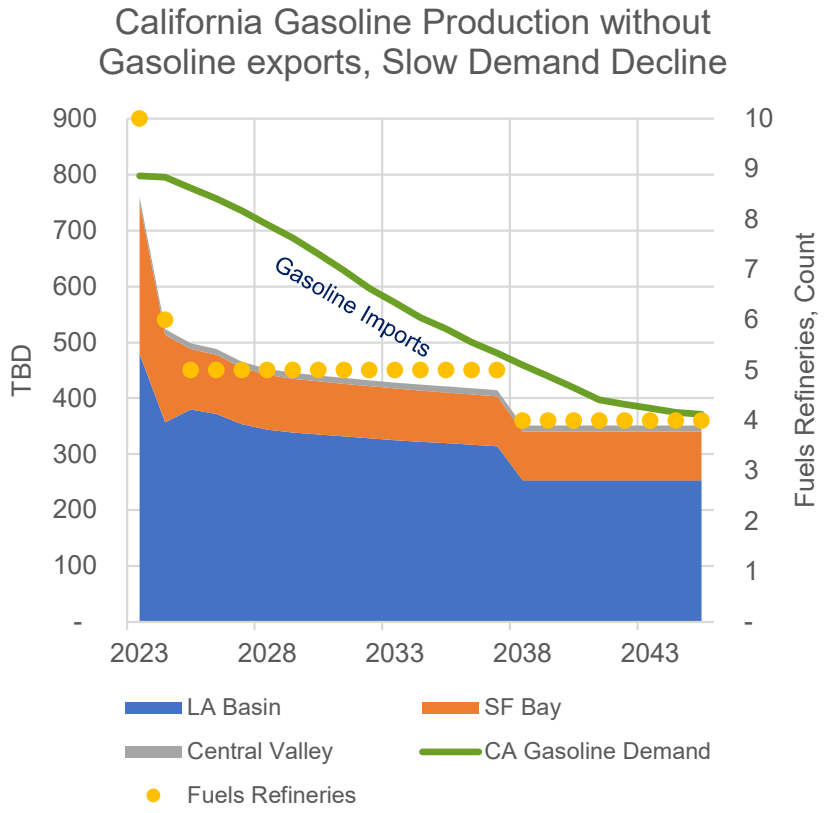




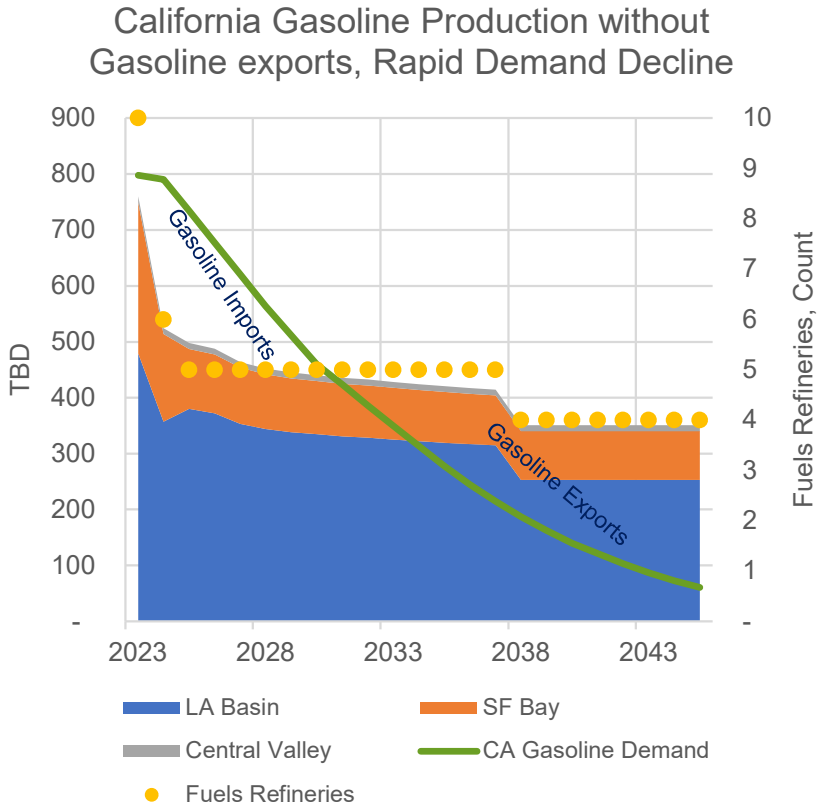
Source: TM&C Modeling

G. Fully Enforced "At-Berth" Emissions Limits (cont)

- California refineries could rapidly shut-down if crude oil availability is limited locally by SB 1137 and by water by the "At-Berth" regulation.
- With slow demand decline, California could perpetually require imports



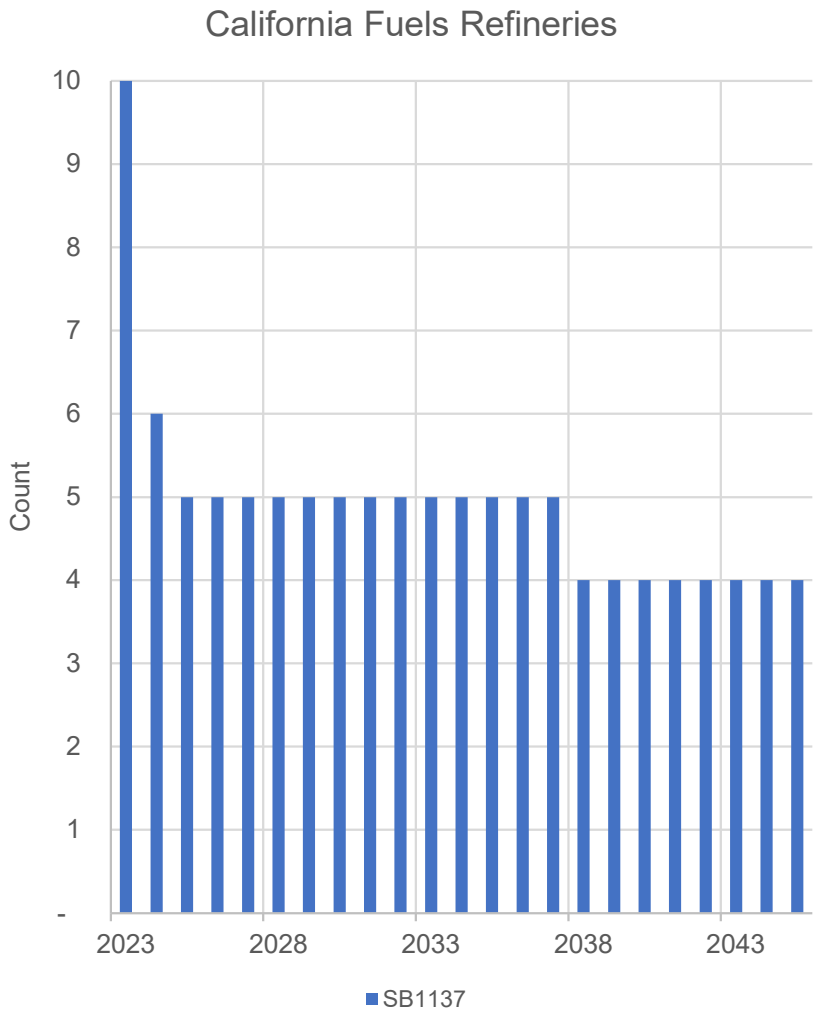
- Imports of gasoline required in early years due to rapid shutdown of refineries ("At-Berth" constrained).
- As California demand rapidly declines, eventually exports of gasoline could be required.
- Moving from imports to exports could induce price volatility



Source: TM&C Modeling

G. Fully Enforced "At-Berth" Emissions Limits (cont.)

- P66 Rodeo refinery fully converted to renewable fuels production in 2024.
- Under SB1137 California Crude Production decline and "At-Berth" constraints, see rapid initial closure of refineries to meet "At-Berth" constraint, and two additional closures in later years as California production continues to decline.
- Pace of refinery closures the same under either CA product demand scenario (Slow or Rapid).



Source: TM&C Modeling

APPENDIX

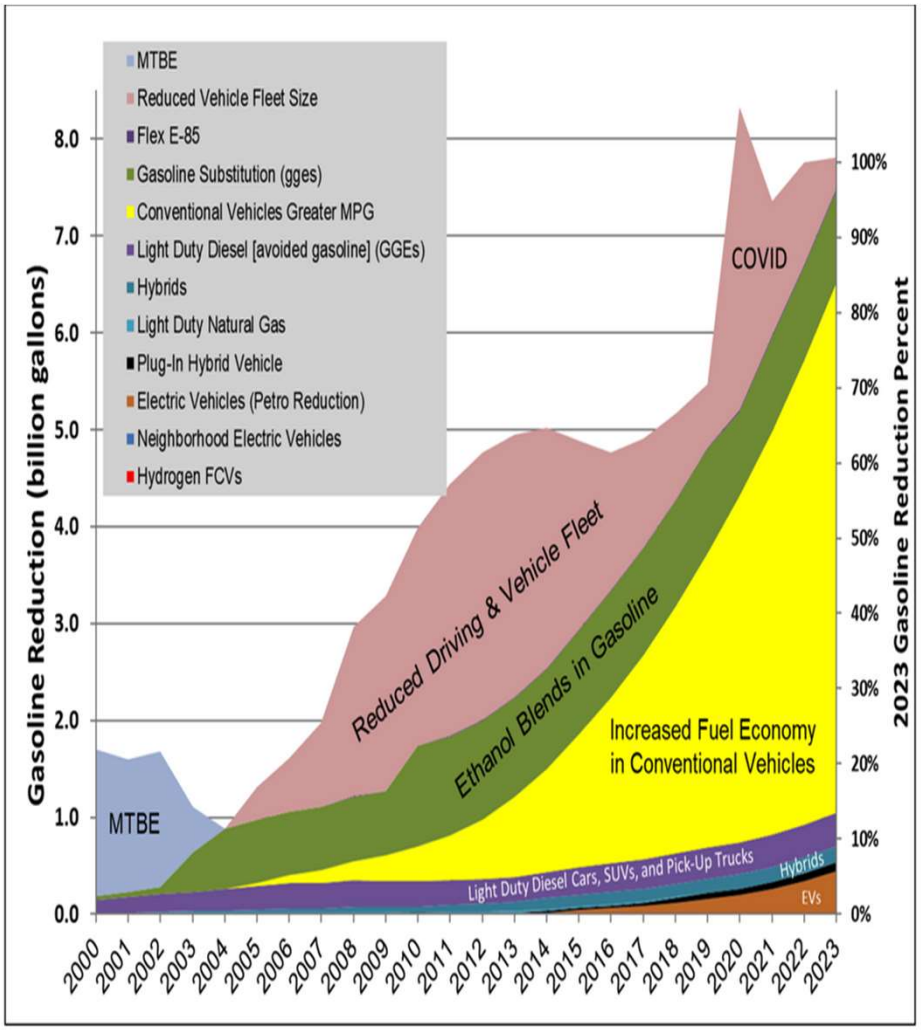
GLOSSARY

AATE3	Additional Achievable Transportation Electrification
AZ	State of Arizona
BBD	Biomass-based Diesel
BOEM	Bureau of Ocean Energy Management (US Department of Interior)
CBI	Confidential Business Information
CalGEM	California Geologic Energy Management Division
CARB	California Air Resources Board
CEC	California Energy Commission
CPUC	California Public Utilities Commission
EIA	Energy Information Agency (US Department of Energy)
EVs	Electric Vehicles
IEPR	Integrated Energy Policy Report
KRV	Kern River Valley
LCFS	Low Carbon Fuel Standard
MM Gals	Million Gallons
MMGY	Million Gallons per Year
NV	Nevada
RD	Renewable Diesel
SJV	San Joaquin Valley
TAN	Total Acid Number
TBD	Thousand Barrels per Day
TESCII	Transportation Energy Supply Chain Infrastructure and Investment
TMX	Trans Mountain Pipeline Expansion
ULSD	Ultra Low Sulfur Diesel
WCS	Western Canadian Select

THE SCOPE OF OUR APPROACH TO THE TESCII STUDY

- This study is based entirely on public information and TM&C analysis. We leveraged this public information on crude oil and refined products to calculate state-level supply/demand balances using State of California projections for future demand.
- Our primary analytical efforts included:
  - Studied recent domestic crude oil production trends and estimated future production declines for major onshore and offshore California production.
  - Mapped crude supply logistics from production fields to refineries along major trunkline networks, including identifying major injection and destination points. Additionally, studied import crude logistics, including major docks/berths capacity and pathways to refineries.
  - Developed representative models of each individual refinery in California using our proprietary Turner Mason Modeling System (TMMS). These configurations were used in an assessment of the viability and risk to the California refinery network at a state level under expected crude supply, product demands, and logistic constraints.
  - Studied existing logistic systems (pipelines, marine, rail) and identified potential developments that could impact these systems in the future.
  - Reviewed expected changes in the regulatory outlook, including proposed rules, permitting bans, executive orders, and new standards. Assessed potential impact of these initiatives on the viability of the transportation fuel delivery system.
- Summarized assessments and results.

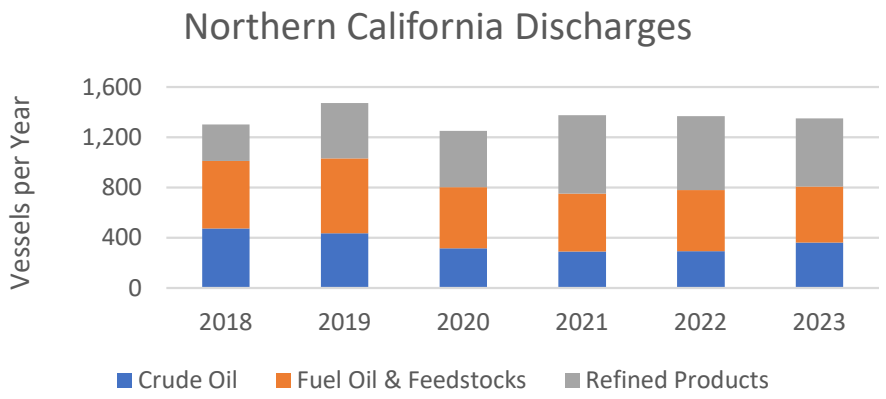
EVs ARE NOT THE ONLY WAY TO REDUCE GASOLINE DEMAND

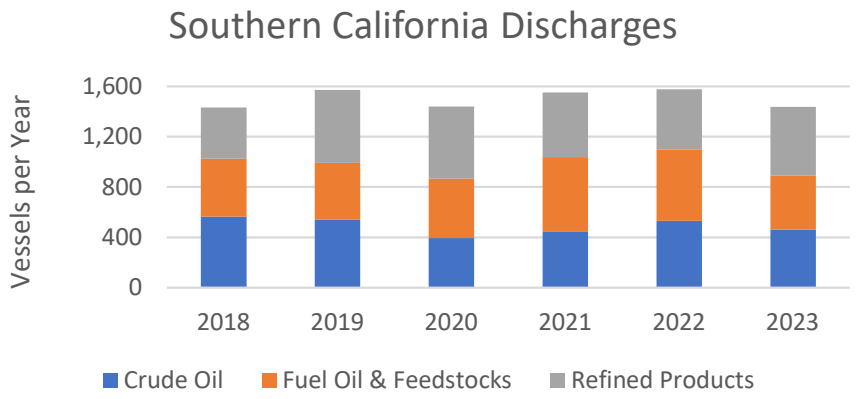


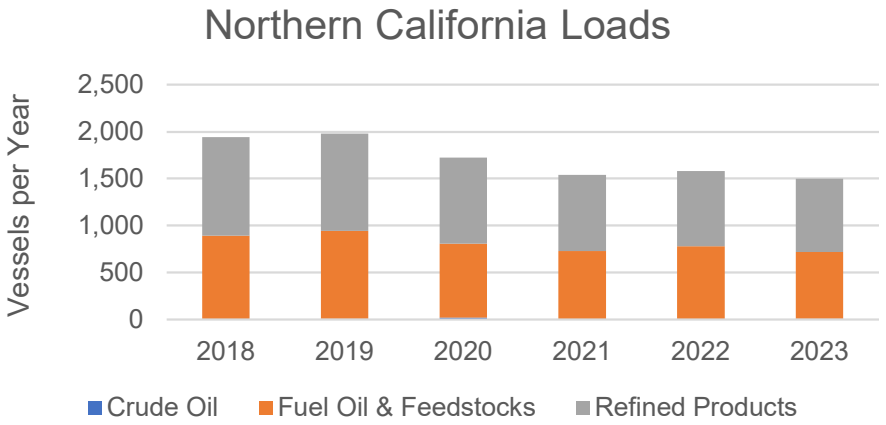
- Over the last 20 years, California has reduced fossil fuel consumption in the state by 7.8 billion gallons compared to the projected trend (extrapolated from the historic trendline)
- California's population growth (1940-2003) was the dominant factor in gasoline demand growth, but population growth has slowed significantly since 2003
- The chart on the left shows the purchase of conventional vehicles (with improving fuel economy since 2003) are responsible for ~75% of gasoline consumption in 2023
- CARB's zero emission vehicle (ZEV) mandate program is estimated to reduce ~7% of 2023 gasoline consumption

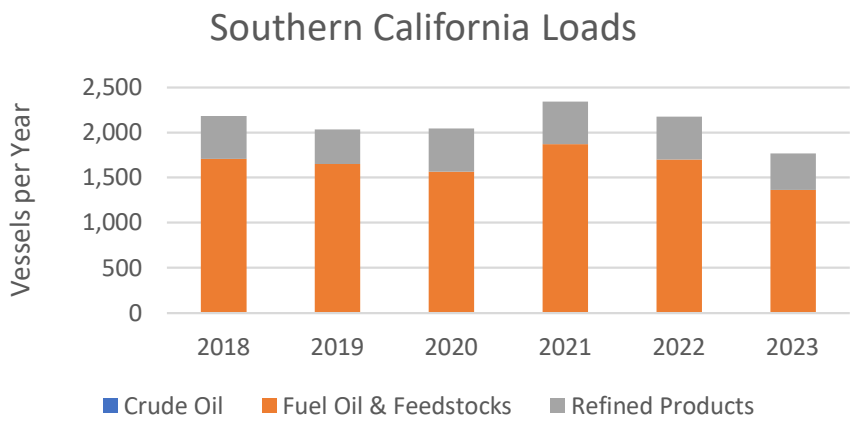
Source: Stillwater & Associates

MARINE LOGISTICS









Discharges and Loads refer to volumes being received from or loaded onto a ship or barge. These should not be confused with imports and exports as much of the volume originates from or is destined to another location within California.

California State Lands Commission; TM&C analysis

SCENARIO MODELING BASIS / ASSUMPTIONS

- Modeled each refinery in TMMS
  - Additional feedstock purchases held constant to represent typical operation
  - No change in configuration over time
- Held operation of four (small) asphalt refineries constant
  - Easiest access to California crude
  - Demand for product not declining
  - Even with shift to EV's and RD, asphalt demand not expected to decline
- Operations of one small fuels refinery held constant
  - Structural advantage of access to crude oil and captive product market
  - Assume niche position keeps refinery economic
- Distribution of California crude production
  - Asphalt refiners running KRV crude (heavier than SJV) at constant rates
  - Distribution of remaining California crude production to SF Bay vs LA Basin
- Distribution of other crudes
  - Alaska crude oil
  - Other grades available within defined min / max limits
  - Marginal grade (Arab Medium) to fill crude units to desired rate as needed
- Years modeled
  - 2023 through 2045
  - CEC transportation fuel demand curves end in 2045
- Refinery shutdown impacts
  - Conversion of P66 Rodeo to renewable fuels production (along with Marathon Martinez) modeled as scenario where crude marine import capability removed from system
  - SF Bay refinery marine logistics associated with individual refineries and not available to rest of circuit after shutdown
  - LA Basin marine logistics separate from individual refineries so still available to rest of circuit as refineries shutdown

METHOD FOR APPLYING SCENARIO CONSTRAINTS

- Crude marine limit / product marine limit
  - Causes utilization to drop
- Physical/Economic utilization minimum
  - Triggers refinery shutdown
- California only demand case
  - Triggers refinery shutdown to reduce gasoline production
- Apply refinery shutdown seriatim
  - Based on size / complexity / resiliency
  - Once shutdown, don't reopen site in later (more constrained) years
- Scaling operating refinery runs to meet marine limits as necessary
  - Can cause utilization to drop
- Iterative process
  - Applying marine limits, utilization limits, California demand limits with adjustments to scaling / shutdowns
- After iterative process, including refinery shutdowns, recast crude slates to remaining refineries based on scaled operations / utilization and re-run refinery models
  - Ensures utilization of full California crude that would have been lost in iterative process due to shutdowns / scaling
  - Minimum impact to product yields

Who We Are

Founded in 1971, Turner, Mason & Company provides technical, commercial and strategic consulting services to worldwide clients in the crude oil, midstream, refining, refined products, biofuels and renewable fuels industries.

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Founded: 1971

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